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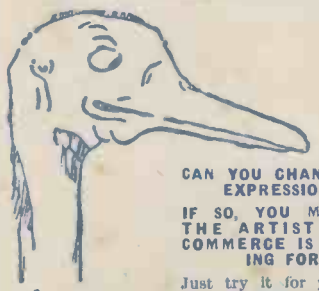

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PRACTICAL MECHANICS

Owing to the paper shortage "The Cyclist" and "Home Movies" are temporarily incorporated

Editor: F. J. CAMM

VOL. VIII. APRIL, 1941 No. 91

FAIR COMMENT

By the Editor

Concentration of Production

AS materials for civil consumption become scarcer, and as labour is absorbed into the Forces or into the war effort, t is obvious that firms catering for civil needs will be operating at reduced efficiency. Thus, three firms manufacturing, say boots, may, in course of time, only be operating at one-third of their productive capacity, yet they are compelled to maintain a personnel capable of 100 per cent. capacity. This results in considerable waste of man-power, whilst machines are idle for two-thirds of the working week.

The Board of Trade is now considering concentration of production, and is contemplating the closing down of factories not operating at 100 per cent. of their capacity. This will mean the release of labour for the Services or for the war effort, and that one of the three firms, by agreement amongst themselves, will be operating at full capacity. This latter firm will be expected, as a result of its increased business, to compensate the two firms closed down.

If they consulted only their own interests, the firms closed down might wish that they should carry on with their share of the trade in the hope that conditions might improve. It is, however, undesirable that cuts in civil consumption should be met by large-scale part-time working, for a spread-over of this kind results in an uneconomical use of certain types of labour. It does not free the factory and storage space which will, in many cases, be needed for Government use. The policy of the Government is to concentrate production in a reduced number of factories working full-time, with due consideration for the geographical position, for obviously it would be unwise to concentrate production in a district vulnerable from the point of view of attack from the air. These factories should be able to produce the output required for Government orders, the greatest practicable export trade and the minimum needs of our population, while at the same time preserving the good-will of the factories closed down. The closed factories must, however, be kept ready to start up again as soon as possible after the war, and the Government Department concerned will then take all measures open to them to assist their speedy re-opening. Meanwhile, the Board of Trade will keep a record of factories closed down and the Ministry of Labour will keep a record of transferred workers, so that they may be able to resume their old employment after the war. The Government are looking to the industries themselves to co-operate by formulating proposals for effecting the necessary measure of concentration, for the firms themselves should be in the best position to frame plans, in the light of their knowledge of their own capacity and circumstances; but where firms are either unwilling or unable to meet the situation by their own efforts, the Government will be prepared, in the last resort, to impose the reorganisation which circumstances require.

Quite obviously, this sytem of concentration raises wide issues. There is the question of secret processes and formulae, as well as that of special processes of manufacture which firms may be unwilling to disclose to their rivals. No doubt, adequate safeguards will be forthcoming.

The National Book Council

ELSEWHERE in this issue we deal with the National Book Council. All those concerned in the national industrial effort will thus be kept informed of books specially selected for use in factories and workshops. The address of the National Book Council is 3 Henrietta Street, London, W.C.2, to whom readers should write for their portfolio containing carefully compiled lists of books. This portfolio will be supplemented at regular intervals, and by writing to the address given readers will be kept up to date in their knowledge of new books as they are published, and they will thus also have rapid access to authoritative information about books which have been specially designed to assist their efforts.

There can be no doubt that technical books are playing a large part in the national war effort, for the technical books issued by the proprietors of *Practical Mechanics* are in use in workshops throughout the country, and in all of the Services. A catalogue of these books is available free to anyone addressing a postcard to The Book Department, George Newnes Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

You and Your Newsagent

YOUR newsagent will do his best in difficult conditions to supply you with this journal regularly, but in certain circumstances you may not be able to obtain it, in which case it can be posted direct from the Publisher, as issued. You may also want to send a copy to friends overseas, particularly those in the Forces, and a postal subscription is the most convenient method. Full details of this service are obtainable from the Publisher, George Newnes Ltd., Tower House, Southampton Street, Strand, London, W.C.2. The subscription rates are printed at the top of this page.

Queries

WE are still receiving a number of queries from readers who do not comply with our query rules. It is essential that these conditions are complied with. Readers must send the query coupon cut from the current issue, a stamped addressed envelope, and three penny stamps. Our service is available only to readers of the paper, and not to those who have been told to write to us by readers of the paper.

Amy Johnson Memorial Fund

IT is proposed to found a scholarship in aviation for a woman, a project in which Amy Johnson was personally interested. Such a scholarship would be the first provision ever made for women to attain professional standard in aviation, except at their own expense. An appeal is, therefore, launched, sponsored by the Viscountess Astor, C.H., M.P., another pioneer woman, Colonel the Rt. Hon. Lord Sempill, A.F.C., and Sir Malcolm Campbell, M.B.E., two men of note who both had a high regard for an outstanding woman, Miss Caroline Haslett, C.B.E., President, Women's Engineering Society, which had the honour of Amy Johnson's presidency for three years, Miss Pauline Gower, Commandant, Women's Section, Air Transport Auxiliary, in whose service Amy found such pleasure and satisfaction, and Mrs. Gabrielle Patterson, A.T.A. and Guild of Air Pilots and Air Navigators of the British Empire. These last three represent the many colleagues, men and women, who enjoyed Amy's friendship, relished her wit and humour, and honoured her skill and accomplishment. These six signatories reflect some of the varied phases of Amy Johnson's wonderful career, which was followed with admiration and warm affection by countless men and women of all ranks, who in this Memorial Fund have an opportunity to share in a lasting tribute.

It is proposed to invest all money in War Bonds during the war, so that donations will at the same time materially assist the war effort. The conditions which will obtain after the war can only be conjectured, but the Guild of Air Pilots and Air Navigators of the British Empire have agreed to act as technical advisers regarding the administration of the Amy Johnson Scholarship in Aviation, and they will also assist in the selection of candidates.

It is further hoped, on the conclusion of hostilities, to set up a memorial in some appropriate place.

A Sunderland Flying Boat on Patrol Work.

Aircraft Recognition

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

LONG RANGE MARINE AIRCRAFT—4.

THE qualification "long-range" is deliberately chosen in order to limit our immediate study to a convenient and easily assimilable number. Aircraft operating with the Fleet Air Arm and R.A.F. Coastal Command might reasonably claim the description "marine aircraft" by virtue of their employment on coastal reconnaissance and similar duties. but many of these, such as the familiar Anson and Hudson are definitely landplanes.

The spotter who wishes to study the smaller fry of marine aircraft will find ample scope for industry, since their name is legion. "Small fry" is used here in no disparaging sense, but simply with reference to the dimensions of the various types and their radius of action. Used in this sense, the term necessarily includes such notable performers as the Fairey Swordfish, victor of Taranto and Sardinia. It certainly would be no consolation to the humiliated Duce to learn that the battle strength of the Italian Navy had been reduced to half by "small fry" of the Fleet Air Arm.

Interesting as these types are, we must leave them for later study, although the following list of the principal friendly and hostile ship and shore-based aircraft may be useful in the meantime :—

British.—Albacore, Fulmar, Nimrod, Osprey, Roc, Seafox, Sea Gladiator, Sea Lion, Seal, Shark, Skua, Swordfish. *Dutch* (serving with R.A.F.).—Fokker T.8.W. *U.S.A.* (serving with R.A.F.).—Bermuda (Brewster 138), Martlet (Grumman F4F).

German.—Arado 95, Arado 196, Heinkel 59, 60, 114, Junkers 52/W.

Italian.—Meridionali Ro 43, Ro 44, Cant. Z501.

Ocean-going Types

The majority of marine aircraft designed to cruise independently with a range of 1,000 miles or more, are built as flying boats, with a seaworthy hull. To most of us this seems but natural and even essential, but the German Air Arm has at least three well-known long-range *monoplane* float-plane types in regular service. These are the twin-engine float seaplanes Heinkel 115, the Blohm & Voss Ha.140, and the four-engine float-seaplane Ha.139.

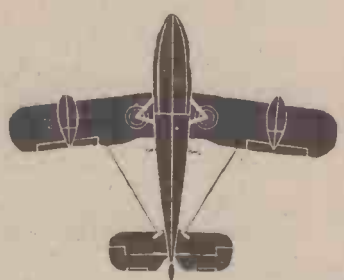
Italy has the Cant. Z506B, a three-engine monoplane float-plane of modern type possessing a range of about 3,000 miles.

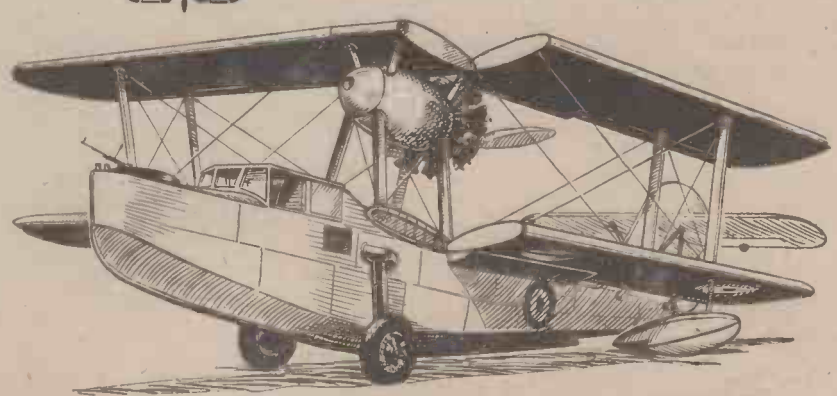
These may quite easily be distinguished from the friendly 'planes already mentioned. In the first place, they are considerably larger; secondly, they have two or more engines, and, thirdly, they are all *monoplane float-seaplanes.*

The Fokker T.8.W. is the only twin-engine monoplane seaplane included in the list of friendly types which might conceivably be confused with, say, the Heinkel 115. The illustrations of these seaplanes should be carefully compared. The Fokker is smaller than the Heinkel, and there is little real resemblance if the nose, fuselage and tail unit are examined. The seaplanes of this type which are now co-operating with the Coastal Command escaped when the Nazis overran Holland.

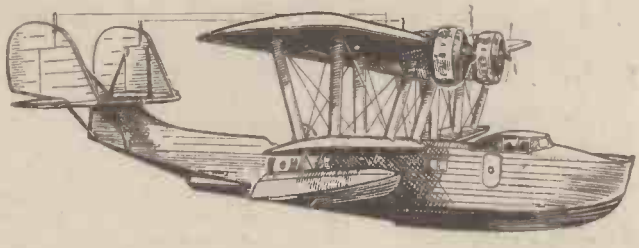
Long-range Marine Aircraft

If Mercury, the float-seaplane component of the experimental Short-Mayo trans-atlantic composite aircraft is excluded, all British long-range marine aircraft are *flying boats*, easily distinguishable from other structural types by the deep, boat-like hull. The principal service flying boats are : *Monoplanes* : Sunderland, Lerwick.





The Walrus amphibian, showing the folding wings andl landing wheels in position. An underside view is shown in the inset.



The London I service flying-boat.

Biplanes : London, Singapore, Stranraer, Walrus. At least two American-built monoplane flying boats are in production for the R.A.F.—the Consolidated PBY-5, and the Consolidated 31.

The three Dorniers, Do.18, 24 and 26, and the Blohm & Voss Ha.138 are, so far as is known at present, the principal types of flying boat operating with the *Luftwaffe*.

These twelve designs form a convenient group for study. Each possesses distinctive and characteristic features which are briefly outlined in the following notes.

Long-Range Marine Aircraft—Flying Boats
Short Sunderland

The Sunderland, the first *monoplane* flying-boat to go into regular service with the R.A.F., is developed from the Short Empire flying-boats, which in 1937 made a number of experimental flights preparatory to the opening of a regular transatlantic service.

The 915 h.p. Bristol Pegasus radial air-cooled engines provide a maximum speed of 210 m.p.h., and a cruising speed of 178 m.p.h. The normal cruising range of 1,780 miles can be increased to nearly 3,000 miles.

A *high-wing monoplane*, with single fin and rudder, the four radial engines mounted on the leading edge of the wings provide the principal recognition feature, since the only similar R.A.F. type, the Saro Lerwick, has twin engines.

German flying-boats—as explained in the following notes—are of radically different design. The four-engined Consolidated 29, which may be ordered for the R.A.F., has a distinctive twin tail.

The Sunderland's power-operated gun-turrets in nose and tail indicate that the business of this British flying-boat is by no means civil. They easily distinguish it from the "C" and "G" versions of Empire flying-boats. The fixed, braced wing-tip floats supply a minor recognition point.

Saro Lerwick

Built by Saunders-Roe, Ltd., the Saro Lerwick is the only twin-engine *monoplane* flying-boat of British design in service with the R.A.F. At least two other twin-engine types, the American-built Consolidated PBY5, or R.A.F. "Catalina," and the Consolidated 31, will be making transatlantic delivery flights to augment our forces during the coming months.

From the spotter's point of view, the Lerwick has little in common with either of these types, or with German designs.

It is much more likely to be confused with the Sunderland, particularly if seen in side elevation. From this point of view, the number of engines may not be clearly distinguishable. On the other hand, the hull, which is noticeably deeper forward, the gun-turret amidships, and the angular fin and rudder, with nearly square-cut tip, are useful distinguishing points. Note also the "bite" below the rudder, where the tail gun turret is mounted.

The Lerwick is fitted with two 1,375 h.p. Bristol Hercules radial air-cooled engines, but performance figures have not been released.

Saro London

The Saro London *biplane* flying-boat, an earlier product of the same company, has been a familiar sight round our coast for several years. Whilst the London is unlikely to be mistaken for either the German or American monoplane flying-boats, it is frequently confused with the Supermarine Stranraer.

The wings are of unequal span, the inequality being much more marked in the London than in the Stranraer. The chord of the lower wing is also noticeably smaller than that of the upper wing. The wings have neither taper nor sweepback. This absence of sweepback in the London provides the easiest means of distinguishing between the two ships, the wings of the Stranraer having marked sweepback.

In the head-on view, the more complex arrangement of interplane struts, the shape of the hull, and the marked unequal span are most helpful.

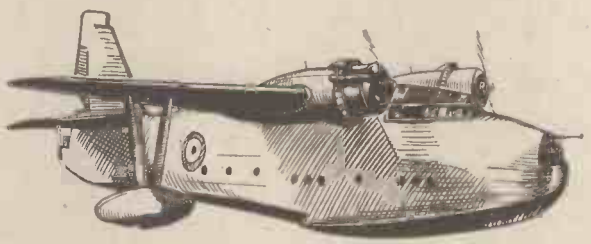
Two Bristol Pegasus air-cooled radial engines of 960 h.p. give the London Mk.II a top speed of 155 m.p.h., a cruising speed of 137 m.p.h., and a range exceeding 1,700 miles.

Supermarine Stranraer

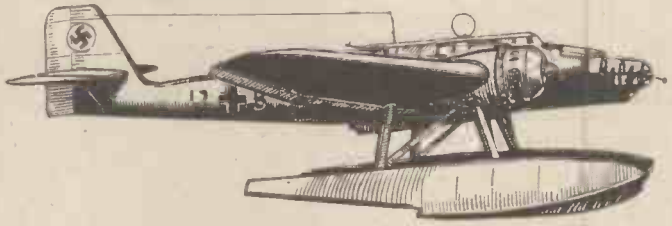
Designed by the Supermarine-Vickers Company, which developed the famous Spitfire, the Stranraer is obviously produced to meet the same general specification as the Saro London, and has a very similar performance. Like the London, it is a *biplane* of unequal span, with twin fins and rudders. The span of the Stranraer is about five feet greater, and the inequality of span is much less marked than in the London. The interplane strutting is simpler, and there is no appreciable difference between the chord of the upper and lower planes.

The sweepback of the wings, which can be observed from many points of view, most easily distinguishes the Stranraer from the London. It is useful to remember the initial letter "S," for Stranraer, "S" for sweepback, and "S" for simple strutting. From the side, the tail unit is most distinctive. The rudders of the London overhang the elevator, resembling the stern of a Venetian gondola. The Stranraer rudders, on the contrary, are cut off short of the stern.

The two Bristol Pegasus radial engines give a maximum speed of 165 m.p.h., a cruising speed of 105 m.p.h., and a range of 1,000 miles.



Left. The Saro Lerwick twin-engined long range marine aircraft. Span 80 ft. 10 in. Length 63 ft. 7½ in.



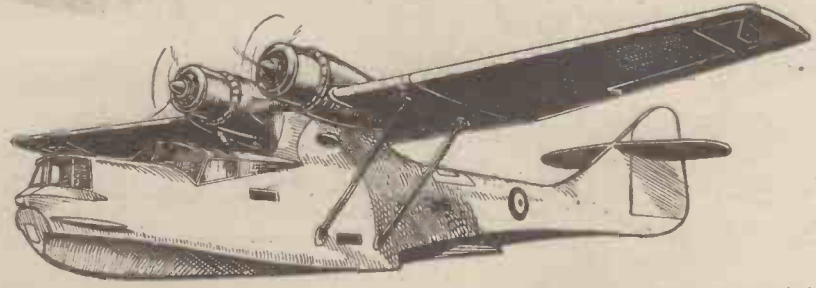
Right. The Heinkel 115 reconnaissance torpedo bomber. Span 73 ft. Length 56 ft. 8 in.

Supermarine Walrus

The Walrus, a product of the same company, has many easily recognisable features. Further, being designed chiefly for Fleet spotting, its cruising speed is low, about 95 m.p.h., and the observer has ample time to notice its salient points as it ambles leisurely across the horizon.

A *biplane* of equal span, its wings are untapered, but have pronounced sweepback. They are cut away at the trailing edge to give clearance for the pusher airscrew, driven by a single Pegasus radial air-cooled engine.

The location of this single engine between the main planes generally distinguishes this flying-boat from other types. In plan view it is not unlike the Stranraer, but the two engines of the latter can be clearly seen from this point of view, whilst the centrally-placed single engine of the Walrus is hidden by the hull. If the observer has a clear view of the underside, the wells of the retracted landing-wheels may be noted, for the Walrus is the only amphibian flying-boat



The R.A.F. twin-engined reconnaissance flying-boat—Catalina. In general outline this is similar to the Dornier D.O. 18 (see next page).

in service with the R.A.F. This flying-boat has also given many years' valuable service in the Royal Australian Air Force, where it is known as the Seagull.

Short Singapore

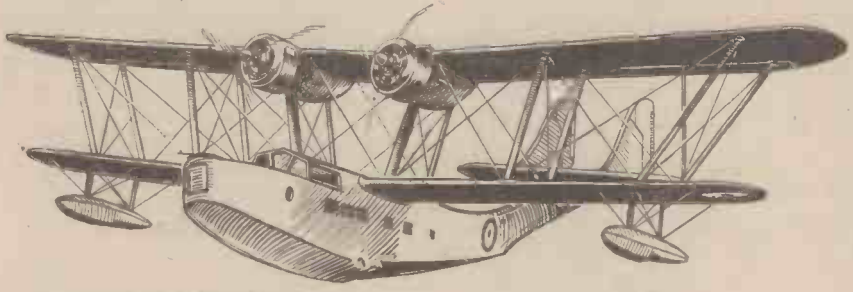
This well-known *biplane* flying-boat is an earlier product of Short Brothers. The type is now rendered rather obsolete by the greatly improved performance of the same company's monoplane flying-boats—the Empire types—and the Sunderland.

The Singapore is exceptional in the R.A.F. in having four engines arranged in two tandem pairs, driving two pusher and two tractor airscrews. The four liquid-cooled Kestrel engines, each pair having a large boiler-like radiator mounted on top, readily distinguish this craft from any other. The tail unit is equally unusual, three fins and rudders being mounted above the large braced tail-plane.

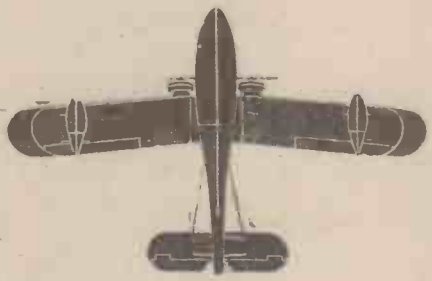
The maximum speed is 145 m.p.h., the cruising speed 123 m.p.h., and the range about 800 miles.

Dornier 26

It is appropriate to study the Dornier 26 after the Singapore, since it has the same feature of four engines arranged in two tandem pairs, driving two pusher and two tractor airscrews.



The Stranraer twin-engined seaplane. This is a biplane of unequal span, and has twin fins and rudders. Inset: Underside view.



The Dornier 26 is, however, one of a long line of *high-wing monoplane* flying-boats descending from the giant Do X, with its twelve engines arranged in six tandem pairs, through the Super Wal, the Wal, the Dornier 18, and the Dornier 24.

The slender hull terminates in a single fin and rudder, and the wings are remarkable for their sharp upward inclination from the hull to the engine nacelles—a form of dihedral generally described as "gull-wing." In contrast to the fixed floats of British types, the Dornier 26 has retractable wing floats.

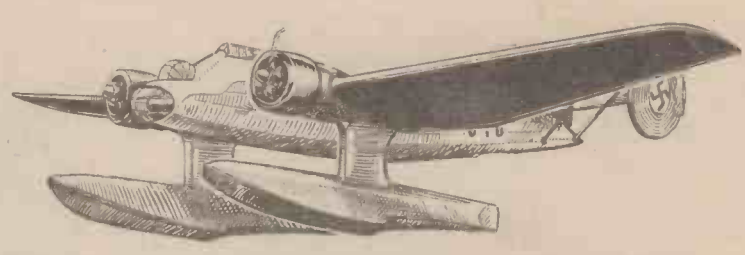
The four 600-h.p. Junkers "Jumo" diesel engines give the Dornier 26 a top speed of 208 m.p.h., a cruising speed of 193 m.p.h., and a maximum range of 5,600 miles.

Dornier 18

The Dornier 18, also a *high-wing monoplane* with single fin and rudder, may almost be described as a simpler version of the Dornier 26, having one instead of two tandem pairs of engines, driving a pusher, and a tractor airscrew.

Whilst the Dornier 18 lacks the distinctive gull wing of the later type it has another recognition point of equal value—stub wings, or sponsons, built on to the hull, instead of the usual fixed or retractable wing-tip floats.

The hull of the Dornier 18 is particularly long and slender. But for the tandem engines and stub wings, it might easily be confused with the R.A.F. Catalina (Consolidated PBY-5). Its two Junkers "Jumo" diesel engines provide a maximum speed of 161 m.p.h., a cruising speed of 140 m.p.h., and a range exceeding 3,000 miles.



The Blohm and Voss H:A.140 long-range seaplane.

Dornier 24

The Dornier 24 *monoplane* flying-boat is a distinct departure from either of the preceding types. It has three radial air-cooled engines mounted along the leading edge of its *parasol wing*. The long slender hull, whilst similar to that of the Dornier 18—having sponsons instead of wing floats—terminates in twin fins and rudders.

Fitted with three 880 h.p. B.M.W. radial engines, the maximum speed is 195 m.p.h., the cruising speed 160 m.p.h., and the range slightly over 2,000 miles.

R.A.F. Catalina (Consolidated PBY-5)

In view of the similarity of its hull lines, it is appropriate to consider here the American-built Catalina, a type known in the U.S. Navy as PBY-5 and developed from the Consolidated Civil Model 28. The slender lines of this *monoplane* flying-boat are in marked contrast with the deep, short hulls of the latest British types, the Sunderland and the Lerwick.

There may be a slight possibility of confusion between the Dornier 18 and this American-built flying-boat, but the twin radial engines of the Catalina, mounted in the orthodox manner, are usually distinguishable from the tandem diesels of the Dornier 18.

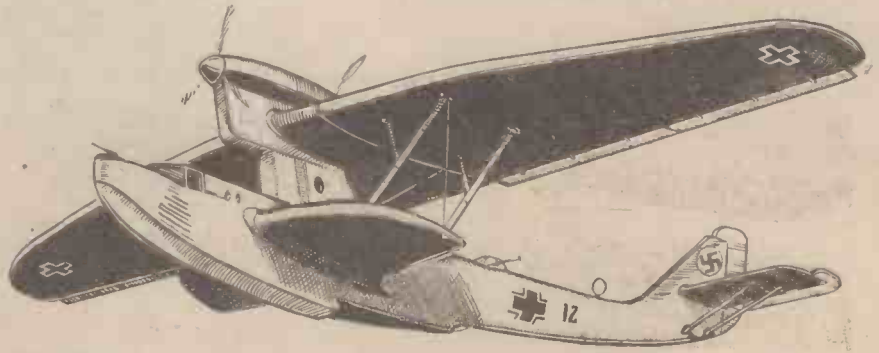
Further, the Catalina has neither sponsons nor fixed wing floats. The observer will notice that the extreme tips of the wings are thicker than the centre-section. These thick wing-tips are actually retractable wing-tip floats.

The power unit consists of either Pratt and Whitney "Twin Wasp" or Wright "Cyclone" radial air-cooled engines. With the latter, the maximum speed is 206 m.p.h., and the normal cruising range about 4,000 miles. The first of this type to be delivered experimentally to Great Britain—in 1939—flew direct from California to Felixstowe, over 5,700 miles with only one refuelling stop, at Botwood, Newfoundland.

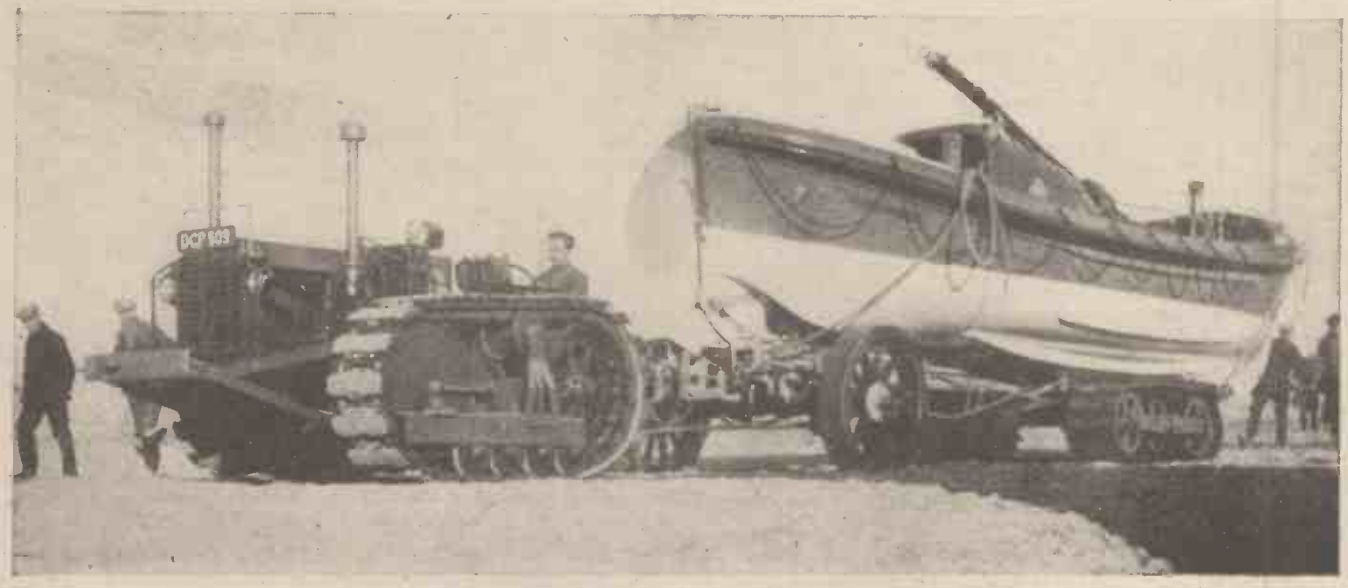
Consolidated 31

This very advanced type is also understood to be in production for the R.A.F. It is characterised by an extremely thin wing of high aspect ratio, a deep, relatively short hull, twin fins and rudders of large size, and retractable wing floats. The power-plant, consisting of two 2,200 h.p. Wright "Duplex Cyclone" radial engines, is reported to provide a cruising range of 10,000 miles. A top speed around 265 m.p.h. is claimed.

The Blohm & Voss Company has followed unconventional lines in developing seaplanes such as the Ha.139 and 140 as long-range ocean-going aircraft. The Ha.138 is equally unconventional, being almost a compromise between a flying-boat and a float-seaplane. This unusual craft is a *high-wing monoplane*, fitted with three Junkers diesel engines, one of which is mounted above the centre-section, and the others centred on the leading edge. The hull is cut short just aft of the trailing edge. Twin fins and rudders are mounted at the extremities of narrow booms which appear to be extensions of the engine nacelles. These also support the tail-plane. Fixed wing-floats are fitted. The power-plant gives a top speed of 171 m.p.h., a cruising speed of 146 m.p.h., and a maximum range of about 1,500 miles.



The Dornier D.O.18, a high-wing monoplane, with single fin and rudder. It has one tandem pair of engines, driving a pusher, and a tractor airscrew.



Lifeboat roadless tractor, with carriage and lifeboat, travelling over sand.

MECHANICAL METHODS OF

Launching Lifeboats

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

THE Royal National Lifeboat Institution was founded in 1824, and its rescue work has been carried on without a break for the past 116 years.

There are at the present time 170 lifeboats available for service at various points round the coast of these islands, and of these 143 are motor lifeboats. A total of 128 can be moored afloat in harbours or are housed in suitable buildings from which they can rapidly be launched down slipways direct into deep and protected water. There remain many hundreds of miles of coast line where such methods are not practicable. In these circumstances it becomes necessary for a proportion of the lifeboats, forty-two in all, to be launched from an open beach, the boat itself often being housed some distance away from where any launch can be made, especially at low tide. The ability to choose between a number of practicable launching places, according to the position of the wreck and weather or tide conditions, may be very valuable. To travel a comparatively short distance along a beach may save many miles of travel by water in the face of a gale and heavy sea. Strategic launching points can be chosen, which may have the effect of saving vital time.

