THE GLEN AFFRIC SCHEME OF THE NORTH OF SCOTLAND HYDRO-ELECTRIC BOARD.

(*Concluded from page* 492.)

FASNAKYLE POWER STATION.

As may be inferred from Fig. 37, the Fasnakyle power station, which forms part of the Glen Affric Hydro-Electric Scheme, is a steel-framed structure with reinforced-concrete walls, which are being faced with Buryhead stone. To construct it the river was diverted from the site by building an earth-filled cofferdam and was returned to its original bed when the work had been completed. A downstream view of the completed diversion is shown in Fig. 42, Plate XLVII. The floor of the turbine-house, which is illustrated in Fig. 40, Plate XLVII, is about 7 ft. above the axis of the spiral casing, and the alternators are set on reinforced-concrete plinths at 232 ft. O.D. The building includes an administrative block and control room from which it is proposed to control other hydro-electric schemes in the area.

The equipment of the station, for which Messrs. Kennedy and Donkin, 12, Caxton-street, London, S.W.1, acted as consultants, consists of three vertical-shaft reaction turbines of the Francis type, each of which has an output of 33,000 h.p. when running at 375 r.p.m. under a net head of 490 ft. The gross static head is 525 ft. and the maximum net head 510 ft., at which figure the output is 34,500 h.p. The speed of 375 r.p.m. was determined by the operating head and output, coupled with the necessity for minimising cavitation and the provision of the requisite flywheel effect in the alternator rotors. This was necessary to ensure satisfactory speed and pressure regulation, stability of governing and the absence of speed fluctuations at no load required for easy synchronising. The turbines are equipped with relief valves in order to limit the pressure rise in the high-pressure tunnel when the load is suddenly removed. In order that certain existing designs could be utilised, the one-piece stainless-steel castings, which form the runners rotate in a counter-clockwise direction looking downwards.

The machines, which are of English Electric design and were manufactured at Messrs. Harland and Wolff's Glasgow works, are generally similar to those installed at Loch Sloy.* Owing to the lower head and the larger physical dimensions, however, the spiral casings were fabricated from mild-steel plate and have cast-steel speed rings. One of these casings was delivered to the site in two halves and welded together on site, but the others were transported in one piece. As the nearest railway station is 20 miles from Fasnakyle, it was found more convenient to convey the material entirely by road to avoid double handling. This decision, however, gave rise to several difficulties, among them being the negotiation of the existing bridge over the River Cannich, $1\frac{3}{4}$ miles from the station. This bridge is a single-span cast-iron structure, 90 ft. long, with a maximum allowable load of 10 tons. As it was incapable of carrying the loads, a temporary Bailey bridge, with a carrying capacity of 110 tons, was built in collaboration with the Army, and the completely welded spiral casings for the second and third machines were carried over it at an angle.

Instead of a mechanical drive an independent electric motor, which is supplied from a low-voltage alternator with a permanent-magnet rotor, is used for the governor head of each turbine. This machine is mounted on the exciter shaft and is directly connected to the synchronous motor driving the governor head. The oil supply to the servomotors operating the turbine guide vanes is obtained from an electrically-driven pump on each machine. The governor gear is illustrated in Fig. 38, on page 554. The alternators are designed to operate as synchronous condensers when necessary. Under these conditions it is unnecessary to have water in the spiral casings, but to avoid heating and possible seizure, a small quantity of water is fed into the labyrinth seals of the runners. The turbine runners are set above the normal water level in the tail race and no special provision has been necessary to keep them clear of the water in the draught tubes. A standby oil pump, which is driven by a Pelton wheel, is coupled to a pipe interconnecting all three governor oil-pressure systems, and thus enables the turbines to be started up without drawing on external electric power. This pump is fitted with an automatic valve so that it starts as soon as the governor oil pressure falls below the normal value. The regulating gear and gearbox are illustrated in Fig. 39, page 554.

The alternators, which were also manufactured by Messrs. Harland and Wolff, to the design of the English Electric Company, are of the two-bracket type and are very similar in construction to those installed at Loch Sloy. They are designed for an output of 22 MW at 11 kV with a power factor of 0·95, but, owing to the overload capacity of the turbine at the higher heads, they can be run for long periods on loads of 23 MW or more. In fact, a station peak load of 68·4 MW has been sustained. As has been said, the stators are carried on mass-concrete plinths, which take the thrust loads of over 200 tons, as well as the machine torques, no fabricated steel supports being provided. Owing to the length of the high-pressure tunnel, it was necessary to provide a flywheel effect of over 4,000,000 lb.-ft.². To do this specially thick manganese-bronze pole end plates were used and the rotor diameter was made as large as practicable taking into account the maximum runaway speed of 687 r.p.m. As the resulting diameter of the rotor plates prevented them from being carried by rail and the total weight of the rotor without the poles was too great for road transport, two packets each containing four plates 6 in. thick and 10 ft. 9 in. across flats were made up. Owing to snowdrifts, the packets for one machine were held up on the road from Glasgow, the journey of 195 miles eventually taking five weeks instead of three or four days.

The arrangement of the bearings and brakes on

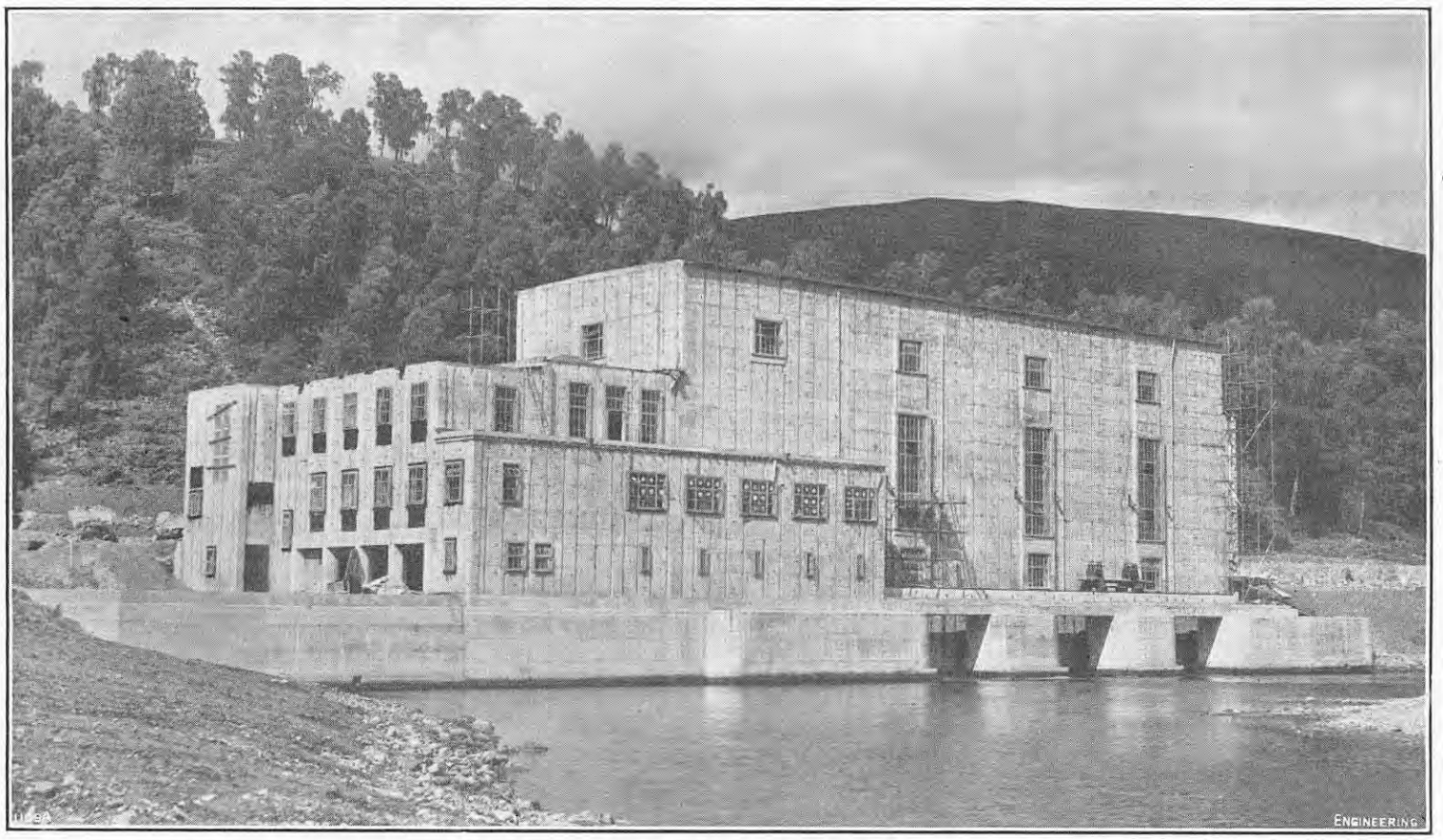


FIG. 37. DOWNSTREAM SIDE OF FASNAKYLE POWER STATION.

* See ENGINEERING, vol. 170, page 1, *et seq.* (1950).

THE GLEN AFFRIC HYDRO-ELECTRIC SCHEME.

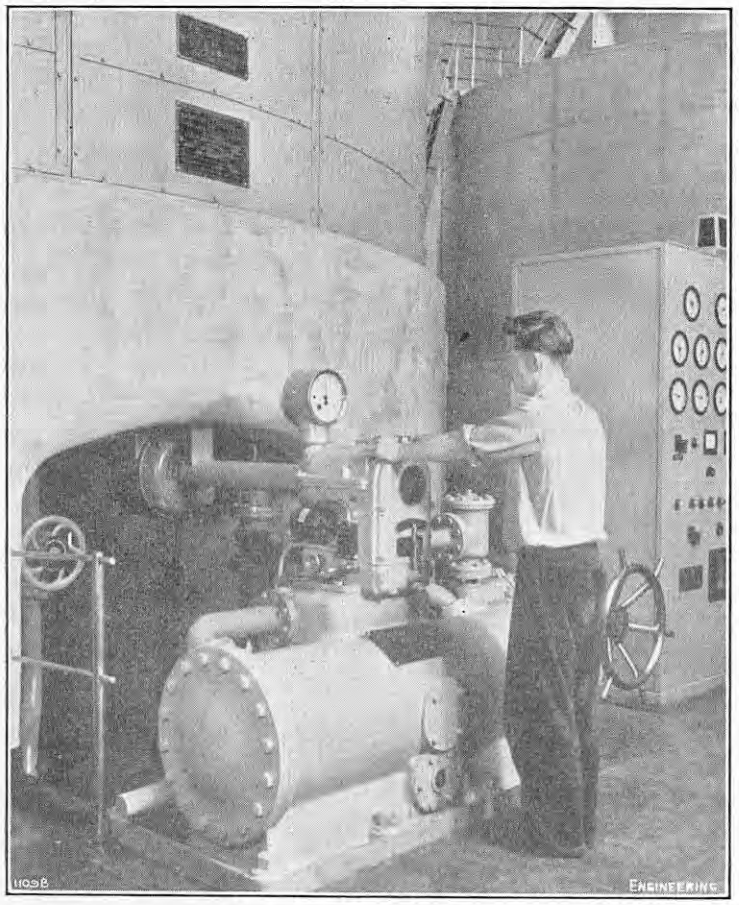


Fig. 38. Governor Gear and Turbine Gauge Panel.

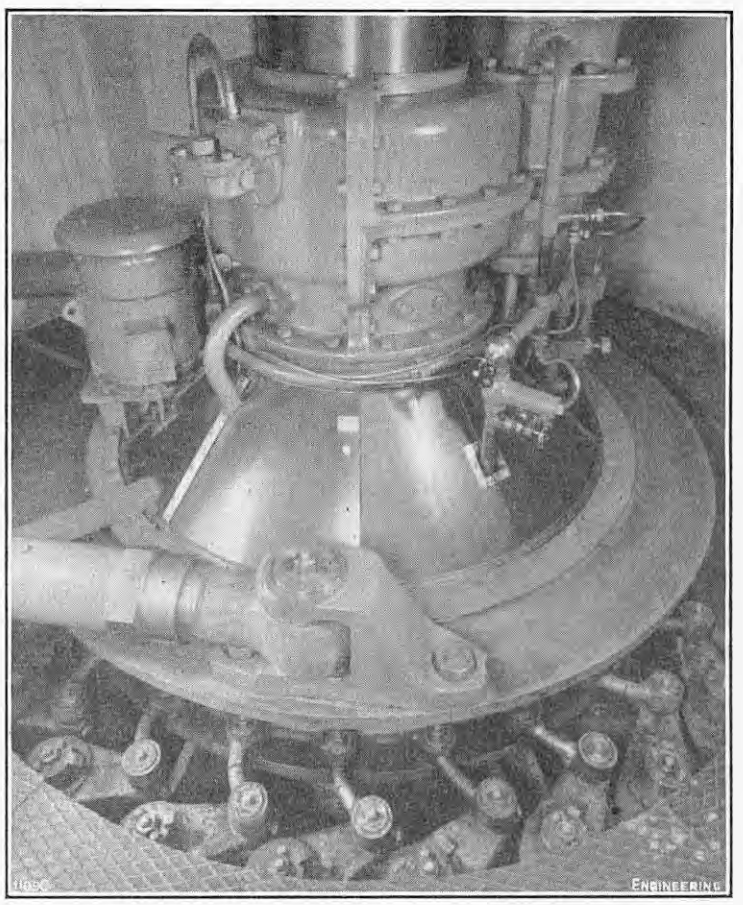


Fig. 39. Regulating Gear.

the Fasnakyle machines is the same as that at Loch Sloy. The thrust and upper guide bearings are of the pivoted-pad type and are housed in a common sump, while the lower guide bearings are of the sleeve type. All these bearings are supplied with oil from a separate pump. The main and pilot exciters are coupled to extensions of the alternator shaft. Closed air-circuit ventilation is provided for the alternators, the air being passed through coolers through which water is pumped either from the leak-offs of the turbine runner seals or from the pipelines through a reducing diaphragm. About 25 per cent. of the air can be extracted for heating the station and this represents a load of about 180 kW. Fire protection is provided by a carbon-dioxide system which is controlled from the turbine gauge panel.

Station Auxiliaries.

The essential station auxiliaries are supplied on a unit system, similar to that installed at Loch Sloy, through three 250-kVA, 11,000/415-volt transformers. These transformers are housed in cells in the power station and are connected to the terminals of the main alternators. The low-tension sides of the transformers, which are of English Electric manufacture, are in turn connected to starters of the latching type. These starters are normally closed, so that the associated motors run up as the speed of the alternators increases and are shut down with the main sets. During starting and shutting down lubricating oil is supplied from a stand-by pump which is driven by a direct-current motor. The low-tension board is of the combination fuse-switch type with hand-operated isolators, so that a supply can be taken from any of the 250-kVA station transformers or from a fourth transformer of the same capacity, which is connected to the local 11-kV system. Contactors are also housed in the isolator cubicles, so that a supply can be maintained automatically from any one of the four transformers to the station lighting circuits.

The main step-up transformers, which were also manufactured by the English Electric Company, are installed at the switching station, some 300 yards downstream from the power station ; the switching station is illustrated in Fig. 41, Plate XLVII. They are solidly connected to the alternators through three 0·6 sq. in. single-core paper-insulated lead-covered cables per phase. These cables, which were manufactured by Scottish Cables, Limited, Renfrew, terminate on a gantry, the final connections to the 11-kV transformer bushings being made by copper strip. The high-tension windings are provided with tappings to give a regulation of 0 to 15 per cent. in ten steps, though the necessary tap-changing gear has not yet been fitted. A separate compartment on the tank contains bolted links, so that this ratio of transformation may be changed manually if required. Forced oil circulation with forced air cooling has been adopted as water is not readily available. Duplicate coolers are installed on each transformer for this purpose, one of which is capable of dealing with the full-load losses. The oil pump and fan motors on one cooler of a pair are supplied from a 150-kVA transformer, which is solidly connected to the 11-kV cables, while those of the other pair are fed from a common services board. The coolers associated with the latter motors are used as a standby and come into operation automatically should either the air or oil flow fail.

The switching station, at which the output of the alternators is controlled, is of the single 'bus-bar single section outdoor type, the 'bus-bars and isolators being supported on reinforced-concrete structures, as can be seen in Fig. 41. There are five circuits, three of which are connected to the alternators and two to the outgoing feeders. At present both these feeders run to Beauly switching station, about 20 miles away, but, ultimately, one of them will form an interconnector to Fort Augustus for the Garry-Moriston scheme. The second feeder will then run directly to Fort Augustus without passing through Fasnakyle. At present, the double circuit line to Fort Augustus is being operated at 33 kV and is being used to supply power for the construction of the Garry-Moriston scheme. Both generator and feeder circuits are controlled by 132-kV oil circuit-breakers with a rupturing capacity of 1,500 MVA. These circuit-breakers, which were manufactured by the English Electric Company, are fitted with high-speed pneumatic closing mechanism and are also generally similar to those installed at Loch Sloy and elsewhere in Scotland. They are, however, provided with a tapping point on the condenser bushings to give low-voltage supplies for the synchronising instruments. These bushings act as capacity-type potential dividers, the tappings being at a point where the voltage to earth is about 5 kV. This voltage is further reduced by a tuned voltage transformer from which the instruments are supplied. The 132 kV isolating and earthing switches are manually operated, but their positions are indicated in the control room.

The two outgoing feeders are provided with telephase protection using power-line carrier-current equipment. This equipment is also employed for communicating by telephone with other control points on the Board's 132-kV system. The generator circuits have overall Translay protection, which covers not only the machines but the interconnecting cables, main transformers and circuit-breakers. Both the telephase and Translay protections are overlapped by a single form of zone protection on the 'bus-bars.

Control Room.

The three generator-transformer circuit-breakers and the two feeder circuit-breakers at the switching station are operated from a control room in the power station at Fasnakyle. This control room, as

(To face page 554.)

THE GLEN AFFRIC SCHEME OF THE NORTH OF SCOTLAND HYDRO-ELECTRIC BOARD.

(*For Description, see Page* 553.)

FIG. 40. GENERAL VIEW OF TURBINE ROOM.

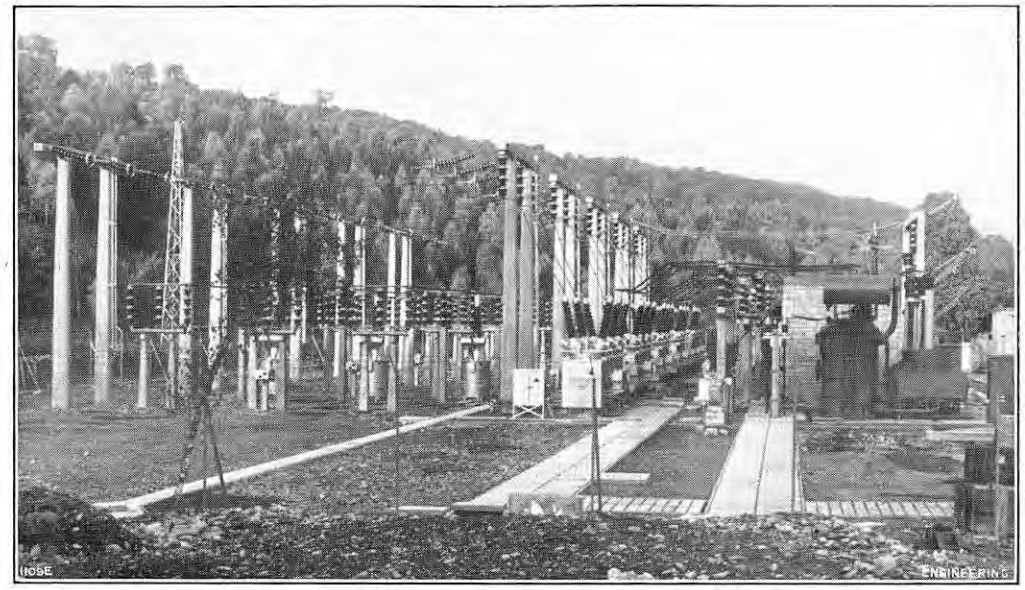


FIG. 41. FASNAKYLE SWITCHING STATION.

FIG. 42. DOWNSTREAM VIEW OF RIVER DIVERSION.

THE GLEN AFFRIC HYDRO-ELECTRIC SCHEME.

Fig. 43. Control Room at Fasnakyle Station.

will be seen from Fig. 43, herewith, contains a desk on the centre portion of which the necessary switches for this purpose are mounted as well as meters for indicating the load, power factor and alternator rotor voltage and current. The left-hand wing of the desk is provided with a number of glass panels on which the conditions of various parts of the plant can be displayed in illuminated lettering, while the right-hand wing carries the switchboard for a private telephone exchange. The wall diagram, which is visible in the background of Fig. 43, incorporates duplicate keys for operating the feeder circuit-breakers and indicators showing the positions of the isolating switches in the adjacent 132-kV station. The positions of the transformer circuit-breakers are also shown on the diagram, as well as on the desk, while meters indicate the feeder current, the frequency, and the incoming and running volts. A synchronoscope and megawatt and megavar meters are also provided.

The various control switches and meters are connected through multi-core cables to a terminal and relay cubicle, where they terminate on telephone-type terminal strips. From these strips jumpers are run to the individual relays, an arrangement which should facilitate future changes or additions. From the cubicle unarmoured lead-covered textile insulated cables are led to a pilot cable junction box, which is, in turn, connected through cores in a paper-insulated lead-covered and wire-armoured cable to a sealing box at the switching station. From this box circuits are run to the necessary interposing relays for operating the equipment and to the current and voltage transformers for the measuring instruments. The control system is operated by direct-current at 50 volts, the necessary supplies for this purpose being obtained from a 24-cell battery at the power station.

The rotary keys used for operating purposes consist of the familiar telephone combination of contacts and springs, the former being of precious metal to ensure good electrical contact with a comparatively light spring pressure. The relays, which are of the standard Post Office design, are provided with split ended contact springs and twin contacts of precious-metal alloy to increase their life and ensure freedom from pitting. Groups of relays are mounted on moulded plastic bases, which have been designed to jack into a connecting box carrying the terminals for the external circuits. The bases are protected by glass covers. The jack contacts are self-cleaning, positive in action and easily accessible for testing, while the fact that the unit can be instantly removed and replaced by another of the same type makes for easy maintenance. The relays are, in turn, connected to the operating equipment of the various circuit-breakers or to the necessary voltage and current transformers of the measuring instruments.

The position of the circuit-breakers is shown on a three-colour indicator, the only part of which that is visible on the face of the control panel being a circular lens in which the light appears. This lens is actually the end of a cylindrical stem, which is formed on the apex of a triangular piece of clear acrylic plastic, known as a director block. Three lamps, each of which has a colour filter, are mounted in line along the base of this block and when they are energised the light from them passes through the appropriate filter and is collected by the plastic. The lens is therefore illuminated by a bright coloured light, which is arranged to be visible over an angle of about 180 deg.

The circuit-breaker control system contains three relays, one of which is operated when the circuit is closed, so that the indicator shows red. When the breaker is tripped normally the indicator shows green, while if it is tripped on a fault a common alarm circuit is closed by another relay, the red and green lamps flash alternately and an alarm bell is sounded. This alarm is "accepted" by operating a special key which energises a third relay and lights the green lamp. All this apparatus was supplied by Standard Telephones & Cables, Limited, Aldwych, London, W.C.2.

The control room also contains apparatus for operating and indicating the position of the gates at Beinn a Mheadhoin, the signals for this purpose being transmitted through a stainless-steel sheathed pilot cable which is carried on the 11-kV pole line. At present there are no similar indications of the conditions at Mullardoch dam, but apparatus for this purpose may be provided later when the subsidiary stations at that place and at Cannich have been built.

LITERATURE.

Table of Arctangents of Rational Numbers.

By John Todd. United States National Bureau of Standards Applied Mathematics Series No. II. U.S. Government Printing Office, Washington, D.C., U.S.A. [Price 1·50 dols.]

Arctangents with rational arguments occur in the imaginary part of log $(m + i\,n)$ and as the polar angle of the point (m, n), so that a table such as this, in conjunction with a table of logarithms and square roots, will serve for the determination of logarithms of complex numbers and for the conversion of rectangular to polar co-ordinates. The method employed in computing the present table was to obtain a representation of arc tan $\frac{m}{n}$ in the form arc tan $\frac{m}{n} = \sum_{i=1}^{l} f_i$ arc tan r_i; where r_i, $|f_i|$ and l are positive integers. The theoretical basis for such a reduction is explained in the introduction, which also describes the process of computation, together with the method of preparing and checking the tabular entries.

Table I gives the principal values in radians to 12 decimal places of arc tan $\frac{m}{n}$ and arc cot $\frac{m}{n}$ for integral values of m and n within the range $0 < m < n \leq 100$. In addition, it lists values of $n^2 + m^2$ and the complete reductions of arc tan $\frac{m}{n}$; thus, for example, the entry in the reduction column corresponding to $n = 13$, $m = 4$, is $-1\,(2) + 1\,(6)$, so that arc tan $\frac{4}{13} = -$ arc tan 2 + arc tan 6.

When m is a positive integer, a representation of the form arc tan $m = \sum_{i=1}^{l} f_i$ arc tan m_i is called a reduction of arc tan m provided that $|f_i|$ and l are positive integers and m_i a positive integer less than m. If such a reduction exists, arc tan m is said to be reducible, and if none exists it is irreducible. When each component arc tan m_i is irreducible, the reduction of arc tan m is said to be complete. Table II provides a list of those integers, not exceeding 2089, of which the arc tangents are reducible together with the corresponding complete reductions. Besides the obvious uses for these tables mentioned at the outset, the reductions contained in Tables I and II are of interest in connection with number theory, and a more recent demand for these functions has arisen in connection with atomic collision problems.

Soil Mechanics for Road Engineers.

Road Research Laboratory. H.M. Stationery Office, Kingsway, London, W.C.2. [Price 30s. net.]

This book is the first of three volumes which are to replace the original *Soils, Concrete and Bituminous Materials* published in 1945. As stated in the foreword by Dr. W. H. Glanville, Director of Road Research, most of the chapters are based on lectures delivered to road engineers at the courses of instruction given at the Road Research Laboratory. Much of the information comes from the results of laboratory research and field observations carried out by the laboratory during recent years. Ten members of the staff of the soil mechanics section of the laboratory collaborated in producing the book, which was edited by Mr. D. J. Maclean, head of the section, assisted by Miss Greysmith and Dr. T. J. Lonsdale.

The book commences with chapters on the scope of the work and the nature, identification and classification of soils, including classification and chemical tests. The next ten chapters deal with various subjects relating to road construction: aggregates, chalk embankments and sub-grades, survey procedure, compaction and stabilisation. Methods of stabilisation described include construction with low-grade aggregates, mechanical

stabilisation, and the use of cement, bitumen and resin. The last of these chapters describes constructional methods used in soil stabilisation, and gives a comparison of their merits. Then follow three chapters on soil moisture, sub-soil drainage and moisture control, and frost damage. Soil moisture and the laws governing its movement have been the subject of extensive fundamental research at the laboratory. Chapter 19 describes fully the various methods of measuring shear strength: shear box, triaxial and unconfined compression, bearing and penetration tests. In the next chapter methods of pavement design are discussed and compared—empirical methods using classification tests, empirical methods using strength tests (including the California Bearing Ratio) and methods partly and wholly theoretical. Then follows a chapter on the investigation of foundation failures. Chapters 22 to 24 deal with soil mechanics problems of a more general nature, such as stresses in soils, bearing capacity, consolidation and settlement of embankments. The next two chapters describe the construction of roads on swampy ground and the stability of clay slopes. Finally, there is a list of equipment for a soil-testing laboratory.

The book is essentially practical. It is well-produced, with many excellent illustrations, and is good value for the money. The detailed descriptions of testing procedure are a valuable feature, and the short summaries at the end of each chapter facilitate its use as a work of reference. It is worthy of a place on the shelves of all civil engineers, particularly those concerned with road and airfield construction. One or two minor points of criticism may be mentioned. In some instances formulæ for the evaluation of test results are quoted without explanation; for example, those relating to particle-size analysis in Chapter 3. The general treatment of Boussinesq's theory of stresses in soil in Chapter 22 might well precede its special application to pavement design in Chapter 20. In Fig. 26.2, page 503, Fellenius' construction for locating the critical circle of slip is given. It should be pointed out that this construction only applies to circles which pass through the toe of the slope; it is more usual for the slip surface to extend beyond the toe of the slope as shown in other diagrams in this chapter.

The Physical Principles of Thermodynamics.

By R. A. Smith, M.A., Ph.D. Chapman and Hall, Limited, 37, Essex-street, London, W.C.2. [Price 30*s.* net.]

Since the science of thermodynamics is concerned with every physical change brought about by natural or artificial processes, its scope is practically unlimited, and for this reason the field to be covered by such a work as this of Dr. Smith is too vast to allow of any special attention being paid to the comparatively small portion of it that is of direct importance to engineers. The physical principles mentioned in the title are those of classical thermodynamics, in which the states of a substance are supposed to be able to vary continuously, so that they can be dealt with by differential equations instead of being subject to the laws of statistical mechanics. By its general style, and by the nature of its contents, the book calls to mind the well-known treatise by Max Planck, though brought up to date by the inclusion of knowledge acquired during the quarter of a century that has now elapsed since the last edition of Planck's work. It has been written to meet the needs of students of experimental and theoretical physics whose interests include matters ranging from the thermodynamics of a stretched string to electrical, magnetic and chemical effects, osmotic pressure and surface tension, besides the innumerable other questions connected with the thermodynamics of gases, liquids, solids and solutions.

The treatment is, of necessity, largely mathematical, but no previous knowledge of the subject is assumed; the arrangement is systematic, and the result is an admirable combination of conciseness with clarity of exposition. Instead of devoting space to the details of experimental apparatus devised by various investigators for the determination of physical quantities, the author has confined himself to the much more important task of making clear the principles on which the measurements are based, rightly holding that such knowledge is essential to any real understanding of the quantities concerned. One of the most interesting chapters of the book is that dealing with phenomena at extremely low temperatures. The anomalous behaviour of liquid helium, the super-conductivity of metals, and the production of temperatures within a small fraction of a degree from the absolute zero by the demagnetisation of paramagnetic salts are all briefly considered. Temperatures of this order cannot be measured by a gas thermometer, and therefore have to be computed as nearly as possible from physical considerations. The demagnetisation method is a repetitive process, by which the absolute zero can be indefinitely approached but never reached. Could it be attained, the entropy of every pure crystalline substance would then be zero. This is in accordance with the orthodox theory, but elsewhere the author makes a very surprising statement. He says that many solids at very low temperatures have irregularities "frozen in," and that such substances, if left to themselves for a sufficient length of time, would change automatically to a perfectly ordered condition with zero entropy at the absolute zero of temperature. Since entropy itself is only another name for internal disorder, the statement implies that a spontaneous physical change can be accompanied by a reduction of entropy, which is contrary to the accepted principles of thermodynamics. The point raised, though important theoretically, has, of course, no bearing on practical work. In any case, it falls into insignificance in appraising the value of a book that is bound to be appreciated by all who are interested in thermodynamics in the broadest sense.

The Old N'Ions Annual Dinner.—The Past Students' Association of the Northampton Engineering College, St. John Street, London, E.C.1, are to hold their silver jubilee annual dinner and reunion at the Connaught Rooms, Great Queen Street, London, W.C.2, on Friday, November 28. The guest of honour will be Lord Eustace Percy, P.C., C.B., C.B.E., M.V.O., a former Minister of Education. Tickets are obtainable, price 20*s.*, from Mr. R. Gilbert, 6, Ella-road, London, N.8.

Intermediate-Frequency Transformer for Miniature Valves.—A new intermediate-frequency transformer, manufactured by the Plessey Co., Ltd., Ilford, Essex, has been designed for use with modern miniature valves and receivers. Its permeability is tuned in the normal manner, and it has a Q factor of 85 and overall band widths of 7·7 kilocycles at 6 decibels and of 15·4 kilocycles at 20 decibels. The coils are tuned by 100 picofarad capacitors. An improved method of core positioning, in which a high-viscosity, chemically-stable packing compound is used between the core threads and the bobbin, allows the core to be adjusted over a wide temperature range. The weight is only about half that of an iron-pot cored miniature intermediate-frequency transformer.

Last of Lancashire and Yorkshire Locomotive Class.—Locomotive No. 50925, the last of a class of 2-4-2 superheated passenger tank locomotives of the former Lancashire and Yorkshire Railway, has recently been withdrawn from service. It was built in 1910 as an un-superheated engine, to Sir John Aspinall's designs, but was rebuilt in 1914 as a superheated engine of the same design as the class-6 2-4-2 engines which had been introduced by George Hughes in 1911. Hughes had started some experiments on superheating in 1910. Considering their size—they had a tractive effort of 24,584 lb., weighed 66·45 tons in working order, had a grate area of 18·75 sq. ft. and 5 ft. 7⅞ in. coupled wheels—they handled comparatively heavy express trains. The most notable train hauled was the 4.25 p.m. Salford to Colne train, weighing 265 tons.

ENGINEERING-BASE BUILDING FOR BRITISH EUROPEAN AIRWAYS.

(*Concluded from page* 524.)

In the first part of this article, the layout and structural features of the new maintenance building at London Airport for British European Airways were described. This part deals with the engineering services.

Heating System.

The installation of the heating and ventilating systems, water and town-gas supplies, and compressed-air services is being carried out by Messrs. J. Jeffreys and Company, Limited, 195-203, Waterloo-road, London, S.E.1. Heat is supplied to the B.E.A. hangars from a high-pressure hot-water central heat station operated by the Ministry of Civil Aviation. At the south end of the B.E.A. maintenance base, two 9-in. branch pipes from the high-pressure heating main are brought into a meter pit, from whence two 6-in. diameter flow and return pipe-lines are led into the base through trenches, below the footpaths, on each side of the roadway. Each branch line supplies two feed lines, to a calorifier room at either end of the adjacent wing. Thus, for ease of maintenance, there are, in effect, four separate heating installations, each feed line supplying approximately similar heat loads to 2½ hangar bays and the adjacent stores, workshops, and offices. The total installed load is about 40 million B.Th.U. per hour. From the calorifier room, distribution pipe-lines are mounted at roof level on the centre columns of the workshop annexes and on the rear wall of the hangar, as illustrated in Fig. 9, opposite.