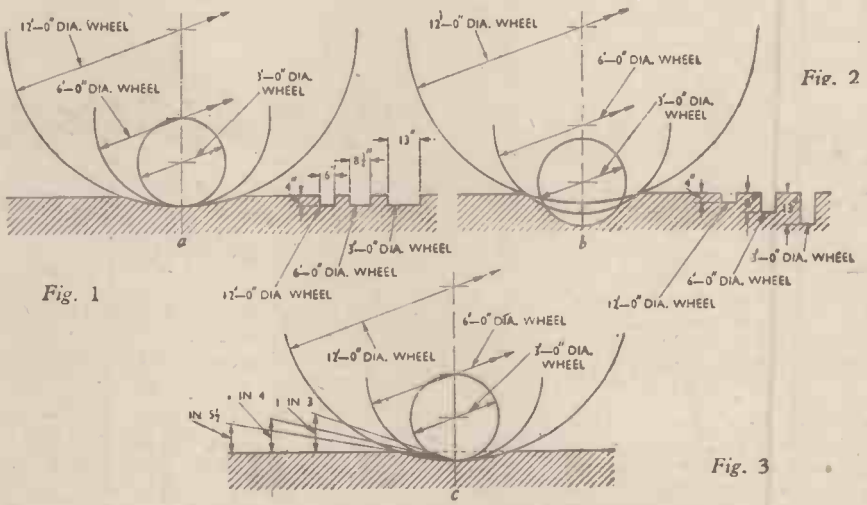


Fig. 1 *Fig.* 2 *Fig.* 3

Figs. 1 *to* 3. *Effect of width and diameter of smooth steel wheels on rolling resistances.*

Fig. 5. *Lifeboat carriage in use, showing Tipping's plates on wheels.*

Beach Conditions

To make the picture clear, it is necessary to describe in some detail the beach conditions in which the launch has to take place. The beaches themselves vary from firm wet sand to deep layers of clean shingle composed of smooth and rounded pebbles with nothing to bind them together; the latter type forms one of the most difficult surfaces to deal with. Up to the point when the shingle approximates to coarse sand, the smaller the pebbles, the more easily do they flow beneath the application of weight to the surface and

thus the more difficult are the conditions for transport. Small wet and clean shingle approximates in behaviour to a fluid rather than to a solid. Sandy beaches may be complicated by dunes of dry wind-blown sand which also present considerable difficulty. Some beaches which may stretch for miles at low tide and are almost level, abound in treacherous mud pockets which have their origin in adjacent river estuaries. An instance of this is the beach at Hoylake, in Cheshire. In other cases the sand may be so waterlogged as to become what is commonly known as quicksand.

Of shingle beaches it is possible that Dungeness is the worst example. Even to walk over some parts of it is so difficult that the local inhabitants have developed the practice of shuffling over the surface on a primitive sort of snow shoes locally known as "back-stays." The pressure put upon the ground by a man of average weight standing on one foot, and assuming no sinkage and thus no support from the instep, is about 10 lb. per sq. in. The "back-stays" have an area approximately five times that of the human foot and thus reduce the pressure to about 2 lb. per sq. in.

In the circumstances referred to, it will be appreciated that very special equipment is called for if a modern motor lifeboat, which, complete with its carriage, weighs approximately 11 tons, is to be hauled over the beach without difficulty. The first mechanical requirement, therefore, for beach launching of the lifeboat is that its weight shall be made movable without undue rolling resistance or sinkage over the urfaces described.

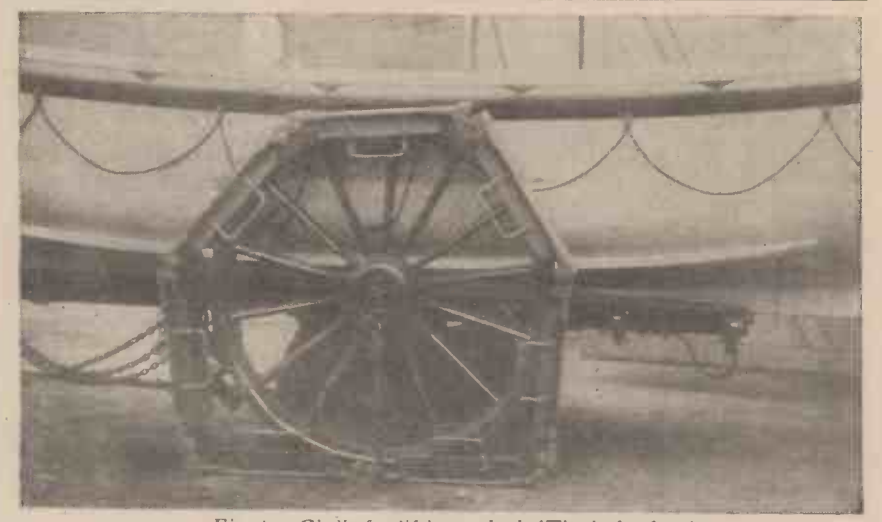


Fig. 4. Girdle for lifeboat wheels (Tipping's plates).

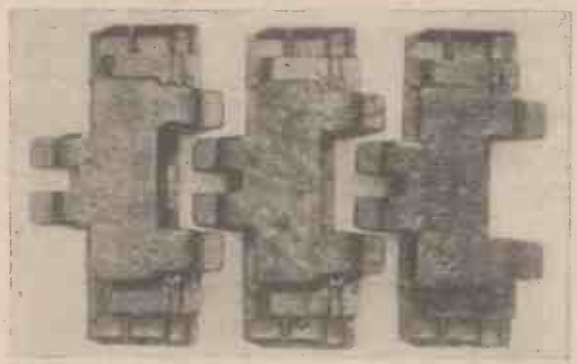


Fig. 7. Double interlock for girder track.

Fig. 8. Girder track assembled without hinge pins.

The Mounting of the Lifeboat and Carriage

The carriage which carries the boat, and from which also the boat is launched into the sea, was developed nearly a century ago and was originally equipped with steel-tyred wheels. Even to this day there are carriages in use with such wheels, and where the boats are of light weight, say 3¾-4 tons, and the beach conditions are favourable, no great difficulty is experienced. In conditions specially favourable, boats up to 6 tons in weight have been and are even now transported on carriages equipped with plain steel-tyred wheels. The weight of the boat is concentrated over the rear axle, the turntable and forecarriage being used for steering and stabilising purposes. As the weight of the boats tended to increase, especially when engine power was substituted for sails and oars, it became increasingly difficult to launch from any but the firmest of wet sand, owing to the high rolling resistance offered by the wheels. It may be appropriate here to deal with some aspects of the rolling resistance of steel-tyred wheels when operating over soft surfaces.

Rolling Resistance of Smooth Steel-Tyred Wheels

Over a good hard road surface the rolling resistance of steel-tyred wheels can be as low as 30 lb. per ton weight of vehicle. Over a loose sandy beach this can rise to 200 or 300 lb. per ton, and even more. In very soft patches, even with wheels of the largest practicable diameter, sinking to a depth involving immobility—within practical limits of motive power—can readily be experienced. The rolling resistance may be such that to effect forward movement a pull equal to or even greater than the total weight of the vehicle is necessary. The power required for haulage is, of course, wasted in the creation of ruts in the ground surface, and a common misconception is that the difficulty of high rolling resistances over soft surfaces can be cured by an increase in wheel width thus offering a larger surface of support.

While in certain cases a moderate increase in width can have beneficial results in minimising the liability to sinkage, yet increase in width alone is no answer to rolling resistance. If a steel-tyred wheel 4 inches wide sinks into a soft surface to a depth of 2 inches the cross-sectional area of the rut created will be 8 sq. in. If by doubling the wheel width the sinkage is halved, then the cross-sectional area is not reduced, being still 8 sq. in. As the cross-sectional area of the rut created is a reasonably accurate measure of the rolling resistance, little if any benefit has been obtained by doubling the width. Great advantage arises, however, from an increase in wheel diameter, as is indicated by Figs. 1 to 3. To illustrate the point, Fig. 1 shows wheels 3 feet, 6 feet, and 12 feet diameter respectively, so proportioned in width that they sink to an equal depth of 4 inches in soft soil when equally weighted. It will be seen from the rut sections that the 3-foot wheel has to be rather more than double the width of the 12-foot wheel, and this is a fairly accurate measure of their respective

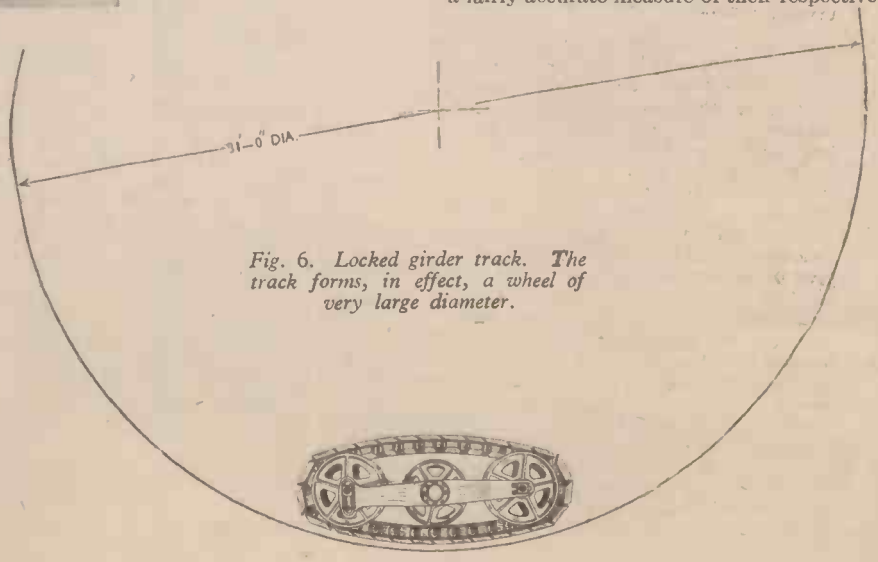


Fig. 6. Locked girder track. The track forms, in effect, a wheel of very large diameter.

rolling resistances. The same three wheels are shown in Fig. 2, but in this case they are all 6 inches wide. With equal loading, the 3-foot wheel creates a rut more than three times the depth of that created by the 12-foot wheel.

Actually, the figures given above are rather more favourable to the small-diameter wheel than would be realised in practice. One factor which the figures do not reveal is the "angle of attack" illustrated by Fig. 3. This shows that, given equal depth of sinkage, the 12-foot wheel is in effect being called upon to climb a gradient of 1 in 5½, the 6-foot wheel a gradient of 1 in 4, and the 3-foot wheel a gradient of 1 in 3. A factor which has not been taken into account in the foregoing, as it does not affect the comparison between the figures, is the essential difference between a wheel which is standing still on a soft surface and one which is moving. Obviously, the area of support given by the ground to a wheel standing on a soft surface is equally distributed on either side of the vertical centre line of the wheel, whereas as soon as it moves forward the rut left behind provides no support to the rear of the vertical centre line and in consequence the area of support for the wheel and its load is halved, involving additional sinkage until the requisite area is obtained. It by no means follows, therefore, because some particular type and size of wheel will support a given load on the surface or without undue sinkage when stationary, that it will do so when moving.

Tipping's Plates.

Towards the end of the nineteenth century an attempt was made to overcome the difficulties with wheels over the softer types of beach by fitting the rear wheels carrying the weight of the boat with girdles consisting of a series of flat plates linked together (see Figs. 4 and 5). These girdles were the invention of Lt.-Commander Gartside-Tipping, R.N., who was appointed District Inspector in the Royal National Lifeboat Service in 1879, in which capacity he served until 1892. While these "Tipping plates" (as they were termed) reduced to some extent the difficulties previously experienced and made it possible to use certain beaches which would otherwise have been quite impracticable, they were not wholly satisfactory. It will be clear from Figs. 4 and 5 that only when the wheel is in the centre of one of the plates is the weight truly distributed over the ground surface. With the weight concentrated on the joint between the plates, sinkage and undue rolling resistance is inevitable, though not so great as in the case of the ungirdled wheels.

(To be continued)

Two Useful Lathe Tools

Constructional Details of Two Tools for Screw Cutting and Light Turning

THE tools shown in the accompanying sketches will be found very useful in their different applications. Figs. 1 to 4, inclusive, show details of a former tool which has the advantage that the grinding of it does not in any way affect its contour. As shown, it is suitable for screw-cutting a V-type thread, such as Whitworth, or any standard angle thread. The tool itself is a disc mounted on a cast-steel shank. The side view shows the cutting edge which is formed by slatting out a gap in the disc.

The disc is turned from a piece of cast-steel bar, or can be drilled out of plate cast steel, and chucked and turned to the shape shown. It is held to the shank by the slotted head screw. This screw has a taper head which fits a taper in the central hole in the tool. The taper is 90 degrees, inclusive, or 45 degrees each side. The tool also has a female taper in the central hole to fit the taper on the screw and a male taper on the other side to fit a female taper in the shank. Fig 2, a sectional view, shows this fitting.

Clamping Screw

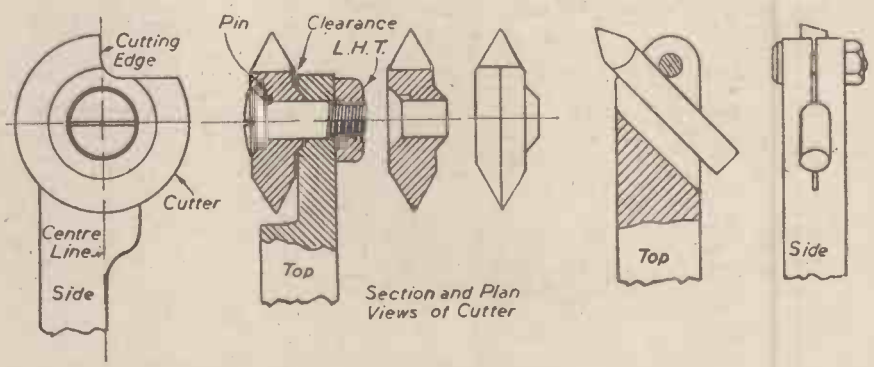
The screw is fitted with a left-hand thread which should be finer than Whitworth, and there should be clearance, as shown, so that the tool cannot bed up against the flat face of the shank, but is held wedged in the taper hole in the latter.

The end of the male taper on the tool should also not extend to the bottom of the taper hole in the shank, the object being to pull the tool up, by the screw and lock-nut tightly in the taper which will give it full support against the pressure of cutting.

The reason for the left-hand thread on the bolt or screw is to ensure that the tendency to turn the tool will be resisted, and the tool tightened by reason of the thread direction being such that the tendency is to tighten it. A small pin, driven in a ⅛ in. hole in the bolt, engages with a slot in the hole in the cotter, and prevents the tool turning on the bolt. Fig. 3 is a sectional view showing the cutting face, and Fig. 4 is a side view.

The slot forming the cutting face can be sawn and filed after turning. The line of the face cuts the centre axis of the tool and intersects the lathe axis.

The circular cotter is hardened and tempered by heating to a full red colour, and quenching in cold salt water. It is then polished bright on its formed edges, and to draw the temper it is threaded on to a bar of red-hot iron or steel and left there till the periphery assumes a golden straw colour when it is immediately quenched again in cold salt water. The bolt and nut can be case-hardened with "Kasenit" to ensure a long-working life.



Figs. 1 to 4. Details of a disc tool for screw-cutting.
Figs. 5 and 6. A simple tool-holder and cutter for light turning.

For Light Turning

In Figs. 5 and 6 is shown a simple tool holder which takes a small cutter of ¾ in. round cast or silver steel stock.

The holder is made from square cast-steel bar of a size to suit the lathe slide rest tool holder.

It is sawn at an angle of 45 degrees at the top, leaving a face through which is drilled a ⅜ in. hole to take the cutter. The hole is square with this face, and can best be drilled by holding the stock in a vice at the required angle, mounting the vice on the drilling machine table and drilling down right through the stock.

Slotting the Holder

The hole for the clamping bolt can then be drilled so that its edge contacts with the edge of the hole for the cutter. A slot is now sawn right down the tool at the same angle as the cutter hole, and bisecting it and extending, as shown, about a quarter inch below it. A ¼-inch case-hardened bolt with a thin flat head, and a hardened hexagon nut is then fitted in the transverse hole and is used to clamp the cutter firmly in the hole.

This tool holder can be used either right or left-handed as the work requires, and the cutter clamping bolt and nut can be fitted with the nut on either surface. The cutters can be ground also to any angle suitable for the job in hand.

Cutters should be hardened dead hard, and the temper then drawn to a golden amber colour, and quenched.

Naval Communications

By Commander Edgar P. Young, R.N.

The Various Means Used for the Transmission of Orders Within the Fleet, and from Ship to Shore

WHEN thinking of naval warfare, there is a natural tendency to think primarily in terms of strategy and tactics, of the manoeuvres of fleets and ships, and of the handling of the various weapons with which they fight. The factor of communications is seldom given a thought. But it is of primary and fundamental importance in any naval operations.

Naval communications may be considered under two headings :—(1) External Communications, (2) Internal Communications.

External Communications

These, as their name implies, are the communications between a fleet, regarded as a unit, and the outside world. A fleet, whether in harbour or at sea, has need of a constant supply of "intelligence," that is to say, of information regarding the enemy, of navigational information (a matter of very great importance in time of war, more especially in connection with minefields laid constantly by the enemy and by its own minelayers), of meteorological information (which may have an important bearing on its operations, especially in connection with aircraft), of orders and instructions from the Admiralty, and of news of a general character for the information of its personnel. It must also be able to communicate to those who are interested or responsible any "intelligence which it may acquire, meteorological data (without which accurate weather forecasts cannot be made), its day-to-day requirements of an urgent character and, of course, the progress and outcome of any operations in which it may engage.

Hoisting a flag signal on board ship. Note the various signalling flags in the lockers.

Internal Communications

These are the communications within a fleet between the Admiral commanding it and the units which he commands and between those units. They are required at all times for the transmission of information and orders within the Fleet. In harbour they are required for little else, as a rule, but when the Fleet is at sea they are required for a multitude of other purposes, such as manoeuvring, fire-control, torpedo-control and, of course, for reporting the enemy.

Means of Communication

The means used for naval communication are no less varied than the purposes for which they are required. Some are useful for only a limited number of purposes, or in certain circumstances, while others may be used for a variety of purposes and in a variety of circumstances, their selection being determined by those circumstances.

They may be discussed, for convenience, under the following four headings :—

(1) Land-line Telegraphy and Telephony.
(2) Visual Signalling.
(3) Sound Signalling.
(4) Wireless Telegraphy and Telephony.

Land-Line Telegraphy and Telephony

This means of communication, which covers also overseas cables, requires no explanation, even to the layman reader. It can, for obvious reasons, be used only by a Fleet or by ships in harbour, and as a rule only for external communications, though the ordinary telephone can sometimes be used for internal communication. Its greatest advantage, perhaps, is its comparative immunity from interception by the enemy and the secrecy which is thereby secured.

Messages passed by this means may be either in plain language or in code, though the use of code for telephonic messages presents certain inconveniences and difficulties.

Visual Signalling

"Visual Signalling" is a term used to cover all forms of signalling which are perceived by the eye. Such forms of signalling may, in certain circumstances, be

used for external communications, but are normally used for purposes of internal communication only. They may be used with equal facility in harbour, where they are used for the handling of most messages, and at sea.

Visual signals may be transmitted by any of the following means:—

(*a*) Flags.
(*b*) Semaphore.
(*c*) Morse Flag.
(*d*) Flashing.

The first three of these can be used only by day, but the fourth may be used either by day or by night. Messages passed by any of these means may be either in plain language or in code, but the use of semaphore for passing messages in code is inconvenient and unreliable, and the use of plain language when signalling by flags is undesirable, for reasons which will be explained.

(*a*) Signalling by Flags

Flag-signalling is conducted by means of flags and pendants, hoisted by halliards at the masts and yards. The flags used for naval signalling may be one of three shapes. The *pendants* used for naval signalling being long and narrow.

For purposes of naval signalling there are used twenty-six Alphabetical flags (representing the letters of our alphabet), ten Numeral flags (representing the numbers 1 to 0, inclusive), twenty-six Special flags (each with a name and designation), ten numbered Pendants (numbered from 1 to 0, inclusive), and fourteen Special Pendants (each with a name and designation).

For details of these, see "Signal Card 1937" (B.R.232), which can be obtained from H.M. Stationery Office for 9d.

These flags and/or pendants are hoisted either singly or in series, each single flag or pendant or series transmitting an order, making an enquiry or conveying information, according to the code book which is in use. Several signals may be hoisted simultaneously, separated one from another, if on the same halliard, by a short length of halliard called a "tack-line." When this is done, the sequence in which such signals are to be read is from starboard (right) to port (left), as regards the halliards, and from top to bottom, as regards each halliard.

In order to indicate to which ships or units a flag signal is addressed, each ship and unit has a "distinguishing signal," composed of one or two flags and/or pendants. These distinguishing signals are hoisted superior to the signal or signals addressed only to certain ships or units, but they may be used also hoisted *inferior* to a signal or signals, to denote such ships or units in connection therewith. A signal which is hoisted with no distinguishing signal superior to it is termed "a general signal," and is addressed to all ships under the command of the officer hoisting it or, in the case of a report, to any ships which may see it.

Flag signals are normally answered by the ship or ships to which they are addressed by means of an *answering pendant*, which is hoisted *at the dip* (or half-way up) as soon as the signal is seen, and *close up* as soon as it has been read and understood. In certain circumstances, as, for instance, when it would be difficult or impossible (on account of distance or of masking) for the ship most distant from the originator to read a signal, it is repeated by all the ships to whom it is addressed, excepting the most distant one, which uses the answering pendant as described above. When this occurs, ships

Sending a signal by means of a flashing lamp.

repeating the signal keep it flying *at the dip* until the most distant ship has hoisted her answering pendant *close up*, and then hoist it *close up* in sequence *from out—in*, to show the originator that it has been read and understood by all to whom it is addressed, the more distant of whom he may be unable to see. Either immediately, or shortly after this procedure has been completed, the signal is hauled down by the originator, as is also the repeated signal or answering pendant by the ships to which it is addressed.

If the signal is one ordering the performance of some evolution or manoeuvre, it is carried into execution as soon as it is hauled down, subject to the instructions contained in the signal books regarding the method of execution. It is possible, however, by hoisting the appropriate flag *superior* to a signal, to indicate that its execution is optional, or, by hoisting the appropriate signal *inferior* to it, to indicate that it is to be executed at a certain time or on arrival at a certain position.

It will be obvious, on consideration of the preceding paragraph, that, in the event of the originator wishing to cancel or modify a signal which has been hoisted, he must not just haul it down. What he must do is to hoist the *Negative Flag* in a position *superior* to the signal, which may be lowered *at the dip* if necessary to make that possible, and then wait until the ship or ships addressed have imitated him before hauling down the signal first, and then the negative flag. After that, he may, if he so wishes, rehoist the signal in its amended form.

The negative flag may be used also, *superior* to a signal, to give it a negative significance (e.g., *superior* to a signal meaning "Fire a salute," to indicate "Do *not* fire a salute), or, in conjunction with distinguishing signals *inferior* to a signal, to denote that the signal is *not addressed to* the ships or units denoted by those distinguishing signals.

Flag signalling is probably the most rapid means of communication when orders or simple reports, for which suitable short groups are provided in the naval code books, are to be conveyed, though wireless now provides a means which is scarcely, if at all, less rapid. It has the great advantage over wireless telegraphy, however, that the use of the latter betrays one's presence, and perhaps even one's exact position, to the enemy.

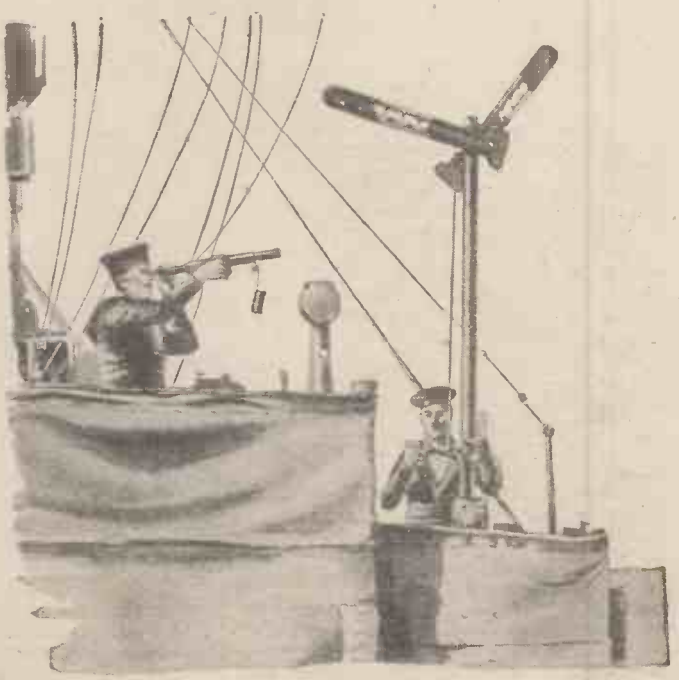
Signalling by Semaphore

Semaphore is used extensively, both at sea and in harbour, for the conveyance in plain language of messages which cannot conveniently be coded, on account either of their nature or of their length. It is both rapid and, generally speaking, unsusceptible to interception by the enemy.

The signs used in the Navy are the same as those in use elsewhere, and they may be transmitted either by a mechanical semaphore or by hand flags. Any ship wishing to pass a message by semaphore hoists a flag which denotes her intention, *inferior*, if necessary, to distinguishing signals indicating those with whom she wishes to communicate. The ships addressed hoist an *answering pendant* at the yard-arm, *close up* when they are ready to receive, and while they can satisfactorily read the message, and *at the dip* if, for any reason, they cannot read it.

Signalling by Morse Flag

Signalling by Morse flag ("flag-wagging") is little practised in the Navy, because ships are provided with so many other, and more convenient, means of communication.



Signalling by semaphore.

It is sometimes used, however, by naval landing parties for communication with their ship or with units of the Army.

The usual Morse code is used, and messages may be either in plain language or in code.

Signalling by Flashing

For purposes of passing messages in the Morse code, it is obviously far quicker to use some flashing device, rather than the flag, described above, which in any case, cannot be used at night. It is not surprising, therefore, that such flashing devices are used very extensively in the Navy.

For signalling by day, since it is impracticable to use a heliograph on board a ship, use is made of signalling projectors of various sizes and, more especially for signalling with aircraft, whose bearing changes very rapidly, the Aldis Lamp. The former, when used for this purpose, are fitted with a shutter which can be opened and closed rapidly by means of a handle operated by hand, while the latter consists of a bright source of light (battery-fed) contained in a small, portable barrel fitted with a pistol-grip and a sight, the beam of which is directed along the line of sight (to make a flash) by the movement of a mirror-reflector, operated by a trigger.

Any of these means can, and in fact are, used also for signalling by night, but suffer from disadvantages, firstly, that they are "directional," and can, therefore, not be used for signalling to several ships at once, and, secondly, that they are very conspicuous. The latter disadvantage, of course, is prohibitive of their use for night signalling in time of war, except at bases and in waters where there is no possibility of the presence of enemy warships or aircraft.

For non-directional signalling, that is to say, for signalling to several ships at once, at night, an all-round light, at the masthead or at the yard-arm, is used. Such a light is fed from the ship's mains, and is keyed from one or other of the bridges. The procedure used is very similar to that used when signalling by flags, a *general call* or a *distinguishing signal* being used by the transmitting ship, according to whether the signal is addressed to all ships in sight, or only to certain ships, and is answered by those addressed with an *answering sign.* Just as in flag-signalling, also, the signal is not only answered, but is repeated, if circumstances render that necessary, by all ships lying between the originator and the most distant of the addressees.

Such *all-round signalling* is, for obvious reasons, not practised where secrecy is desired, but is substituted by *directional signalling* with a screened lamp (portable and battery-fed), which can be shaded as necessary to reduce its range. Any signal passed by this means which is addressed to more than one ship must be made to each ship separately, and must, in many circumstances, be relayed from ship to ship.

Sound Signalling

Sound-signalling, by means of a syren or hooter, is used only when fog or low visibility render it impossible to communicate by visual means and when the use of wireless is, for some reason, considered undesirable.

The Morse code is used, and the procedure for passing signals is similar to that used when signalling by flashing.

Wireless Telegraphy

Wireless telegraphy is used extensively in the Navy, both for external and for internal communications. The increased accuracy of the tuning of wireless transmitters, and the increased selectivity of wireless receivers permit of the use of wireless telegraphy on several frequencies (or wavelengths) for both these purposes.

For reasons of secrecy it would be undesirable to describe in any detail the types of instruments which are used, and how provision is made for the elimination of mutual interference between them. It is permissible, however, to remark that in every modern warship the fullest possible provision is made, within the limits of space available, for long-range and short-range communication by wireless.

Transmitting a message in Morse code.

The number of lines of radio-communication which are required by any ship is dependent, of course, on the functions which it may be called upon to perform and on the degree in which it is required to co-operate tactically with consorts, or with aircraft and/or submarines. It must evidently be greater on board a flagship than on board a private ship. Some idea of the number of lines which may be required may be gathered when it is stated that wireless communication is used:—

Externally. For the transmission and reception by ships of—

(1) Meteorological Reports.
(2) Navigational Information and Warnings.
(3) Intelligence of a strategical character.
(4) Requests for, and the issue of, orders from the Admiralty.

Internally. For the transmission and reception by ships of—

(5) Enemy Reports and other Intelligence of a tactical character.
(6) Operational Orders.
(7) Manoeuvring Signals.
(8) Fire-control Signals.
(9) Torpedo-control Signals.
(10) Signals to and from aircraft engaged on reconnaissance or enemy-observation duty or spotting the fall-of-shot.

Wireless Telephony

Wireless Telephony has replaced Wireless Telegraphy for use for some of the purposes mentioned above, more especially for communication with and between fast-moving units such as aircraft, E-boats and, to a lesser extent, destroyers. It has done so also where circumstances render direct conversation between principals desirable for purposes of greater speed and flexibility.

It suffers, however, from disadvantages of a technical nature—such as, for instance, the greater risk of mistakes being made, its greater interference with communication on other wireless lines, and its lack of secrecy—which render its more extended use improbable.

Owing to the fact that the transmission of a wireless message by a ship, even if low power is used or if a high frequency is employed, enables the enemy's direction-finding stations and enemy ships fitted with direction finders to fix the position of that ship, the use of wireless is subject to severe restriction in time of war. Where circumstances render it possible, or desirable, that a ship should "break wireless silence," it may nevertheless be undesirable that other ships should do likewise in answering the message transmitted. In such circumstances the message may either be broadcast twice over for purposes of securing its correct reception, or be transmitted to, and repeated back by, some shore wireless station or some other ship which can afford to betray its position, with the intention that it shall be intercepted by those to whom it is directed.