On account of the large hangar door openings, the problem of heating the hangar space is considerable. It has been solved by a combination of radiant heating and convection heating. Operating directly from the high-pressure hot-water system are some 24 "floor diffusers" designed by Messrs. Flexaire, Limited, 108, Victoria-street, London, S.W.1, and also shown in Fig. 9. In these heaters, air is drawn by a fan through the top of the diffuser casing and through a heater coil, fed from the hot-water main. The inlet temperature of the water is about 320 deg. F. and the outlet temperature 220 deg. F. The hot air is delivered through a grille at floor level. In addition, on each hangar-door pylon there are two large high-level unit heaters set cornerwise, so that they direct hot air across the door openings. They are also supplied directly from the high-pressure hot-water system by branch pipes from the high-pressure pipe lines on the rear hangar wall taken below floor level across to the pylons. For a depth of 36 ft. behind the hangar doors, floor panels are also installed made from ½-in. copper piping set in the floor, as shown in Fig. 10, fed from a low-temperature hot-water system. All the hangar heaters and floor panels are individually and manually controlled.

Each calorifier room is equipped with two Hartley and Sugden calorifiers; a "low-temperature" calorifier has a capacity of 1,250,000 B.Th.U. per hour, and, in conjunction with two Pulsometer pumps each with an output of 85 gallons per minute, supplies hangar floor panels with water at 100 deg. F. Automatic temperature regulators are fitted to limit the temperature to 110 deg. F. Another, and larger, calorifier has an output of 3,800,000 B.Th.U. per hour, and supplies a system for the workshops, stores and offices. Two Pulsometer pumps with an output of 370 gallons per minute circulate water at a mean temperature of 170 deg. F. through this system, which is thermostatically controlled by a "Weatherstat" and comprises small unit heaters and hot-water radiators. The large calorifiers are

ENGINEERING-BASE BUILDING FOR BRITISH EUROPEAN AIRWAYS.

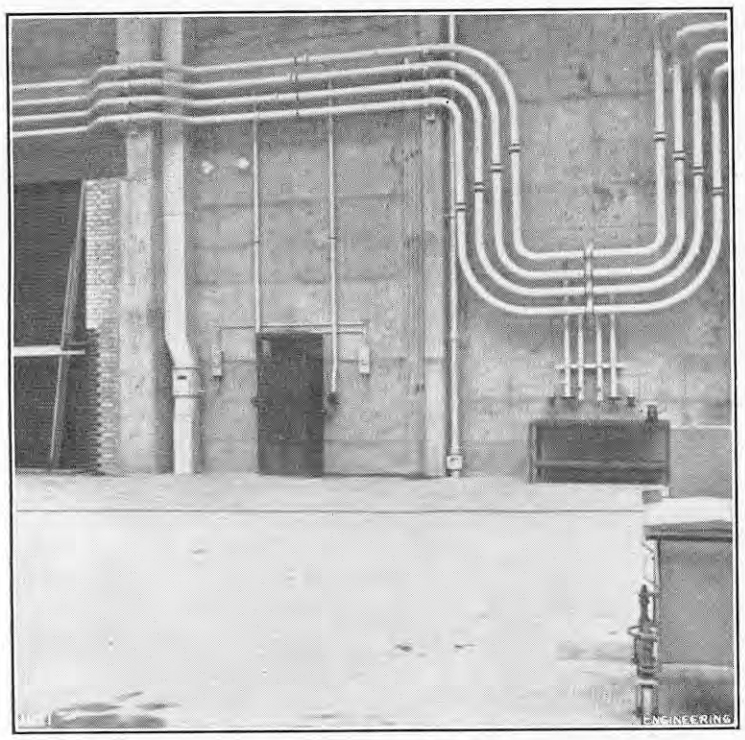


FIG. 9. HEATING SYSTEM PIPES AND FLOOR DIFFUSER IN HANGAR.

FIG. 10. HANGAR FLOOR HEATING COILS.

provided with a thermostatically-controlled by-pass on the high-pressure side, which opens when the temperature in the calorifier rises above 180 deg. F. Each group of toilets is supplied with hot water from an individual storage calorifier fed from the high-pressure hot-water system. All the thermostatic controls are supplied by Messrs. Sarco Thermostats, Limited, Cheltenham.

VENTILATION.

Referring to the layout of the base, which was shown in Fig. 2, on page 521, *ante*, it will be seen that it is intended to install a paint, spray and dope shop at the north end of the east block; this is one of the few immovable installations on the site. The other "fixed" shops are the battery-charging room, the process shop, the pump test-house and the inflammable store in the west block; and the electrical instrument and radio shops in the east block. The paint and dope shops will be air-conditioned to a temperature of 70 deg. F., approximately 30 changes of air an hour being provided by an axial-flow fan, installed over the adjacent switch room, which feeds filtered fresh air, drawn through louvres in the roof and passed through a tubular heater fed by the high-pressure, hot-water system, into the dope shop. The high-pressure hot-water supply to the heater is thermostatically controlled. Six extractor fans, with flameproof motors and switchgear, provide for discharging fumes from the dope shop to atmosphere.

Extractor fans and fresh-air ventilation are also provided in the inflammable store, the battery-charging room, the pump-test room and the process room. Above the radio, instrument and electrical shops, a plant room will be provided on the first floor, with a fresh-air inlet in the roof. Heated and filtered fresh air will be supplied at high level to these shops by two axial-flow fans and tube heaters.

Apart from the dope shop, the pump test-house, and the inflammable store, workshop annexes generally are not provided with flameproof equipment. In order to guard against the accumulation of inflammable vapour from the hangars in the non-flameproof areas, a heavy grille is provided in the annexe floor immediately in front of each doorway, which can be closed and sealed by a roller shutter, as illustrated in Fig. 11, between the annexe and hangar; the grille communicates with an extractor duct in the hangar, in which is installed a flameproof extractor fan. The ducting is led to the highest point of the hangar roof and discharges any fumes through a cowl.

FIG. 11. HANGAR ACCESS DOOR, SHOWING FIREPROOF SHUTTER.

COLD-WATER AND GAS SUPPLIES.

A 6-in. diameter pipe-line from the cold-water main serving London Airport is brought into the meter pit. From here, a 5-in. pipe-line divides into 4-in. and 3-in. diameter mains running in the service trenches on each side of the roadway. A 3-in. diameter connection is also provided for a canteen building which is eventually to be erected at the south end of the site. The mains are led into the annexe buildings at the south end and are carried at roof level along the centre columns of the annexes; branch connectors are provided at intervals for drawing off supplies for processes and for feeding roof storage tanks adjacent to the cloak-rooms.

The 6-in. gas main is also brought into the site at the meter pit, and a 4-in. diameter main is carried into the west annexe in the same manner as the water main. The gas main will supply much of the equipment to be installed in the process and degreasing room, and an additional 4-in. main provides for future canteen services.

COMPRESSED-AIR SUPPLY.

For operating pneumatic tools and equipment in the workshops and the hangar floor pits, and also for the "deluge" fire-protection system, a compressed-air system is provided. In the compressor room, the layout of which is shown in Figs. 12 and 13, on page 558, are installed, on anti-vibration spring-mounted bases, two Broom and Wade compressors, with silencers and after-coolers, and there is provision for a third compressor later. Each compressor has an output of 320 cub. ft. of free air per minute at a pressure of 100 lb. per square inch, and is driven through V-belts by a 70-h.p. Crompton Parkinson slip-ring electric motor, of the fully automatic contactor type. A Heenan and Froude water-cooling tower, including a circulating pump and an axial-flow fan, is provided. This cooler is capable of cooling continuously 3,000 gallons per hour of fresh water from 97 deg. F. to 77 deg. F. in average warm summer conditions. A thermostat controlling the cooling-tower fan motor is inserted in the cooling-water pipe-line, after the cooling tower, to regulate the temperature of the cooling water supplied to the compressors and after-coolers. The coils operating the contactors of the compressor motors are connected in series with the cooling-pump starters, so that the main motors cannot run unless the cooling pumps are working. The compressors charge a cylindrical air receiver which has a capacity of 10,000 cub. ft. of free air.

The compressors may be controlled automatically in two ways: either by a spring-loaded air governor on each machine, which operates the compressor inlet valve, or electrically by a pressure switch in conjunction with a solenoid-operated pressure-

unloading valve. When the probable air demand is heavy, the controls are arranged so that one compressor is controlled by the air governor, which is set to open the compressor air-inlet valve when the receiver pressure falls to 90 lb. per sq. in. and to close it when the pressure has risen to 100 lb. per sq. in.; the compressor continues to idle on no-load. The other compressor is controlled by the pressure switch, and is switched off when not actually pumping.

The main compressed-air delivery lines are taken through the annexes at roof level, along the workshop centre columns, and pipe connections, for supplying the equipment that may be installed later, are provided at frequent intervals. The compressed-air supply to the hangars is taken below floor level to the hangar service pits.

Electrical Supply.

The maintenance base is served by four electrical substations, one at each end of the west and east annexes, each carrying a load of about 1,000 kVA, and supplying 2½ hangar bays and the adjacent workshops. The north block is supplied from No. 1 substation, at the north end of the west annexe. High-tension switchboards in each substation are connected by an 11,000-volt ring main, the incoming branch from the London Airport 11,000-volt three-phase 50-cycle main being connected to the high-tension switchboard in No. 1 substation. In each substation, the primaries of two 500-kVA transformers are connected in parallel between the high-tension switchboard; they transform down to a three-phase 415/240-volt supply feeding a low-tension switchboard in the substation, from which leads are taken to the local power, heating and ventilating, and lighting distribution boards for the annexes, hangars, apron, etc. The high-tension switchboards and transformers were supplied by Messrs. Johnson and Phillips, Limited, Victoria Works, Charlton, London, S.E.7. The installation of the electrical services was carried out by Messrs. Rashleigh Phipps and Company, Limited, Esmond House, Thackeray-street, London, S.W.8.

In order to maintain a flexible layout in the workshops, underfloor power-distribution grids, in which the wiring is enclosed in metal ducts buried in screed, have been adopted. They were supplied by Walsall Conduits, Limited, Dial-lane, West Bromwich, Staffordshire, and Simplex Electric, Limited, Broadwell, Oldbury, Birmingham. Tapping points are provided at 3-ft. centres throughout the workshop area, which also serve to give access to the ducts for rewiring. In the electrical, radio, and instrument workshops, there will be an overhead 'bus-bar 40-volt direct-current system supplied by a motor-generator set, regulated to within $\pm \frac{1}{2}$ per cent. over the whole load range. An overhead 'bus-bar 30-volt direct-current system is to be installed in the battery-charging room.

As already noted, the power and local lighting supplies for carrying out work in the hangar are introduced in underfloor pits in each hangar bay. Each hangar has four 100-ampere, four 30-ampere three-phase, and eight 15-ampere single-phase supply points, controlled by flameproof contactors, supplied by M. and C. Switchgear, Limited, Kelvin-side Works, Kirkintilloch, Glasgow. Up to a height of 22 ft. all the electrical equipment installed in the hangars is flameproof. The electrical system in the hangars is inter-connected with the fire-detector circuit of the deluge system, so that in the event of fire, the supply to the hangar power and main lighting system is automatically cut off, but pilot lights are left on.

Lighting.

From the point of view of the maintenance engineers working at the base, the outstanding feature of the new buildings is probably the exceptionally high standard of lighting that has been provided in the hangars and workshops. Fig. 14 gives an excellent impression of the uniformity of the artificial lighting and the absence of reflections in the hangars, in which a lighting intensity of 25 ft.-candles at floor level has been achieved over the whole area. In the annexes, the intensity of lighting at floor level is 20 ft.-candles. These results have been obtained by using cold-cathode fluorescent lighting fittings, supplied by Ionlite, Limited, 89, Scrubbs-lane, London, N.W.10. It is believed that this is the largest cold-cathode lighting system that has yet been installed anywhere in the world; it is certainly the largest in the United Kingdom. In each hangar bay, there are 12 rows of 10 four-tube fittings, about 10 ft. long, under each roof beam, at a height of 40 ft. above roof level. They are accessible from the crane gantry, and are all interchangeable. In the annexes and the north block, three-tube and two-tube fittings are employed. The cold-cathode fittings, although heavier in first cost, are stated to have a life of 10,000 hours and to be more economical in maintenance than hot-cathode fluorescent tubes.

BRITISH EUROPEAN AIRWAYS' ENGINEERING BASE.

COMPRESSOR ROOM LAYOUT.

Fig. 12. ELEVATION ON A-A.

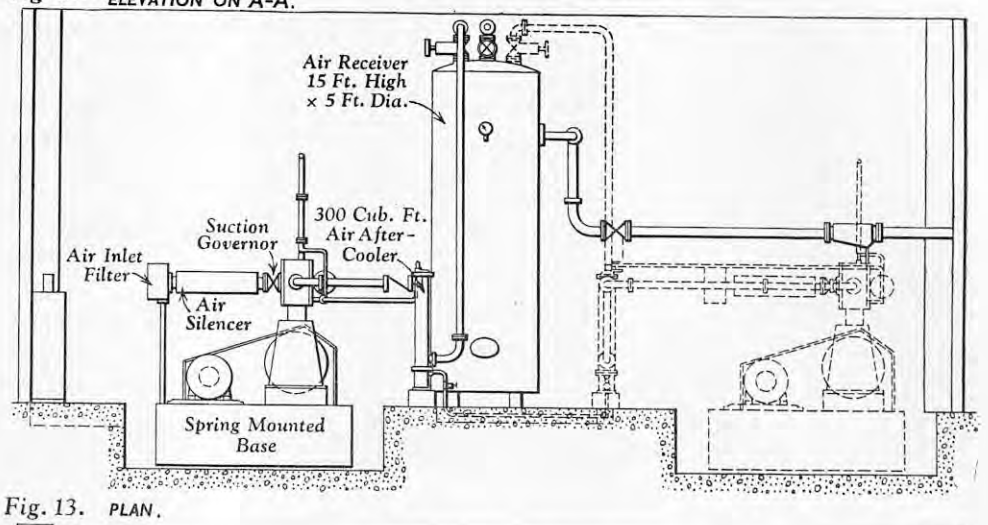
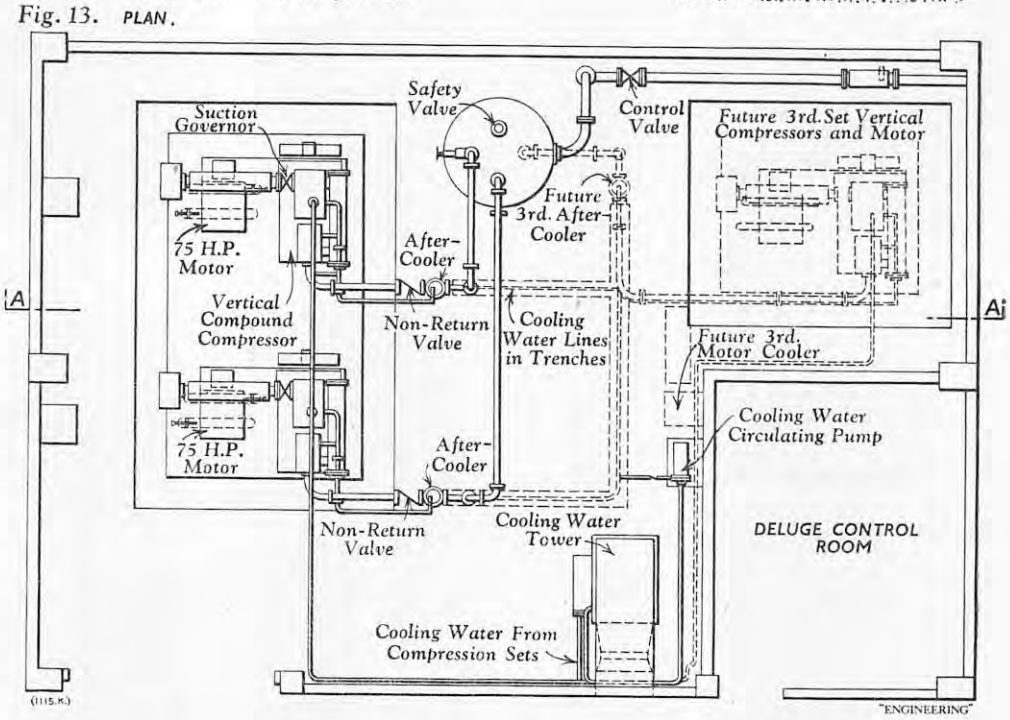


Fig. 13. PLAN.



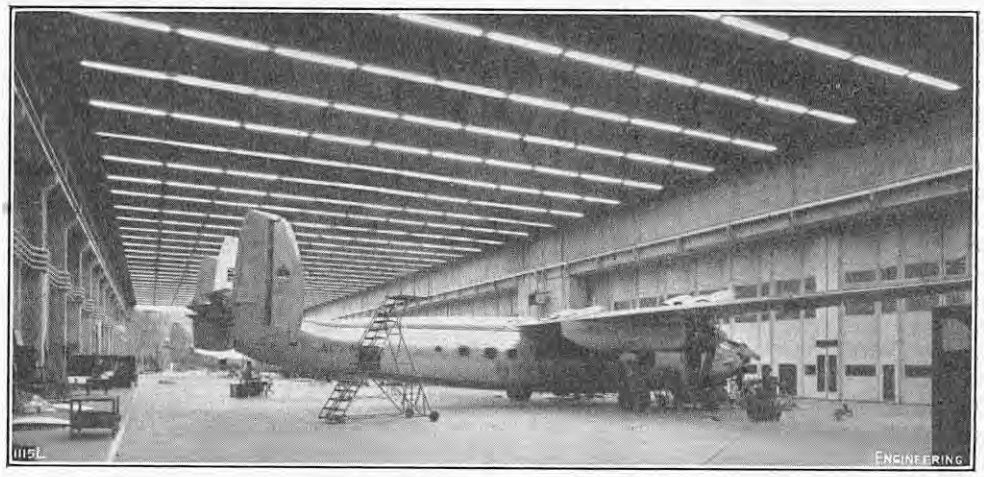
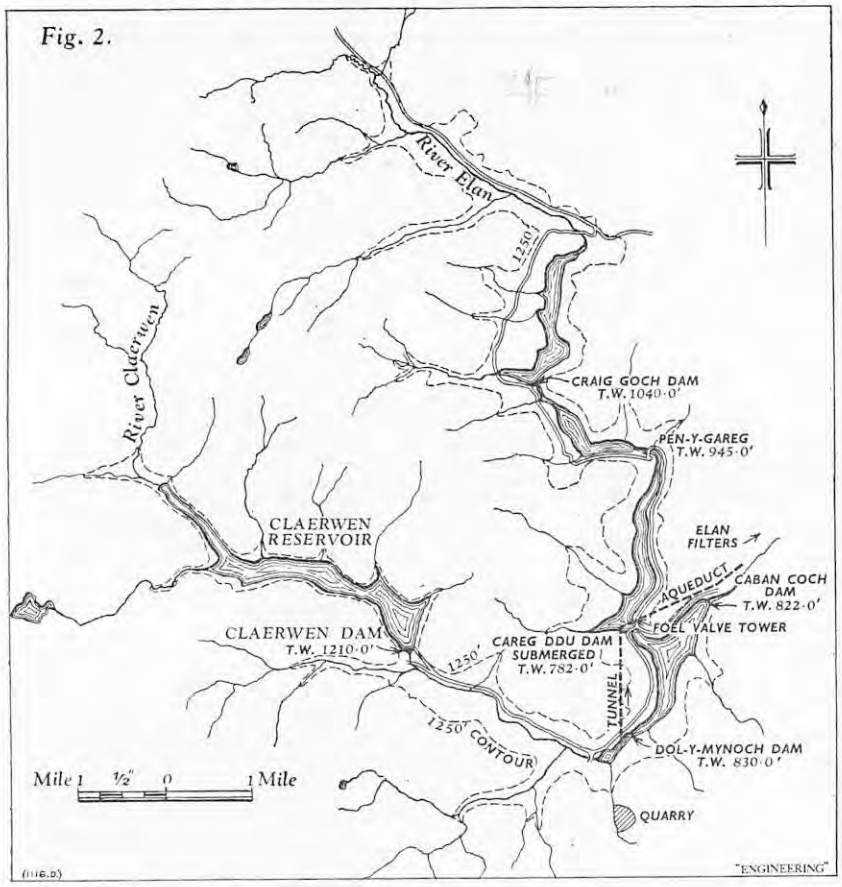


Fig. 14. Hangar Illuminated by Cold-Cathode Lighting.

BIRMINGHAM WATERWORKS: THE CLAERWEN DAM.



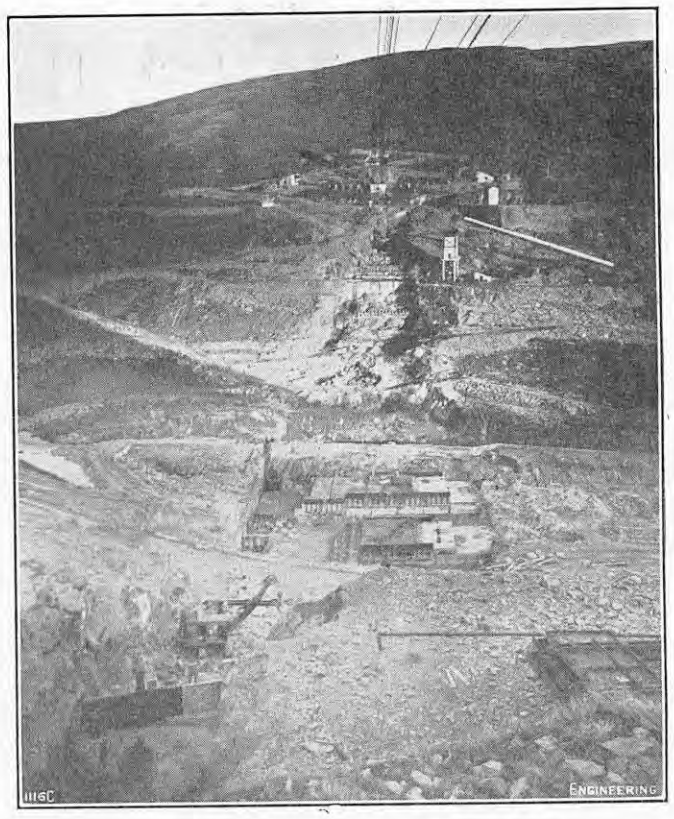


FIG. 3. EARLY EXCAVATIONS FOR THE DAM.

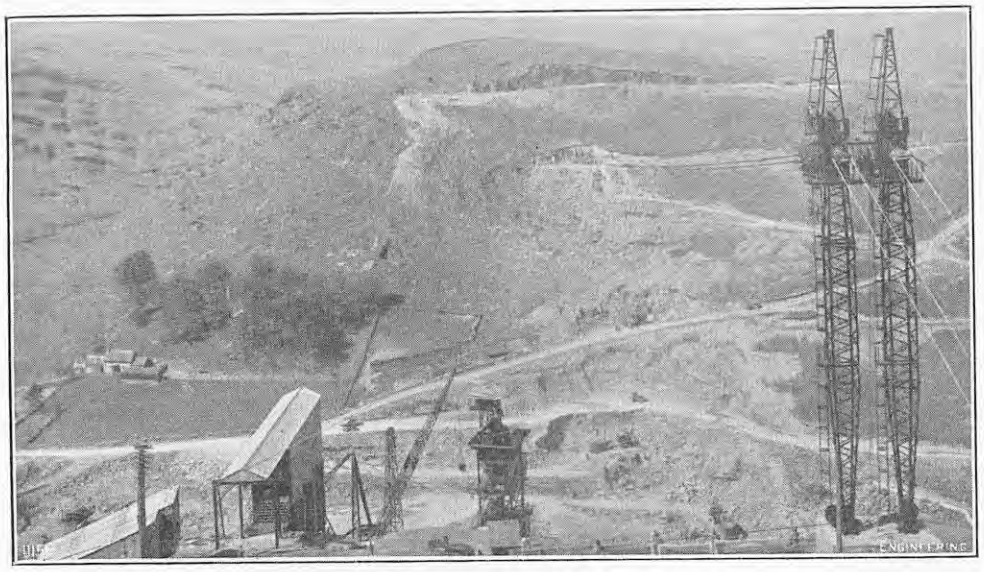


FIG. 4. SITE AT THE COMMENCEMENT OF THE WORK.

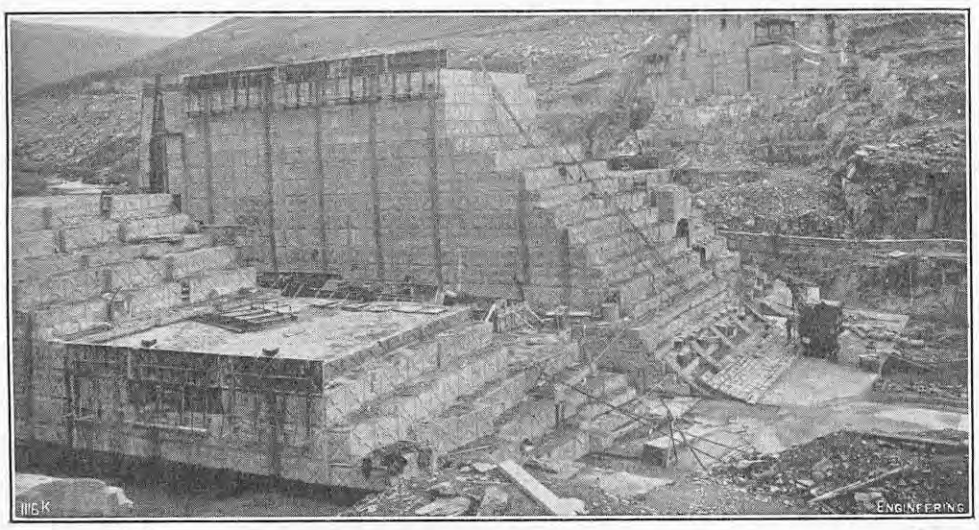


FIG. 5. CONCRETE WORK IN PROGRESS.

THE CLAERWEN DAM.

(*Concluded from page* 531.)

CONSTRUCTION OF THE DAM.

SLOW progress was made during the first year of construction, due to the difficulties of obtaining delivery of the essential plant and equipment and also to the very severe weather experienced during the early months of 1947. During the following summer, however, and in the three succeeding years, good progress was maintained despite the shortages of various materials. Bad weather in the summer of 1950 and in the following winter slowed down the work, but by December, 1951, mass concreting was virtually finished. The use of timber on the site was greatly reduced by fabricating steel shuttering from water-tank plates, and the adoption of prestressed concrete for the arches over the spillway nearly obviated the need for reinforcing bars, which were hard to obtain at that time. Difficulties were also experienced in obtaining sufficient deliveries of the masonry facing, because of a shortage of stonemasons in the British quarrying industry; but after prolonged negotiations with Government Departments and the trade unions concerned, arrangements were made to recruit stonemasons from Italy to work in the quarries of South Wales and on the site of the Dam. Fig. 2, herewith, is an outline map of the site; Figs. 3 to 5, on this page Figs. 10 to 13, on Plate XLVIII, and Figs. 14 to 16, on page 561, show various stages of the work; and in Figs. 6 to 9, on page 560, are reproduced the plan, elevation and sections of the Dam.

During the construction of the central portion of the Dam, the river was diverted into a by-pass channel 820 ft. long, excavated to the east of the original river bed. The diversion was effected by a temporary dam erected across the river course at the upstream end of the channel; backflow into the works was prevented by a second temporary dam at the downstream end of the by-pass. When the central blocks of the main structure were completed to above the flood level of the river, the dams were removed and the upstream end of the diversion

BIRMINGHAM WATERWORKS: THE CLAERWEN DAM.

Fig. 6. ELEVATION.

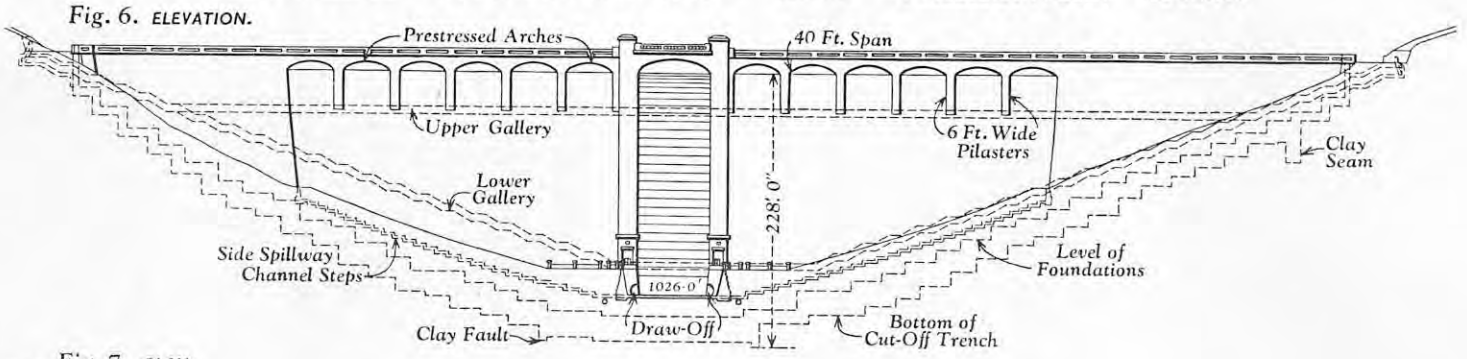


Fig. 7. PLAN.

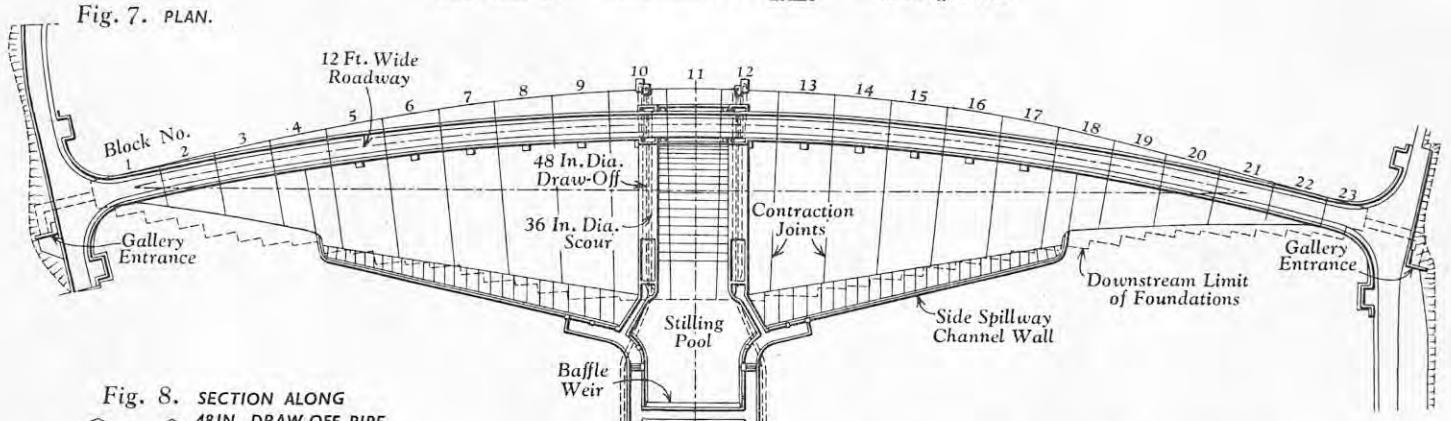


Fig. 8. SECTION ALONG 48IN. DRAW-OFF PIPE.

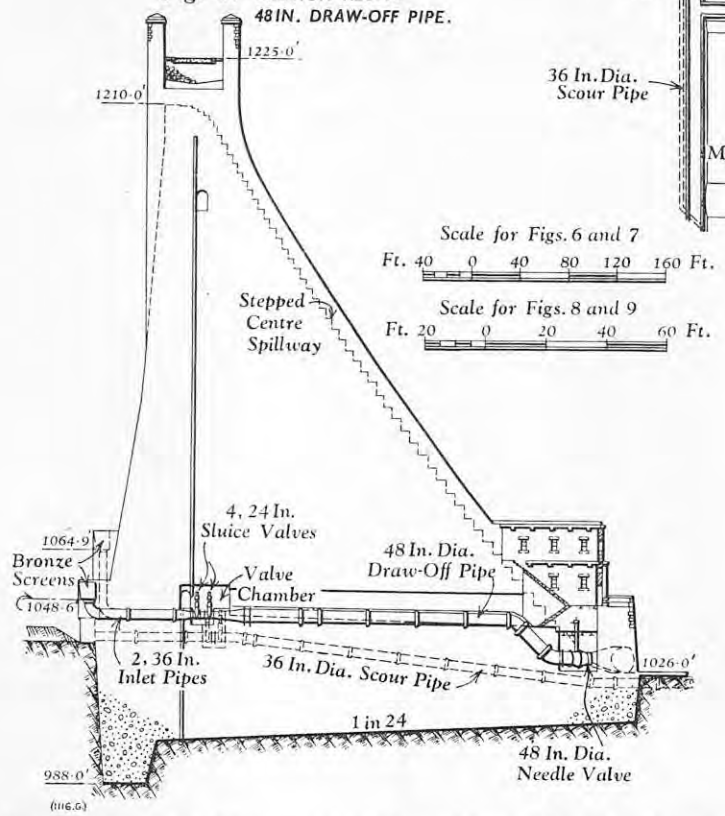
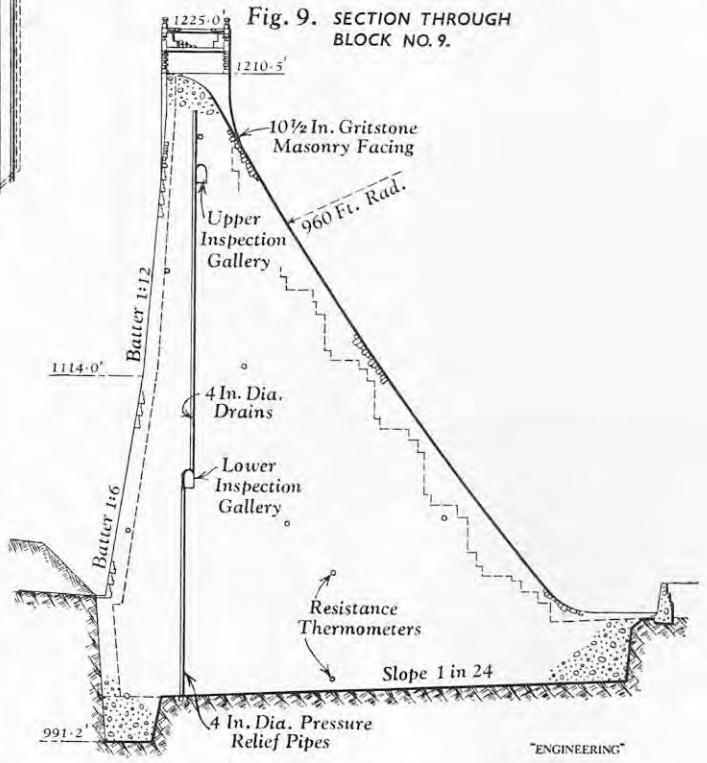


Fig. 9. SECTION THROUGH BLOCK NO. 9.



channel blocked by a third temporary dam. The river was allowed to pass through two scour mains in the work thus far completed, and one of the permanent 12-ft. access tunnels was left open through the Dam to ensure that any flood water could be drained away. After completion of the foundation and the raising of the concrete blocks of the Dam in the course of the diversion channel, the upstream end of this tunnel was plugged with concrete and later grouted.