Technical Books Service

IN response to an urgent need which has lately become evident, the National Book Council, 3 Henrietta Street, W.C.2, have compiled a portfolio of information concerning recent technical books from leading publishers, This portfolio provides a free service to British Industry, and should help towards a greater and a speedier output. A great deal of care has been put into the compilation of the lists of selective and authoritative books, and the portfolio will prove handy for reference. An order slip is included so that any books mentioned in the lists can conveniently be ordered from a bookseller. Fuller particulars of individual titles will be gladly supplied from the address given. It is proposed to circulate future issues of Supplementary Lists, four or six times a year, and the N.B.C. will be pleased to receive any suggestions with regard to these lists. One of these useful portfolios should be in the hands of all users of technical books.

Another service of the N.B.C. is an Enquiries Bureau, for the use of which there is no charge to members of the National Book Council. The full privileges of membership can be had for half a guinea, and further particulars may be obtained from the Secretary.

A Loud speaking Telephone

Radiator Type Loudspeaker having an output of Twenty Watts.

MANY high-quality sound producing systems have been constructed in recent years with various loud-speaker elements designed to cover a wide frequency range. For the most part these systems have utilised multiple devices in which two or more loud speaker units have been used in combination, each component unit reproducing only a part of the frequency spectrum. Other systems have been constructed in which a single loudspeaker plays the double role of reproducing lower frequencies through a horn connected to one side of the diaphragm, and higher frequencies directly from the opposite side. In some cases, a rather wide frequency range has been produced, and very satisfactory quality has been obtained.

Several factors associated with sound radiation and vibrating systems have necessitated multiple systems for reproducing wide frequency ranges. The more important of these are the low-frequency radiation requirements, which demand large amplitudes even when large radiating surfaces are used; the inertia of the vibrating system which results in a loss of efficiency at the higher frequencies; and the directivity of sound radiators at higher frequencies, which is a function of the size of the radiator or diaphragm.

Multiple units generally involve complications both in the mechanical structure, and in the associated circuits. These complications can be overcome by careful design, but the result is an instrument of relatively high cost. For some time a low-cost speaker of high quality, small size, and moderate power capacity has been needed. Such instrument is required in broadcast monitoring rooms, and in reproducing systems for small rooms.

Direct Radiator Type

Low cost and small size are most readily obtainable in a direct-radiator loud-speaker; that is, one whose diaphragm radiates sound directly into the air, and which does not require a horn. To obtain the high-quality performance desired with a single loudspeaker of the direct-radiator type, the diaphragm must be small enough so that it will not be too directive at the higher frequencies. At the same time the diaphragm must be capable of operating at the large amplitudes required for radiating the lower frequencies. In addition, the effective mass of the diaphragm must be small enough to radiate the higher frequencies efficiently. Even with very thin

The new loud-speaking telephone, and its designer.

metal diaphragms, mass reaction is sufficient to cause excessive loss in the high-frequency range if the diaphragm operates as a piston: that is, if all parts of the diaphragm surface move in unison. This effect can be overcome by using a diaphragm in which all parts do not move in unison when operated at higher frequencies, and such a diaphragm will radiate uniformly at all frequencies if properly designed. The problem, then, becomes one of determining the proper diaphragm material, and shape, to provide the desired high-frequency performance, and at the same time to permit free piston vibration at low frequencies where large amplitudes must be provided for.

Thin metallic diaphragms offered the most favourable properties for such a development as far as the desired effects are concerned, but the problem of forming a diaphragm of this type, which would permit the necessary amplitudes at low frequencies, have the required high-frequency performance, and be free from rattles and extraneous sounds, required considerable experimental work. The development of such a device, however, was finally successful in the Western Electric 750A loudspeaker.

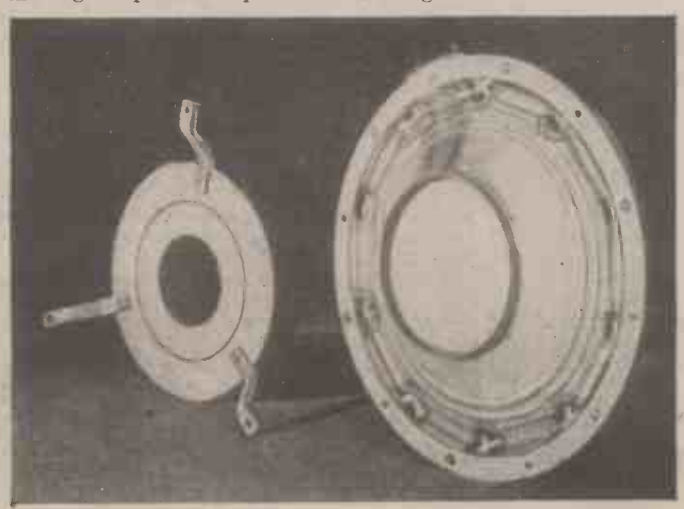
This instrument is a direct radiator with a formed metal diaphragm eight inches in diameter, and a driving coil four inches in diameter, which moves in a permanent magnet field. The loudspeaker is intended for mounting in a closed cabinet of the proper design and capacity; when furnished so mounted, the combination is known as the 751A loudspeaker. Any cabinet of suitable design, however, may be used.

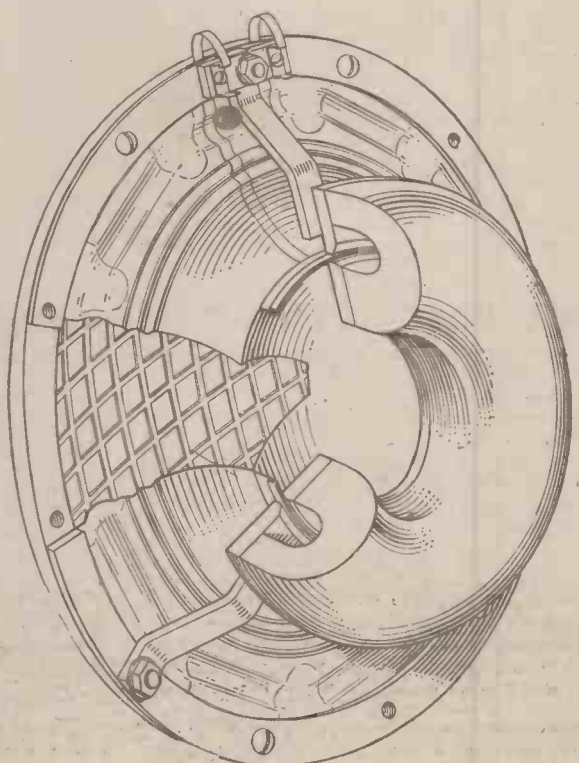
Response-Frequency Characteristic

A representative response frequency characteristic of the loudspeaker when thus housed is shown by the solid curve in Fig. 3. The sound pressures measured on the axis are relatively uniform from about 60 to 11,000

Fig. 2 (Right). The driving coil vibrates in a narrow slot in the ring-shapad field magnet.

Fig. 1 (Below). The diaphragm and magnet unit.





cycles, a frequency range sufficient for high-quality reproduction. The sound output is somewhat less uniform in the upper frequency range than for some horn-type speakers, but it is adequate for good reproduction. For comparative purposes, the response-frequency characteristic of the best commercial cone-type dynamic speaker which has come to our attention is shown in dotted line on the same drawing. Identical testing conditions were imposed in measuring the two speakers. One feature of the 750A loudspeaker, the effect of which is indicated on the response curves, is application of mechanical damping which reduces the low-frequency resonance peak so as to eliminate so-called "hang-over" effects.

An inherent limitation in a device of this type, as compared with a more elaborate combination of horn-type speakers, is the inability to control the distribution of the radiated sound. As previously indicated, the reproduction from a speaker of this type is more and more deficient in the higher frequency range as the observer moves away from the axis of the speaker. The best quality is observed within a thirty-degree angle, but satisfactory performance over a wider angle is obtained for many purposes. The diminution of high-frequency radiation is not serious up to an angle of forty-five degrees. In rectangular rooms of moderate size a single speaker usually suffices. For larger rooms, or rooms of considerable width, two or more speakers may be required for the best reproduction.

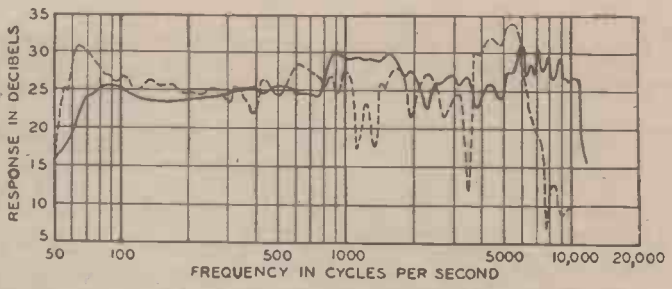


Fig. 3. Response-frequency characteristic of the 750A loud-speaking telephone in its cabinet (full line) compared with that of one of the best commercial instruments (dotted line).

Twenty Watts Output

The efficiency of the new loudspeaker is equal to that of commercially available cone-dynamic speakers of the same size and weight. When reproducing speech or music it is capable of handling the maximum undistorted output of a twenty-watt amplifier at single-frequency rating.

The 750A loudspeaker is not intended to replace existing multiple-unit systems, but rather to fill a long-felt need in situations where more elaborate devices are not required or may be prohibitive because of cost or size. In locations where high sound levels are not necessary, and where the angle of coverage is not too great, the instrument will reproduce speech and music with remarkable fidelity.—*Bell Laboratories*

NEW SERIES

Making a Success of Your Photography

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

(*Continued from page 209, March issue*)

Some Interesting Facts concerning Sensitised Material and Chemicals.

THE following is an interesting experiment which anyone can do, and it will only cost the price of a spool; get a friend to sit for you while you expose four of the eight, the first at six or ten feet, whichever is the first distance on the scale, the second at the next distance, and the fourth at infinity mark; the next four exposures should be made on a building such as a church at varying distances. Take a very careful note of the position of the main object in each exposure; in the case of the portraits you would naturally note the head, and this should be in the centre of the view-finder. Also be careful to hold the camera perfectly square; it must not be tilted, and finally be sure of the distances up to infinity. Your notes will help you on examining the negatives to see what is wrong. It is quite possible that every result will be perfect, and you have got in the negative all that you saw in the finder, and that proves that when you took a little extra care no mistakes occurred. What really happens when you behead the subject being photographed is very often due to holding the camera slightly tilted, or it may be that the finder has had a knock, and is in consequence out of its true position. A careful application of the pliers will put the trouble right.

Comparisons

Your experiment will have shown you some interesting comparisons. Put the prints from those eight exposures in a line, in their proper order, and note what a differeuce there is in the size of each image. It will also have given you the opportunity to test the markings of your distance scale, and to make any necessary adjustments to this and thus avoid having blurred images when taking close-ups.

Do not get the impression that it is only possible to do good photography if one possesses a "high-class" camera; it has been know for a beginner with a cheap camera to score a "winner" and to take a big money prize, and for one with a 30-guinea apparatus to make a real mess of his first efforts. There is with photography, as with almost any other hobby, a touch of "beginner's luck," but the great thing is to know everything you possibly can about your own instrument, and make it do what you want. But there are limits, and a reflex, with a first-class lens and shutter will obviously offer more opportunities than a camera costing only one guinea, just as a Rolls Royce is more capable than a car costing £150.

A stack of bars of silver for turning into nitrate of silver. Each bar weighs about 1000 ozs.

Historical Notes

To arrive at a really appreciative understanding of the very high quality of our present-day films, papers and chemicals, it is necessary to delve into the history of photography, and to follow step by step the work of our scientists and chemists whose perseverance has given amateur photographers such high-grade material that it can almost be said to be fool-proof.

The word photography is derived from, or has the meaning of, "sun writing or drawing"; just when it was first used can only be a matter of conjecture, as there are no definite dates or records, but the early Egyptians were well versed in the art of carrying sunlight by means of mirrors into dark chambers, and it is quite possible their magicians knew the equivalent of the camera obscura, a popular exhibit in the last century.

Our earliest records of the actual use of photography indicate that Thomas Wedgwood, in about 1802, made use of a form of "sun-drawing" in connection with designs for use on his pottery, and also that Sir Humphry Davy was keenly interested in this process. Early in the nineteenth century, three men devoted a considerable amount of their wealth, time and knowledge to proving and perfecting what was known as the "silver" image; two of these were Frenchmen, Neipce—1765 to 1833, and Daguerre—1787 to 1851; the third was an Englishman, named Fox-Talbot—1800 to

1877. These three names are indelibly linked with the commencement of the practice of photography, and it is to them that we owe the initial work on the permanency of the silver image.

Wet Collodion Process

There follows in fairly quick succession many names of English scientists and experimenters who, seeing the great potentialities of the photographic image in silver, worked hard in their laboratories to turn the device into a commercial proposition, and in 1851 a Londoner named Scott Archer, published a description of his formula for the wet collodion process, and it is interesting to note that, although this process is still practised in our process engraving departments for the reproduction of first-class illustrations for the press and magazines, it has had but very little alteration or improvement since it was invented.

Wet-plate photography, however, because it was a cumbersome business, had only a limited following, but in the "seventies" there were definite moves being made for finding a method of making negatives in a simpler or more convenient manner, and the result was the appearance of "dry" plates. These were manufactured by the firm of Ilford, Ltd., whose films, plates and papers are to-day known all over the world; the Selo films, made by this firm, are very popular with amateurs.

The "Silver Image"

The word "silver" in connection with image has been mentioned, and calls for some explanation; the design which is found on a negative or photographic print is only made possible by the incorporation of a salt of silver in the emulsion that is coated on the glass, celluloid or paper; this salt is the sensitising agent, or, in other words, it makes the emulsion capable of recording the action of light. It is manufactured as nitrate of silver, and it must be of a remarkable degree of purity otherwise it would create great difficulties for the makers of films, and amateurs would not be able to do the first-class work which they are now able to do so easily. Although some tons of nitrate are produced weekly, each ounce of which has to contain 0.625 of pure silver metal, yet the analytical chemists who use it will not permit more than 0.0004 per cent. impurities. One of the accompanying illustrations shows bars of silver, each about 1,000 ounces in weight, that has been refined to 999.9 purity. These bars are cut into small pieces and the metal is then granulated ready for dissolving in nitric acid, which purifies it further and also reduces it to a state for crystallising and re-crystallising, as shown in the second illustration, in which condition it is sold to the film and paper manufacturers. Silver nitrate is manufactured by the 200 years old firm of Johnson & Sons, who have been supplying it for photographic purposes ever since the very earliest days.

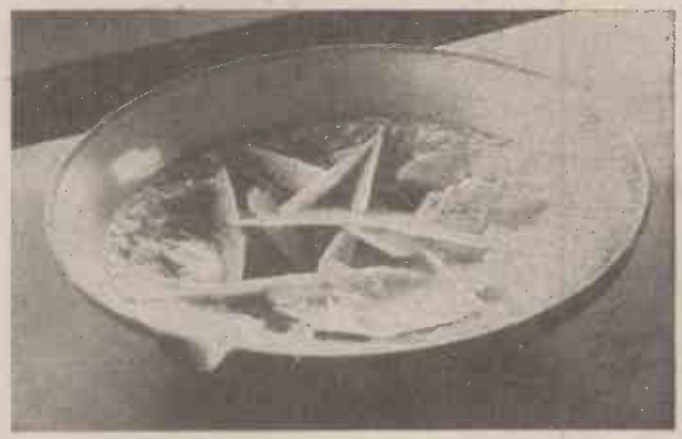
The reason why amateurs have such excellent material for their hobby is due entirely to the skill of our British chemists, scientists and engineers; so much care is given that it is almost impossible for an inferior batch to leave the factories, and this is a point which we must remember when anything goes wrong with our work; it is more likely to be due to something which we ourselves have slipped up on, rather than the chemicals, films or papers.

Most advanced amateurs have their own particular fancy as to which is the best film, and it takes a lot to convince them that something better has come on to the market. This is not altogether a fault, for if their case could be thoroughly analysed, it would be found that they have been rather careful to find out all they can, in a practical manner, any little characteristics of the film, such as the latitude that could be allowed in exposure, or the developer which was most suitable for it; whether it gained density too quickly, and what sort of gradation was possible. In this way he was able to obtain results which, to him, were better than he might have obtained from other brands.

Overhauling and Testing

Here, then, is the lesson which should appeal to all who desire to make their photography more successful; there is a wide range of very excellent films, and you cannot help selecting a good make, but having made your choice, stick to it until you have mastered its capabilities, and you will find that your work is improving. If, for some unknown reason, you are not getting entire satisfaction, you must first examine your own method of working. Overhaul the camera, test the dark-room lamp; take the temperature of the developer before using; is the thermometer registering accurately? and so on.

Here is an example. A friend bought an expensive camera to take on an excursion to Switzerland, and was advised to use a certain make of film; on receiving his prints from a "D & P" chemist, he was disgusted to find them spoiled through a number of spots of all shapes; he at once blamed the films and the party who advocated their use. I asked to see his negatives and his camera. It was only necessary to look at two of the negatives to read the whole story, for when the camera was opened and shaken over a piece of white paper, numerous tiny fragments of dust, straw and wood fell out. There was nothing else wrong, the camera was good and so were the films.



A bowl of re-crystallised silver nitrate ready for supplying to sensitised material manufacturers.

Classification of Films

Films can be classified into two groups, monochrome and colour sensitive, the former being largely superseded by the latter. Monochrome films have their advantages for certain work, but that is mostly industrial or commercial work, and not, therefore, of much interest to amateurs. the ortho or panchromatic variety offers opportunities to those who revel in outdoor pictorial work such as landscapes, trees, street scenes, etc., where colour plays such an important part in the general design, construction and effect of the scene, and which can only be correctly reproduced, in black and white, if the medium used is capable of differentiating between the extremes of black and white and giving a true rendering of half-tones, i.e., the steps between the extremes. This is exactly what our photographic emulsion makers have succeeded in doing for us, and the panchromatic grades will be the right films for you to use for this class of work. Certain sensitive dyes have been incorporated in the emulsions; also, filters can be used in connection with the exposures which can so control the power of the light reflected from the various colours in the landscape, or other subject being photographed, as to give each its true position in the scale of gradation in the negative, and ultimately in the print.

There is one important point that must never be forgotten when panchromatic films are used for the first time; they are, as the name implies, sensitive to all colours, therefore, they will not stand the ruby light of the darkroom, and must be processed in the dark. Further mention will be made of this in the next article when dealing with developing.

Speed of Films

Having decided to use a colour sensitive film, the next question which arises is, should that film be a slow, fast or speedy one? The answer rather depends on the type of camera in use, and the class of subjects that you are interested in. If you are using a camara with a fast lens, one with a large stop such as F4.5 or 5.6, you are probably specialising on fast-moving objects, and require a speedy film, but with such stops, a medium-fast will serve most purposes; if the camera works at F7.7 or F8 as its largest stop, then the speedy film is advocated, especially if it is intended to use filters, but the fast films which are now obtainable will be found quite fast enough for average work. There is no special advantage to be gained in using slow films for general work.

It has only been possible to mention very briefly certain features of our present-day films, but more will be said in subsequent articles.

Men operating the new life-saving at sea. A description of this ingenious appliance is given elsewhere on this page.

THE MONTH OF SCIENCE

Automatic Radio Control

ALTHOUGH radio control of aircraft has been in use for a number of years, a completely new type of directional automatic radio control was recently demonstrated in America before Army and Naval officials. Without any more help from the pilot than the depressing of a couple of buttons the plane is able to fly in a straight line from point to point. Years of experimentation are behind this new device, which has been developed in Los Angeles by the Harvey Machine Company. This new control consists of two radio receivers. Two radio stations are chosen on the proposed line of flight and each receiving set is tuned to one of these stations. The signals are mixed in the control that operates the automatic pilot so that the plane is held in an absolute straight line, regardless of cross winds or other outside conditions. To make this possible, the plane will often fly up-wind, or "crab," at an angle to the true course, but the body of the plane exactly follows an imaginary "white line" in the sky.

Fire Bomb Snuffer

MR. W. KELLETT, a Sheffield engineer, has placed on the market a device for dealing with incendiary bombs, which has been granted a patent. Mr. Kellett states that by mass production methods he could manufacture the device at a price which would put it within the reach of the working man's pocket. The apparatus consists of a steel conduit, through which runs a rod attached to a pair of jaws shaped so that they can pick up an incendiary bomb for safe disposal in a bucket of sand or earth.

Giant X-Ray Machine

INSPECTION of certain large machinery parts will be speeded up by about forty times now that the world's largest industrial X-ray unit has been completed at Schenectady according to engineers of the General Electric Corporation there.

The giant machine rated at 1,000,000 volts, and exceeding by 600,000 volts the largest previous industrial unit, is said to be capable of producing energy equal to that of about £22,500,000 worth of radium. It is housed in a special building behind walls 26 in. thick to prevent injury to workers from its powerful rays. Engineers said that it would expose a picture through five inches of steel in five minutes, compared with three and a half hours taken by the 400,000-volt machine.

Fire Bomb Alarm

FIRE-BOMB detectors that operate by means of light action on a photo-electric cell are among a number of devices to fight incendiaries recommended by the Institution of Electrical Engineers in a report to the Ministry of Home Security. The ignition of a fire bomb 300 feet from the cell, it is stated, will sound the alarm.

Plastic Planes

THE use of plastics in the manufacture of aeroplanes has been explored by officials of the Aircraft Production Branch of the Canadian Department of Munitions and Supply. Mr. Ralph P. Bell, director-general of the Aircraft Production Branch, recently revealed in a statement that if processes now under study fulfil promises held out by their inventors, mass production of plastic fuselages, wings, tail plane assemblies and other aircraft components may result.

An Elephant Tramway

AN elephant-drawn tramway, possibly the only one of its kind in the world, is to be built at Port Blair, in the Andaman Islands. The Government of India, who administer the islands, have approved the project, which is intended to facilitate the transport of timber and other products which now reach Port Blair by a circuitous route round the coast. The elephant tramway will cut through the forest, thus cheapening and speeding up transport.

New Copper-lead bearing

A NEW copper-lead bearing is being made by powder metallurgy. This different form of bearing consists of a powdered metal sintered to a steel supporting piece which acts as a strengthening of a comparatively thin layer of babbitt metal. Triplex bearings of this type are said to withstand fatigue to a higher degree than ordinary babbitt metal bearings. A further bearing development is the copper tellurium bearing, the metal of which it is composed being easily forged, hardened and machined.

Any-way-up-raft

MR. R. S. CHIPCHASE, managing director of the Tyne Dock Engineering Company, has invented a new type of life-saving raft. No matter how the raft enters the water it is the right way up. Both sides have similar provision for the storage of equipment, water, provisions, sails, mast and occupation. It is bullet proof and can even float a sinking ship if there is no time to launch it. Mr. Chipchase who has given the patent to the Ministry of Shipping, says, "I want to make nothing out of it."

Corrosion resistance

AN invaluable invention is the increasing of corrosion resistance in metals by impregnation with silicon. The silicon alloy forming the case has valuable physical properties, and does not part from the core, while it is virtually free from the tendency to split or flake. The silicon impregnation is no more expensive than ordinary case-carburising. Thousands of transport vehicle parts have been used to replace expensive ally steel parts when treated in this way.

620-Miles-an-hour

AN American test pilot has probably flown at the greatest speed any man has ever travelled in an aeroplane. Testing an Airacobra fighter plane he reached a height of 27,000 ft. and then shot down in a 5,000 ft. dive while a film camera photographed the instruments of the plane. The photograph developed afterwards showed the speed needle well past the 620-miles-an-hour mark.

Bombarding Smoke

ACCORDING to the American *Aluminium News-Letter*, a strange device which bombards smoke with high-frequency sound waves, thereby causing the smoke to "lie down," is being developed by the United States Bureau of Mines. The idea is to attach one of these units to every chimney and stack, and prevent the smoke from getting out and spreading around the countryside. Inside a piece of hollow pipe is a large piece of aluminium which is connected at one end to a loud speaker and special radio set. The radio sets up a magnetic field which causes the aluminium

cylinder to vibrate, producing a powerful high frequency sound that, in turn, creates high-frequency waves. These waves are directed at the smoke and cause the particles in the smoke to coagulate into large lumps of soot which fall out of the air stream by gravity. Although still in the experimental stage, it is claimed that the device has possibilities of doing much to reduce air pollution by smoke, if it can be applied to large-scale service.

Niagara Falls New Bridge

SPECIAL ceremonies were held at Niagara Falls recently relating to work on the new Rainbow Bridge being built between the United States and Canada to replace the structure destroyed by ice on January 27th, 1938. Concrete and steel foundations have already been completed on both sides of the river, and it is hoped that the new bridge will be completed by August or September. It will cost £1,000,000 and will be 1,440 ft. long. At the point where it is being built, which is a few hundred feet downstream from the side of the old bridge, the cliffs are 1,230 ft. apart, and the roadway will tower 200 ft. above the mean level of the river.

Magnesium Die Castings

IN pursuit of increased lightness many sections of the transport vehicle industry are turning to magnesium die castings and abandoning those of aluminium. Magnesium castings are both lighter and more machinable than aluminium. They easily take protective films and finishes ; they are highly suitable from the standpoint of mechanical properties ; and they represent a considerable economy. Body finishing equipment, portable tools, and other purposes represent typical employments. Brass die castings have also extended their use, such parts as transmission synchroniser rings, door latch parts, striker plates, and shifter shoes, having been made from them. Radiator grills are being formed from alloy die castings possessing a zinc base.

New Narrow Gauge Locomotive

A NEW design of oil-engined locomotive has recently been developed by the Hunslet Engine Co., for service in sugar plantations. It is of the 0-6-0 type for 2 ft. 6 in. gauge, with a wheelbase of 5 ft. 6 in. allowing operation on a track with radius curves of 75 ft. The locomotive, which has a total weight of 10 tons 15 cwt., is driven by a four-cylinder Gardner oil engine of 102 b.h.p., designed to develop that power at a speed of 1,200 revs. per minute. The Hunslet-type clutch is employed in conjunction with the makers' constant mesh three-speed gear box. The tractive effort is 6,500 lb., with a maximum speed of 4¾ m.p.h. on this gear, the other gears giving 8½ m.p.h. and 13½ m.p.h. respectively. This high tractive effort renders the locomotive well suited for long, steep gradients.

World's Largest Dam

ACCORDING to a recent report, 97,000 visitors a month arrive by bus, car and plane to view the wonders of the great Boulder Dam. Recognised as being one of the world's greatest engineering feats, seven million tons of concrete were used for the foundations alone, and above this the dam rises to a height of 730 feet to hold back the billions of tons of water of the Colorado river.

IN THE WORLD AND INVENTION

Large Oil-engined Generator for N.S.W.

THE power station at Mullumbimby, N.S.W., is to be enlarged by the installation of a 310-kW. Diesel-engined generating set. The present plant comprises two 140-kW. water turbine sets, and a 137-kW. and a 230-kW. oil-engined alternator.

Fireproofing Forests

GERMAN chemists claim to have perfected a process for making forests proof against R.A.F. incendiary leaves. Wooden houses, barracks and factory buildings will also be treated with the preparation.

Doze solves a Problem

A RESEARCH chemist of Cleveland, Ohio, dozed while experimenting in the manufacture of red copper oxide, which is used extensively in ship paint to prevent the growth of salt water parasites on the sides of vessels. His furnace overheated, and thereby provided the solution to the economical production of red copper oxide, previously manufactured by an expensive electrolytic method.

Well-Balanced Bridge

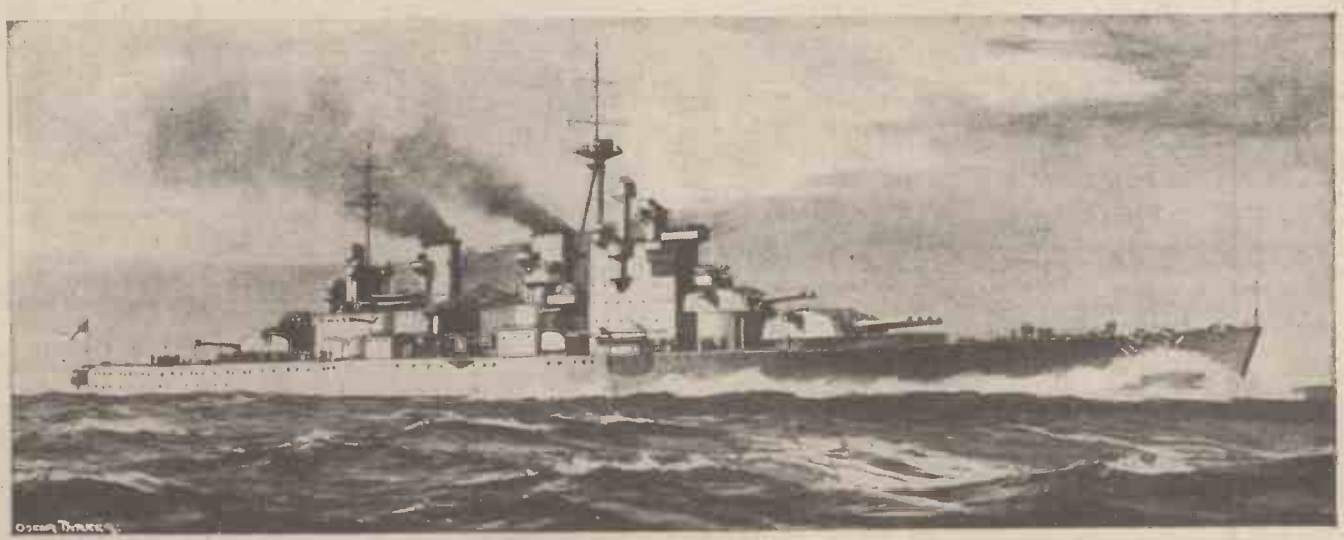
IT is interesting to note that when the Kincardine Bridge over the Forth was built, it was so nicely balanced that the huge 1,600 tons span can be moved into position by a power no greater than that generated by a motor-cycle engine. This is all the more wonderful when it is remembered that the bridge is the longest road bridge in Britain, and the swing span one of the largest in Europe.