The foundation of the Dam has a maximum breadth of 180 ft. and at the toe is carried down to a depth varying between 10 ft. and 15 ft. into the bedrock. The bottom of the excavation dips towards the upstream face, where a cut-off trench of 15-ft. maximum width and depth is excavated below the level of the main foundation. On the sides of the valley the foundation is benched into the rock in horizontal steps. The depth of the excavation at the upstream face is generally between 40 ft. and 50 ft., though it reaches a maximum depth of 77 ft. at one point on the west bank of the valley. To ensure the watertightness of the rock below the cut-off, the bottom of the trench was drilled to a further depth of 50 ft. and cement grout injected under pressure to seal any fissures in the rock. The work during early stages of the excavations is shown in Fig. 3, on page 559.

The elliptical arches that carry the roadway and its footways along the crest of the Dam, which are shown in Fig. 14, on page 561, were originally designed as normal reinforced-concrete units, to be constructed *in situ*. To eliminate the use of reinforcing bars the contractors obtained permission to substitute prestressed-concrete arches, designed for them by the Prestressed Concrete Company, Limited, 131, Victoria-street, London, S.W.1. The main arch, of 60-ft. span, over the central spillway was, in fact, cast in position above centring and this part of the work, prior to concreting, is shown in Fig. 15, on page 561. Each of the remaining twelve arches, of 40 ft. span, was divided into eight precast, prestressed, arched ribs, fabricated at convenient points along the top of the then incomplete Dam and ultimately transported to its respective position by the overhead cableway. A set of these arched ribs, each of which weighed nearly 9 tons, is shown in Fig. 16; the rib on the left of the illustration has been concreted and the remainder, the cables in position, are ready for the concrete. The Freyssinet system of prestressing was adopted throughout, the cables being jacked and grouted seven days after the concrete had been placed, when, according to the specification, the concrete should have attained a strength of 4,500 lb. per square inch. The elliptical form of the arches, with a relatively small radius of curvature at the springings, gave rise to some difficulties when jacking the cables due to the friction encountered between the cable and the wall of its duct. These difficulties were

BIRMINGHAM WATERWORKS: THE CLAERWEN DAM.

(*For Description, see Page* 559.)

FIG. 10. TAILPOSTS OF CABLEWAYS.

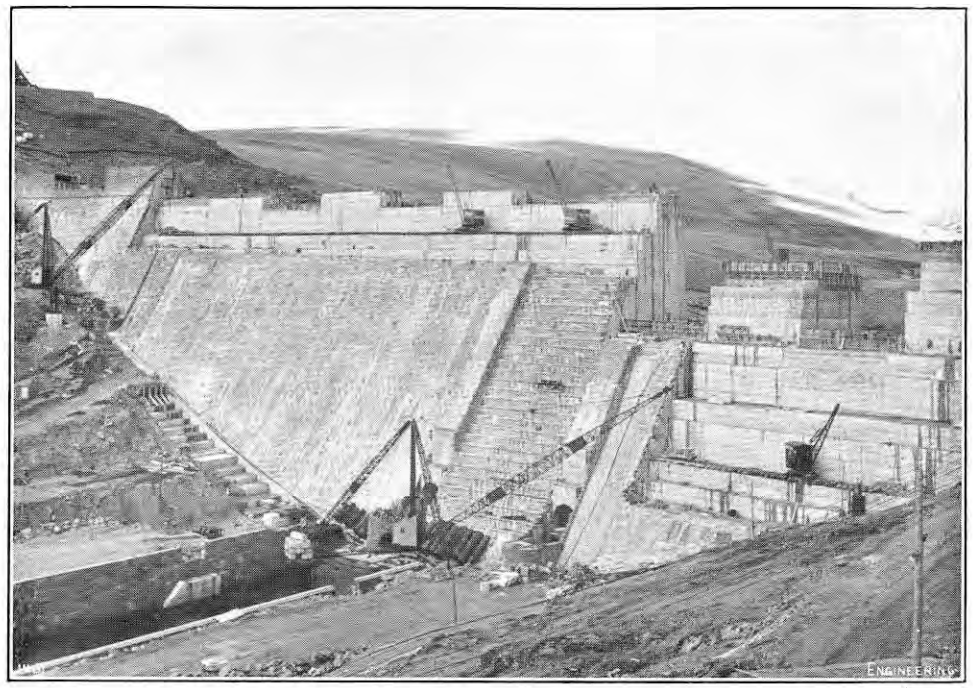


FIG. 11. CONSTRUCTION OF DAM OVER LINE OF DIVERSION CHANNEL.

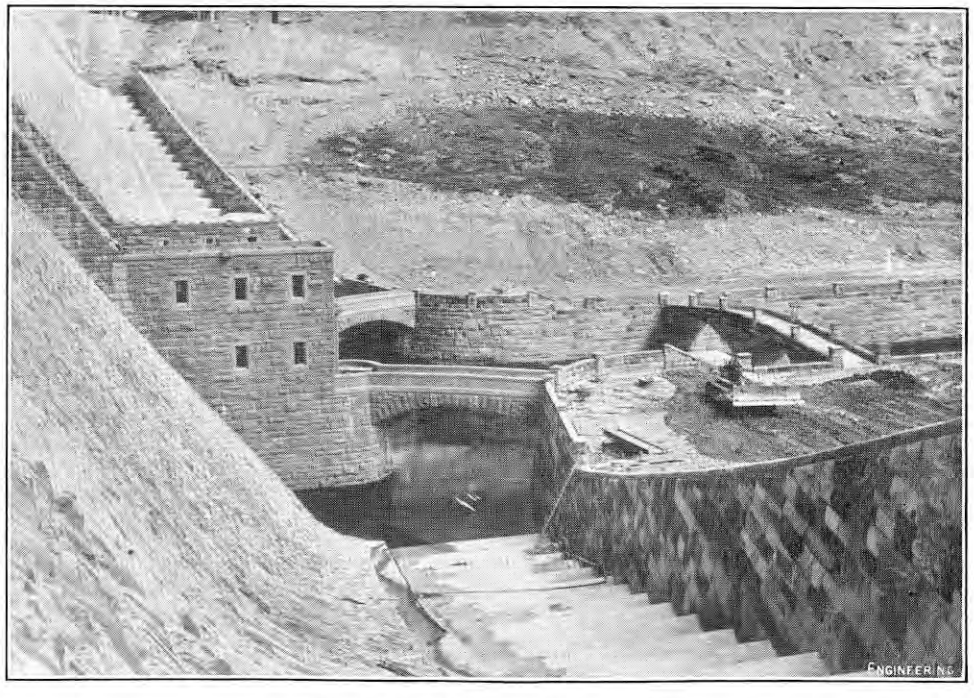


FIG. 12. VALVE HOUSE AT FOOT OF SPILLWAY.

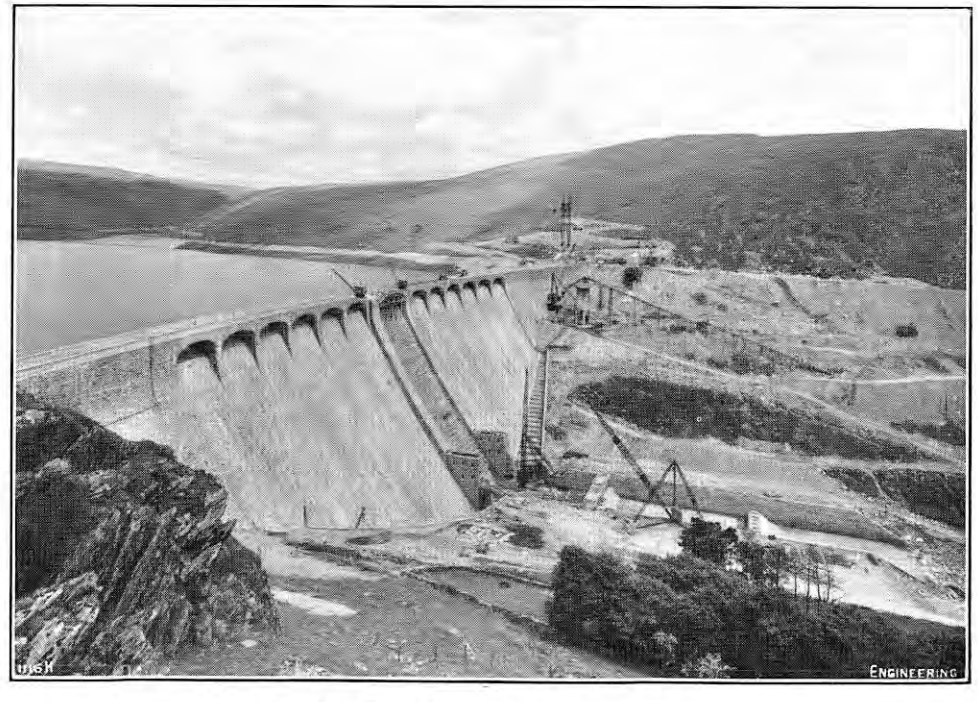


FIG. 13. DAM NEARING COMPLETION.

(*To face page* 560.)

BIRMINGHAM WATERWORKS: THE CLAERWEN DAM.

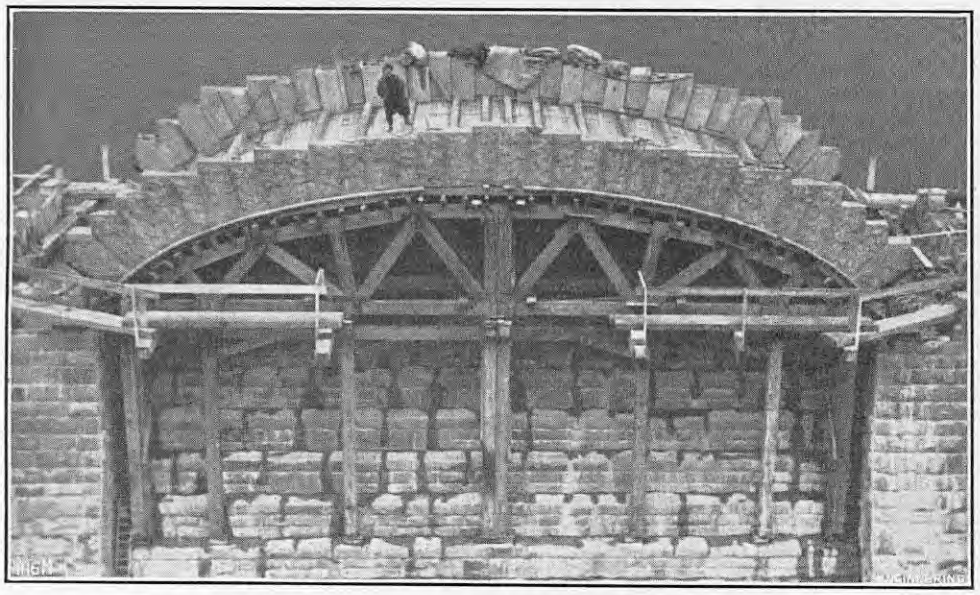


FIG. 14. CONSTRUCTION OF CENTRAL ARCH OVER SPILLWAY.

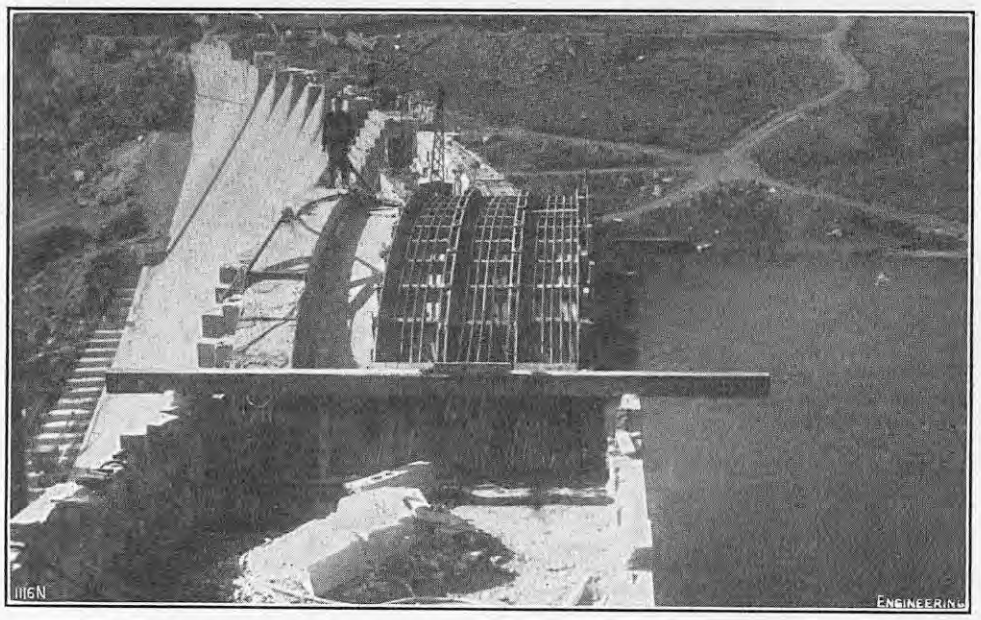


FIG. 15. PRE-CAST ARCH RIBS OF 40-FT. SPAN READY FOR CONCRETING.

eased in two ways: first, by the use of a lubricant, forced into the duct, and, secondly, by "working" the cables, that is, alternately jacking and then partly releasing the load before re-jacking to a yet higher load. By these means it was found possible to overcome most of the friction and so to obtain a nearly uniformly-strained cable. Before constructing the ribs required for the work, a sample rib was tested to destruction, when rupture occurred by a compressive failure close to one of the springings.

The outside ribs of each arch are each 4 ft. thick and were cast as composite members with the masonry face already in position. The stones were held in place partly by the bond between the back of the stones and the concrete, but mainly by wire-mesh ties bedded into the core of the rib and welded to dowels set in the mortar joint between the stones. No trouble was experienced, such as might have been expected, by the stones spalling from the concrete when the cables were loaded. On the main 60-ft. span the facing stones were drilled and a cable threaded through them so that the facing itself contributes to the working strength of the arch.

The ribs were designed as two-hinged arches and so as to approach this condition, the end bearings have been restricted to a 2-in. wide phosphor-bronze pad set into a dry mortar seating, cast after the ribs had been put into position. To strengthen both the springings of the ribs and the mass concrete in the skewbacks, helically-wound cages have been used to reinforce these points against heavy loading.