Secret Aero Engine

IT is reported that a Leicester syndicate has offered to the Minister for Aircraft Production plans for a new aero engine, details of which are a closely guarded secret. The invention is the work of a London inventor, whose name is well-known throughout the engineering world, and he claims that the engine is capable of a speed of more than 600 miles per hour in the air ; has a fuel economy of at least 40 per cent. compared with engines now in use ; the cost of production is 50 per cent. of the cost of any existing aero engine ; has perfect balance and no vibration, and is of a very low weight.

U.S. "Stratoliners" for Britain

ACCORDING to a recent report, British air experts are considering buying five thirty-three passenger "Stratoliners" from the Trans-Continental and Western Airways Company. These four-motored high-flying machines, it is said, would be useful in ferrying pilots engaged in flying planes from Canada to England.



The King George V., the most powerful and fastest battleship. Main armament consists of ten 14 in. guns, sixteen 5.2 in. guns, and multiple pom-poms.

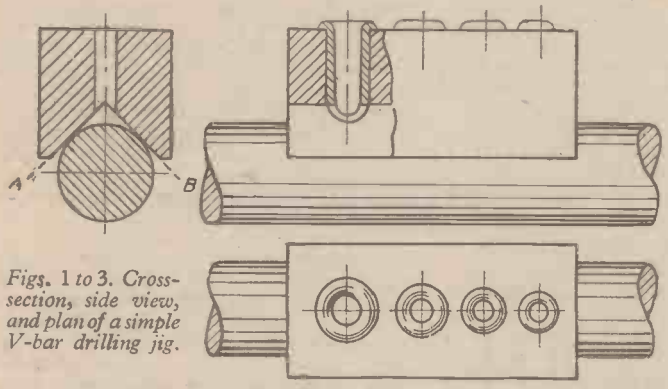
Useful Drilling Jigs

Two Handy Fitments for Use in Drilling Round Bars

ONE of those simple jobs which require much more care and attention than at first seems necessary is the drilling of a hole through a round bar, shaft or spindle exactly square with and exactly intersecting its axis.

A simple jig, which can be used for this purpose and can also be made to suit several sizes is shown in Figs. 1 and 2. It is a V-bar, which can be made of cast-iron, cast from a wooden pattern. On its under edge it is grooved to an angle of 90 degrees, and through its height are drilled and reamered different sized holes to take different sized drills.

The axis of these holes bisect the angle A.B. so that when the V-block is laid on the spindle or shaft it acts as a guide to the drill. The holes may be bushed if desired. One bushed hole is shown in the sectional part of the side view in Fig. 2. The bush is of cast steel and hardened. It may be almost dead hard, and is pressed in a drilled hole. The top view of the block is shown in Fig. 3.



Figs. 1 to 3. Cross-section, side view, and plan of a simple V-bar drilling jig.

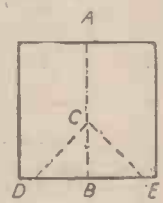


Fig 4. (above). Method of marking out the V-bar.

Shaping the V-Block

To make the jig, lay the block (the sides of which should be dead parallel with each other, and the top and bottom also dead parallel) on the surface plate, and scribe lines A.B. at each end exactly dividing the oblong and without moving the block on the plate. At the point C, at equal height at each end, scribe lines down to the base each side of line A.B. and each line at an angle of 45 degrees to the line A.B. These lines are shown at C.D. and C.E. Without moving the block on the surface plate, scribe lines on the bottom face and top face from A and B on one end, to A.B. on the other end. These lines are important and should be carefully scribed with a sharp scriber giving a fine line. Now saw down line A.B. from B to C, using the longitudinal line from B to B on the bottom surface as a guide and sawing no further than the point C at each end, finishing the cut with the saw dead flat in the cut.

Next saw down lines D-C and E-C from the line on the base which have been scribed from the surface plate from E at one end to E at the other, and from D at one end to D at the other. These saw cuts will, like the cut B C, end in the point C at each end of the block.

File the 90 degrees V-groove thus sawn out carefully to the scribed lines with a hand smooth file. The saw cuts should just leave the lines along the bottom, and at each end showing at the side of the cut, as the two surfaces of the V-groove have to be filed dead flat down to these fine scribed lines.

Now setting the block on its base—apex of the triangle D.C.E. upwards—we can lay it on the table of the sensitive drill and drill $\frac{1}{8}$ in. holes along the top at the positions shown in Fig. 3 on the line we have scribed. The axis of these holes will bisect the angle of the V-groove. We can open them out to the size of drill we want, or we can open them to take bushes, as seen in the sectional part of Fig. 2.

A Modified Jig

Using the same methods to slot the V-groove, we can make the more elaborate jig shown in Figs. 5 and 6. Here the V-block stands open at the top, and an angle plate B is screwed to the V-block, A, along one side. This angle plate is drilled in the top for guide bushes, the axis of the bushes being in dead vertical line passing through the axis of the bar being held in the V-groove, and also in dead vertical line with the apex of the angle in the block.

This angle piece, B, is slotted at the back, and lies against one side of the V-block. A set screw and washer hold it in place. This arrangement allows it to be raised or lowered for different diameters of bar or tube to be drilled. The set screw is loosened, and the angle piece lowered to touch the top of the bar being drilled, and then the set screw is tightened. This arrangement has the advantage that the drill guide comes close to the work whatever the diameter—within the adjustable range of the tool.

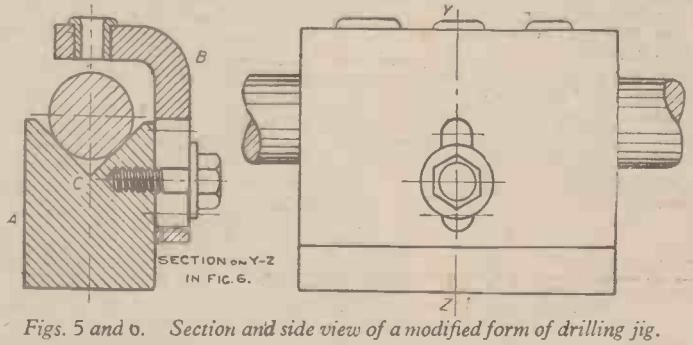
To ensure the guide holes being in line with the axis of the job, the jig is made up all but drilling the guide holes in the angle piece. The position of the holes is determined as follows:—Lay the block on the surface plate on the face A, set the scriber of the scribing block to the apex C of the V-groove. Then, without moving anything, scribe the line for the holes along the top of the angle piece.

Another way is to hold a piece of round stock in the V-groove, the stock being accurately centred at each end and held by the angle plate, B. Use the centre pops each end to set the scriber points of the scribing block, the V-block being down on the surface plate, resting on face A as before. Then, all being in the same position, scribe the line on the top of the angle piece, B.

Mark the centres of the guide holes on this line. Keep the round parallel stock in position and adjust the angle plate by the back screw so that it rests tightly on the stock. It will now be parallel with the base and we can then drill the guide holes which will then be square with the base when the base is laid on the table of the sensitive drill.

It is well, when doing this drilling, to leave the round stock in the jig and drill through into it. Open out the holes as required for different drill sizes, or to take hardened bushes in exactly the same way as described in dealing with the simple jig shown in Figs. 1 to 4.

When drilling shafts or bars, the angle-piece should always be lowered to rest on the bar. That will ensure the holes being square with the axis of the bar being drilled. The V-base will ensure them passing through the axis of the bar or tube.



Figs. 5 and 6. Section and side view of a modified form of drilling jig.

Simple Jig for Small Work

In Fig. 7 is shown a simple drill jig for various small work. It is intended for any drilling in the sensitive drill, and acts solely as a steady for the drill. It is an iron bar cranked as shown, with the surfaces A-B and C-D parallel with each other. The base A.B. is slotted to take a bolt and nut for holding it to the drill table. The height marked E will suit the work generally done.

The drill guide is a hardened bush, F, with a shoulder which rests against the guide bar, as shown. Different bushes will be made for different sized drills, and all will be the same diameters outside and will push in the hole made in the guide bar.

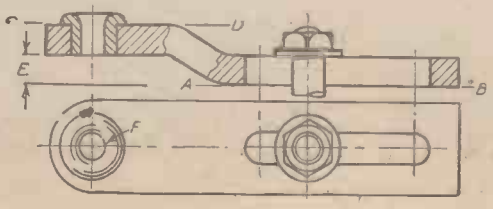


Fig. 7. Section and plan of a simple drilling jig for small work.

Diesel Rail Traction

A General Survey of the Progress made with Diesel-engined Locomotives during the past decade.

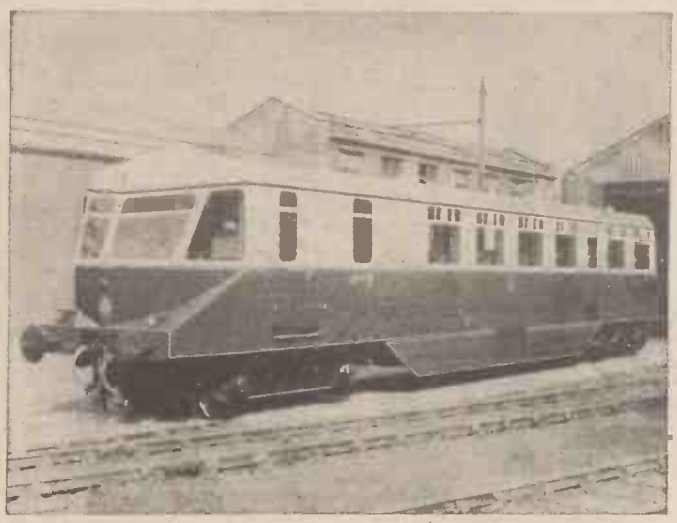


Fig. 1. An A.E.C. Diesel-engined coach in operation on the Great Western Railway

THE possibility of employing the diese engine in locomotives, railcars, and other rail power units to greater advantage than can ever be attained with the steam engine has intrigued engineers for many years past, and as ten years have now elapsed since a leading firm of locomotive builders in Britain pioneered this proposal and applied their resources seriously to this end, it may be opportune to survey the field to-day, and assess the future possibilities of this form of traction in the light of the work accomplished in the past decade.

Whether the diesel vehicle will ever wholly displace the steam unit is an idle speculation, although some have attempted to convince themselves, and others, that such is not merely possible but actually inevitable. As a matter of fact, it would seem at present that one is complementary to the other—each having a definite field wherein its operation is particularly successful, and where the rival is at a distinct disadvantage when in competition with the other. Examples that come to mind are those of the fast main line locomotive, and the local railcar. In this country no success has yet been achieved with the diesel in the realm of the first-named, while on the other hand, it is a definite fact that the diesel-operated railcar has reached remarkably successful results in actual service.

In considering the work done by either unit—steam or diesel—the essentials to receive prior consideration are

(1) Reliability in service.
(2) Maximum availability.
(3) Economical working.
(4) Ease of operation and maintenance.

Other features call for comment also—as, for example, the absence of standby losses in the diesel—and these will be referred to later where appropriate. Before considering the foregoing essentials, however, some remarks will not be out of place on the various types of diesel units which in different countries are seriously competing with the steam locomotive.

Passenger Transport

For passenger transport three types are available for selection by those responsible on the various railway systems—the single, or twin, railbus or railcoach (according to capacity required); the heavier power house and permanently coupled train, which may comprise one coach in addition to the power unit, or any other number up to eight or even twelve coaches; or the independent locomotive, capable of operating for passenger or goods traffic with very slight changes. With those three types it is definitely possible to produce a series of units that can operate the entire traffic on any system, and although experience so far in this country does not extend beyond the railbus and railcoach for passenger traffic, and the smaller-powered locomotive for shunting operations, all types appear to be operating successfully in other fields, notably in France, U.S.A., South America, and the Far East. By articulating the adjacent ends of two coaches in the Gresley manner, considerable savings in first cost, power for operation, and final maintenance are obtainable for the longer trains and power houses, this practice being already in vogue on certain suburban straight electric services, with very marked success.

Railbus and Railcoach

As already stated, the railbus and railcoach are in successful operation in Britain, many of these giving extremely good results their seating capacity being usually in the region of sixty passengers with suitable space for luggage. Fig. 1 shows one of the A.E.C. single units in operation on the Great Western Railway, and Fig. 2 a diagram of one of the "twin" cars fitted with buffet and lavatories, and eminently suitable for long-distance runs. On various railway systems in the South American and Australian continents, cars are in regular service, covering journeys of 200 to 300 miles daily with ease, many of these possessing most of the refinements of a British long-distance express train. In India and Ceylon, also, many of these vehicles are doing fine work on leading railways, and have become a very attractive feature with the passengers for several reasons, not the least important being their ability to keep abreast of the severest operating schedules with ease.

In South America and the U.S.A. the permanently-coupled diesel power house and train with driving compartments at each end are being used with increasing success, and provide a means of high speed transport with luxurious comfort in the most modern of designs. As these units operate over long distances, every convenience is provided, and the traveller on some of these trains is provided with facilities which compare very favourably with those offered in the best hotels, and at charges appreciably less when allowance is made for the included cost of transport. For this section, Fig. 3 illustrates the type described, and shows a four-coach articulated train set recently built by the English Electric Co. for the Ceylon Government Railways.

High-Powered Diesel Locomotives

The diesel locomotive for high speed passenger transport has not so far achieved the same degree of successful operation as the railcoach or power house, probably owing to the larger proportions of the engine power unit required, and the relatively smaller experience which has so far been obtained with these. This fact carries no reflection whatever on the possibilities of these vehicles when the experience required with the larger engine

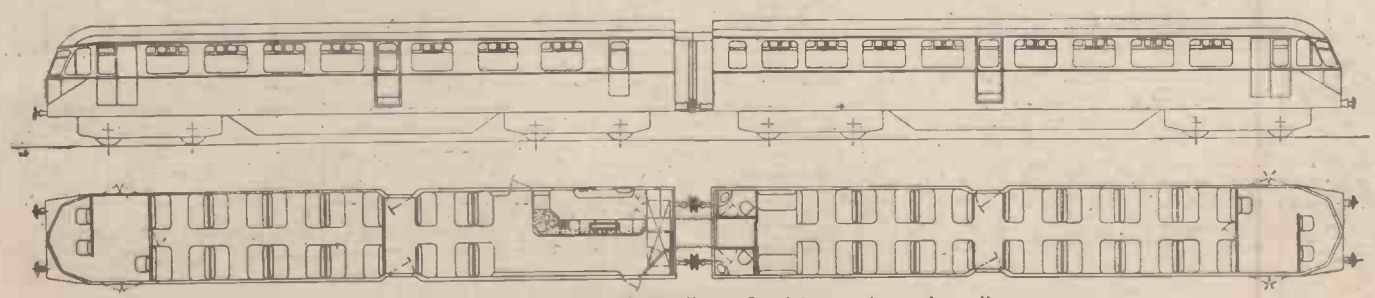


Fig. 2. Elevation and plan of a "twin" car fitted for service on long distance runs.

units will have been gained, and from those already in operation in the U.S.A., France and elsewhere results are being obtained which fully justify the belief that the successful operation of the high-powered diesel locomotive can definitely be envisaged during the early post-war years. A recent example of this design is shown by Fig. 4, and affords an excellent idea of the lines which such a unit may follow.

Although not yet the dependable unit necessary for passenger operation, the diesel locomotive cannot be so criticised when the field of shunting operations is under review. For this service smaller engines are required, and owing to the fact that a large number of engine builders have very fine designs available, development in the diesel shunters has been most extensive, and the results quite remarkable. The power of the diesel engines available vary from 30 H.P. to 600 H.P., and the transmissions include mechanical, hydraulic and electrical, each of these having a fair measure of success to its credit. Practically all the shunters built by reputable locomotive builders are successful in their own spheres of operation, and the final selection is largely influenced by consideration of engine design, transmission and general assembly features, as well as cost. Figs. 5 and 6 show two recent types that are to-day rendering valuable service on railway systems in Britain and Ceylon respectively.

Of the four essentials stated in an earlier paragraph, the chief is probably that of reliability in service, and judging from the records kept by users at home and abroad, this is amply proved in favour of the diesel. Two factors which operate in its favour are incontestable, viz.:

(*a*) the absence of the steam boiler with its limitations and disability due to being continually under stress while the vehicle is in service, and

(*b*) the fact that the number of diesel-engine hours is well below the number of hours during which the locomotive itself is on duty, thus appreciably extending the useful life of the engine.

This feature, however, merges into that of availability so greatly that possibly the clearest definition of the latter term is—dependability at all times. This is certainly the experience of most of those operating carefully designed power units, and will become increasingly so as time eliminates the various weaknesses in the vehicles now in use.

Fig. 3. An eight-coach (two four-coach units) "English Electric" Diesel-electric articulated train in service on the Ceylon Government Railways.

Availability

Maximum availability, referred to in the previous paragraph, is an asset which is peculiar to the diesel vehicle if well designed and constructed, as users of these confirm. In the steam unit the boiler, engine and carriage are the main sections, and these correspond to the engine, transmission and carriage on the diesel vehicle. The boiler and the diesel engine would, therefore, be co-related, and might logically be considered as the members likely to cause the highest maintenance charges in their respective machines. Of the two, the boiler is definitely that which will have the highest charge levied against it for maintenance, largely due to the fact, already referred to, of its continuance under stress during the entire service period of the locomotive, while the diesel engine is operating for but a fraction of the time. The newer type of vehicle is available for the entire twenty-four hours of each day for at least six to six-and-a-half days out of most weeks in the year, and can be operated, therefore, by crew relays without difficulty. But no C.M.E. would dream of running his steam locomotives in this manner except during times of extreme necessity. A further good point in favour of the diesel is the ease with which the engine can be removed and a replace unit substituted, thus ensuring the locomotive being almost constantly on duty. To change a steam locomotive boiler is a vastly different undertaking, as expert readers can well appreciate.

The economy in the working of the diesel power unit comprises several factors, and for purposes of comparison the main items that go to make up the bill in each case may be tabulated, thus:—

Steam.	*Diesel.*
Fuel.	Fuel.
Water.	Cooling Water.
Lubricating Oil.	Lubricating Oil.

The fuel charges for the diesel are lower, due to the fact that

(1) the engine is only running intermittently on this vehicle, whereas the steam boiler is continuously eating fuel, irrespective of whether the locomotive is actually in operation or not, and

(2) the fuel costs less per horse-power developed than for the steam locomotive.

True, the fuel required must be imported so far as British railways are concerned, but so long as the export trade for coal can be maintained—and the present condition is definitely abnormal and not one likely to endure when war is over—it should be possible for the one more or less to balance the other. Water consumption—and, therefore, costs—for the steam engine is naturally much higher than for the diesel, and the consumption of lubricating oil is higher on the former than on the latter, due to that

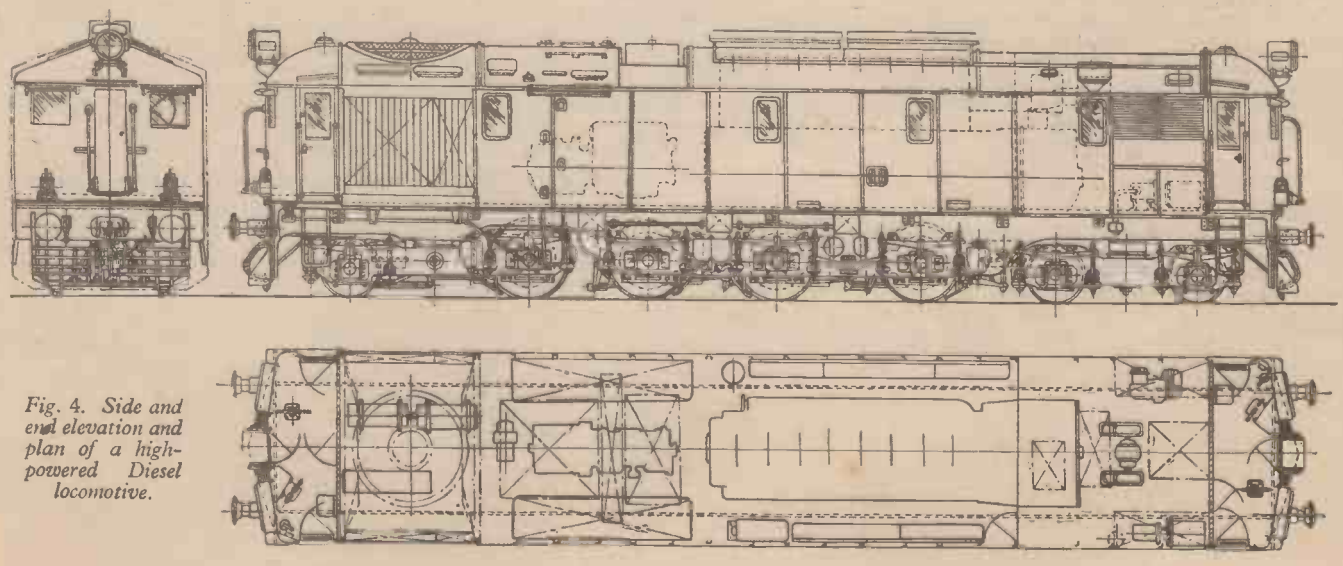


Fig. 4. Side and end elevation and plan of a high-powered Diesel locomotive.

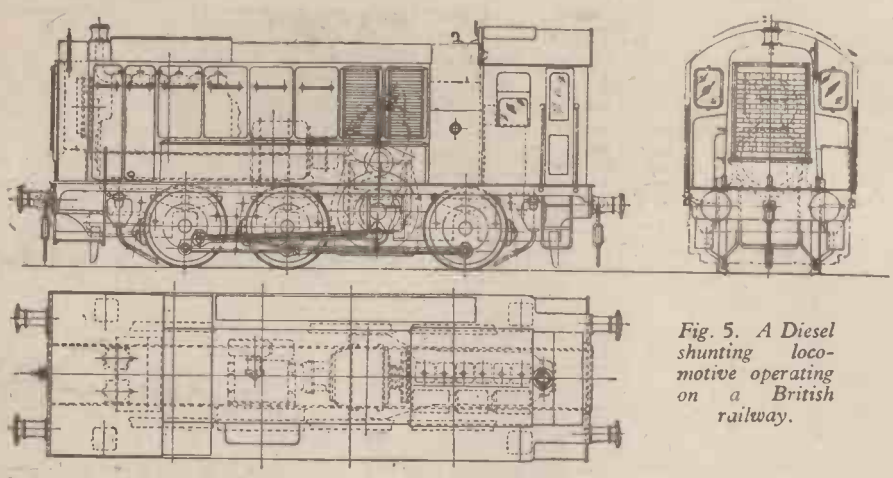


Fig. 5. A Diesel shunting locomotive operating on a British railway.

lost on the road, and in the exhaust steam. With suitable filters and cleaners, most of the oil on the diesel engine can be used over again repeatedly, this being the actual daily experience of many large operators.

Single Man Working

A further feature, the value of which has yet to be obtained by the big railways, lies in the economy of single-man working, and where suitable accommodation is available for handling the traffic at the stations, issuing and collecting of tickets, handling luggage, etc., no other vehicle can compare with the diesel in this respect. If the objection be raised that a second man on the car is essential to stand in the breach should the driver collapse, this is countered by the fact that where such happens—and it is an exceedingly rare event—the dead-man control takes complete charge and brings the vehicle to rest. Incidentally, have those who raise this objection ever considered what would happen on a road vehicle which has no such automatic device, but has the driver cabined in such a manner that, when running, no conductor can possibly take over the controls if the driver should collapse.

Ease of operation and maintenance has only to be seen to be acknowledged, the former, especially on the railcar or smaller shunting locomotive, being often achieved by a beginner in a few days, while a steam locomotive driver must go through what is virtually a long apprenticeship to the job before being entrusted with the control of a main line locomotive. Actually, the driver of a diesel car or other vehicle can be trained in a maximum of three to six months' not only to drive the car skilfully and efficiently but at the same time to do a multitude of smaller jobs which avoid laying it up for attention, where a steam driver will enter similar points on his daily report sheet for shed attention.

Transmission Methods

A point which has not hitherto been referred to concerns the method of transmission. Assuming naturally that capital cost must have due consideration, probably the following would constitute the most desirable solution, judging from recent experience.

Railcars.—Engine units up to 150 h.p.—Mechanical transmission.

Do. above 150 h.p.—Electrical transmission.

Do. of any power, if expense is not the ruling consideration—Electrical transmission.

Power Houses and Trains.—Any power—Electrical transmission.

Locomotives, Shunting.—As for railcars above.

Do. Main Line.—As the power of these will be well above 500 h.p., an electrical transmission would appear to be the best form, and this has been the line developed by all the leading constructors so far.

No statistics have been given in this review of the position, as these notes are rather intended as a general survey of the lines along which considerable success has followed during the past decade. The trend of events in the more progressive spheres of railway operation would certainly suggest a greater use of diesel railcars and shunters (both heavy and light) in Britain in the future when conditions become more normal; close-coupled and self-contained power houses and trains in the American continent, together with the double-bogie type of diesel electric shunting locomotive. The future of the heavy express main line diesel locomotive, whether for passenger or goods transport, lies with the designers and builders of the diesel engine and the electrical transmission—when these can be produced to give the same degree of successful and reliable service as their smaller brethren are to-day rendering, the big diesel locomotive will come into its own, and the continued use of the steam locomotive will then have greater cause for its justification than would seem to exist to-day.

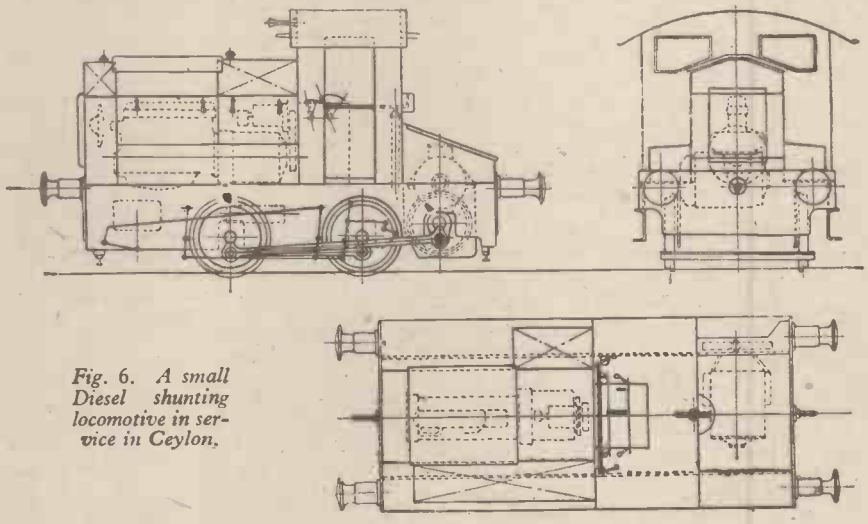


Fig. 6. A small Diesel shunting locomotive in service in Ceylon.

"Gladiators" Make History

BRITISH, Canadian and Australian fighter pilots have recently been gaining glory in encounters over the Western Desert with fighter and bomber aircraft of Italy's Regia Aeronautica. Among the aircraft they have used is the Gloster Gladiator, last of the long line of fighter biplanes adopted by the R.A.F.

Names of British fighter aircraft are singularly apt. "Hurricane" and "Spitfire" have caught the imagination of friend and foe, typifying as they do the great speed and devastating fire-power of these modern eight-gun monoplane types. But never was a combat aircraft more appropriately named than the Gladiator, calling to mind the fighter in the arena. Although speed is not its great asset, probably no aircraft has ever been designed more suited to the close and intricate manoeuvres of air fighting. Some of the most spectacular aerobatics and breath-taking formation flying seen at Hendon displays before the war were carried out by Gladiators. And, as the first British fighter to mount more than two guns—four being the Gladiator's standard armament—it was the first multi-gun fighter to go into service. Gladiators were also used for the high-altitude "weather flights" which were a feature of pre-war days.

Technically, the Gladiator may be described as a single-seat, equal-span biplane with metal structure fuselage and wings. Wing span is about 32 feet—5 feet less than the Spitfire—and the single Bristol Mercury engine of 840 h.p. gives it a top speed of around 255 m.p.h.

During the Norway campaign a squadron of Gladiators distinguished itself in an epic fight against immense climatic difficulties and overwhelming odds. Operating from an improvised landing ground, 17 out of 18 Gladiators were lost in two days' continuous fighting; but heavy losses were inflicted on the enemy.

Gladiators have since exacted their full revenge, in combat against the Italian invaders of Greece and Egypt, though often fighting against superior numbers. In one fight in Egypt recently, six Gladiator pilots met and routed 18 Fiat C.R.42 fighters; in another, four Australians, flying Gladiators, smashed a formation of 17 C.R.42s; whilst the exploits of "Lucky B" flight in clearing Egypt's air of the Italians have already made history.

Our Busy Inventors

By "Dynamo"

For Shavers

THE safety razor is not extinct like the dodo; but, as I write, it is annoyingly rare. Therefore, any effective means of renewing the cutting edge of existing blades will be hailed with a chorus of welcome by shavers of larger growth. An invention with this raison d'etre is the subject of an application which has recently been accepted by the British Patent Office.

This new appliance has a handle and one or more rotatable cylindrical sharpening elements. It is admitted by the inventor that a knife sharpener of this type is not a new idea. He points out, however, that a previous apparatus of the kind has possessed an electric motor, whereas his device is distinguished from its predecessor by not being power-driven. His chief aims have been to produce a blade sharpener of simple construction, and one that can be carried in the pocket or will occupy little space in one's luggage. The sharpening element is preferably made of glass, but it may be composed of other material such as carborundum.

In these days when waste is deprecated, it is almost a sin to discard blades which are not worn out, and which may have their keenness constantly restored.

Elbow Shelf

THE arm-rest is a familiar object in railway carriages and other vehicles; but, as a rule, it is rigid. An adjustable shelf on which to repose one's arm has been devised for the travelling public. This arm-rest is intended to be fitted to the inside of a vehicle door. On to the window ledge of the door may be placed a hook with a shank having a number of holes. These holes enable one to fix an arm-rest in a position convenient to the driver or passenger. And both the height and the angle may be regulated to support the elbow in the most comfortable attitude.

Sowing Machine

AN improved apparatus for the systematic cultivation of the soil has appeared at an appropriate time. This new acquisition for the agricultural home front is a seed-distributing device. The sower who broadcasts by hand the seed, some of which falls on stony ground, is a familiar sight in devotional pictures. This method of sowing may now be replaced by a mechanical sower arranged to be attached to a harrow or roller. It comprises a seed-box with delivery holes and chutes. The seed is fed from the box to the chutes by means of feed-wheels. These are mounted on the box behind the delivery holes on a shaft coupled to a driving wheel running on the ground by the side of the harrow or roller.

This apparatus will ensure the rapid and even distribution of seed

Signs Which Bend

IT is an irony of fate that signs which are erected to assist the motorist are sometimes struck by the car of the driver whom they direct. If the sign be of unyielding material, the result may be disastrous to the inanimate guide.

In order to reduce the violence of an impact, there has been constructed from rubber, signs which bend when struck or run over by a vehicle. Consequently, upon their release, they recover their normal uprightness. The resumption of the vertical position is assisted by incorporating with the sign one or more metallic springs.

A patent for a sign of this description has been applied for in this country. The invention is a flexible sign-panel moulded with equally flexible supporting pillars, each having a coiled spring embedded in it. The lower end of each pillar is adapted to receive an arrangement for attaching the pillars to a solid foundation.

A lighting attachment for a standard tin hat

The sign may be fitted with one or more electric lamps, which are so made and mounted as to be shielded from damage when the sign is struck or run over.

This wayside cicerone, which gives way so courteously, will add to the amenities of transport.

To X-Ray Tyres

TAPPING with a hammer, is a time-honoured method of testing the soundness of the wheel of a railway coach. Guilty metal has a cracked voice. It is now proposed to examine pneumatic tyres by means of an X-ray inspection equipment. This permits a scrutiny without the removal of the tyre.

Hitherto we have been accustomed to associate X-rays with an investigation of the interior of the human body. By the same method it will henceforth be possible to penetrate the inmost recesses of mounted tyres.

A Clean Sheet

THE paper towel is not a novelty. A revised version of this handy sheet has appeared. Presumably the idea of the new towel was conceived prior to the scarcity of paper. The most effective material for this article is a flexible sheet possessing a high degree of absorption of water and also considerable strength, when moistened. It should not have the feeble character of wet blotting paper.

According to the newly proposed process, the paper is treated with an aqueous solution of a water-soluble cellulose ether. This sheet will be especially acceptable to travellers, who appreciate a virgin towel, and do not care to share a communal drying cloth.

Attachuent for a Tin Hat

THE illustration on this page shows an attachment for a standard tin hat. It will be seen that a small container is attached by the screw which is fitted in every tin hat.

Inside the container is a small flat-type electric torch battery. By simply rotating the container a small amount, the battery is made to make or break contact with the electric lamp bulb fitted in front. Encircling the container is a celluloid band, parts of which are coloured purple and red, and a part is uncoloured. Moving this band, white light, purple or red light can be shown. The appliance is very easy to manufacture and apply to all existing tin hats, and standard batteries and lamps would be used. Variations of the white, purple and red light can be used, and words instead of colours could be employed. The inventor is Mr. J. Kingston, Reading. Enquiries relating to the device should be addressed to Gascoignes (Reading), Ltd.

For the Home Fires

IN these days of scarcity of coal, any method of adding to the longevity of the home fires will be welcomed with appropriate warmth. As the briquette contributes to the durability of the fire, a new process of working up coal into blocks is worthy of consideration. The process in question dispenses with binders. It has been discovered that a material particularly suitable for moulding into briquettes without the aid of binders can be produced by moistening the coal before the fine comminution; that is to say, by increasing the water content. After this treatment, the fuel is dried.

Seat-Indicator for Cinemas

MILLIONS of people attend the cinema at least once every week. Seating this enormous crowd is not achieved without difficulty. The problem of the long, waiting queue is still unsolved.

It is interesting to note the characteristics of a recently introduced seat indicator for picture theatres. In the case of this indicator, each seat has a switch which is actuated when the seat is occupied. The switches of all seats in a row are connected in series and also in series with an electric lamp. And the switches and lamps of various rows are arranged in parallel in a common circuit. As a result, when all the seats in a row are occupied, the circuit to the lamp of that row is completed. When all the rows of a group are filled, the current flowing in the common circuit operates another lamp or other indicator to show that the whole of the seats are in use. This makes necessary the intimation, "Standing room only."

Transformer Building

The Design and Construction of Small Static Transformers.

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

FEW of the smaller electrical appliances within the scope of the amateur constructor offer a better return and surer results from his efforts than the transformer. Its design can be calculated and its working characteristics pre-determined within close limits, while the constructional work it entails is of the very simplest.

Technically speaking, the term "transformer" can be used to describe apparatus widely differing in principle and operation; there are Rotary Transformers, Static Transformers, Voltage Transformers, Current Transformers, etc., with further variations in the way of auto-connections and independent-windings. It is correct to speak of Rotary transformers only for direct current operation, their purpose being to transform direct currents from one voltage to another. Static transformers are those which deal entirely with alternating currents or the transformation of one alternating voltage to another. Apparatus which changes the nature of the current itself, from direct to alternating, or *vice versa*, comes under the description of converters, and should not be confused with transformers.

Rotary Transformer

The rotary transformer, shown in diagram in Fig. 1, is used for stepping up or stepping down direct currents from one voltage to another, and is a running appliance similar in construction to a direct-current electric motor but having two windings on its armature. One of these functions as a motor winding, the other as a generator winding, the latter being connected to a separate commutator and set of brushes. By this means an output voltage differing from the input volts can be obtained according to the ratio existing between the turns in the two armature windings. Machines such as these naturally involve a considerable amount of work and skill in fashioning the running parts; also, they are subject to wear and tear which is absent entirely from the static or A.C. transformer. The latter is an absolutely stationary device; there are no moving parts. But energy in some form must be supplied to it as an input before any output is possible. If connected to a D.C. circuit it will not function as a transformer at all. What, then, is the form of energy communicated to it when connected to an A.C. circuit?

There is no visible motion with which we are accustomed in the case of most electrical and mechanical devices. The answer to this lies in the fact that although motion is unquestionably present it takes the invisible form of a rapidly oscillating magnetic flux in the molecules of the iron core, and these in their turn cause strong reactions in the stationary copper coils surrounding the core as the flux threads them first in one direction and then the other at a high rate of speed. In the rotary transformer it is the armature coils that move in a stationary magnetic field; in the static transformer it is the magnetic field or flux which moves through a system of stationary coils. The two ideas are expressed in Figs. 1 and 2. The D.C. rotary transformer in Fig. 1 shows two armature windings on one core, rotating together on one shaft, the motor commutator and brushes in connection with one set of windings, the generator commutator and brushes at the opposite end. The fields are excited by the input current which drives the armature also as a motor. Motion is represented by the curved arrow, and remains continuously in one direction. In Fig. 2, which is a conventional diagram of a static transformer, all the parts—namely, iron core, primary and secondary coils—are stationary, and it is the magnetic flux that

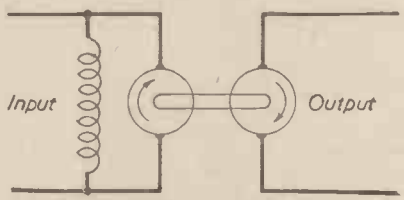


Fig. 1. Diagram of a rotary transformer.

moves rapidly to and fro through them with every reversal of current in the primary coil, the rate of motion responding to the frequency of the supply, usually 50 cycles per second, or 3,000 cycles per minute. The flux speed is thus easily comparable with the rate of armature revolution in the

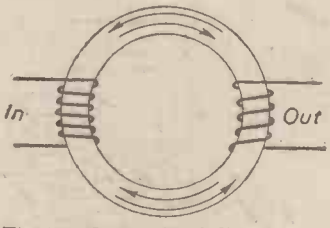


Fig. 2. Conventional diagram of a static transformer.

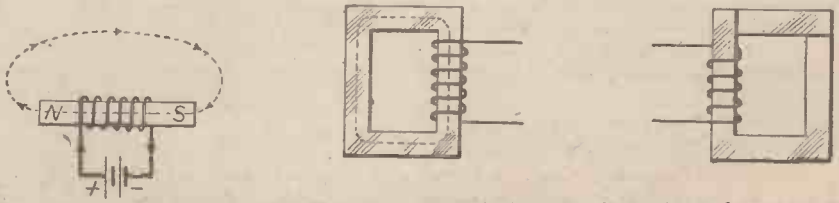
D.C. type of transformer. If a static transformer were connected to a D.C. supply there would be no motion of the flux after the instant of switching on or off, hence there would be no reaction or transformer effect in the coils.

General Form

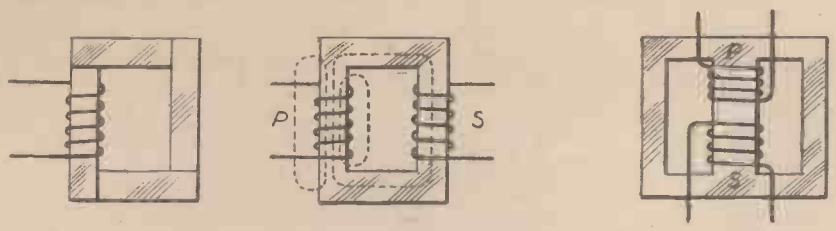
Confining attention particularly to the static transformer in this article, being the simplest of almost all electrical devices to build, one can next consider what general form they take in practice. The simple diagram in Fig. 2 represents a circular ring-shaped iron core, the most symmetrical shape that would naturally suggest itself, and, in fact, the one adopted by early experimenters. It presents rather obvious disadvantages, however, from the maker's point of view, when it comes to hand-winding a large number of turns of wire, all of which have to be threaded through the centre of the ring. This would take a long time, and inevitably lead to rather an untidy finished appearance as they could not lie closely on a curved surface. Practical considerations soon decided, therefore, that a plain straight core was necessary to accommodate the coils. Why not, therefore, a plain straight core like that of the induction or spark coil? This form proved easy enough to wind but resulted in unexpected difficulties, the chief of which was excessive magnetic leakage owing to the great air-gap existing between its two ends. Every magnetic line generated in an iron core by reason of current flowing round an exciting coil has a complete circuit of its own. Fig. 3 illustrates this. Current from the battery flowing through a coil wound over the iron gives rise to a magnetic flux, one line of which is indicated. All lines leave the coil at one end and re-enter at the other. In completing their circuits they find an easy path through the iron, but a much more difficult one where they emerge into air, the result being to reduce greatly the number of lines set up by a given excitation. The same magnetising power of the coil can be used to far greater effect if the length traversed through air can be shortened. In other words, instead of an "open" magnetic circuit a closed circuit should be aimed at, so that the lines encounter the least possible resistance. Since the circular form of closed core is open to objections already pointed out the alternative is a core of rectangular shape, such as Fig. 4. Here the magnetic lines have an all-iron path and the exciting coil lies on a straight limb, making it easy to wind, so that two distinct advantages have been secured. But still the transformer would not be easy to wind if the core were made in one piece, owing to the necessity of threading the wire through the centre opening The idea of building the core in separate parts was the next step forward, the result being a two-piece construction, as Fig. 5.

Independent Coil Winding

This allows of the coils being wound independently, insulated, and afterwards slipped over the straight limb of the core, thus effecting a great saving of time. Eventually it was found possible to further reduce the cost of construction by building up the sides of the core from straight slips of steel sheet, after the style of Fig. 6, since this entails the least possible waste of material and calls for no special tools or dies.



Figs. 3, 4 and 5. Diagrams indicating magnetic flux, and shape of transformer core.



Figs. 6, 7 and 8. Various types of transformer cores, and disposition of windings.

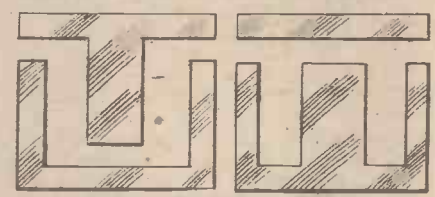
These are the stages by which the "Core" type of transformer was arrived at, a form still very popular and as efficient as any. There is another form preferred by some, known as the "Shell" type, Fig. 8. In this it is the centre limb that receives the coils and the magnetic flux after threading them divides up right and left at the ends, returning by the yoke or outer shell. Since the shell thus carries only half the total flux, its sectional area can be reduced to half that of the centre limb. Stampings for these cores are obtainable in two forms, one a "TU" shape, the other an "EL" combination, Figs. 9 and 10.

The positioning of the two coils, primary and secondary, on any of the foregoing cores, is a matter of some importance. In the Shell type both coils naturally are wound on the centre limb, and there is no choice of position, but in the Core type two arrangements are possible. For the sake of symmetry one would naturally incline towards putting the primary on one limb and the secondary on the opposite one, but there are objections to this course, not at once apparent. If Fig. 7 is examined, where this method is illustrated, with the primary and secondary coils separated on opposite limbs, it will be clear that the magnetic lines generated by coil P will have a tendency, when heavily loaded, to leak away as shown by the dotted lines, so that they do not wholly thread the other limb of the core but leak away on shorter circuits without threading the secondary coil S. Any loss so entailed upsets the true voltage ratio between the two coils and the "regulation" of the transformer suffers accordingly. The best practice, therefore, is to wind both the primary and the secondary coils on one and the same limb; this restricts magnetic leakage effects to a minimum. With the same object in view, the secondary coil should be wound next to the iron core, with the primary coil encircling it.

Laminated Construction

In all alternating current devices, and transformers in particular, there is a reason for using thin stampings instead of solid bars or castings, as a laminated construction checks the formation of heavy cross currents in the substance of the core when it is subjected to an alternating magnetic flux. These, known as "eddy currents," would cause serious heat losses, and it would be impossible to keep the temperature of the whole transformer down to a reasonable figure without this precaution. Currents such as these circulate in a direction at right-angles to the flux in the core itself, (see Fig. 11), and as they are generated at very low voltages a relatively small resistance in their path reduces them to a harmless extent. When the stampings are sufficiently thin, the natural scale or oxide on their surfaces forms almost sufficient resistance by itself, but in practice it is usual to give additional protection by coating one side of the stampings with very thin paper, or spraying them with a special insulating varnish.

Not only must the iron core be laminated, therefore, but the choice of material from which it is built is of importance. A definite magnetising force produces a much greater response in some grades of iron or steel than in others. Materials having a high "permeability" are, therefore, essential, and equally so is the ability of the iron to follow the rapid reversals of flux directions with as little lag as possible. Magnetic lag, or "hysteresis," means a loss of energy, and lowers the overall efficiency as well as increasing the core temperature. Fig. 12 serves to illustrate both these points. An alternating magnetising force applied to the core first in the direction + H causes a response in the iron indicated by



Figs. 9 and 10. Two forms of transformer stampings.

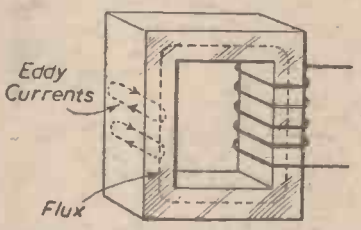


Fig. 11. Showing the formation of "eddy currents" in a solid iron core.

the curve *a b*. When the exciting current dies down again to zero before reversing, the magnetisation does not fall to zero but remains at some value *c*, a little higher than the point *a* where is started. This is due to a certain hardness or "retentivity" of the iron. A further magnetising current *d*, therefore, becomes necessary in the opposite direction H — before the iron can be brought to zero condition again. The same thing happens with the second half cycle of magnetisation when current is reversed through the exciting coil. The results, if plotted out in the form of a complete curve, give a figure representing hysteresis loss in one complete cycle of magnetisation. The closeness or open-ness of this F-shaped curve represents magnetic friction and is a measure of the suitability of the iron for its purpose. The smaller the area enclosed by the curve, the fewer watts will be wasted in iron losses, and the higher the overall efficiency.

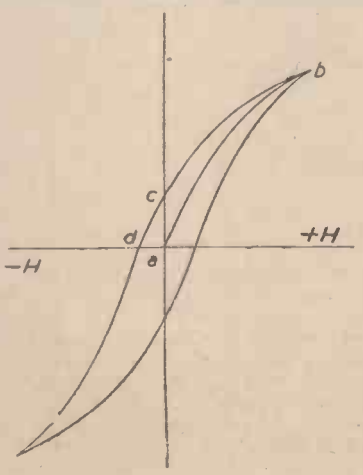


Fig. 12 (Left). Diagram representing hysteresis loss.

Material for Stampings

Although "Stalloy" may be regarded as a standard material for use in transformer cores, a good deal of interest centres round some of the newer alloys of nickel and aluminium with iron, such as "Permalloy," "Perminvar," "Mumetal," "Radiometal," etc. Some of these have extraordinarily high permeability values at the lower magnetising forces. Others possess an extremely small hysteresis loss, a feature which is highly important from the designer's point of view in connection with radio work. Here the frequencies are much higher than those met with in commercial transformers. Their use in such work also permits of a striking reduction in weight and dimensions. For instance, the drawing to scale in Fig. 13 shows the comparison between the sizes of stampings for two radio transformers of similar output capacity, the large one in ordinary silicon-steel and the other in special nickel-iron alloy. Their relative weights are as 24 oz. to 0.64 oz.

Permeability

A curious feature of some of these alloys is the way in which they are affected by the presence of the element nickel in varying proportions. The permeability of pure iron, for instance, is gradually lowered by adding from 10 per cent. upwards of nickel until a point where the nickel content reaches 30 per cent., when the alloy becomes practically non-magnetic. Further additions of nickel, however, have the rather surprising result of again increasing the permeability until a mixture of 78 per cent. nickel with iron gives an alloy superior in magnetic qualities to almost any other known substance. A small addition of copper, too, appears to further improve performance and stabilise the properties generally. Special alloys like these, however, are expensive, and their utility lies more in the line of radio work where low magnetising forces, audio-frequencies, and minimum possible dimensions count largely. For general industrial work, Stalloy, or silcon-steel alloy, practically holds the field.

(To be continued)

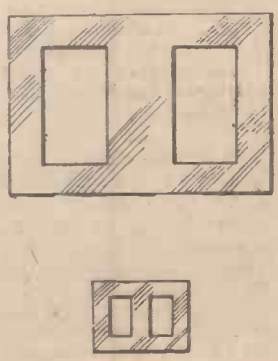


Fig. 13. (Right) Comparison between the sizes of stampings for two radio transformers of equal capacity. The large one is of silicon steel, and the other of nickel-iron alloy.

Phosphors and Phosphorogens

The New Types of Luminous Materials used in Modern Industrial and Scientific Work.

IN the year 1602 a cobbler of Bologna, in Italy, named Casciarolus, who also dabbled in alchemy, prepared a strange kind of "earth" by heating mineral barytes with charcoal. The resulting material was luminous in the dark, and it was subsequently given the name of "Bolognian phosphorus," a title which clung to it for centuries and by which it is sometimes known even at the present day.

The Bolognian phosphorus, which consisted of impure barium sulphide, was the first luminous substance to be prepared artificially. It had, however, no practical uses, for its luminescence was far too feeble for the material to be utilised commercially.

At a later date other similar luminous compounds were discovered, but it is only within the last decade or two that the scientific study and systematic manufacture of luminous compounds have been taken up seriously.

The true cause of the luminescence which some materials exhibit when exposed to certain types of radiation is still unknown, although several promising theories have been put forward to explain their action. It is not now proposed to discuss the inner causation of luminescence. Suffice it to state that luminous materials convert a portion of the radiation which impinges upon them into visible light, whereas, with ordinary, non-luminescing substances the incident radiation absorbed by them is converted merely into heat.

Two Types of Luminescence

Modern technical science distinguishes two types of luminescence, viz., "fluorescence" and "phosphorescence."

A fluorescent substance (so-called because the mineral *fluorspar* was one of the first studied of luminescing materials) is one which directly converts into visible light some of the radiation which it receives, the material thereby glowing or "fluorescing" as long as the energising radiation, such as ultra-violet rays, is allowed to act upon it. When, however, the incident radiation ceases, the fluorescence at once terminates.

Fluorescent substances are, therefore, radiation-convertors, converting the short-wave radiation of ultra-violet light, cathode and X-rays into the longer wavelengths of visible light.

Phosphorescent materials, on the other hand, act as radiation accumulators. They luminesce under the influence of short-wave radiation, but their glow does not cease when the incident radiation stops. On the contrary, the phosphorent material contrives to glow for many hours after its activating radiation has been stopped, the substance functioning as a veritable storer of light and subsequently releasing its accumulated store of light energy in small amounts over a period of several hours.

All the ordinary commercial luminous paints belong to the category of "phosphorescent" substances. They require periodical "activation" by being exposed to a bright light, after which they emit light of a gradually decreasing intensity until they are again reactivated by a fresh exposure to the energising light source.

Luminous Compounds

Considerable strides have lately been made in the commercial manufacture of luminous compounds, both of the fluorescent and of the phosphorescent types. Such compounds are now generically termed "phosphors."

Regarding the nature of these phosphors, it has been shown that they all comprise certain inorganic or mineral-like materials in a micro-crystalline state.

Phosphors usually comprise the sulphides, silicates, phosphates, borates or tungstates of the metals zinc, cadmium, calcium and magnesium. Almost any of these compounds can function as phosphors provided that they are in a fine, or, as it is termed, a "micro" state of crystallisation. If such materials are not in a crystalline condition, they are useless as phosphors.

These flasks contain liquid fluorescent solutions. Above them is an ultra-violet ray generated with filtering screen of Wood's glass to filter out any visible light.

In addition to being in a state of micro crystallisation, phosphors must be internally activated by the presence within them of a minute trace of some foreign metallic substance, which latter is now usually termed a "phosphorogen."

Phosphor Preparation

Copper, silver and manganese compounds can all act as very efficient phosphorogens in aiding the full development of the luminous properties of the phosphor.

In commercial practice, the phosphor is manufactured on the laboratory scale, the greatest possible care being taken to obtain it in the highest possible state of chemical purity, for if certain contaminating compounds are present, even in the minutest degree, the phosphor, fluorescent or phosphorescent, will not function satisfactorily.

The selected phosphorogen or activating trace-material is then added in minute proportion to the phosphor, after which the latter is very carefully heated for some hours to a controlled temperature in order to induce the necessary micro state of crystallisation. The greatest possible care is necessary in this work of phosphor preparation. Almost a bacteriological technique is required to keep contaminating impurities at bay during the making of the phosphor. It is chiefly on this account that the amateur preparation of such phosphors or luminescent materials is not usually satisfactory.

The first commercial application of a phosphor or luminescent material followed the discovery of the X-rays in 1895. X-rays were first detected by their action in causing barium platinocyanide crystals to fluoresce, and thereafter fluorescent screens containing barium or potassium platinocyanide (mainly the former) were employed in hospital and industrial radiographic work. Barium platinocyanide, however, for radiographic screen work has two attendant disadvantages. In the first place, it is extremely expensive, and, in the second place, it is apt to be converted into a brown modification by the action of the X-rays, which modification is practically non-fluorescent. Hence, barium platinocyanide visual screens for X-ray work were continually decreasing in luminosity and efficiency. They remained in use, however, until about 1912, when visual X-ray screens containing powdered *Willemite*, a natural silicate of zinc, were introduced for metallurgical and industrial radiography and also for hospital work. Subsequently, artificially prepared Willemite was substituted for the natural mineral.

Willemite (zinc silicate), whether natural or artificial, fluoresces a bright green. It is far cheaper than the platinocyanides and more efficient.

Fluorescent Screens

After Willemite, cadmium tungstate was introduced for fluorescent screens. This material glows with a bluish-white colouration under X-ray excitation. Moreover, it is extremely permanent and does not decrease in luminosity under prolonged X-ray bombardment.

Then, for the same class of work, came zinc-cadmium sulphide which superseded ordinary cadmium tungstate, since it glows with about four times the brightness of the latter under the same intensity of X-rays.

Recent developments in the making of X-ray screens comprise the introduction of screens carrying calcium tungstate, and also another type of screen bearing an active material of zinc sulphide which has been specially "doped" by the presence of a silver phosphorogen which imparts to it a brilliant blue fluorescence under X-ray excitation.

Modern research work in this direction is concentrating upon the problem of artificially preparing a phosphor which will emit the maximum intensity of fluorescent glow with the minimum intensity of X-ray action, thereby enabling lower-powered X-ray tubes to be employed and photographic exposures to be lessened. For this purpose, the search for more suitable phosphors proceeds apace.

Cathode-ray Tube Screens

The employment of phosphors in the construction of cathode-ray tube screens for television, and other purposes, has given a very great impetus to the recently-established phosphor manufacturing industry, although, of course, the war has temporarily called a halt to such activities.

For a television cathode-ray tube, the fluorescent screen should ideally give a black and white image, since greenish and bluish coloured images are less pleasing when viewed continuously.

There is no phosphor known at present which produces by itself a perfectly white fluorescence. However, by combining two phosphors in the one screen, one giving an orange and the other a blue fluorescence, a very good approach to a perfectly white fluorescence is obtainable. It is upon such problems that much commercial research work will be directed after the war, for the cathode-ray tube is showing itself to be capable of many important applications not only for television work, but also in other spheres of industry.

Mercury Vapour Tubes

Another application of scientifically-prepared phosphors which will rise to the highest importance in the post-war period relates to the use of these materials in gas discharge tubes of the mercury vapour illuminating type.

It is well known that, in addition to the visible light produced by these tubes, a large proportion of invisible ultra-violet rays are also generated. These are usually wasted, since such gas discharge tubes are generally employed solely for visual illuminating purposes. It has, however, been proved possible to give an inside coating of a specially-prepared phosphor to these tubes so that the ultra-violet radiation activates the phosphor, and is partially converted by the latter into a visible and highly-brilliant fluorescent glow.

Various types of phosphors have been used for the construction of such gas discharge tubes, and the colouration of the illumination produced by any given tube depends upon the natural colour of the glowing gas combined with the characteristic hue of the fluorescing material. By varying both the nature of the gas in the tube and that of the phosphor employed, it is possible to obtain a wide range of brilliant colours, some of which have actually been employed for advertising work.

The light-giving efficiency of these tubes is very satisfactory. For instance, a mercury vapour tube internally coated with a zinc silicate phosphor activated with a special type of phosphorogen (the nature of which is secret) gives a brilliant greenish light, the efficiency of which is of the order of about 95-100 lumens per watt, whereas the efficiency of an ordinary gas-filled lamp operating on a similar voltage is only about 10 lumens per watt.

Mercury vapour lamps for street and factory lighting are very deficient in red rays, which fact imparts to their characteristic illumination a rather ghastly nature which is unpleasing to a large number of individuals. If, however, a mercury vapour tube is surrounded with another tube internally coated with a zinc-cadmium sulphide phosphor, the fluorescence of which is orange, the red deficiency of the mercury's radiation is compensated, and a very much more pleasing illumination is obtained.

Luminous Paints

Ordinary phosphorescent materials of the "luminous paint" variety have not found anything like the important applications of the fluorescent phosphors. Calcium and barium sulphides have been used for years in the preparation of luminous paints. These compounds emit a blur phosphorescence which persists for a long time, albeit its luminosity is but feeble.

Research on the effect of specially-devised phosphorogens on the luminosity of ordinary phosphorescent materials may be expected to "improve the breed" of these substances very considerably.

Phosphorescent zinc sulphide is the most popular of this class of phosphors at the present time. It forms the basis of many luminous paints and enamels, and since it can withstand the effects of heat, it can be made up into vitreous enamels without much detriment to its properties. It is in this manner that many of the luminous buttons and other devices are manufactured.

In Germany, enamels prepared from this phosphor have for a few years been employed for the making of air-raid shelter direction notices.

A novel use of such phosphors consists in incorporating them with plastic moulding powders of the synthetic resin type. These powders are moulded in the ordinary manner by hydraulic pressure, and an article of the bakelite type results, which is self-luminous after exposure to light. Here, again, is a post-war development which will take place upon a considerable scale.

A modern zinc silicate phosphor photographed by its own glow under ultra-violet activation.

Luminised Dials

The use of radio-active compounds in the preparation of luminous paints is one which has been known at least since the last war. A very small amount of a radio-active compound is intimately mixed with a suitable phosphor and the resulting material is utilised for the painting of numerals on watch dials, for the tipping of compass needles, watch and clock hands, and other indicators. The paint or enamel so applied is more or less permanently luminous since the ceaseless radiation (alpha rays) from the radio-active compound acts in the same way as short-wave ultra-violet or other radiations.

Many of these "luminised" dials find an application in the construction of navigation instruments, both aeronautical and marine, and they have been employed in the making of many varied types of sighting devices.

During the last war, radium bromide was employed as the energising material of a zinc sulphide phosphor. About 0.4 milligram of radium bromide was incorporated in one gram of luminous material. Experience proved, however, that these "self-luminous" paints and enamels were not so foolproof as they were at first considered to be. The bombardment of the particles of the phosphor by the alpha-rays of the radium resulted in a progressive deterioration of the former, so much so, that the efficiency of the luminosity of such paints fell to about a quarter of their original during the first year of their life. Furthermore, by increasing the radium content of the zinc sulphide phosphor (and, thereby, the resulting brilliancy of the luminescence) the rate of decrease in luminosity of the preparation was greatly accelerated.

Nowadays, radium "self-luminous" materials contain 0.2 milligrams of radium bromide per one gram of phosphor. The cost of such materials is approximately halved, and the rate of decrease in luminosity is very much lessened, owing to the smaller radium content.

Self-Luminous Materials

In modern times the tendency is to manufacture "self luminous" materials from mesothorium salts instead of from radium bromide, and, in consequence, the use of radium paints is becoming obsolete.

Mesothorium "self luminous" phosphors are usually made to the standard of 0.2 milligram of mesothorium salt to one gram of phosphor, which usually consists of synthetic zinc sulphide. The mesothorium used for this purpose is freshly extracted from its sources, since it has been shown that the alpha-ray activity of mesothorium increases during the first four and a half years of its life. In practice, the luminosity of mesothorium phosphors is quite constant over the first twelve or eighteen months of their lives, after which it decreases very gradually.

For many important uses, these "self-luminous" paints of either the mesothorium or the radium type are vital. Yet it must not be imagined, as many are inclined to do, that these luminous paints are essentially permanent in their luminosity. In all cases, as we have seen, there is eventually a slow decrease in efficiency due to the deterioration of the phosphor.