No suitable stone for concrete aggregate being available nearer to the site, a quarry was opened about four miles away, from which a very hard quartzite rock was obtainable. Three quarry faces were worked. To transport the stone to the site an access road, a mile long, and two bridges had to be built. The lump stone brought down at the quarry was transported by lorry to the main site for crushing and screening into suitable grades; "plums" up to 6 in. in size were permitted in the concrete for the heart of the dam. The greater part of the sand for the concrete had to be brought 80 miles by road from the Severn valley. The concrete was mixed in 5-ton batches at a central plant designed and built at the site by Winget, Limited, Rochester. The storage, fed by conveyor belts, consisted of a 120-cub. yard bin with four aggregate compartments, built around a central cement silo, welded out of sheet steel. The aggregates and the cement were each weighed on independent scales and the water was also measured by weight in

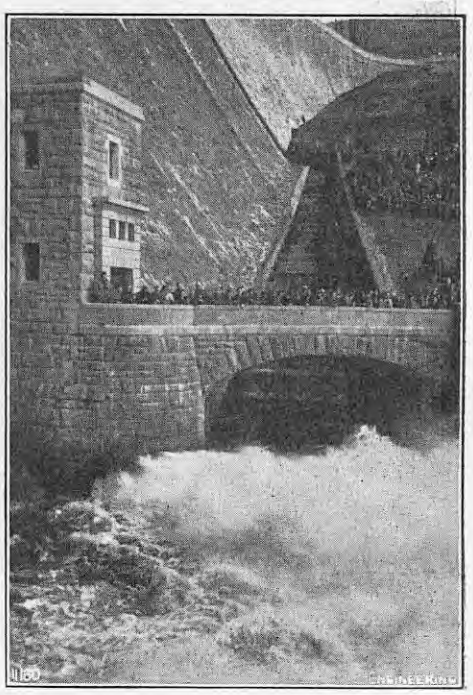


FIG. 16. DISCHARGE OF WATER AFTER THE "OPENING."

a water balance built into the reservoir tank. A Winget-Koehring 84T tilting concrete-mixer, pneumatically operated, was located below the bins. An average output of 5,000 tons of concrete per week was maintained over lengthy periods, the largest quantity actually placed in 24 hours being 2,300 tons.

All the concrete for the main structure was handled by two electric 10-ton Henderson cableways, with spans of 1,370 ft. The cableways each operated from fixed head-masts, 80 ft. high, to counterbalanced tailposts travelling on a radial track at the far end, so enabling the whole area of the site to be covered. The head-masts can be seen in Fig. 3, and an illustration of the tailpost is given in Fig. 10, on Plate XLVIII. The capacity of the cableways was sufficient for the contractors' mobile cranes, weighing about 9 tons apiece, to be lifted bodily. These cranes worked on tracks laid along benching formed in the mass of the concrete blocks of the dam and by slinging them on the cableways it was possible to lift a crane to a higher level or on to another section of the work and have it working again within a short time. Approximately $1\frac{1}{4}$ million bricks, half a million tons of crushed stone, 200,000 tons of sand, 70,000 tons of cement and 18,500 tons of masonry were used, and had to be transported to the site. In all, the total volume of concrete, brickwork and masonry amounted to 390,000 cubic yards. In addition, all the necessary plant and equipment had to be carried to the site. An electricity-generating station with a capacity of 1,500 kW was constructed to provide the power for the cableways, stone-crushing plant, concrete batching plant, conveyors, winches, and the five main compressors. The equipment included two Diesel-driven generating sets, supplied by the English Electric Company, Limited, Queen's House, Kingsway, London, W.C.2. The engines were of the four-cylinder pressure-charged 4SK type, with a continuous output of 300 brake horse-power at 600 r.p.m. and having a bore and stroke of 10 in. and 12 in., respectively, with a mean piston speed of 1,200 ft. per minute. The construction plant imposed a considerable load on these generators and on occasions the two sets were run at an overload of $17\frac{1}{2}$ per cent. for periods of several hours, with momentary peak loads well above this figure.

EXPLOSION OF FIRST BRITISH ATOMIC WEAPON.

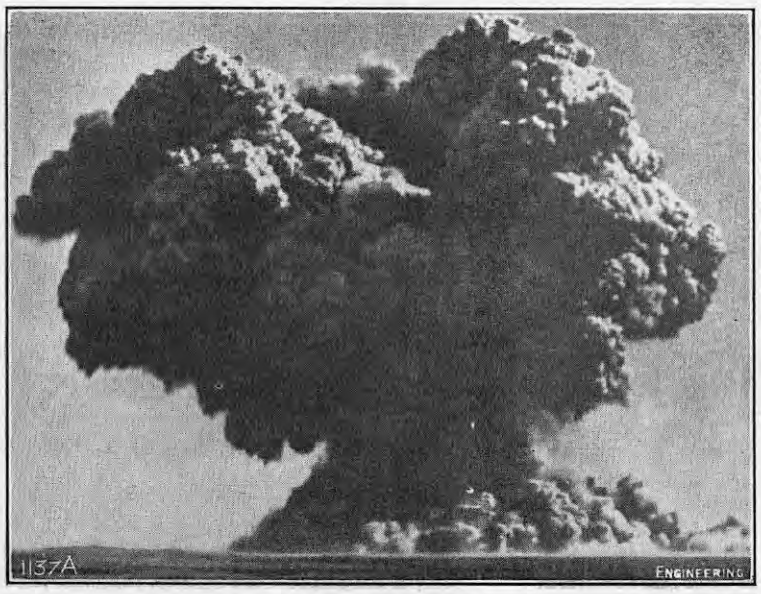


Fig. 1.

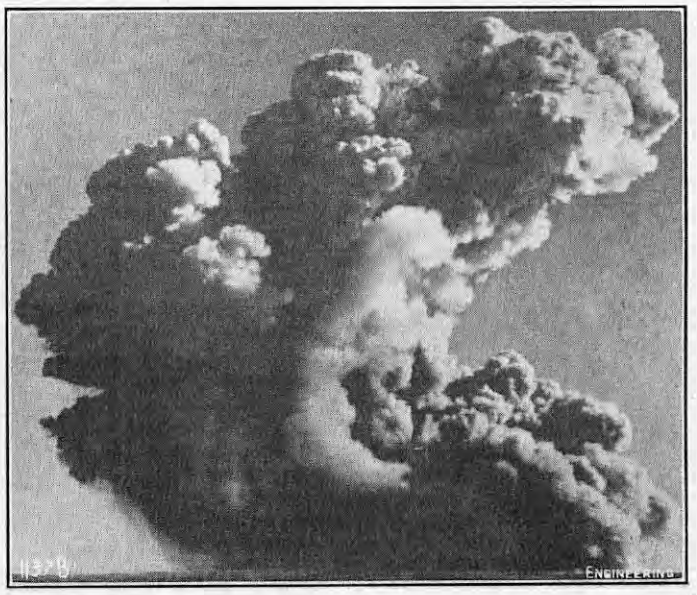


Fig. 2.

The switchgear used was also supplied by the English Electric Company.

All the valve equipment for the Dam was supplied by Glenfield and Kennedy, Limited, Kilmarnock. On each discharge main there is a 24-in. guard valve of the wedge type, followed, on the downstream side, by a parallel-face 24-in. valve. The control valves are of the needle type, with a 48-in. inlet and a 42-in. outlet. On the scour mains the valves are 36 in. in diameter and, as on the discharge mains, a wedge-type guard valve precedes a parallel-face type of valve. In all this equipment the castings are of Meehanite cast iron, faced with gunmetal and the bronze spindles are solid-forged and ground.

The maximum number of men employed amounted to 370, and included some recruited from the Polish Resettlement Corps, others from Ireland and the stonemasons from Italy. The staff of the resident engineer numbered 12. A temporary camp, capable of accommodating 200 men, as well as bungalows for members of the staff, was built by the contractors about seven miles from the site and outside the catchment area, so as to avoid pollution of the existing water supplies. Other accommodation was found in the town of Rhayader, 10 miles away. Local men who were employed were brought in coaches from as much as 40 miles away.

The Claerwen Dam was designed, and the construction supervised, by Sir William Halcrow and Partners, MM.I.C.E., Alliance House, Caxton-street, Westminster, S.W.1. The principal contractors for the project were Edmund Nuttall, Sons and Company (London), Limited, 22, Grosvenor-gardens, London, S.W.1.

The Opening Ceremony.

Last week's issue of Engineering went to press only a few hours after the official inauguration of the new Dam and reservoir by Her Majesty the Queen, so that there was no opportunity to do more than record that the ceremony had taken place. Its organisation was a task of peculiar difficulty because of the remote location of the Dam, and the smoothness with which it was accomplished reflects much credit on those responsible. The Royal party travelled by special train to Llandrindod Wells and proceeded thence by motor cars to the Dam. Her Majesty was accompanied by H.R.H. the Duke of Edinburgh and was attended, among others, by Sir David Maxwell Fyfe, Q.C., Home Secretary and Minister for Welsh Affairs, the Lord Mayor of Birmingham (Alderman W. T. Bowen, J.P.), the Lady Mayoress, and civil officials.

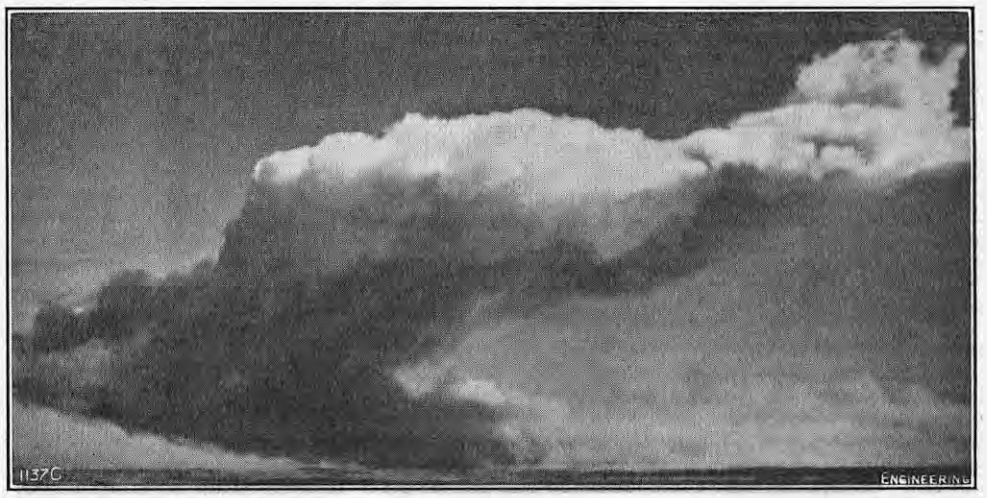


Fig. 3.

Among those presented to Her Majesty were Alderman H. Humphreys, J.P., chairman of the Birmingham Water Committee; Mr. A. E. Fordham, general manager and secretary of the Water Department, and Mr. C. A. Risbridger, B.Sc., M.I.C.E., chief engineer of the Department; Sir William Halcrow, M.I.C.E., consulting engineer for the Dam; and Mr. R. J. C. Walton, M.I.C.E., the resident engineer, and representative workmen of various trades.

Her Majesty was then conducted down the internal stairway in the Dam to the valve house on the Brecon side, and so to the Royal stand, where she operated the mechanism which opened the outlet valves. Fig. 16, on page 561, shows the stream of water flowing down the outlet channel from the Dam, with the valve house in the background. After the ceremony, Her Majesty and the Royal party lunched with the Lord Mayor and Lady Mayoress in a pavilion erected near the Dam, and afterwards toured the earlier system of the Elan Valley waterworks before returning to Llandrindod Wells.

New Miniature Radio-Frequency Pentode Valve.—Mullard Ltd., Shaftesbury-avenue, London, W.C.2, have produced a radio-frequency pentode valve, which has been designed to improve the signal/noise ratio of receivers operating up to 200 megacycles. The valve has very low input and anode to grid capacitances and its optimum performance can be obtained with a high-tension voltage of only 180 volts. Good results are also possible with voltages of 120 volts and less. Its filament current consumption is 175 milliamperes, the heater voltage being 6·3 volts.

EXPLOSION OF FIRST BRITISH ATOMIC WEAPON.

Mr. Winston Churchill's statement in the House of Commons on October 23 inevitably contained only a brief reference to the technical aspects of the explosion of the first British atomic weapon. He said that "the weapon behaved exactly as expected and forecast in many precise details by Dr. W. G. Penney, whose services were of the highest order. Scientific observations and measurements show that the weapon does not contradict the natural expectation that progress in this sphere would be continual." The object of the test, he said, was to investigate the effects of an atomic explosion in a harbour. The weapon was placed in H.M.S. Plym, a frigate of 1,450 tons which was anchored in the Monte Bello Islands, and was exploded on the morning of October 3. Thousands of tons of water and of mud and rock were thrown many thousands of feet into the air and a high tidal wave was caused. The effect of blast and radioactive contamination extended over a wide area and H.M.S. Plym was vaporised, except for some red-hot fragments which were scattered over one of the islands and started fires in the dry vegetation. Three stages within 30 minutes of the explosion are illustrated above. Fig. 1 was taken soon after the explosion; Fig. 2 shows the cloud formation later, when it was about two miles high and a mile across; and Fig. 3 shows the effect of southerly winds after half an hour. Work in connection with the explosion was carried out mainly by the Ministry of Supply, the personnel concerned being led by Dr. Penney (on whom, it is announced, a knighthood is being conferred), and his deputy Dr. L. C. Tyte.

THE MOTOR SHOW, EARL'S COURT.

FIG. 6. SPORTS CAR; TRIUMPH MOTOR CO. (1945), LTD.

INTERNATIONAL MOTOR SHOW, EARL'S COURT.

(*Concluded from page* 541.)

IF the attendance figures are anything to judge by, the 37th International Motor Show, which closes at Earl's Court to-morrow night, having been open since October 22, was undoubtedly successful, the attendance figures so far having surpassed even the most optimistic estimates. It is difficult to account exactly for the Show's popularity, but probably the removal of the Covenant from most of the more expensive cars has had a great deal to do with it; persons having 900*l.* or more to spend on a new car have now a reasonable chance of early delivery. People having this amount of money available for the purpose can only have accounted for a minor proportion of the attendance. Possibly the news that the higher-priced cars are easier to obtain has raised the hopes of those less fortunate people who are patiently awaiting an increase in the supplies of medium-priced and low-priced cars, the term "low-priced" being used with present-day values in mind.

Unfortunately, the success or failure of a show cannot be judged by attendance figures alone. It is the business transacted that really matters, and here preliminary reports are not so satisfactory, particularly so far as home sales of the more expensive cars are concerned. There is little doubt that the high rate of purchase tax is the major cause of this setback and it is obvious that prospective purchasers are waiting to see whether the tax will be reduced in the next Budget, this attitude having been encouraged by rumours that such action will be taken. There is, without doubt, a case, and a strong case at that, for a reduction in this crippling tax, and unless something is done soon sales will decline. At present, the motor industry, which has more than fulfilled its obligations towards the export drive, is going through a particularly difficult period, brought about by the need to find new export markets, growing competition from European manufacturers, some of whom are subsidised by their Governments, a continuing shortage of raw materials, increasing costs and a pre-occupation with re-armament. The need to find new export markets, it should be added, is due to no fault of the industry, but is the result of world-wide trade restrictions, their cars being either banned from, or their entry restricted into, many countries. British cars have been proved in many different places; they are wanted, and wanted badly, all over the world, and it only requires a slight easing of currency restrictions and similar bars to trade for the industry's export problems to be solved. In the meantime, the Government can help by paying more attention to the industry's needs.

Fortunately, the member firms of the industry, by the merging of interests, reduction in the number of models, and the instigation of extensive schemes of rationalisation, have placed themselves in a strong position to meet foreign competition. One of the most heartening features of the Show, in fact, is the comparatively small number of models produced by individual firms and, where several firms are in the same group, the use, so far as practicable, of the same components. The Standard Motor Company, Limited, for instance, who are responsible for the manufacture of the Standard Vanguard and the Triumph Renown, Mayflower and Sports models, fit what is basically the same engine in three of these cars, namely, the Vanguard, Renown and Sports. This engine, incidentally, is also used, in a modified form, in the Ferguson tractor. The savings brought about by such an arrangement will be obvious.

The search for new outlets for British cars has led to a renewed assault on the American market. Fortunately, there is one type of car, namely, the two-seater roadster, or sports car, which is finding great favour in this market, and, more fortunately still, it is in the production of such cars that this country excels. Examples which come to mind are the M.G. Midget, the Jowett Jupiter, the Jaguar XK 120 and XK 120C, the Healey, the Allard and the Talbot 90. All of these cars have put up outstanding performances in several European events and have achieved reputations for reliability allied with exceptional performance. One of these, namely, the Jaguar XK 120C, is capable of cruising at 120 miles an hour and yet costs less than 1,500*l.*, excluding purchase tax.

TRIUMPH SPORTS CAR.

Apart from minor modifications, most of these cars are being shown in their last year's form. There is, however, a newcomer, namely, the Triumph Sports, brief reference to which was made above. The production of this type of car, however, is by no means a new venture for the Triumph Motor Company as, in pre-war years, they were pre-eminent in the field of sports cars, gaining many successes in Alpine trials and Monte Carlo rallies. The new model, which is illustrated in Fig. 6, herewith, is intended for the motorist who wishes to participate in sports events or who has the opportunity for high-speed touring. It is fitted with a four-cylinder engine having a bore and stroke of 83 mm. and 92 mm., respectively, and capable of developing 75 brake horse-power at 4,500 r.p.m. The piston speed is 2,500 ft. per minute at 4,200 r.p.m., equivalent to a road speed of 80 miles an hour in top gear. As previously intimated, many of the parts of this engine are similar to those used for the Triumph Renown and Standard Vanguard models. Features of the design include the use of centrifugally-cast wet-type liners of nickel-chromium iron, aluminium-alloy split-skirt pistons, a three-bearing fully-balanced crankshaft, a four-bearing camshaft incorporating Hyposine cams, push-rod operated overhead valves and twin carburettors of the S.U. semi down-draught type.