The fact that all phosphors when combined with suitable phosphorogens will fluoresce vividly under the influence of invisible ultra-violet rays has rendered many of these new compounds of use for stage and advertising work. A certain type of glass, known as "Wood's glass," containing a small percentage of nickel, is transparent to the invisible ultra-violet rays, but is almost opaque to all visible light rays. If, now, articles of stage scenery, written advertising characters, or designs, and similar objects are given a thin varnish coating of a suitable phosphor, they will shine brilliantly when activated by ultra-violet radiation filtered through a piece of Wood's glass. And since ultra-violet light is invisible, such articles when excluded from any visible illumination will appear to shine of their own accord in the dark.

By varying the nature of the phosphors, multi-coloured effects of great vividness and beauty may readily be obtained under ultra-violet ray radiation.

Here, again, is another application of the properties of modern phosphors which will see further extension in the post-war period. It may even be extended to industrial usuages, for, in some circumstances, it is often desirable to have certain areas illuminated by invisible radiation, and the employment of a selected phosphor combined with filtered ultra-violet radiation provides an admirable, and simple means of effecting such requirements.

MASTERS OF MECHANICS

No. 65—James Brindley, Millwright, Engineer and Constructor of the World's First Big Canals.

FOR many years it has been the custom among writers on industrial history to look down upon the character and merits of James Brindley, England's first canal builder, because he was altogether uneducated, and almost illiterate. Throughout his life he could hardly read anything save the most elementary of sentences, and when he wrote his necessary accounts it was only with the very greatest difficulty that he managed such a task.

Other individuals since Brindley's time have patronised the man's memory. They have regarded him with a certain amount of good humour, and have dubbed him as an eccentric person. The truth of the matter, however, is that James Brindley, entirely untutored and unlettered though he undoubtedly was, stands out vividly, if, perhaps, somewhat picturesquely, in the history of industrialism as a natural genius whose circumstances during his mature years were fortunately such as enabled him to carry out his creative works with the very minimum of opposition.

It was James Brindley who engineered the first of the world's big canals, an enterprise which was rapidly to result in the covering of England (as well, also, in after years, of other civilised countries) with a veritable network of artificial waterways.

Brindley's first canal still exists in much the same condition as it did originally. Running from Worsley to Manchester, a distance of more than seven miles, this now historic waterway provides to this day a convenient channel of commerce for many lumbering chains of horse-drawn barges, which slowly and contentedly navigate its gentle turns and windings.

Early Life

The birth of Brindley was as obscure as his parentage. He first came into the world in a small roadside cottage which stood in a lonely spot between the hamlets of Tunstead and Great Rocks, near Buxton, Derbyshire. The year of his birth is assumed to be 1716, but no records of the event appear in any of the local parish registers. The lonely and almost desolate cottage, in which the future canal builder made his entry into the world has, after remaining in a ruined condition for decades, long since entirely disappeared, leaving not even a stone to mark the unrecorded birth of one of England's mechanical geniuses.

Brindley's father was a humble crofter who seems to have been fonder of dissipations than he was of work. Consequently, his family was reduced almost to beggary, although, during his later life, Brindley senior became more industrious and abstemious in his habits, and prospered accordingly.

It was from his mother, a humble, industrious woman, that young James Brindley acquired whatever little education and knowledge he possessed in his childhood days. James, however, being the eldest of the family, had to fend for himself very early on in his life's career, and from about the age of eight until he was seventeen, the lad worked as a farm boy. But during this time he showed clear signs of the very remarkable mechanical abilities which he possessed. He took a delight in visiting neighbouring grist-mills and in noting carefully the action of their machinery. Then, during the long, dreary nights of the wintertime, he would make miniature

James Brindley.

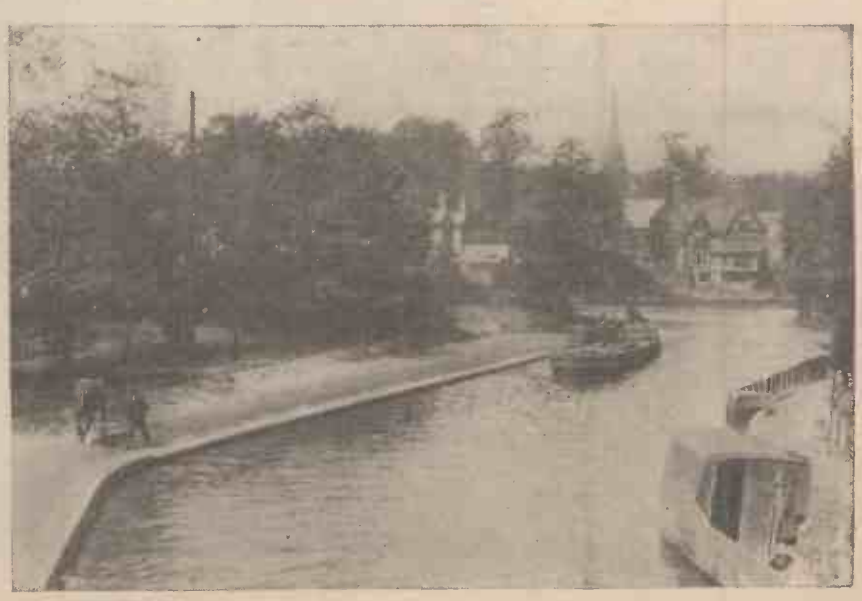
models of the mills which he had visited, employing bits of wood and scraps of wrought iron for his purpose, and these models, rough as they were, worked well. Miniature water-wheels, operated by a neighbouring stream, windmills and other types of mechanisms came into being under Brindley's active hands during these formative years of his. They all, of course, pointed to his evident passion for mechanical pursuits, and his mother, being a shrewd and sensible woman, encouraged him in his activities, believing that they would be the means of his ultimately acquiring a competence in life.

Apprenticeship

In the village of Sutton, near Macclesfield, there lived one, Abraham Bennett, a millwright and a wheelwright. A millwright in those days was an individual who not only made, assembled and erected machinery, but who also functioned as a practical consulting engineer, whose fame, if it existed at all, would be known far and wide over the surrounding districts. Millwrights were carpenters, mechanics and engineers all rolled into one. Their knowledge of mechanical matters, or perhaps it would be better to say their experience of such affairs had to be comprehensive and sound, so that they could tackle any mechanical job from the mending of a plough to the handling and erection of a wind or a water mill, or even one of the then new-fangled steam pumping engines.

Brindley, having attained the age of seventeen years, sought out millwright Bennett, and, at his mother's prompting, offered himself as apprentice to the village mechanic. This was in the year 1733. Bennett was favourably impressed by the lad's enthusiasm for mechanical matters, He took him on trial for a few weeks, and then bound him apprentice for seven years.

Of Brindley's prowess with millwright Bennett there is extant quite a wealth of information. It would seem that, although Brindley had within him the vital spark of creative genius, he was very slow to acquire the essential details of his millwright's training. Abraham Bennett thought him the stupidest and slowest of all the apprentices who had ever passed through his hands, and he made no secret of his opinion.



The starting point of Brindley's original canal at Worsley, near Manchester.

Even at the present day, Brindley's original "Bridgwater" canal from Worsley to Manchester still serves as a busy lane for water-borne traffic.

Nevertheless, Brindley was nothing if not a determined "trier." He worked his way to manual skill in the carpenters' and metalworkers' arts by dint of sheer perseverance. Unlike the many journeymen with whom he worked, he was of sober and industrious habits. But during the first couple of years of his apprenticeship, he made so many blunders, ruined so many tools, and was the cause of so much wastage of material, that his master was on the point of turning him away from his service.

Turning Point in Career

Then, curiously, came a turning point in Brindley's career. He seemed to acquire practical skill with very great rapidity. In the autumn of 1735, for instance, a silk mill at Macclesfield had been very badly damaged by fire. Bennett was called upon to overhaul and re-erect the salvaged machinery, and, since labour was not too easy to obtain at that period, he took with him his "bungling apprentice," James Brindley. The latter acquitted himself exceedingly well at his allotted tasks, so much so that the mill owner praised him, and insisted that he should be sent to the mill on any future occasion requiring the services of a millwright.

No one was more surprised at this sudden acquisition of fame than old Abraham Bennett. To his master's questionings as to how he had managed so well on the job, Brindley could only answer in all sincerity and truth, "it came natural-like!"

During the course of the next few jobs which Brindley was sent out to undertake, he made the discovery that there existed within him the power of diagnosing a mechanical complaint with very little trouble and, also, of thinking out the appropriate remedy with equal facility. These things his associate apprentices and journeymen could not do. They were more interested in the customary allowance of free ale which was handed round in the local hostelry after the task was completed.

As an apprentice, the former "bungling Brindley" was now beginning to gain quite a local reputation for himself. He designed and put into operation a new paper mill at Manchester, which triumph put him on almost equal terms with his master. Suffice it to say, that ever afterwards he lived with old Abraham Bennett on the greatest of good terms, and served him faithfully as a journeyman until he died. Then, after winding up his accounts, he removed to the little town of Leek, in Staffordshire, there to begin business for himself in an humble way in the year 1742.

Leek was only a small market town in those days, but industry in England was rising, and the demand for competent millwrights, engineers and mechanics was rapidly outstripping the supply. At that period, the average millwright worked independently of any factory or undertaking. His services would be called in whenever necessary by a mill owner in much the same manner as the present-day farmer may call for the expert assistance of a veterinary surgeon.

As a Master Man

Thus it was that when Brindley commenced business at Leek it was not long before he found himself prospering steadily.

His first jobs consisted in the repairing of local corn and grist-mills, of assembling new water wheels, and in actually constructing a number of these appliances. Gradually, his fame extended to other districts and he became known as an expert and highly skilled engineer, even in the busy Potteries, which were then rising to importance under the direction of the renowned Josiah Wedgwood.

Brindley did many mechanical jobs in the Potteries, and he became generally known as "The Schemer," in consequence of the many new notions which he put forward during the course of his work.

Throughout his career, Brindley made a practice of making day-by-day entries in a number of notebooks, which were, in fact record books and ledgers of his growing business. These memoranda books of Brindley have, fortunately, been preserved, and they give us a clear insight into the essentially hard-working and honest character of James Brindley, besides allowing us to gain an understanding of the technical methods adopted by him.

Early on in his memoranda volumes we find a record of Brindley's fitting a water pump for "Arle Gower." Now, this "Arle Gower," as Brindley calls him, happened to be Earl Gower, an influential landowner of the Midlands, for whom Brindley, during the course of his career at Leek, performed many services. Earl Gower seems to have constituted the tide in Brindley's affairs which ultimately led, if not to his fortune, at least to fame and a reasonable competence, for had not Earl Gower come into contact with Brindley, it is possible that posterity might never have heard of England's pioneer canal builder.

About the time at which Brindley was making a name for himself in the north Midlands, there was residing in his old Hall at Worsley,, a picturesque rural hamlet to the west of Manchester and verging on the borders of the then notorious Chat Moss, one Francis, Duke of Bridgewater. The Duke had had an unsettled career. In particular, he had been badly crossed in love, which event had converted him from one of Society's shining lights into a misogynist of retiring and decidedly curious dispositions. Indeed, as the years passed by, Francis, Duke of Bridgewater, became, in some of his habits, wildly eccentric.

Despite the above fact, the Duke of Bridgewater was a shrewd enough man. He owned collieries at Worsley, the coal from which had to be carried in carts or on the backs of mules to the river Irwell, some distance away, on which river it was shipped into Manchester on barges.

The Duke of Bridgewater was nothing if not enthusiastic over any idea which seized him. Now, one of the notions which rapidly became uppermost in his mind was

The modern swing-bridge which carries Brindley's original canal across what is now the Manchester Ship Canal.

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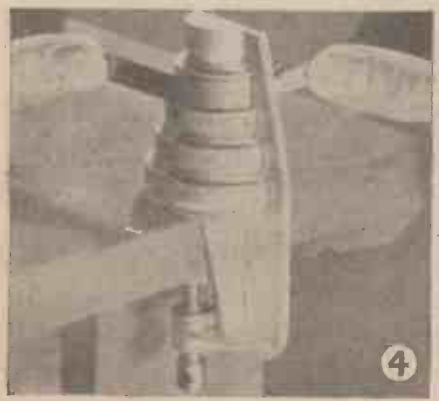

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that of cutting a canal leading from the Bridgewater mines at Worsley almost into the heart of commercial Manchester. He expounded the idea at great lengths to the few friends and acquaintances which he had, but all ridiculed it as impossible. There was just the Duke's land agent, John Gilbert, who thought that there might be something in the notion, although Gilbert himself could suggest no practical means of carrying it out.

But the Duke had a relative, one Earl Gower (afterwards the Marquis of Stafford), who, Gilbert had heard, had had some dealings with a man named Brindley, a working millwright, who was said to be a bit of a genius in his way. Upon Gilbert's suggestion, the Duke of Bridgewater communicated with Earl Gower, and the upshot of it was that Brindley shortly afterwards travelled up to Worsley, and was received in person by the Duke himself.

It would appear that Francis, Duke of Bridgewater and humble, practical James Brindley instantly took a mutual liking to each other. The Duke propounded his ideas at great length to the interested Brindley. He explained that if he could get his coals to Manchester at a cheap rate, not only he himself, but the inhabitants of Manchester would benefit greatly.

Brindley's First Canal

Any ordinary individual would have been overawed by the magnitude of the proposition, but apparently Brindley just treated it as another commission. At first he made what he spells in his memorandum book " an ochilor servey or a ricconitoring " (an ocular survey or a reconnoitring) of the country between Worsley and Manchester. Upon the results of this survey he drew up plans for the design of the Duke's canal.

Canal building had been attempted in England previously, but very little success had been made of it. Brindley, however, saw no reason why it should not be possible to cut an artificial waterway between the Worsley coal pits, and seven miles-distant Manchester. The one snag in the project was the existence of the River Irwell flowing almost at right angles to the projected track of the canal. It had been proposed to make the canal level descend to that of the Irwell by means of a series of locks, but Brindley rejected this plan. Instead, he put forward the brilliant, and at that time almost wildly audacious plan of carrying the canal over the Irwell by means of a brick-built aqueduct supported on stone columns, thereby doing away with the necessity for locks and making it possible for a barge to navigate the waterway high above a vessel sailing on the River Irwell below it.

At first, the Duke of Bridgewater doubted the feasibility of Brindley's project. He called in several engineers, among whom is said to have been Smeaton, the lighthouse builder, and they all pronounced Brindley's plan as being absolutely impossible of attainment.

By his friends, the Duke was entreated not to throw away good money upon the attempt to construct his canal, but, being a man of adventure, he eventually consented to Brindley's engineering the project. For years, the local folk at Worsley had called the Duke " canal mad," because he had been unable to think or talk of any other subject. Now, when the rumours of his projected attempt to carry one waterway across another began to be booted about, they called him a raving lunatic, and gave him up as hopeless.

As soon as Brindley began his canal—or, rather, the " Duke's Canal "—from Worsley, its progress was watched with great interest. Off it went from Worsley across country in an almost direct line. Then its engineer took it for two hundred yards across the River Irwell at Barton on a stone aqueduct or bridge which carried it some thirty-nine feet above the river below, and, from thence, eventually it made its way to Manchester, no particular trouble being experienced in its cutting or engineering.

Brindley's secret of rendering his canal watertight, especially that portion of it which was carried over the River Irwell, was to puddle it well with clay. He formed strong embankments for the canal where it passed through flat country, making it almost impossible for the waterway to burst its banks. On an average, the canal cost the Duke about a thousand guineas per mile to cut, and to this expense was added the cost of its terminals at Manchester and Worsley. But the canal was eminently successful. It brought fame both to Brindley and the Duke, and perhaps more to the latter than to the former.

The " Duke's folly," as the canal had been dubbed when it was first begun, turned out to be a veritable wonder of its age. People flocked from far and near to see it, and in particular to witness barges being carried high above the River Irwell at Barton.

Needless to say, Brindley's canal projects did not stop with the successful completion of the Bridgwater canal. He subsequently extended this waterway and, under the auspices of the Duke, undertook the cutting of canals in other districts as well.

Grand Trunk Canal

At a later date, Brindley engineered the making of the Grand Trunk canal which connected the Mersey with the Trent, and both these rivers with the Severn, therefore enabling inland water communication to be made between the ports of Liverpool, Hull and Bristol. Perhaps, indeed, this was James Brindley's biggest enterprise. Yet he projected and engineered numerous other canals which, invariably were more to his patrons' financial benefit than to his own.

It is a curious fact that Brindley seldom paid himself anything more than a mere labourer's wage. He was " cheap," as the canal owners remarked. They forgot, however, to observe the fact that Brindley, despite his illiteracy and his humble mannerisms, was a genius, and that he was at that time performing work which no other man living could do.

For Brindley, canal planning and engineering lasted until the end of his life. For, in this pre-railway era, canals offered a cheap mode of transport of goods across the country from one town to another. Canal projectors waxed rich, speculation in canal building became rife, and some financial crashes resulted.

Brindley, however, had no interest in such movements. To him, a canal was purely and simply an engineering project containing many various problems to be overcome.

A canal in mid air! An end-on view of Brindley's canal as it is being swung across the Manchester Ship Canal to permit sailing ships to go by.

His Last Job

It was in consequence of a long spell of canal surveying that Brindley met his death which took place on 27th September, 1772. He had been engaged in planning out a canal which was to be cut near his adopted home town of Leek, Staffordshire. For a long day he had remained out in the rain without anything to eat or drink. He returned chilled and famished to the inn at which he was staying. They put him into a damp bed, and that was the last of Brindley. On the following day he just managed to crawl to his home at Turnhurst, near Leek, where, after a short period of illness, he expired.

In the whole gamut of engineering history there is no other example of self-acquired experience, and innate ability in the same category as that possessed by James Brindley. Brindley was the true pioneer. Devoted to his duties, courageous, efficient and even brilliant, he forged ahead even in the face of his handicap of lack of schooling. Needless to say, after his death, he had many imitators, but no equal, in the sphere of canal building.

"MOTILUS" PEEPS INTO

A fine scale model of the "Sirius," the first steamship to cross the Atlantic, beating Brunel's "Great Western" by a few hours.

ONE comes across weird model contraptions from time to time. and here are two views of a model, sent me by a friend who is interested in oddities in model work. These illustrations show a very crude attempt on the part of some person or persons unknown, at modelling a locomotive. The present owner is Mr. Dunkley, an active member of the Coventry Society of Model Engineers, but although the model is in his possession he is not "the perpetrator of the outrage." The model was literally "dug up" on a new housing estate in that city, and when it saw the light of day, clay was still clogging the wheels! The overall length is about 18 inches, and the height to the top of the chimney 8 inches. The distinctive arrangement of the steam pipe from the dome to the oscillating cylinder is certainly an innovation. The regulator, too, you will notice is high up in the dome, evidently to be certain the steam was dry! Whether it ever worked or not, is a mystery, and I expect it will remain so!

A Model Span Bridge

These are days of building in steel, and when the war is over, no doubt the rebuilding of Britain will see much steel constructional work, as well as re-inforced concrete. Here is a fine example, in miniature, of British steel work—a model of a 45-metre span bridge, built in this country and presented by Vickers Ltd. and the Metropolitan-Cammell Carriage and Wagon Co. Ltd. to the Tientsin Pukow Railway. The actual span was constructed by their subsidiary company, the Patent Shaft & Axletree Co. Ltd. The model was made for record purposes, contained all accurate detail, and is to a scale of 1 inch to 1 foot. Every nut, bolt and rivet is shown, and there are approximately 5,000 model rivets in the model.

An Interesting Model Locomotive

Looking into the repair shop of Messrs. Bassett-Lowke Ltd., when in Northampton recently, I was most interested to see a model of the old L. & N.W.R. 4-4-0 locomotive, "Black Prince." There are few models, I suppose, that have been so famous from a commercial point of view as this in its various stages. A model of this well-known British locomotive was first placed on the market by Bassett-Lowke Ltd. (then W. J. Bassett-Lowke & Co.) in 2½ in. gauge tinplate in 1902, and caused quite a sensation. It was hailed at the time as a most important new model, a really creditable representation of the "Black Prince" L. & N.W.R. locomotive and tender, with slide valve cylinders and reversing motion, which is deserving of great praise as a genuine step in the direction of more realistic model locos. than have often been supplied by professional model makers. One happy purchaser of a similar engine wrote: "The appearance is most realistic and it works splendidly. With only four burners going, and running light with tender only, it ran without a stop for forty minutes and covered 3,000 yards. The way in which it keeps the steam up is surprising. The above was on a track with many curves and points; on a straight track it would probably do far better."

Later on the "Black Prince" was modelled in 2-inch and in 1¾-inch gauge, and the model here shown is one of the last of the models before the locomotive disappeared from the market. It will be seen that this model has the standard type of piston valve cylinder, still in use, and the cylindrical boiler is heated by a vaporising spirit burner, which has long superseded the wick type.

A model of the famous L. & N.W.R. "Black Prince" locomotive seen recently in Bassett-Lowke's repair shop.

A scale model of a punch press, made in America for advertisement purposes.

An Interesting

Business as Usual

I was in ——— the other day, which, as we all know, has suffered very much from enemy action, and last time I was there I happened to take the snap reproduced here, of Messrs. Bassett-Lowke's very attractive window. Alas, this shop has now been damaged by the attack on the opposite side of the particular street, and the windows are boarded up. *But* there is still a display of those famous models which fascinate enthusiasts. For a week or two Mr. Cox, Bassett-Lowke's energetic manager, carried on business via the back door. But now the windows are boarded up with display "holes" in them, and it is almost "business as usual." It takes more than the ferocity of the enemy to rob the British public of one of its favourite hobbies, or to make those who cater for them give up because of difficulties, albeit some of them seem sometimes insurmountable.

A Liner of the Future!

When the war is over—and when that will be no one knows—there is sure to be renewed activity on the land, sea and in the air. No doubt, progress in the air is being advanced by the war, and the developments made in bombers and fighters will no doubt be turned to good use in air transport. But

THE MODEL WORLD

Description of Models Ancient and Modern

what of the sea? Warships are not convertible to civilian use and shipbuilding, except for cargo ships, has almost come to a standstill, not only in this but in other countries. At the World's Fair in New York, there was a model review of ships that have made history, commencing with the *Sirius*, which was reputed to be the first steamship to cross the Atlantic, arriving a few hours before Brunel's *Great Western*, on April 23rd, 1838. The Cunard-White Star *Queen Elizabeth*, was our latest development in ocean transport designed up to the outbreak of the war, but designers were busy on further ideas in fast ocean transport, and here is a model of "the liner of the future," as visualised by Mr. A. C. Hardy, famous ship designer, and Monsieur P. de Malglaive, technical director of the French Line. In a recent paper to the Institute of Marine Engineers, Monsieur de Malglaive described what, in his opinion, would be the "Ship of the Future." He stated that the threat of trans-ocean air travel made it necessary to tackle shipbuilding from a new angle. The ship could never compete with the air liner in speed, but it could offer its passengers comfort, safety, cuisine, freedom, amusement and rest to a far greater degree.

Two views of a weird model locomotive "dug up" on a housing site at Coventry.

Streamlining

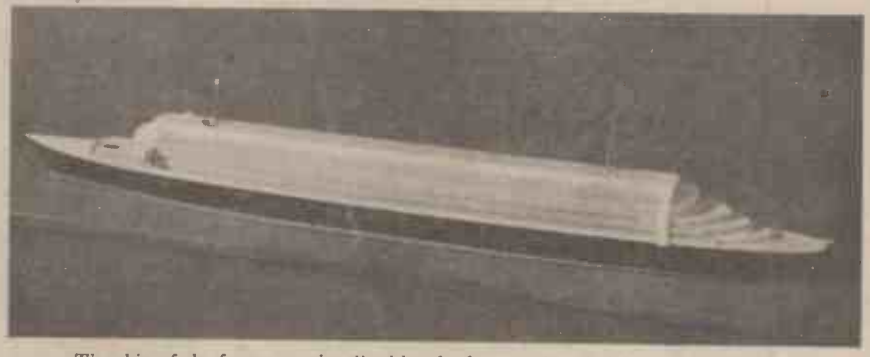
These things, therefore, must be exploited to the full. As will be seen from the illustration, streamlining is an essential part of the design, and the decks are glass-enclosed to decrease wind resistance, as well as protect passengers from the breath of the sea. Indeed, it is possible that conditioned air would be used throughout the ship except in the outside cabins. The ship would be electrically driven, the exhaust gases from the motors being carried along the sun deck and out near the stern, to prevent fumes and smuts, and when nearing port two collapsible funnels would come into action. As will be seen, the ship has beautiful lines, and one wonders when the war is over whether experiments will be made in this direction, because designers are satisfied that finality in ship design and propulsion has by no means yet been reached.

A Model Punch Press

This picture of a punch press comes from America. The model was on a circular base and covered with a glass cover, which was removed in order to take the photograph. At the time when this model was built, hexagonal nuts were not a commercial production, and all of those used were made by hand, as indeed was nearly everything else on this realistic model, which is only about 6 inches high. The makers, the Thexton Mfg. Co., of Minneapolis, have a window in which they display productions to advertise their business, and this model was made for this purpose.

A realistic model of a 45-metre span bridge—scale 1 in. to 1 foot—as used on the Tientsin Pukow railway in China.

Bassett-Lowke's attractive shop window at ——— as it appeared before the "blitz."



The ship of the future as visualised by the famous ship designer, A. C. Hardy, and Monsieur P. de Malglaive of the well-known French line.

WAR DAMAGE—AND YOU

DESPITE the Prime Minister's efforts to get rid of jargon in official publications, and replace it with straightforward English, the War Damage Act contains phraseology which is even puzzling lawyers. If *they* cannot make head or tail of some of it, what chance has the ordinary individual?

The man in the street is asking all sorts of questions about the new Act. To whom does he make contributions? What happens if he does not agree with the value placed on his damaged property—a thorny problem indeed! Can he obtain an immediate advance on a damaged shop to start elsewhere?

These are a few of the vital problems affecting many thousands already—but to sift the answers from the mass of long-winded English in the Act is no easy task.

For months, however, a barrister has been working through the Act, section by section, setting down in simple language exactly what the man in the street wants to know, and anticipating his questions and answering them. The result is the publication on Friday, April 4, of *War Damage Compensation*, an invaluable book for all at the popular price of 1/-.

Obtainable at newsagents, bookstalls and booksellers 1/-, or 1/2 by post from George Newnes, Ltd. (Book Dept.), Tower House, Southampton Street, London, W.C.2.

HOME MOVIES

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

NEWS AND COMMENTS

Practical Tracking

MOST amateurs get an urge at times to try "tracking" shots, in which the camera runs up to or draws back from the subject, but few meet with much success. The reason is simple: a good tracking shot demands a certain amount of preparation, and unless you are ready to give it the attention it needs you had better give up the idea.

Better weather and light will soon be with us (we hope!) and since much of our shooting is now done perforce in our own gardens, it may be worth while to think about tracking shots; the garden is just the place for them.

The first requirement is something on wheels to clamp the camera upon. A dinner wagon or a child's tricycle does quite well. Next in importance comes a really smooth track for your "camera truck" to run along. Some stout planks are best, but a very carefully smoothed and rolled section of lawn or path will serve.

Do not be too ambitious in your first attempts. Let the tracking be over but a moderate distance, say, 15 feet, moving in from a lens-to-subject distance of 20 feet at the beginning to one of 5 feet at the finish of the shot, and you are likely to make a success of it.

Next you need an assistant, carefully drilled to push the "camera truck" along slowly, steadily and smoothly, and come gently to a halt at a spot previously marked. This leaves you free to handle the camera, adjusting the focus as you go.

To make this latter operation simple and certain, mark two or three of the intermediate distances, so that as you come to each you can turn the distance scale on the lens to the appropriate setting for that range. In between these points you can leave the lens alone: "depth of field" will cover the differences if the light is good enough for you to work at a fairly small stop, such as f/8. As you near the end of the track, you must gradually turn the lens scale to the mark for the final distance; it is only over the last few feet that you need to do this, because it is only here that the range is becoming short enough to make the focus really critical.

Make Friends With "H.F.D."!

MANY otherwise sound and sensible cinematographers seem to have something approaching a horror of that really very useful quantity, the hyperfocal distance of their lens. Now that is a pity, for "H.F.D." can be a very good friend if rightly applied, and there is nothing alarming about it at all.

One of the main uses of the hyperfocal distance is in calculating the depth of field at a given stop and focussing distance, but that is admittedly rather a laborious business which most of us shirk.

A simpler and even more valuable application is in deciding how to set a focussing-mount lens for use as a fixed-focus objective. When the subject to be filmed is one which involves quick shooting at a variety of distances, with no time for measurement or careful estimation of range, that can be an extremely useful dodge.

What one does in practice is to look up the H.F.D. for the stop in use and set the focussing scale to that distance. When that has been done, everything will be reasonably sharp from *half* the H.F.D. up to infinity. Suppose, for instance, that for the stop in use the H.F.D. turns out to be 30 feet; the operator then knows that if he sets his scale to 30 feet he can shoot anything which is more than 15 feet away without further adjustment.

It is true that objects at a great distance will not, under these conditions, be *quite* so sharp as they would be if the lens were properly set to infinity, but the difference will be very slight indeed. In any case, it is not likely that a subject at great range will present itself under conditions calling for the H.F.D. setting. If it does, well, it is simple enough to slip the lens collar round to the infinity mark, make the shot, then put it back to the H.F.D. before resuming operations at shorter ranges.

This is how to find the hyperfocal distance. Take the focal length of the lens, *in inches*, and square it. (Multiply it by itself, that is.) Then multiply the lens aperture in use by .001 and divide the result into the squared focal length. The result is the H.F.D. *in inches*.

If you prefer it as a formula, here it is:

$$\text{H.F.D.} = \frac{f^2}{s \times .001}$$

"s," of course, is the stop number, while the figure .001 is an arbitrary one chosen according to the standard of definition at which you are aiming. The figure given is a good all-round value.

Perhaps an example will make the method clearer. Suppose we are using the 1-inch lens which is standard on most 16-m.m. and many 9.5 m.m. cameras. First, we "square" the focal length. That means multiplying one by one, and, of course, the answer is still just one. Next, we decide the right stop for the job in hand is f/4. Multiplying 4 by .001, we get .004. Dividing this into 1 (the focal length squared), we find it goes 250 times. That is our hyperfocal distance *in inches*, or 20 feet 10 inches, in fact, which we shall probably decide to call 21 feet for practical purposes.

That is not an operation to be done in the field, while preparing to make a shot. A good plan is to work out the H.F.D. for each stop marked on the diaphragm scale and write out the result on a piece of stiff card which can be carried in the camera case. It is then only the work of a moment to refer to the table, set the lens, and get busy.

QUESTIONS ANSWERED

Using Variable Shutters

What is the object of the variable-opening shutter on some very expensive cameras? I thought the aim should be to get all the light possible through the shutter—not to cut it down?

A shutter opening of something less than the full 180 deg. or thereabouts which is standard can be useful in various ways. For example, a reduced opening will prevent unduly blurred individual frames when filming a fast-moving object, and it solves the problem which arises when a very fast film is used under conditions of very bright light. (This case should not arise, of course, but is sometimes unavoidable.) A more important use for the variable shutter is in permitting the operator to use some particular lens aperture, which he desires for depth-of-field reasons. Suppose, for instance, that he is making a semi-close-up and desires to have his background right out of focus so that the subject shall stand out well; his exposure meter may tell him that at normal shutter opening the stop for correct exposure would be f/8 but from his depth-of-field tables he sees that this stop would give him an almost sharp background. From the tables he decides that f/4 is the stop he wants, so he sets the diaphragm to that and then reduces the shutter opening to the angle which will give correct exposure at this stop. (This is given by another table.)

Finding a Speed Rating

I have several hundred feet of a French film which has been in the country for nearly a year. What speed will it need on my Weston meter?

Even if we knew the make of the film we could not answer this one, because in a year the film may have lost some speed, but it gives us an opportunity to explain once more how a speed rating can be found by the user for himself. Take the camera out on a sunny day and hunt up some good test subjects—scenes with bright highlights and some shadow areas as well. On each expose short lengths of film at progressive speed settings on the meter. In the case under consideration, for example, these should be run off at meter settings of 8, 12, 16 and 20 Weston, i.e., set the instrument to each of these speeds in turn, find the exposures then indicated, and shoot a foot of film at each of these stops. Do this on each of the chosen subjects, and then when the film has been processed, pull it slowly through the projector by hand and decide which exposure gives the best results. Speed ratings determined in this way have the advantage that they take into account individual projection and processing conditions, and are to that extent preferable to the ratings issued by the makers, which must necessarily be averaged to suit some assumed set of conditions.

Comparison of DIN and Scheiner

Is the DIN system of speed rating simply another form of the Scheiner degree scale?

No, there is a radical difference in the method of measuring speeds on these systems. Scheiner is based on a measurement of the smallest amount of light needed to produce a just-perceptible image, whereas DIN works on the amount of light required to produce a certain (small) standard strength of image.

Filters for Colour Contrast

What is the rule for choosing a filter to make coloured items in the view contrast with each other?

The filter *lightens* objects of similar colour to its own, *darkens* those of the colours it blocks. Thus, a red lightens red and yellow tones, darkens blue ones; a yellow lightens reds and yellows and darkens blues, but to a lesser extent; a green lightens yellows and greens, darkens both reds and blues.

Depth of Field Tables

Would it be very difficult to work out a depth of focus table for my 1-inch f/2.5 lens?

Not at all difficult (only simple arithmetic is involved), but rather tedious. The result is well worth the labour, however, a definite knowledge of depth of field conditions being often of great practical value. The formulae which follow are simple forms of the calculation, but give results of sufficient accuracy for normal purposes. The first step is to find the "Hyperfocal Distance," usually called the H.F.D., thus:—

$$\text{H.F.D.} = \frac{f^2}{s \times .001}$$

Here f is the focal length of the lens in inches, and s is the stop number. In the case in question f is one, hence f^2 is also one, and the little calculation becomes very simple indeed.

Having found the H.F.D. for the particular stop at which it is desired to find the depth of field, we next proceed to work out the near and far limits of definition for a particular distance to which the focussing scale is set, thus:—

$$\text{Near Limit} = \frac{\text{H.F.D.} \times D}{\text{H.F.D.} + D}$$

$$\text{Far Limit} = \frac{\text{H.F.D.} \times D}{\text{H.F.D.} - D}$$

In each case, "D" is the distance to which the lens focussing scale is set. (All distances must be put into *inches* for the calculation, and the final result converted into feet afterwards.)

As will be seen, the H.F.D. must be worked out for each stop in which we are interested, and the near and far limits calculated for a series of distances at each stop. Thus, the first step is to find the H.F.D. for the maximum aperture of the lens, then work out the near and far limits for focussing distances of, for example, 3. 5. 10, 15, 20 and 30 feet. Next the operations are repeated for the next smaller stop, and so on until all the marked apertures (or just those in common use) have been dealt with.

How they pick up the voice of a moving actor. Note the microphone boom being swung near the player (Leslie Henson) as he mounts the stairs.

QUERIES and ENQUIRIES

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

Thermo-couples

I HAVE recently seen references to a thermo-electric densitometer employing a silver-bismuth thermo-couple.

Can you please give me the general principle of such a thermo-couple and its approximate sensitivity to light? How would it be used in this instrument? Are these thermo-couples purchasable, if so, can you give me the approximate cost?—G. Omerod (Abu-Sueir, Egypt).

THERMO-COUPLES are not sensitive to light rays. Some of the more delicate thermo-couples, however, are sensitive to the heat rays accompanying some light rays, and, in virtue of this fact, are able to give some measure of the radiation passing through a given medium and falling upon them. The silver-bismuth thermo-couple operates upon ordinary thermo-couple lines, that is to say a silver element and a bismuth element make contact at one end, the opposite ends being connected together through an external circuit containing the necessary current-measuring apparatus. Heat falling upon the contacting ends of the two dissimilar metals sets up a thermo-electric effect, the result being that a very small current flows in the external circuit. In order to increase the amount of current, thermo-couples are often constructed by combining a number of single thermo-couple contacts in the one instrument.

As we have already explained, the silver-bismuth thermo-couple (or any other thermo-couple, for that matter) is not actually sensitive to light. Its sensitivity to the heat rays admixed with light depends upon their radiating source and the screen, medium or filter through which they have passed. It is possible, however, to make very delicate thermo-couples. Some of these are fixed in the eyepiece of a telescope, and are able to measure the heat radiations of stars situated countless millions of miles out in space. We doubt whether you will be able to purchase a silver-bismuth thermo-couple of the type you mention. You might, however, try the General Electric Company, Wembley, and, also, Messrs. Electradix Radios, 214 Upper Thames Street, London, E.C.4.

Phosphorized Ether

I SHALL be glad if you will give me information on the following subjects:

(1) What is phosphorized ether, and how can I make it?

(2) I have some ethyl iodide, which I have prepared myself by the usual method, from iodine, red phosphorus, and ethyl alcohol. How can I keep it to stop it from going brown, due to the separation of iodine, as it invariably does in ordinary circumstances?

(3) I have, in my possession, a very good set of chemical weights, but they are in grains; as most modern chemical books give the weights in grams, how may I convert grains to grams, and vice versa?

(4) I want to obtain an arc lamp. Can you tell me of a good firm where I may obtain a second-hand one at a reasonably cheap price?—J. S. E. Gilbart (Bury St. Edmunds).

A PHOSPHORIZED ether is merely a solution of yellow phosphorus in ether. It is a dangerous solution to prepare, and still more dangerous, perhaps, to keep. We would advise you not to attempt to prepare this solution.

(2) Ethyl iodide invariably undergoes slight decomposition, with the consequent liberation of free iodine, when allowed to stand in contact with air, moisture and/or light. In order to obtain perfectly colourless ethyl iodide, you must distil the liquid *in vacuo* at as low a temperature as possible, and the distilled liquid must be sealed up in a tube or other vessel and then stored in the dark. Even under these conditions, the ethyl iodide may gradually darken in colour, particularly if it is slightly impure, and if air and moisture remain within the tube.

(3) To convert grams into grains, multiply by 15.43. To convert grains into grams, divide by 15.43.

(4) You may be able to obtain a second-

hand arc lamp from Electradix Radios, Ltd., 214 Upper Thames Street, London, E.C.4.

Re-conditioning Lubricating Oil

I UNDERSTAND that most beans grown in Britain contain about 50 per cent. carbohydrates. Could you please tell me if an oil (or grease) can be extracted from these, which could be used as an engine lubricant, and if so, how is this accomplished? Would you also please inform me how to recondition used lubricating oil in order that it may be re-used. How, and from what plant is cellulose obtained, in a fairly pure state.—John Gillan (Glasgow).

YOU cannot extract an oil or a grease from beans, for the proportion of oil contained by them (or by their pods) is very small, and, in any case, is of no use as a lubricant.

The precise method of reconditioning used lubricating oil depends mainly upon the viscosity of the oil and the average nature of its impurities. Frequently the oil is redistilled or filtered under pressure or vacuum through a bed of kieselguhr, magnesium carbonate and/or charcoal. In your case, the best thing to do is to construct a three or four-inch deep bed of these latter materials mixed in approximately equal proportions and to allow the oil to percolate through the bed. The filtering bed should be constructed with the least amount of "packing" of its materials in order to allow of a "loose"-grained filtering medium being obtained. If the oil is at all viscous, its time of percolation through even the best of these filtering media will be lengthy, but, without applying pressure or vacuum filtering, you cannot avoid this drawback. Cellulose is obtained from the cotton plant, and raw cotton wool is very nearly pure cellulose.

Liquid Stove Polish

IN an attempt to make up a liquid stove polish, I have used graphite and methylated spirit. I have also tried vinegar, but fail to get the black lustre and shine, which commercial stove polishes give. I should welcome any suggestions you can give me, which might give better results.—A. J. Umphray (Foula).

YOUR trouble seems to lie in the quality of graphite which you are using. For your particular purpose, the graphite should be in finely powdered condition, and it should be *pure*. Many samples of so-called graphite or "blacklead" are adulterated with ordinary carbon, which, of course, detracts from the quality of the graphite. The stove polish should not be too thinly liquid. It is advantageous, also, if it contains a trace of wax—either beeswax or paraffin wax—which not only acts as a binder for the graphite particles but also improves the lustre of the polish. The wax is incorporated with the polish by dissolving it in the methylated spirits, only a small amount of it being used. A small quantity of turpentine, also dissolved in methylated spirits may also improve the shine of the polish.

Do not use vinegar or other watery fluids, since these lessen the degree to which the graphite can be polished.

"Molecular Deformation" of Metal

IN the course of my work recently I was confronted with a rather curious problem. A fellow-workman drew my attention to a job that he was doing. In fitting a new spindle to a cast-iron roller he turned the spindle a shrinking fit, and proceeded to heat the roller. He removed the roller from the fire, however, when the metal immediately around the bores was red hot, but the outside of the roller was still comparatively cold. It was found that the spindle did not slide into the roller as was expected. The roller was left to cool, and it was then found that the bores were smaller than they had been before heating. Even the old spindle could not be driven in. Was this contraction caused by the pressure set up between the hot and cold parts of the roller. Why did the bore not come back to normal on cooling, and did the break in the circles caused by the keyways help the hot parts to expand inwards, thus tending to close the bores?—John Main (Lossiemouth).

WITHOUT actually examining the roller and spindle which you describe, it is impossible to say *with certainty* the exact cause of the parts refusing to fit together as expected. It is very probable, however, that the whole trouble was due to what is known as "molecular deformation" of the metal.

Some metals, particularly "crystalline" metals, such as cast iron, are solidified under strain. When such metals are heated, the internal strain alters in some way, and, at times, even vanishes, and, in so doing, brings about a deformation of the metal so that it is no longer the same size as it was before it was heated. Such a phenomenon is responsible for those occasional instances of a mass of metal appearing to contract on heating and expand on cooling. Again, from what you say, it would appear that your roller parts were not equally heated. This might easily bring about a species of apparent warping of the metal, owing to excessive and unequal pressure being set up in the sides of the roller. We do not think the presence of the keyways had anything to do with the trouble. Rather, we think that the trouble was due to the effect of "molecular deformation," as explained above, and also, perhaps, to the unequal pressures set up between the hot and cold parts of the roller, as you point out in your letter. When heating articles and components in order to effect shrinking fits, the heat should be applied slowly, and equally so that there are no differences in temperature between various parts of the same mass of metal.

Solenoid Winding

WILL you please advise me as to the following problem:—I wish to make a solenoid coil, capable of lifting a core weighing 1 lb., a height of about six inches. The dia. of the core is 1¼in. The voltage it is proposed to use is 12 v. Would it be quicker acting if a higher voltage was used and what amperage would be needed; Also what is the size of wire required, the number of turns, and would the solenoid require to be wound in sections? Would it be necessary to place an additional winding around the lower entrance to the coil, to lift the core into the coil, the top of the core being just below the lower entrance, not just entering the coil?

Can you give me the title of any book that is written on Solenoid Coils?—Jas. H. Fowles (Handbridge).

WE do not know of any book dealing exclusively with the construction and winding of solenoids. S. P. Thompson's "The Electromagnet" is the only one devoting much space to the subject, and this being long out of print is unobtainable. Perhaps a copy can be seen at your nearest technical library. Most of the apparatus calling for the use of solenoids is developed by trial-and-error methods, as pure design is practically impossible in the majority of cases. The pull of a solenoid on its iron core is so variable in relation to the distance by which it is immersed within the coil that it is impossible to obtain a steady tractive effort through any considerable distance without resorting to some device in the nature of equalising cams. The whole design must of necessity be experimental rather than a calculation. In your sketch (not reproduced) the core is so short that it would certainly not traverse the whole length of the solenoid unless the winding were sectionised, and successive coils energised progressively as the core is drawn in. On 12 volts the current consumption might amount to 15 or 20 amperes, at least.

Dynamo for Windmill

WILL you please tell me how to alter a car dynamo so that it will start generating at about 250 or 300 r.p.m. I wish to make a small wind-driven electric light plant. Can you recommend a book that will explain the alterations I have to make?—Donald Keeley (Buckley).

IT is unlikely that a standard car dynamo of English manufacture will be found to run at so low a speed as 250-300 r.p.m. and give any useful output. The Lucas "A;900" generator specially wound for wind-operated plants is designed to commence charging at the exceptionally low speed of 450 r.p.m., and with a suitable airscrew there should be no difficulty in making this serve the purpose. Most of the other British car dynamos give practically negligible outputs under 700-900 r.p.m., and although the speed may be reduced by rewinding the field coils with one gauge larger wire, this does not make a great deal of difference, and the voltage regulation may not be so good, as well as tending to a higher temperature. To obtain any appreciable output at very low speeds it is necessary to separately excite the fields of the generator, by disconnecting the field coils entirely from the brushes and taking excitation current direct from the battery terminals. This naturally leads to a continuous small discharge from the battery, which is returned, of course, all the time the dynamo is generating any EMF in excess of the battery voltage.

Cleaning Petrol Can

HOW can I clean a petrol can so that it will hold water without contaminating it?—N. P. (Knebworth).

PROVIDED that the petrol can has only contained petrol, it is not a difficult matter to clean it thoroughly. The best way to go about this job is to pour about half a pint of methylated spirit into the can, shake the can vigorously and then to drain the spirit away. This operation may be repeated with the fresh lot of the spirit.

The can should not be placed in a warm situation in order to allow the traces of methylated spirit in the can to evaporate completely.

After this, a little soap powder and a small quantity of soda should be placed in the can, water poured in to half fill it, and the can placed on a gas-ring in order to bring the contents of the can to a boil. A long brush should now be inserted into the can or, alternatively, a clean stick with a piece of rag tied to the end of it, and the inner sides of the can should be very vigorously mopped and cleaned.

Finally, the soapy water should be poured away and the can rinsed several times with clean, hot water. It should then be in a fit condition to hold clean water without contaminating the latter in any way.

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Editor: F. J. CAMM

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Comments of the Month

By F. J. C.

After the War

IT is intriguing to consider the position of cycle sport after the war, and to envisage the place which the pastime will occupy in our lives. Many millions of people are compelled during the war to use the bicycle instead of normal means of transport, and there are those who think that most of these will maintain their interest in the pastime and continue as devotees. If the last war is any index of tendency, we do not think so, even though we may hope so. In the 1914-1918 war many thousands of people used motor-cycles who had never motor-cycled before, and the motor-cycling movement was hopeful that those who had joined the ranks, though vicariously, would provide the nucleus for the post-war movement. In those days, petrol was not so severely rationed as it is to-day, but when the war ended, there was only a temporary boom in the sale of motor-cycles, and then the trade slumped.

In the last war, too, tens of thousands of people purchased bicycles, but deserted the pastime when the war was over and normal conditions returned.

The hard core of the cycling movement seems to be comprised by about 100,000 people, representing the combined membership and to some degree, an overlapping membership, of the C.T.C. and the N.C.U. It is my view that the 100,000 figure is on the high side, but we will accept it. The war conditions, however, have brought the inevitable depletion of membership and, so far from post-war membership showing an increase, we think that the national associations will be hard-pressed to get back to their pre-war level.

Difficult Times

DURING the war there is little that the associations can do, for cycling news is scarce, and the sport, during the war, is going to have a difficult time. Those clubs which anticipated this difficult time by cancelling events have been severely criticised by those who are not really genuinely interested in maintaining the sport, except for motives unconcerned with it, and in some cases clubs have reinstated their programmes this year. Already they are meeting the anticipated difficulties. Refugees are occupying well-known club racing headquarters, and it is difficult to find accommodation. A solution may be found by providing tents, but this is a somewhat meagre substitute for the conviviality of the bar parlour.

There are others who think that the scientific developments of the war will automatically develop the bicycle. We hope this is so, for there are many directions in which the bicycle needs to be improved.

Then there is the question of roads. They will be in a sorry state of repair when the war is finished, for very little money is being spent in maintaining them. It will take at least two years, after the war, to bring them back to their pre-war state. We do not think that this will operate against cycle touring, but it equally will not operate for it.

Rear Lights and Cycle Paths

ON the legislative side will there be the same old war about rear-lights and cycle-paths, and taxes; there is, in our opinion, bound to be a struggle, after the war, for the abolition of rear-lights which now we are compelled to carry, and we hope it is successful. But the war is compelling the public to accept conditions against which, in normal times, it would have resisted. Will the public be in the same frame of mind when this war is over? Will it be in the frame of mind to fight for the pre-war principles? Will the national organisations be so successful in gaining a hearing? These are questions which are urgent and intriguing. It may be that when the war is over, the fortunes of the cycling movement will be in the hands of different men, with different outlooks, under different conditions. It may be that the cycling movement will be purged of many of those who are not in it for the good of the sport, and who operate by subterannean intrigue and subterfuge.

In any case, the war is the time to cleanse the Augean stables, to clear the decks for the post-war period. Cycle touring and foreign touring are practically non-existent, whilst the sport is struggling to carry on. National bodies might well, therefore, use the war period to examine their rules and regulations, to emend their organisations, and to elide those clauses in their constitution which provide the loop-holes for the intrigue to which we have referred.

We should like to see the sporting movement run entirely by sportsmen, and all those who do not fall within that category removed from office.

The Cyclist in Weekly Form!

THERE is one post-war development to which cyclists all over the country are looking forward. It is the reappearance of *The Cyclist* in its weekly form, with its unrivalled news service, its impartial and frank criticisms, and the journalistic scoops which established it as the leading cyclists' news magazine.

It will be observed that we have maintained some of the features for which the journal has become famous, and that we are still served by the contributors who helped to make the journal famous. They are retained against the time when *The Cyclist* will reappear as a weekly, and provide the link at present missing.

In this respect we gratefully acknowledge the hundreds of letters we have received from readers of *The Cyclist* who continue to read the *Cyclist Supplement* which our present ration of paper has compelled us to provide as a substitute.

We are laying plans for the post-war period now, and have in hand some excellent cycling material.

One Amongst 39!

BRITISH cycle manufacturers are planning to export over one million bicycles this year. This means that those available for the home market will be greatly restricted, and as a fact, only one cyclist in thirty-nine will be able to buy a new bicycle. The sales manager of one of our leading companies issued an appeal to cyclists overseas, explaining that they can assist our war effort by buying British bicycles. The British Government has decided that 75 per cent. of British bicycle production must be exported to help replenish Britain's reserves of foreign exchange For every three machines sold abroad, manufacturers are permitted to make one for the home market. It is obvious, therefore, that as the overseas sales go up, the number of machines available for the British market will rise commensurately. It is estimated that about 320,000 bicycles will become available this year for Britain's 12,000,000 cyclists.

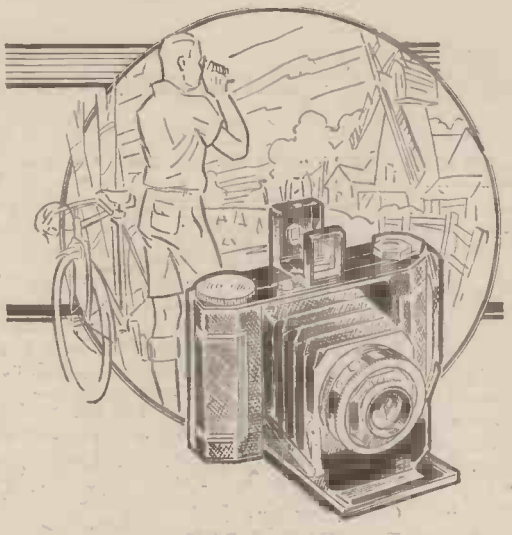
Photographs

WE shall be glad to supply to readers, for a nominal sum, copies of the photograph which we published last month, showing C. A. (Bath Road) Smith, presenting the original Bath Road "100" cup, which he won in 1891-1892, to the President of the Bath Road Club. It must be noted that this photograph is the copyright of this journal, and it may only be reproduced by permission of the Editor.

The New Call-up

MR. BEVIN'S new call-up will not only affect the male side of the cycling group, but also the female, for women between the ages of nineteen and thirty are to register, and will finally be absorbed into the war effort. Several clubs have delegated their tasks to women officers, so it seems that the cycling movement will suffer a further blow under the new scheme.

On the sporting side we learn from some club secretaries that their plans to carry on this year are not likely to fructify, although they will do their best to carry out as large a part of the programme as possible. We hope that every club will endeavour to do so, notwithstanding the restrictions of overtime and Sunday work, but always provided that the sport does not interfere with war effort. Our main consideration must to be win the war.



Paragrams

Racing Cyclist Passes Over

RICKMANSWORTH C.C. are mourning the loss of E. S. Orbell, well-known in North London racing circles, who was killed in action while serving with the R.A.F. With his two brothers, J. H. and A. J. Orbell, he volunteered for service and, for a time, all three were stationed together.

Old Clubman in London's Fire Blitz

NOW recovered from his injuries sustained when serving with the A.F.S. in London's tragic fire in December, Ron. White is back again with the Highgate C.C. and will again supervise arrangements for their annual open "100."

Well-Known Ten-miler Dies

WINNER of the Southgate Cycling Club paced ten-mile championship in 1890, Rupert W. Davey has died.

Scots Girls Time-Trial

SCOTS girls are to promote their own open cycling events this season; if a time-trial opening is encouraged. This is one of the decisions made at the annual general meeting of the Scottish Women's Cycling Association held recently.

Club Vice-President's Wedding Gift

E. F. ANGRAVE, Lichfield City Cycling Club, was presented with a barometer by fellow members. This was not only to mark his services to the club of which he is a vice-president, N.C.U. delegate, and R.T.T.C. handicapper and timekeeper, but as a wedding gift.

Lighting Offences

AT Tottenham (London, N.) police court recently, over 70 cyclists were summoned for alleged lighting offences. Fines ranged from 10/- to 30/- and, in nearly two hours £60 (or ten shillings a minute) had been collected.

Famous Speedman Marries

FRED TURNER, famous Cheshire Roads speedman of a decade ago, has married Miss Marjorie Beecroft, sister of a fellow member.

Luton's Open "25's"

LUTON Wheelers have decided to hold two open "25's" this year.

Former N.C.U. Official Joins the Army

A former official of the London Centre N.C.U., the North Middlesex and Herts. Cycling Association, and the West London Cycling Association, Stan. Thomas, keen track official of the Catford C.C., has joined the army.

Catford C.C.'s Activities

THE Catford C.C. will this year hold its open "50" and its classic Hill Climb. The club has a membership of 270 and has re-elected W. W. Lucas as president.

Old Timer's Versatility

SOUTHGATE Cycling Club's president is Mr. A. T. Green, one-time hon. sec, of the now defunct Wood Green Cycling Club, who despite his 77 years still cycles. He is a member of the F.O.T.C. and chairman of the Concert Artistes' Benevolent Association on whose committee he has served for 40 years.

Glasgow Wheeler now in Near East

"KING of the Mountains" in the 1939 Manx T.T., Donald Morrison, Glasgow Wheelers, is now in the Near East with the R.A.F.

Club Member "Missing"

REPORTED "Missing" in June last, news has now been received that Guy Crowe, Crouch Hill C.C., must be "Presumed Dead." The boat on which he was returning to England from Dunkirk was sunk as the result of enemy action.

Coming S.C.C.U. Events

SIX 25-mile events and two at 50 miles are scheduled for competition by the Southern Counties Cycling Union. The Union has accepted the resignation of president Jas. Blair and elected, in his stead, W. A. ("Wally") Smith, a founder-member of the Union.

Sweden Solves a Transport Problem

SHORTAGE of petrol in Sweden has created a new form of goods transport. Tandems pulling specially-made light steel trucks with pneumatic tyres are to be seen in the streets of Stockholm.

Kentish Wheeler as Vocalist

FRED LATHAM, Kentish Wheelers, who is probably known to a wider world as a dance-band vocalist, has been doing some excellent work with E.N.S.A. in the North of England.

Crack Riders to Wed

GEORGE FLEMING, the Belle Vue road crack, is to wed, and so is Alec Horwood, D.C.M., of the Bath Road Club. Fleming hopes to compete in road events this year.

University C.C.'s Open "30"

THE University C.C. open 30-mile fixture for tandems will be held this year but, in view of the probable shortage of tandem crews, it will be held in conjunction with a "30" for singles. Winners on each type of machine will be suitably rewarded.

East Anglian Events

THERE will be at least six open and semi-open events in the East Anglian area this year, including the noted Wisbech Wheeler's open "25."

Oak C.C.'s "25"

THE Oak C.C. are taking over the usual Kingsdale Rough Rider's 25-mile fixture to be held shortly.

Southgate C.C.'s Open Events

REVERSING their 1940 decision, Southgate Cycling Club are to hold their open "25" and to promote club events at 25, 30 and 50 miles. Perpetual trophies in these events will be competed for.

Hon. Treasurer's Twenty Years Service

FOLLOWING his re-election as hon. treasurer, Mr. A. J. Ballantyne enters his twentieth year as an official of the Southgate Cycling Club.

Popular Glasgow Rider in Royal Navy

ALEC CALDER, Glasgow Cycling and youth-hostelling enthusiast, now in the Royal Navy, has written to a friend in Glasgow from a remote corner of the world. His letter took two months to reach its destination!

Record Holder in B.B. Unit

HOLDER of the National Fifty-mile tricycle record, Albert Watson, well-known Edinburgh time-trialist, is with a Balloon Barrage unit.

Club's Track Meetings

MARLBOROUGH Cycling and Athletic Club have decided to promote eleven evening track meetings on Paddington track.

Australian Racer in R.A. Navy

HAROLD SMITH, the Australian who competed in one of Wembley's Six Day races, was recently in English waters. He is now a sub-lieutenant in the Royal Australian Navy.

S. Parker in the Near East

SYD. PARKER, Ealing C.C., former holder of the London-Bath-London tricycle record and holder of the 12-hour record for the same type of machine, is now in the Near East.

Well-Known Clubman's Bereavement

BERT HOUGHTON, who has figured prominently in R.R.A. and S.R.R.A. records in the past, has suffered terrible bereavement. His wife and their two children have been killed during an air raid. They had been evacuated for safety.

Popular Clubman Killed

THE Victoria C.C. have learned with regret of the death of one of their members, Ernie Wirth, who, when working with a Bomb Disposal Squad, lost his life. He was one of the club's most popular and active members.

Club President's Loss

SIR CHARLES McCREA, popular president of the Highgate Cycling Club, has suffered a tragic loss in the death of his son, Hugh McCrea, who was killed in action. He was a Naval Officer.

Hill Climbing Champion in Iceland

THE hill climbing champion of the Rotherham Wheelers, R. H. Flower, is now stationed in Iceland.

Leading Scots Join Up

TWO of the best Scots speedmen have volunteered for the Forces. They are Alex. Humphreys, who started in 1940 as a road novice, and then went on to win several opens, and Tommie M'Nulty, roadman, trackman, and hill-climber. Humphreys has joined the Navy, and M'Nulty the Air Force. Both are members of the Glasgow Wheelers.

Peakland Valley Safeguards

EDALE Valley, popular with Sheffield and Manchester cyclists, has been further safeguarded against despoilation by the National Trust, which has acquired three hundred acres at the head of the dale.

Bicycle Trailers in Holland

LACK of petrol in Holland has caused greater use of bicycle trailers. These are now being used for transport of all kinds of goods in town and country.

Advice from Lord Keith

SPEAKING at a gathering of cyclists and walkers organised in Edinburgh by the Scottish Youth Hostels Association, Lord Keith advised all who could to go into the country in these difficult times and get the benefit of fresh air and healthy exercise.

Some hundreds attended the gathering, the best-attended outdoors meeting held in Edinburgh since the start of the war.

Bicycle Boom in Eire

PETROL scarcity is causing a bicycle boom in Eire. Delivery of new machines is not good, and second-hands are being sold at very little less than the price of new bicycles.

Mid-Scotland Promotions for 1941

THE Mid-Scotland Time Trials Association has compiled its 1941 programme. There are eight events including two 25's and a 10 by the Association, a 25, a 10, and a hill-climb by the Hamilton C.C., and 25's by the Royal Albert C.C. and the Shotts Wheelers.

Because of the large number of reserved workers in the area covered by this Association, its officials believe that it should be possible to run off the events, which are fewer than in previous years.

Dundee Promoting Opens

DUNDEE cycling bodies propose to organise events this summer at distances of 10, 25, 50 and 100 miles, and the local cycling league, which was a success last year, is to be re-formed.

These decisions were reached at the annual general meeting of the Dundee and District Time Trials Association. New secretary of the Association is J. Hunter, 33 Leng Street, Dundee, Angus.

Women's Record Passed

THE Women's Road Records Association, meeting in London, has passed the British 50 miles record for women set up on October 6th, 1940, by Ann Briercliffe, West of Scotland Clarion C. & A.C. Her time was 1 hr. 59 mins. 14 secs.