The transmission assembly follows traditional lines, consisting of a four-speed gearbox, an open propeller shaft and hypoid rear axle. The power from the engine is transmitted to the gearbox through a 9-in. diameter hydraulically-operated Borg and Beck dry-plate clutch, the engine, clutch bell-housing and gearbox forming a single unit, which is supported from the chassis through flexible mountings. Synchromesh elements are provided for second, third and top gears and the ratios of the various speeds are: 3·382 to 1 in first speed; 2·008 to 1 in second; 1·325 to 1 in third; and 1·0 to 1·0 in top speed. The frame consists of box-section side members joined together by a cruciform centre bracing, a tubular rear cross member and a deep front cross member. In accordance with modern practice, independent springing is provided for the front wheels, the system employing swinging links of the wishbone pattern operating in conjunction with coiled springs. Exceptional rigidity is given to the forward end of the frame by a stout tubular cross member, which joins the upper ends of the supports for the suspension system. Semi-elliptical springs are employed at the rear and springing is controlled front and rear by telescopic dampers. Lockheed hydraulic brakes are fitted to the front and rear wheels, those at the front being of the two leading-shoe type and those at the rear of the leading-and-trailing shoe type. The wheelbase is 7 ft. 4 in., the front track 3 ft. 9 in., and the rear track 3 ft. 9½ in. The weight of the complete car, including tools, fuel, oil and water, is 15 cwt. 3 qr. This low weight, in conjunction with the 75 brake horse-power engine, should give the vehicle an outstanding performance and no difficulty should be experienced in attaining a speed in excess of 90 miles an hour.

ENGINE FOR MORRIS "MINOR."

Reference was made earlier to the benefits that can be expected, particularly in the field of standardised components, from the grouping of various interests. It will be recalled that towards the end of last year the Austin and Morris groups of companies came together under the title of British Motor Corporation and one of the first engineering benefits from this fusing of interests was the production of a new overhead-valve engine suitable for use in the Austin Seven and Morris Eight cars. This new engine is already in production, but for the time being it is being installed in vehicles for export only. It is illustrated in Fig. 7, on page 564, where it is shown complete with clutch bell housing and associated gearbox. There are four cylinders, with a bore and stroke of 58 mm. and 76 mm., respectively, and the engine can develop 30 brake horse-power at 4,800 r.p.m., a remarkable output for so small an engine. When fitted in the Morris Minor, for example, this engine provides a mean maximum speed of approximately 65 miles an hour and in top gear, with two persons carried, the speed can be increased from 20 miles an hour to 60 miles an hour in 45 seconds. It should, therefore, find considerable favour in overseas markets.

In general, the design of the engine follows normal practice, the high performance being obtained by careful attention to detail and progressive development rather than by the introduction of novelties. The cylinders and crankcase form a single casting, the water jackets extending the full length of the bores. The valves are set in line in the detachable cylinder head and are operated by push rods and rocking levers in the usual manner, an outstanding feature of the valve gear being the fitting of oil seals to the valve stems and rockers. To avoid valve-spring surge a special form of cam is used which also incorporates a "lead-in" to give quiet operation. Aluminium pistons of the split-skirt type are used; these are anodised and each is fitted with three compression rings and a single slotted oil-control ring. The crankshaft is machined from a steel forging and is supported by three main bearings of the steel-backed white-metal lined type, the centre bearing being designed to take the thrust. Similar bearings are fitted to the big ends of the connecting rods and the crankshaft has passages drilled in the main journals, webs and crankpins for the lubrication of these bearings and the cylinder walls. Forged-steel connecting rods are used and the gudgeon pins are clamped in the small ends, which is an unusual feature for engines of this size.

Forced lubrication is, of course, employed, the oil being fed to the bearings, etc., by a rotary-type pump fitted to the rear end of the camshaft. This draws oil from the sump through a large gauze strainer and delivers it to a gallery in the side of the crankcase which, in turn, directs it through drilled passages to the main bearings, holes drilled in the big ends delivering the oil to the cylinder walls. The camshaft front bearing feeds oil at a reduced pressure to the valve gear, timing chain, etc., the tappets being lubricated by the oil as it returns from the rocker gear to the sump. A by-pass oil filter is provided and this communicates with the main gallery through a drilled passage. At the front of the cylinder block there is a centrifugal water pump which, together with the dynamo, is driven from the crankshaft through a V belt, engine temperature being regulated by a thermostat which operates in conjunction with a by-pass. The induction manifold is of aluminium and is provided with a hot-spot. A single S.U. carburettor is fitted; this is of the semi down-draught type and is supplied with petrol by an S.U. electric pump. On export models, the carburettor is fitted with a combined silencer and oil-bath air cleaner, but home models are fitted with a dry cleaner. Coil ignition is employed, the distributor, which has a built-in vacuum control and automatic advance, being mounted on an accessible position at the right-hand side of the engine.

"Four Forty-Four" Saloon Car.

Apart from alterations to detail and, of course, the fitting of the new engine, the Morris Minor remains very much as before, particularly so far as appearance is concerned. Another number of the Nuffield organisation, namely, Wolseley Motors, Limited, however, are showing an entirely new model. Known as the Wolseley Four Forty-Four, the new model is illustrated in Fig. 8, herewith. Notable features of the design are the employment of integral construction wherein the chassis and body form a single stressed unit and independent front suspension. This model affords another example of sensible rationalisation, as it is fitted with a 1¼-litre overhead-valve engine similar to that employed in another Nuffield vehicle. This unit is of orthodox construction, having four cylinders with a bore and stroke of 66·5 mm. and 90 mm. respectively, which gives a swept volume of 1,250 c.c. The valves are operated by push rods and rocking levers and the equipment installed on the engine includes an S.U. carburettor. The transmission group comprises a single dry-plate clutch, a four-speed gearbox and a hypoid-bevel rear axle final drive, the gearbox selectors being operated from a lever under the steering wheel. Coiled springs are used for the front suspension; these operate in conjunction with transverse swinging links in the normal manner, the top links being of the wishbone form. Single arms are employed at the bottom of the swivel pins and these are located longitudinally by radius rods, the trailing ends of which are attached to the under frame. This arrangement will be clear from Fig. 9, on this page, which shows the suspension assembly for the offside front wheel. To avoid the transmission of road shocks to the frame of the car, the radius rods are provided at each end with rubber mountings. The radius arms also take the braking loads. Lockheed hydraulic brakes are fitted to all four wheels, those at the front being of the two leading-shoe pattern.

The Humber "Super Snipe."

The Rootes Group of Companies have already done much towards the export drive and to meet the increasing competition in world markets have introduced an entirely new car at this year's show. This model, which is being manufactured by Humber, Limited, Coventry, and is known as the Humber Super Snipe, is illustrated in Fig. 10, opposite. It is available in two forms, namely, as a standard saloon and as a touring limousine, the former being shown in the illustration. Both versions are fitted with a new six-cylinder 4-litre overhead-valve engine capable of developing 113 brake horse-power. It should be pointed out, however, that the Group's objective has not been to provide the highest possible maximum speed of which the new engine is capable, but to give rapid acceleration combined with high cruising speeds. Nevertheless, a maximum speed of over 90 miles an hour is well within the car's capabilities and the maintenance of high cruising speeds should, therefore, present no problem.

The six-cylinder engine has a bore and stroke of 3·5 in. (88·9 mm.) and 4·375 in. (111·13 mm.), respectively which gives a swept volume of 252·6 cub. in. (4,138·8 c.c.). A compression ratio of 6·48 to 1 is used and the maximum output of 113 brake horse-power is developed at 3,400 r.p.m., the piston speed at these revolutions being 2,625 ft. per minute. The maximum torque is 206·5 lb. ft. and this is developed at 1,400 r.p.m. In general, the design of the engine follows the usual practice for a unit of this class. A single casting forms the cylinder block and crankcase, the water jackets being designed to extend the full length of the cylinder bores. A seven-bearing crankshaft is employed, the diameters of the journals being 2¾ in. It is fully balanced and is fitted at the front with a torsional-vibration damper which is incorporated in the fan pulley. Steel-backed white-metal lined bearings are

THE MOTOR SHOW, EARL'S COURT.

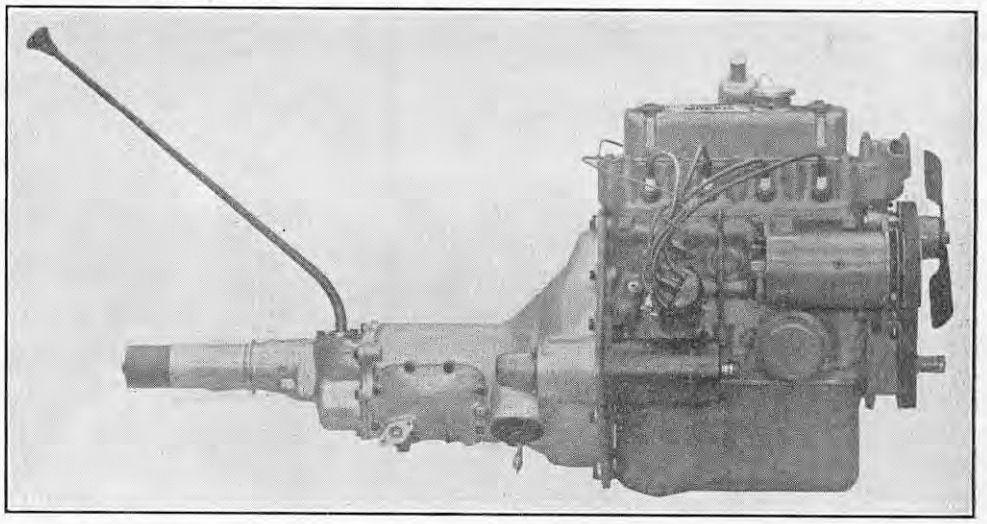


Fig. 7. 803-c.c. Engine for Morris "Minor"; Morris Motors, Ltd.

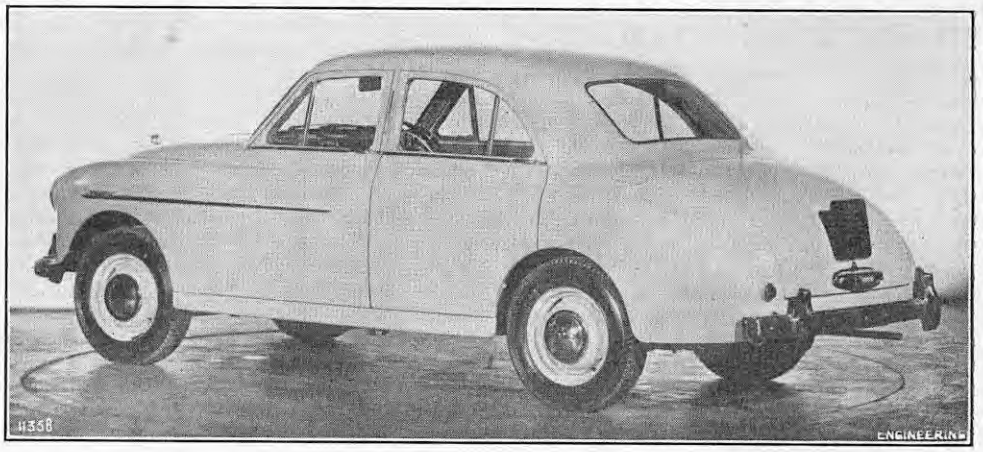


Fig. 8. "Four Forty-Four" Saloon Car; Wolseley Motors, Ltd.

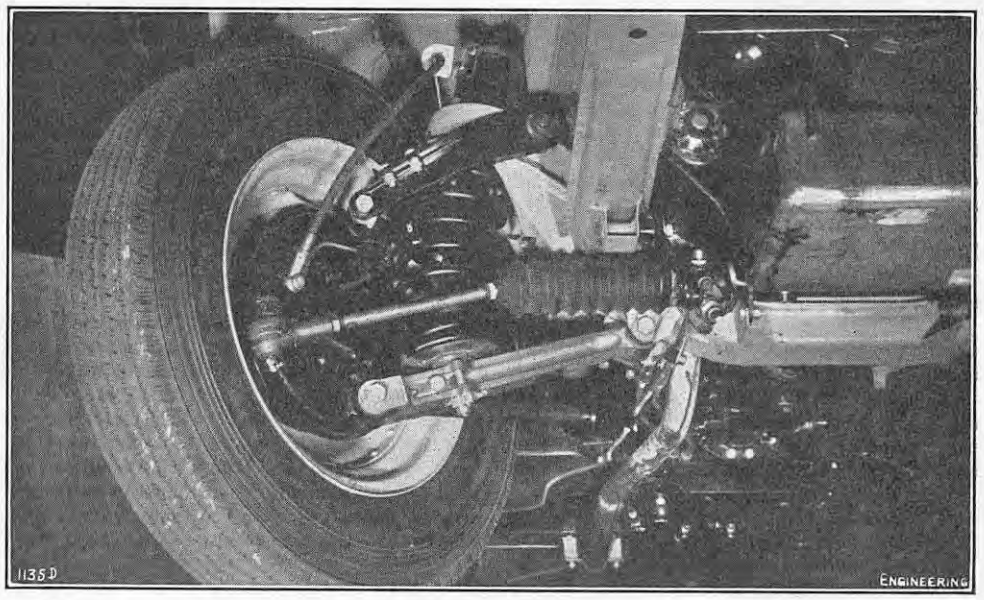


Fig. 9. Independent Front Suspension; Wolseley Motors, Ltd.

THE MOTOR SHOW, EARL'S COURT.

Fig. 10. "Super Snipe" Car; Humber Ltd.

used both for the main and big-end bearings, the crankshaft being located by the rear main bearing. The pistons are machined from Lo-Ex alloy die castings and are fitted with two compression rings and a single scraper ring, an extra groove being provided for fitting an additional scraper ring at a later date when the engine is worn. They are joined to the crankshaft by steel H-section connecting rods the big-ends of which are split diagonally and located relative to each other by hollow dowels through which the clamping bolts pass. A notable feature of the connecting-rod design is the provision of a central drilled way for conveying oil to the gudgeon-pin bearings.

A single casting is used for the cylinder head, this unit, as previously indicated, being fitted with overhead valve gear. The valves are located in line and are operated from the camshaft through push rods and rocking levers in the usual manner, the camshaft being located at the offside of the engine and driven by a duplex chain from the forward end of the crankshaft. A skew gear incorporated in the camshaft is arranged to drive an inclined spindle, the top of which operates the distributor and the lower end the oil pump for the forced lubrication system. A submerged gear-type pump is used, the oil being drawn from the sump through a floating filter and delivered through an A.C. full-flow filter to a main gallery which distributes it to the main and big-end bearings, camshaft bearings, valve-rocker gear, etc. Coolant is circulated by a centrifugal pump installed at the front end of the cylinder block and driven from the crankshaft by a V-belt, the pump assembly also incorporating a four-bladed, 17-in. diameter pressed-steel fan.

The design of the transmission follows established principles, the drive being transmitted to the gearbox through a Borg and Beck single dry-plate clutch and then by an open propeller shaft to a hypoid-bevel final-drive assembly. The gearbox provides four forward speeds, a notable feature of the design being the provision of synchronising elements for all forward speeds. The ratios of the various gears are: 3·124 to 1 in first speed; 2·092 to 1 in second; 1·42 to 1 in third; and 1 to 1 in top speed. Alternative ratios of 3·90 to 1 and 3·70 to 1 are available for the final-drive assembly. The chassis frame is of orthodox construction and is built-up from channel-section side members boxed-in for most of their length and three cross members, the whole being strengthened by an I-section cruciform bracing. Independent suspension is provided for the front wheels, each assembly consisting of short and long wishbone swinging links arranged to work in conjunction with a coiled spring. In accordance with the manufacturers' usual practice, threaded bushes are fitted to upper and lower wishbone bearings. Telescopic dampers are installed inside the coiled springs and the suspension system incorporates an anti-roll bar. Conventional semi-elliptical leaf-type springs are used at the rear and these work in conjunction with telescopic directly-acting shock absorbers. Lockheed hydraulic brakes are fitted to all four wheels, the diameter of the brake drums being 11 in. and the width of the brake linings 2¼ in. The front brakes are of the two leading-shoe type but those at the rear are of the conventional leading and trailing shoe pattern.

The Spanish "Pegaso" Car.

This year the Motor Show is truly international in character and several Continental manufacturers are represented. These include the Empresa Nacional de Autocamiones S.A., of Madrid, who are exhibiting at Earl's Court for the first time. One model only is being shown, however, namely the Pegaso, a high-performance car which obviously has been designed with a view to competition. It is powered by an eight-cylinder engine in which the cylinders are arranged in two banks of four in V-formation, each bank being provided with twin overhead camshafts. The bore and stroke are 75 mm. and 70 mm., respectively, and the output is stated to be in the neighbourhood of 170 brake horse-power. The transmission assembly is unusual, in that the gearbox is located behind the final-drive assembly, an arrangement which reduces unsprung weight to a minimum, increases the weight on the rear wheels and improves the factor of adhesion. The gearbox and final-drive assembly is installed on the chassis and the drive is transmitted to the road wheels through short open shafts fitted with universal joints. This arrangement permits the use of independent springing for all four wheels, torsion bars being employed for this purpose. The rear suspension, however, is not truly independent, in that a modified form of de Dion rear axle is used.

Racing Cars.