Cumnock Rally Date

MEETING late in February, the West of Scotland Cyclists' Defence Committee fixed the date for this year's Cumnock rally. The rally will be held on the week-end June 28th-29th.

For the first time, Harry Price, secretary of the Scottish Amateur Cycling Association, is serving on the Committee, and was appointed with Messrs. Dunsmore, Marshall, Gormley, Briercliffe, Davidson, and Mailer, to the executive.

Some Members of the Famous Bath Road Club, on the occasion of their Annual Photo Run. The picture was taken in the grounds of "The Angel" at Thames Ditton.

AROUND THE WHEELWORLD—By Icarus

Abbreviations

IT seems necessary that someone should produce, for the edification of those somewhat new to the cycling movement, whether they are described as Great Cycling Authorities or not, a list of the standard abbreviations adopted in the cycling trade. We have in this country the British Standards Institution, whose job it is to standardise the nomenclature of various industries. I suppose that everyone claiming even nodding acquaintance with cycling, knows that the abbreviation M/c. means *machine*. Apparently not everyone, however, understands this, for a friend of mine was mortified to find that this abbreviation which he had used in a letter, had been interpreted as meaning *motorcycle*. As a result, he has had his leg well and truly pulled, for he has been a cyclist all his life, and his name has never been associated with the petrol-driven two-wheeler. Of course, no reader of *The Cyclist* would be guilty of making this error, but it does seem to me that the newer generation of cyclists, who seem quite unfamiliar with technical terms, need to have some explanatory leaflet to prevent them making such elementary mistakes, which not only offend the writers of letters but are likely to hold up to ridicule those who comment upon such letters. It has always been my contention that those entrusted with the criticism of mechanical matters should have an engineering training. If that is not possible, then they should be trained in the very elementary terms connected with engineering. As a start I suggest that they memorise the following: T.p.i. means threads per inch; Wh. means Whitworth; C.I. means cast iron; W.I., wrought iron; C.S., cast steel; m.p.h., miles per hour; d.n.s., did not start; d.n.f., did not finish. It also seems necessary to remind them that the bicycle is *not* the most difficult vehicle to immobilise, and that it consists of two wheels with thirty-two spokes in the front wheel and forty in the back, that the saddle is the apparatus on which the rider sits, that the cranks provide the means of propulsion, and that the tyres are inflated with air. I am thinking of starting some evening classes on the subject, and for full terms apply to me.

Historians Please Note

THE standard work on the history of the bicycle is "Cycling," by H. H. Griffin, which originally was published by George Bell & Sons. This book has been out of print for many years, but the copyright of the book was purchased by the editor of this journal a couple of years ago, and is owned by the proprietors of *The Cyclist*. I am asked to remind all those who write or talk about the history of the bicycle that we intend to safeguard our rights in this work, and that quotations from it, either spoken or written, are expressly forbidden without our permission, and in any case may not be made without acknowledgment to *The Cyclist*.

Voluntary Timekeepers

I WAS somewhat amused to read in a contemporary the suggestion that there should be a panel of timekeepers who are prepared to offer their services voluntarily. I am not really amused at the suggestion, with which I, of course, agree, but at the reception such a suggestion will receive. Whilst many timekeepers pay lip-service to the sport, its clean traditions and freedom from shamateurism, they still like to earn their casual guineas from clubs which can ill afford the money. There are many timekeepers who resent the suggestion that timekeeping should be undertaken in an honorary capacity, even in an amateur sport. It must not be forgotten that timekeepers are on committees which elect timekeepers, and they are thus in a position to keep out those who, genuinely interested in helping clubs during the difficult times, offer their services and the use of their watches without fee. I do not think, therefore, that there will be a panel of voluntary timekeepers.

Cycling Broadcasts

HEREWITH quotation from our contemporary *Practical Wireless*: "I am pleased to note, as an old cyclist, that the B.B.C. is devoting considerably more programme time to cycling matters. I hope they bring to the microphone real cycling authorities such as Frank Urry, "Wayfarer," Percy Brazendale, and others of similar lifelong experience. Each of these men has been cycling all his life for the love of the pastime. They are free from commercial interests, and could bring richness of experience, and wealth of anecdote, as flavouring essences to their talks. The sport of cycling should not be given much programme space. It interests at the most 30,000 people in this country, whereas there are 12,000,000 cyclists. The part cannot be greater than the whole."

Cycling in the Netherlands

SHORTAGE of timber in the Netherlands has led to the demolition of a great number of cycling tracks. The famous Rijswijk track near the Hague, the scene of many great cycling events, is the latest victim of this German drive for timber. Before long only the concrete tracks will remain. The number of timber tracks in Holland, however, is much greater as the last few years only timber tracks were built.

The Cumnock Rally

THE West of Scotland Cyclist Defence Committee will again promote the Cumnock Rally this year. The date is fixed for June. In the last three years attendances at the Rally have been 6,000, 10,000, and 4,000 respectively. Robert Marshall will organise the event, supported by the thirty associations comprising the S.C.D.S.

C. K. Mills

I REGRET to record the passing of my old friend, C. K. Mills, who, from 1888 to 1941 had been associated with the sport of cycling without break. I say that he had been associated with the sport of cycling, but it was chiefly on the executive side, for he was never a record breaker nor one who distinguished himself at racing. It was chiefly in connection with the N.C.U. and as a delegate for the North London C.C. that he distinguished himself. He served for several years on the London centre and General Council. A patent agent by occupation (I dislike the word profession), he met most of the so-called inventors in the boom-years of cycling. Yes, and the racketeers, from which the movement has never been entirely free. Whilst he never did anything spectacular, his pleasant manner, and his wise judgment endeared him to a wide circle, and many will deplore his passing.

To-day's Accommodation.

MOST of us—indeed, all of us—are affected by the war in one way or another. Possibly we cyclists still remain in the category to which I once applied the political and economic phrase of "most-favoured nation." In normal times, as well as in this abnormal era, we are particularly blessed. It is true that we have now—and for the time being, only—to carry the burden of additional and restricted lighting (that sounds contradictory, but it isn't!), and we suffer from the fact that motor traffic is of necessity inadequately illuminated. Beyond that, of what is there to complain? Not much. Yesterday (as I write), I had tea at a farm-house which at long last has ceased to display lump sugar, though there was plenty of the soft variety. Three dishes of jam were placed before me, in place of the usual *four*, but there was no change in the quality or quantity of the home-made cakes with which the table was laden. As I travelled homewards, filled with a splendid feed, I came to the conclusion that it wasn't such a bad old war after all!

But here is a point where we may hit snags. On a Saturday afternoon a few weeks ago I made a dive into Shropshire, there to enjoy (as I hoped) a slap-up tea at a favourite house of call. Alas! My hostess met me at the door and was sorry she couldn't oblige. Her house had been filled with evacuees and no accommodation remained for old customers. So I turned sorrowfully away and found another (and an inferior) place for tea. Moral: beware of the possibility of our rest-houses being crowded out with folks who, unluckily, have been expelled from their homes by bombs. Another instance: I gave a good country address to a friend who wanted a quiet week-end. As he neared his destination, he observed that an A.A. gun had been installed in a field at the back of the house, and he decided to "give it best." Moral: the barrage spreads far and wide. Beware of the possibility of the quietude of yesterday being transformed into a hideous and sleep-disturbing cacophony. Of course, the further we go afield, and the more we keep away from the large centres of population and from legitimate military objectives, the less likely are we to encounter noises that shatter the night.

This is How

BELIEVE it or not, there are still some cyclists who do not know how best to see to it that, after an adjustment, they have finished up with the handle-bar in the right position. You may do the trick by getting the bar at right-angles to the front wheel, first making sure that the front wheel is exactly straight. The proper way to do it is to take the line of the front hub. When the handle-bar is parallel with that, it is correctly placed.

The Purchase Tax

SEVERAL dealers still do not seem to understand the correct basis of assessment of the Purchase Tax. As agreed between the Manufacturers' Union and the Customs and Excise, the wholesale value of bicycles is determined by deducting 30 per cent. from the retail price, and then adding 33⅓ per cent. to this figure as the amount of purchase tax.

The Accommodation Problem

FROM the number of telephone calls I have had asking for assistance in the matter of transport of helpers, loan of my watches, use of my car, etc., it seems that promoters of road events are meeting the snags which some of the older clubs anticipated when they cancelled events last year. Of course, I am most anxious to help and I am giving every available minute each week-end to the transport of helpers, timing, and so on. Very naturally, I cannot be in two places at once, and so clubs will understand that if I have to decline their offers it is because I have a prior engagement. And quite naturally, I am giving priority to those clubs which have not opposed the voluntary timekeeping which I suggested in the early days of the war. Whilst clubs are finding it difficult to find the prize-money and are being put to extra expense in other ways, it is my firm view that those who offer their services as timekeepers free of charge should have been encouraged. Unfortunately, there are many timekeepers who oppose this point of view and still insist upon their pound of flesh. They have, in some cases, succeeded in obtaining the backing of certain clubs. These latter are now appealing for voluntary help, and they cannot be surprised because the help is not forthcoming. You cannot expect the owner of a watch or the owner of a car to be made use of in this way, especially when their attitude has received the quasi-support of some of the R.T.T.C. officials. Those anxious to help the sport and are willing to put themselves to some expense, and not a small amount of trouble, in helping clubs have been positively discouraged by officialdom, and it is not surprising that those who originally volunteered to help the sport along during the difficult war period have withdrawn their offer.

There needs to be a totally different atmosphere in the sphere of cycle sport if it is to survive. There are far too many associated with the sport who are in it for what they can get out of it, and they speak of the sport and maintaining its traditions with their tongues in their cheeks. Indeed, many of them keep good people out of the sport, for good men do not like to be associated with them.

Cycling should not be brought down to the level of the kerb-stone wheelers, and if kerb-stone wheelers are permitted to take a leading part in the sport, that is what it will descend to, for like begets like.

WAYSIDE THOUGHTS

By F. J. URRY

Daily Conditions

WHATEVER the spring and summer may have in store for road users, we certainly know what happened to us in the first month of this year of grace. Authority tells us we had a foot and a quarter of snow in the Midlands: and yet I was only divorced from the saddle for a couple of days, which I think is a compliment to the City of Birmingham scavenger department for dealing so promptly with the main roads of the district. They—the authorities—evidently took warning from the experiences of January 1940, when it was nearly a fortnight after the heavy snowfall that I was able to ride a bicycle with any reasonable degree of safety. On this recent occasion I was lucky in obtaining friendly lifts from the regular motorists who parade my pitch, for which many thanks; but oh! how they pulled my leg because the bicycle wheels had ceased rolling for the moment. A week later, however, I had the satisfaction of leading a string of them home in the fog, for they could follow my tail light with ease, whereas "on their own" the freezing mixture completely blinded them. For some ten days after that snowfall the roads were truly awful, and my poor old bicycle looked as if it was enamelled with earth, as indeed it was. I gave the bearing and brake parts a generous dose of oil every other day, while the oil bath case of the old Sunbeam took every care of the rest of the transmission, and so we slurred through the mud without much trouble. But I noticed in passing, and being passed by other cyclists, that chains were crackling with the mixture of snowy slush, and there will be sprockets to scrap and chains to replace on many machines before the full flavour of spring is in the air. That kind of weather is the mixture that a Sunbeam loves, and my old favourite of 23 winters faced it as merrily as ever, and looks little the worse now it has had a clean. But I must admit I do not like carrying around the weight handicap of a gear case except in really bad conditions, and then it is worth the added poundage many times over.

Supplies

I DO not want to sound a pessimistic note, but let me advise you to buy a new bicycle—if you want one—or have the old one rejuvenated, as soon as possible. Materials are becoming more and more difficult to obtain, and the immediate position is that as stocks are exhausted, no one knows when they are likely to be replaced. I will not go as far as to say they will not be replaced until after the war, because at the moment of writing, quotas for material are in the air; yet everyone connected with the trade knows such a condition of things may transpire. It is no use blaming the maker or the dealer if you cannot get what you require, for the former is very strictly controlled, and the latter is necessarily entirely dependent on his supplier. The same thing can be said on the question of replacements, and I tell you frankly I have put into my shed a small stock of covers and brake blocks, so that I shall not be held up from fitting my particular fancy in these things. This may be selfish; that I have not fully determined, but I am sure it is wise. Chains I can always get because I have a brother who helps to make them. Old cyclists have their special favourites in the matter of fitments, and though it may seem absurd, it is nevertheless true that unless their machines are equipped according to their notions, they never think the bicycle is performing to the top of its form. In this they are no different to other sporting people like the cricketer, the tennis player or the golfer, who have their favourite implements, and if these are missing, blame all bad shots to their absence. It is a lucky thing for us that bicycles last such a long time with a minimum of care, for replacements of worn parts, even in these days, are not abnormally expensive; were it otherwise, many a machine would go out of commission. As things are, get your machine in perfect order, and if you are lucky enough to have two, or more, see that they are in sound condition. You may need them, and in any case it is always pleasant to be in a position to lend one to a friend.

Take the Chances

BY the time you read these notes, March will be on the torn off pad, the month that ushers in the spring, or at least gives us some merry glances of that freshening period that puts another inch in your stride. True enough, there will be a few east winds with an edge like a whetted knife to remind us that winter still lingers, but there will also be sparkling days with tufts of green among the sheltered hedgerows, and the gay pink flags of the almond awake, to say nothing of the daffodil that will line a route I know running from a British Camp on the Malverns, to the warm valleys by Eastnor Castle. Nor shall we have to await for the extra hour of daylight this year until after Easter, for we have it with us now, and the illumination we spent in the dark mornings of mid-winter will bring their full dividend. Maybe, as one grows older, it is natural that the turn of the year seems more delightful than ever, and to make a little holiday of the odd hours of leisure during these distracted times is surely part of the heaven upon earth. Work, yes, with all your might; but when you have a short space of leisure, I know of no more delightful manner of using it than taking the keen sweet March air on a sunny day to see the land stretching itself, as it were, after the long dark slumber of winter. Some people walk, which is good for them, but limits their horizon; I prefer to ride, to stay awhile here and there where "the quick cloud shadows trail" and smoke, watch the waking woodlands rejoice, and hear them talk of the summer to come. And at the end of such a day I generally find that sixty miles or so of perfect movement has been packed into an unspoken poem; and it is then I thank all the gods there be that I can still ride a bicycle, and claim the relief from the many pressing things that now make life so urgent, and sometimes so adventurous. It is easy to do as the world usually does on its leisure days; but if you would jewel life with bright memories, go and look at the countryside in spring, eschew the armchair, and write your own story of simple happiness intertwined with the miles of travel.

Making Friends

DURING the last month I have received numerous invitations to visit corresponding friends at their homes, or, alternatively, go riding with them any day of the week, or if that is not possible, any week-end. Such gestures are nice to receive because they carry a genial compliment; but unfortunately—or otherwise, according to outlook—I am hard at it for at least five-and-a-half days a week, and have occasional night-duties that make me a sleepy individual on the following day. I have, however, made one or two such assignations, and will let you know how they turn out, because, to be candid, I am inclined to the view that actual contact following correspondence is frequently a disappointment. For you only know an individual well when you have tried him out, and particularly when you have trusted him, and these conditions are not possible to attain during the fleeting hours of a day along the road. But what a fine game this cycling must be when folk who know nothing about me, and the little idiocyncrasies that handicap every human, are prepared to take the risk of disappointment. I tell you, there is nothing more inducive to friendship than cycling, and its highest expression is to be found in touring. I have perhaps half-a-dozen friends near my own age with whom I roam the land whenever the chance of a holiday comes along, and half the pleasure of our journeying is derived from sharing the loveliness through which we travel, and the little adventures by the way. I can, and do, enjoy lonely cycling, but the best form and the deepest impression of the pastime have undoubtedly been garnered in the company of sympathetic companions. And so I say to you, make friends awheel, for by sharing the pleasures of the road you enhance them, and by dividing the little troubles that are bound to come, you reduce them to a jocular outlook.

Catering Troubles

ABOUT a year ago I wrote a paragraph in another place, saying that in my opinion the difficulties of catering for the touring or week-ending cyclist would increase as the war period extended, and I received numerous letters from young folk who, because they were welcomed in most places last summer, were inclined to the opinion that my early remarks were pessimistic. As a matter of fact, and from my experience, we have reached the difficult stage much sooner on this occasion than in 1914-18, for if I remember rightly, it was not until the summer of 1916 that accommodation became a problem. But it only showed itself a problem to be fairly easily solved. Then, as now, there were few folk fortunate enough to enjoy a prolonged holiday; our cycling excursions were mainly confined to a day's outing, with an occasional week-end to a spot where we knew accommodation was available. So we started packing our food and using the rest houses still available for "tea only," frequently taking the herb and the sugar (if any) with us. That was the start of the "tea only" habit which has persisted, and spread to most parts of the country, and it was also the beginning of the much wider picnicing habits which have appealed to every type of wanderer. To some extent the hotel folk and the caterers encouraged this habit of independence for some time after the close of the Great War, because, having got used to making money easily by pulling the beer-engine handle, they could not be worried with the needs of wanderers. I remember being in the south-west country in 1920, and my wife and I often experienced real difficulty in securing accommodation during a fortnight's tour, and to some extent our holiday was spoiled because of the time wasted in seeking quarters. It is to be hoped our catering friends will not make the same mistake again, but will endeavour to retain some sort of accommodation, so that when peace comes the stage will be set for wide-spread touring. In the meantime the difficulties of catering will not stay me from wandering. A thermos of coffee, and whatever the home larder can provide will keep me going for a day—and I shall refresh where loveliness lies in my eyes.

Hostels After the War

IN February, the Scottish Youth Hostels Association held its first formal gathering, a supper in Edinburgh to celebrate the foundation of the movement ten years ago

Amongst those present was Lord Salvesen, Lord Keith, and J. A. Waters (Editor, *The Scotsman*), and they spoke of the success of the Association, even in the first year of war.

Also present were pioneers of the movement like R. B. Fasken, present chairman of the Association, John Francey, and Alex. Beith.

Mr. Beith, a former member of the C.T.C. Council, said that in the lean years which would doubtless follow the war, there would be greater need than ever for the facilities the Association provided for cyclists and walkers.

My Point of View

BY "WAYFARER"

Not Quite the Same

A SHORT time ago I called at a tiny pub. in the very heart of the country—in the Midlands—for a spot of refreshment, and was surprised to find the place full of people who, at midday, were making merry. Well oiled, they raised their voices in what, presumably, would be called "song"—and the results were not exactly musical. 'Who are your friends?" I enquired of the publican. 'Seafaring folk," says he. My face registered astonishment, because the nearest salt water was about 100 miles away; and then it was explained to me that the clamorous people concerned were barge-folk from the adjacent canal, which is not quite the same thing as the sea!

Empty Roads

AS I may have remarked before, these are great days from the cycling point of view. At least, I find them so, and I revel in current conditions. What strikes me as much as anything is the series of empty roads which are encountered, taking one back to pre-motor days. It might be thought that the great increase in the amount of military traffic would more than counter-balance the withdrawal of private motoring which arises from the strict rationing of petrol, but such is not the case—so far as my experience goes. The main impression left on my mind concerns those empty roads of which I have spoken, and it seems to me that cyclists who are failing to take advantage of current conditions are doing themselves a great disservice. So, my friends, if your bicycle is out of commission, have it "tuned up" without delay and put it back on the road again. All the old joys of cycling await you, plus the new joys which arise from the diminution of traffic. If you are working hard, there is all the more reason why you should insist upon obtaining your share of our glorious pastime. If your leisure moments are few and far between, cycling is the very best method of occupying them, for in no other way can you so easily and conveniently make use of your spare time. I know from long experience that the effect of an hour or two devoted to cycling, especially when life is full of worries and problems, constitutes a splendid tonic, which enables you to return to your "grind-stone" refreshed and strengthened. The great "versatility" of cycling—good for an hour or a week: good in fine weather or wet: good in sunshine or frost: good in daylight or darkness: good for a lounge or a "scorch"—is enhanced by those empty roads to which reference is here made. It's a grand game—and it now has greater possibilities than ever before.

Thanks to the Bicycle

RECENTLY, when I was engaged in conference with a man with whom it was desirable for me to stand well, the conversation lagged, and we were in danger of drifting into an awkward silence. The situation was saved by his telling me that he had just completed a business visit to Ireland, travelling to and fro by air. After that we went along swimmingly, for cycling has given me a deep interest in and knowledge of "the Island of the Saints." A question or two brought forth the information—very attractive and provocative to me!—that my friend had been to Connemara, and that he was concerned in a factory which had been built near the River Corrib in Galway City. We were instantly on common ground. He knew Ireland from a commercial standpoint: I knew the country as a cyclist, and we found plenty to talk about—the roads, the folks and their habits, the mountains with their marvellous colour scheme, the vast lakes, the fretted coast-line, the huge spread of ocean known as Galway Bay, and the distant islands which form a sort of natural breakwater. And so, thanks to the bicycle, which has made me a "travelled man," the door was opened to a pleasant talk, which happily whiled away the rest of the time I spent with that business man—and which, I found, did me no harm. What a debt of gratitude we owe, in one way and another, to the bicycle!

The Slothful Way

IN a lazy moment, the other morning, when one of my tyres refused to accept the supply of air it needed, I followed the line of least resistance by slightly heating the valve shell with a match, and then the pump was allowed to "do its stuff." I knew quite well that this expedient was purely a temporary one, and, sure enough, two days later—when, it need hardly be said, I was pressed for time—the valve went on strike, and it was necessary for me to fit a new rubber tube. That was punishment for my laziness. How much better it would have been to do the right thing when it was borne in upon me that the tubing was on its last legs! As a matter of good form (so to speak), the process of heating the valve shell should be reserved for those occasions when it is desired to remove an obstinate length of rubber from its lair; it should *not* be used to extend the life of a vital portion of the air inlet.

Sacrifice

AT the breaking out of the war, I heard of a business man who, on the announcement of petrol rationing, said: "Well, I'll buy a bike now. It won't be *infra dig* to cycle!" I could have kicked his shins! He was nobody of any importance—a £500-a-year man who was provided by his employers with a motor car, the possession of which had evidently endowed him with bigger ideas than his salary justified, and made him something of a snob. But there are many such—and there are thousands of others who refuse to ride bicycles because "it isn't done": because the family meat and the family newspapers are delivered to their houses by boys mounted on bicycles: because every tyke you see careers about the country on a bicycle. No: "It isn't done." These worthy people are prepared to sell their birthright for a mess of petrol, and to give up all the undeniable joys accruing from the pastime of cycling because—forsooth!—so many of their fellow-men indulge in cycling. My view is: let all who will, cycle. As for me, I am an adherent to the finest pastime in the world, and I have never been one to give up the best for something inferior—even if the inferior thing seems more "respectable." Members of the snobocracy earn my greatest contempt.

Notes of a Highwayman

By Leonard Ellis

Where Shires Meet

FRONTIERS have always fascinated touring cyclists because I believe that nearly all tourists are romantic and imaginative. To them is given the power to see beyond the simple stone or post, and to conjure up visions of strange lands and stranger customs. Since it is necessary to go abroad to find frontiers it might seem that this little hobby is confined to the fortunate few who can tour abroad. Luckily, however, a similar thrill usually accompanies the crossing from one British country to another, and strangely enough the border-line seems to be a veritable magnet for romance and romantic tales. I can always recall with a thrill my first sight of the Scottish boundary, simply marked by a St. Andrew's Cross, and the legend "Scotland." It was an event, and we solemnly marked the occasion by dismounting and reverently gazing at this symbol of our arrival, and our welcome to a new land. I have stood wistfully at the frontier of a country not named in my passport, and could always imagine that there must be many most desirable things to see because they were temporarily beyond my reach.

The Fascination of County Boundaries

EVEN county boundaries have a decided fascination, and here, again, others have felt the urge to mark the spot, and to invest the scene with romantic tales. There are several places in these Islands where two or more counties come together, and the spot is generally marked by some tangible object, and is often known by a name that explains its importance.

Near Moreton-in-the-Marsh, in the Cotswolds, and on the road to Stow-in-the-Wold, stands the very well-known square stone pillar surmounted by a stone ball, marking the spot where the counties of Warwick, Worcester, Oxford and Gloucester touch. It is, incidentally, a tragic example of the vandalism that characterises a certain class of traveller. The stone is shockingly mutilated by scores of names and initials. It is difficult to understand how Worcester comes into the picture, and I sometimes wonder if one of those queer little "islands" once existed here and has been swept away in an endeavour to clarify a once wildly-contorted boundary line.

Four Shire Stone, Moreton-in-the-Marsh.

On the road northward from Tamworth to Ashby-de-la-Zouch, there is a little inn named by someone with a "boundary complex." It is called the "Four Counties Inn," and although the boundaries of Warwick, Leicester, Stafford and Derby are not far distant, it must be regretfully admitted that all four boundaries do not touch the point. It might be true to say that all four can be seen from the windows of the house; it might even be that once the boundaries did come together.

A romantically named point on a romantic road is County Gate, in North Devon. This, without doubt, marks the dividing line between Devon and Somerset, and is situated on one of the most glorious touring roads in the south-west. At this spot a gate once marked the boundary between Wessex and Devonia.

The Haunt of the Bad Men

I THINK however that one of the most fascinating shire spots is that marked on the maps as "Three Shire Head." It is not an easy place to find, but once found it will be easy to realise the truth of many of the strange stories woven around it. It is a wild spot in a hollow of the Dane Valley in Macclesfield Forest. Here Derbyshire, Cheshire and Staffordshire come together, and this very proximity of counties was the reason for its notoriety. It is said that in the old prize-fighting days the ring would be pitched in one county, and the battle would proceed until the police of that county pounced. Then up came the ring posts to be transported a few feet into another county where the police were powerless to act. We are not told what happened when the police of all three counties arrived on the scene. To complete the picture of its ill-repute we must move over to Flash, or, as it is alternatively called, Quarnford. Around this district in the bad old days, the tinkers and tramps would congregate during the winter. They had their own customs and their own slang, and in order to pass away the dreary months in a profitable way, they manufactured spurious coins. Even to-day such money is often called "flash money."

News and Notes

Honour for Union Chief

MAJOR H. R. WATLING, Director of the British Cycle and Motor Cycle Manufacturers and Traders Union, Coventry, has been added to the Commission of the Peace for the County of Warwick.

New Container for Bicycle Oil

CYCLISTS who have been finding difficulty in obtaining B.S.A. lubricating oil will be glad to hear that a new type of container has been devised to overcome the war-time difficulty of obtaining adequate supplies of the familiar tins. Although the new B.S.A. metallised container holds exactly half a pint of lubricating oil—considerably more than the tin—it costs only 7½d., compared with the present price of the tin which is 9d. The container is used by punching two small holes in the top, when oil can then be poured into an oil-can as required.

Strike Because of Borrowed Bicycle

DURING February, 400 apprentices employed in Leith shipyards struck work because one of them was dismissed by the management of one firm for borrowing a bicycle during the dinner hour. The owner of the bicycle was one of those who came out on strike in support of the dismissed apprentice welder.

Flooding at Shrewsbury

A FEW weeks ago, Shrewsbury, the popular Midland cycling centre, had the worst floods for forty years. All the main roads into the town were flooded, except for one.

All vehicles were held up, but cyclists were amongst those who tried to pass through the floods. For miles upstream, fields and roads were under water.

New Youth Hostel

"THE finest youth hostel in Scotland" (official description) is to be opened in April at "Dunselma," Strone Point, near Dunoon, Firth of Clyde.

A four-storey building, formerly owned by the Coates family, of Paisley, "Dunselma" will be the most up-to-date hostel north of the Border. Electric light and water supply are duplicated, and there is a first-class air-raid shelter in the basement.

The hostel has been obtained through the good offices of the Forestry Commissioners.

Douglas Champion Volunteers

KENNETH COCHRANE, club champion of the Douglas C.C., of Glasgow, in 1940, has volunteered for the R.A.F. and is now serving. Nineteen years of age, Cochrane was the most promising youngster in the Douglas, and held club records.

Mid-Scotland Guarantee

THE Mid-Scotland Time Trials Association has decided to guarantee to its affiliated clubs that if they are unable to promote any of their listed events, the Association will step in and run them. The Association and its affiliated clubs propose to hold eight open events this season.

Over One Hundred at Aberdeen Prizegiving

MOST successful Aberdeen social event of recent years was the annual presentation of the North-East of Scotland Time Trials Association, held jointly this year with the Aberdeen Wheelers.

Councillor Fraser McIntosh presided, and James Ogilvie was the leading prizewinner.

Scots Girls to Promote

AT the annual general meeting of the Scottish Women's Cycling Association in Glasgow, it was decided to promote open events during 1941. A trial event is to be run off early in the season, and if this is successful, further events will be organised. Many of the members of the Association are at present working week-ends.

All the retiring officials were re-elected, with Ann Briercliffe, 16 Scotstoun Street, Glasgow, W.4, as general secretary.

Oldham's Messenger Cyclists

THE County Borough of Oldham, Lancashire, has what is believed to be the best A.R.P. boy messenger service in the country. The boys, who come from the senior departments of local schools, report for duty at the Oldham Education Offices on the morning after heavy raids.

The messengers, who must be thirteen years of age or over, are chosen not only for their ability to ride and repair their bicycles, but for their dependability and initiative.

West of Scotland Programme

THE West of Scotland Time Trials Association and its affiliated clubs propose to hold seventeen open events during 1941. They include Glasgow Eastern 10 and 25, Glasgow Wheelers 25, West of Scotland Clarion 25 and 100, Ivy 25, Lancia 25 and 50, Nightingale 25 and 100, Glasgow United 50, Lomond Roads 50, and Association Novice 25, 25, 50, 100, and hill climb.

While officials are prepared to run these events, difficulties may arise in securing entries as most of the remaining young men are in the forces.

The picturesque 13th century gate spanning the MONNOW BRIDGE at MONMOUTH

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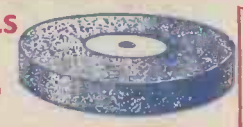

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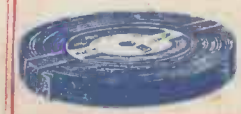

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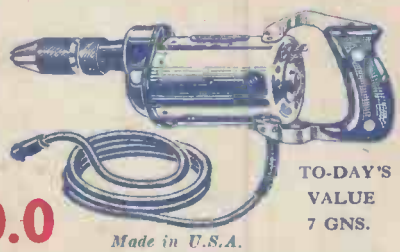

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