An innovation at this year's show is a display of racing and other cars of outstanding merit. The racing cars on view, all of which have put up outstanding performances in racing events during the first part of this year, include, in Formula 2, the Alta, Connaught, Cooper-Bristol, Frazer-Nash and H.W.M. machines and, in Formula 3, the Kieft and Cooper machines. The Society have also encouraged car exhibitors to show machines of special interest and the response has been particularly good. Jaguar Cars, Limited, Coventry, for example, are showing their XK120 fixed-head coupé which this year exceeded 100 miles an hour during a continuous seven-day run at Montlhéry, France, and in so doing established four world and five international class C records. The M.G. Car Company, Limited, Cowley, Oxford, are showing Lt.Colonel Goldie Gardner's M.G. car, which set up three international class E records and two international class F records in August of this year. Aston Martin, Limited, Feltham, Middlesex, are showing their D.B.2, sports saloon which, in the 1950 Le Mans event, was first in the 3-litre class and equal first on index of performance, and in the 1951 event first again in the 3-litre class and third in the general classification. This car was also first in the over 2-litre Vetture Veloci class of the 1951 Mille Miglia, first in the over 2-litre grand-touring class in the 1952 Mille Miglia and first in the 3-litre class of the 1952 International Alpine Trial. Other notable cars on view include the Sunbeam-Talbot "90," driven by Mr. George Murray Frame in the 1952 Rallye Internationale des Alpes and which was one of three similar cars to gain the Coupe des Alpes, the highest individual award and a Frazer Nash Le Mans replica which, driven by Mr. Anthony Crook, gained the International Class E 200-mile record at Montlhéry with a speed of 120·16 miles an hour from a standing start. This car also won the *Daily Express* International production-car race at Silverstone in May, 1951.

FLIGHT-REFUELLING EQUIPMENT FOR THE U.S. NAVY.

As a result of combat experience in Korea, which has demonstrated the need for increasing the range and endurance of jet-propelled naval fighters, the United States Navy is to adopt the probe-and-drogue method for refuelling carrier-borne fighter aircraft in flight. The probe-and-drogue technique and equipment, which was described fully in Engineering on page 491 of volume 171 (1951), is designed and constructed by Flight Refuelling, Limited, Tarrant Rushton Airfield, near Blandford, Dorset. The first American carrier-borne fighter aeroplanes to be equipped for refuelling in flight are the Grumman F9F Panther, powered by a single jet engine, and the McDonnell F2H Banshee twin-engine aircraft. Both are single-seat machines. The U.S. Navy's heaviest carrier-borne aircraft the 55,000-lb. North American AJ-1 Savage naval attack aeroplane, will serve as a tanker, a Flight Refuelling delivery pack being installed in the bomb bay. Drop tanks will provide additional fuel capacity for delivering to receiving aircraft. The U.S. Navy are also considering the use of the Convair P5Y flying boat, which is propelled by four propeller-turbines, as a tanker, with two delivery units, one mounted in each wing tip. It has been revealed recently that the probe-and-drogue method has been used successfully by the United States Air Force under combat conditions in Korea. On September 28, 1951, a Lockheed F80 Shooting Star fighter-bomber remained airborne for 14 hours 15 minutes and carried out five sorties. Eight refuellings were made during the flight, from a Boeing B29 tanker.

British Railways.—A new edition of "Facts and Figures about British Railways," a booklet last published in 1947, is now available, without charge, from the Public Relations Department, Railway Executive, 222, Marylebone-road, London, N.W.1, or from the public relations and publicity officer of any of the six regions. It contains a wealth of significant information. A few examples, taken at random, are: the railways' daily revenue is now over 1,000,000*l.*; more than 1,000 million passengers are carried per annum—nearly double the number carried on the main lines of the United States; there are four expresses booked at start-to-stop speeds of 60 miles an hour or over for portions of their journeys; there are some 400 different types of steam locomotives; and extensive plans are ready for further electrification as soon as the Government authorise the capital expenditure.

The Late Mr. L. O. Newton.—We note with regret the sudden death of Mr. Leonard Owen Newton, which occurred on October 2. Mr. Newton, who was 70 years of age, was managing director of Sofnol Ltd., a consulting chemical engineer, and a member of Gray's Inn. He was also for many years an officer of the Institution of Chemical Engineers, which he joined as a member in 1928. He was a vice-president in 1938 and 1939 and was appointed chairman of the nomination committee in 1940, serving in this capacity for 12 years. He was appointed joint honorary secretary of the Institution in 1945, in succession to Dr. A. J. V. Underwood, and continued to serve in this capacity with Mr. (now Professor) M. B. Donald until 1949, when the latter relinquished his position and Mr. Newton became sole honorary secretary of the Institution. Mr. Newton was still occupying the position at the time of his death. As stated in our "Personal" column, on page 567, Professor Donald has now accepted the Council's invitation to resume the position of honorary secretary of the Institution.

NOTES FROM THE INDUSTRIAL CENTRES.

SCOTLAND.

The Need for Mining Engineers.—The mechanisation of mines called for a higher and more specialised degree of mechanical and electrical knowledge and skill than hitherto, said Sir Andrew Bryan, member of the National Coal Board, when delivering his presidential address to the Glasgow University Engineering Society on October 23. In the phrase, "mining engineering," he added, the emphasis must now be laid with greater firmness on the word "engineering." The scope and complexity of the mining, mechanical, electrical, and civil engineering problems at a modern colliery were great and demanded engineers of a very high calibre. In the supply of such men the universities must play a larger part than they had ever done.

Steel Re-Rolling Industry.—Although heavy arrears assure full-time working conditions for periods ahead which range from six to 18 months, the steel re-rolling firms are concerned because, in some directions, new business is not developing as rapidly as the old orders are being worked off. The tendency has been accentuated during the past week or so with heavier arrivals of Continental finished-steel products. Remembering the first half of 1950, re-rollers of small bars and light sections are a little apprehensive. Then, Belgian exporters rushed in substantial tonnages, orders on home re-rollers almost ceased and three rolling mills had to close down.

Industrial Uses for Seaweed and Peat.—Ways of making greater industrial use of seaweed, peat, and a number of agricultural wastes were discussed with American experts by Dr. R. N. Woodward, director of the Institute of Seaweed Research, Musselburgh, and honorary scientific adviser to the Secretary of State for Scotland, during a recent tour of the United States and Canada. Dr. Woodward has arranged a number of collaborative investigations between Scottish and American research workers.

Whiteinch-Linthouse Tunnel.—The Cementation Co., Ltd., Doncaster, have commenced test borings in the bed of the river Clyde in connection with the proposed vehicular tunnel between Whiteinch and Linthouse, Glasgow. The actual construction of the tunnel, however, still awaits Government sanction.

Power Plant for Shetland.—Shetland County Council have agreed to join with Lerwick Town Council in asking the North of Scotland Hydro-Electric Board to establish an experimental power plant in Shetland for generating electricity from peat fuel.

Fish-Canning at Inverness.—Inverness Corporation Planning Committee have received an inquiry from a Lowestoft firm who are interested in establishing a fish-canning factory in Inverness.

CLEVELAND AND THE NORTHERN COUNTIES.

Defence Orders in the North-East.—The North-East Engineering Bureau, Newcastle-on-Tyne, is making representations for a greater allocation of defence orders in the North-East. The Bureau has 140 firms in its membership, and, although 64 per cent. of these have facilities for handling defence work, only 19 firms have been invited to tender. Orders worth about 1,500,000*l.* have been allocated to 13 firms.

Refitting of Destroyers on the Tyne.—Two British destroyers which are to be transferred on loan to the Norwegian Government are due in the Tyne for refitting. They are H.M.S. Beaufort, to be overhauled by T. R. Dowson & Co., Ltd., Tyne Dock, and H.M.S. Zetland, to be dealt with by the Tyne Dock Engineering Co. Ltd., South Shields.

Tees-Side Industrial and Social Survey.—Representatives of Tees-side local authorities are to meet on November 7 to discuss a proposed industrial and social survey of the area by the North-East Development Association and the Northern Industrial Group. The proposed survey has been approved in principle by the Tees-side Industrial Development Board, but as the cost of the work, which is to be spread over three years, will be 5,250*l.*, it is proposed to ask the local authorities to contribute towards the cost.

Pontop Pike Television Transmitter.—It has been announced that a temporary television transmitter is to be set up at Pontop Pike, the highest point in North-West Durham and that it is expected to be in operation by next April. The transmitter will serve a radius of 20 miles, but will be only one-fifth of the power of the permanent transmitter to be built on the site at a future date.

Servicing of Reserve Fleet Ships at Hartlepool.—The Docks and Inland Waterways Executive are to recondition the No. 3 graving dock at West Hartlepool for the servicing of ships of the Reserve Fleet.

Proposed Deepening of the Tyne at Stella.—The Tyne Improvement Commission are considering a proposal to deepen the River Tyne in the vicinity of the two new power stations now being built at Stella. This would allow coastal vessels to proceed up the river as far as the power stations.

Shipyard Improvements at Willington Quay.—Messrs. Clelands (Successors), Ltd., Willington Quay on-Tyne, who have carried out extensive improvements to their shipyard during the past few years, are now widening their No. 2 building berth by 5 ft. and replacing the derricks serving the berth by a 5-ton crane. It is proposed later to lay out a steel stockyard, new concrete roads and crane tracks.

River Wear Traffic.—At the monthly meeting of the River Wear Commissioners it was reported that coal shipments during the first eight months of the year, at 2,091,860 tons, were 4 per cent. more than in the corresponding period of 1951, but 27 per cent. less than in that of 1938. Imports, at 363,427 tons, were 10 per cent. up on last year and 66 per cent. more than in 1938, while exports of general merchandise, at 56,870 tons, were down 20 per cent. on 1951, but 11 per cent. up on 1938. The Commissioners have now completed the removal of a piece of land jutting into the river and known as Folly End. The work has cost over 100,000*l.*

LANCASHIRE AND SOUTH YORKSHIRE.

Sheffield Steel Production.—Sheffield steelmakers are maintaining the level of production in many instances and have been able to increase their output as a result of fuller supplies of pig iron and a temporary accumulation of scrap at some melting plants. There are still complaints that allocations are inadequate.

Foremen's Study Course.—A five days' intensive study of the foreman's place in the steel industry was begun on October 20 at the steel industry's college at Hope, Derbyshire. The men, who were drawn from 22 departments of 16 steelworks in Sheffield and district, were received by the chairman of the course, Mr. N. Tunbridge, rolling-mill manager at the Sheffield works of the English Steel Corporation, Ltd., and Dr. W. D. Hargreaves, area training officer of the British Iron and Steel Federation. The first lecture was given by Mr. G. U. Noden, works director of a Bradford alloy-steel firm, who emphasised the importance of the foreman's position as a link between the management and the employees.

Anglo-Indian Technical Co-operation.—Mr. M. N. Khanna, a member of the staff of the Council of Scientific and Industrial Research of India is the first Indian engineer to arrive in Sheffield under the Colombo Plan scheme for training men to meet the needs of South and South-East Asia. He is to spend six months at the works of the English Steel Corporation, Ltd. Mr. Khanna is a B.Sc. in metallurgical engineering. His visit has been arranged, through the British Colonial Office, by the British Iron and Steel Federation.

THE MIDLANDS.

Walsall Trolley-'Bus Services.—The municipal transport department at Walsall is contemplating a considerable extension of the present trolley-'bus services. Mr. R. Edgley Cox, general manager, has prepared a report which is to be submitted to the Town Council shortly for approval. It is proposed to convert 16 routes, at present served by Diesel-engined vehicles, to trolley-'bus operation. Walsall has at present only two routes operated by trolley 'buses, and possesses 33 double-deck vehicles. Some of the proposed services would extend into neighbouring towns.

Opencast Mining.—The National Coal Board have informed the Worcestershire County Council that they have decided not to proceed with the matter at present. In Warwickshire, borehole tests are still being made, and the Coal Board have notified their intention to extend these tests to Wood Park Farm, near Polesworth.

The Speed of Canal Transport.—The Inland Waterways Association have issued a statement on the relative speeds of railway and canal transport between London and Birmingham, in which they claim that, when the shunting and marshalling of wagons is taken into account, the boat makes the journey in a slightly shorter time than a wagon. The canal boat takes 4½ days to go from London and Birmingham, and the average speed, including time spent in locking, is between three and four knots. By comparison, according to the Association, the average speed of a railway wagon, on the same journey, is about 3 m.p.h.

The Production of Coinage in Birmingham.—At a recent visit to the works of the Mint, Birmingham, the Lord Mayor and Lady Mayoress of Birmingham (Alderman and Mrs. W. T. Bowen) were able to see the manufacture of coins on a considerable scale. Coins have been made at the Birmingham Mint for over a century, and in 1850 the then proprietor, Ralph Heaton, acquired most of the machinery from the defunct Soho Mint, formerly the property of Matthew Boulton. Coining represents only a small proportion of the work done at the Birmingham Mint, but at present the output is about 2,500,000 coins a week. British currency has not been made at Birmingham Mint since 1919, and the whole of the output is for export. Coins are at present being sent to Bolivia, East and West Africa, and Israel.

Trade with Canada.—At a meeting of the Midland Regional Board for Industry in Birmingham, on October 21, Mr. Barry Kay, Regional Controller of the Board of Trade, said that Canada was one of Britain's biggest potential markets. Mr. Kay added that it was hoped that substantial engineering contracts would be awarded to Midland firms in the next two years, when the St. Lawrence Seaway project was started.

Car Chassis for Training Purposes.—The Austin Motor Co., Ltd., Longbridge, Birmingham, have presented to Wolverhampton and Staffordshire Technical College a complete Austin "Sheerline" chassis. The college offers courses in automobile engineering, and the chassis will be used for instructional purposes.

SOUTH-WEST ENGLAND AND SOUTH WALES.

Industrial Development in Wales.—Steady progress in industrial development, an increased trade passing through the docks, and the maintenance of the high output of steel ingots and castings are features of the *Report of Government Action in Wales and Monmouthshire* for the year ended June 30, 1952. Unemployed fell to 20,574 in July, 1951, increased by nearly 10,000 in the subsequent six months, but declined again until at the end of June the total stood at 24,405. Under the industrial development programme, 390 factory projects have been completed and 205 others are under construction or have been approved for building. The saleable-coal output, at 26,038,200 tons for the whole of Wales, was 599,100 tons above the level of the previous year. Major schemes of reorganisation are proceeding at Nantgarw, Maerdy, Ffaldau, Llanharan, Point of Ayr and Llay Main. Work on the new anthracite colliery in the Gwendraeth Valley, which will cost 7,500,000*l.* and produce 1,000,000 tons of coal annually, has commenced. Trade at the ports reached 20,500,000 tons, the highest figure since 1939.

Coal-Loading Equipment.—American-type coal-loading equipment may be introduced at Swansea and other South Wales ports. Mr. Eddie James, Swansea-area marketing officer (export) of the National Coal Board, who was a member of a party which recently visited Canada and the United States to inspect coal loading appliances, on his return said that possibly some of the plants that they saw might be adopted, in whole or in part, at Swansea.

Payment of Miners' Transport Fares.—By a majority of seven to one, South-Wales miners have accepted the new transport agreement, tentatively reached between their union and the Divisional Coal Board. Under this, the Board will pay, on non-subsidised omnibus services, the greater part of all miners' fares, to and from their work, when these amount to over 5*s.* a week.

Bristol Waterworks Progress Reconnaisance by Helicopter.—On Friday, October 24, directors and executives of the Bristol Waterworks Company viewed development work in progress from the air. Two reconnaissance flights were made from Filton airport in a Bristol Type 171 helicopter, covering some 70 miles, over Filton, Knowle, Barrow, Chew Stoke, Bishop Sutton, Blagdon, Portishead, Redcliffe Bay and Shirehampton. Among the works surveyed is a reservoir under construction at Chew Stoke, with a surface area of 1,200 acres, which will supply Bath, South Gloucestershire, and North Somersetshire. The flights, the first of the kind to be carried out in this country, enabled the officials to carry out in an hour a survey which would have taken several days by road.

NOTICES OF MEETINGS.

IT is requested that particulars for insertion in this column shall reach the Editor not later than Tuesday morning in the week preceding the date of the meeting.

INSTITUTION OF STRUCTURAL ENGINEERS.—*Wales and Monmouthshire Branch:* Saturday, November 1, 6 p.m., County Buildings, Colwyn Bay. Chairman's Address, by Colonel R. D. Heseltine. *Northern Counties Branch:* Tuesday, November 4, 6.30 p.m., Cleveland Scientific and Technical Institution, Middlesbrough. "Unusual Design for a Large Constructional Shop," by Mr. F. R. Bullen. Also at the *Northern Counties Branch* on Wednesday, November 5, 6.30 p.m., Neville Hall, Newcastle-upon-Tyne. *Western Counties Branch:* Friday, November 7, 6 p.m., The University, Bristol. Joint Meeting with the INSTITUTION OF CIVIL ENGINEERS (*South-Western Association*). "The Design and Construction of Reinforced-Concrete Silos and Bunkers," by Mr. G. P. Bridges.

SOCIETY OF ENGINEERS.—Monday, November 3, 5.30 p.m., Geological Society's Apartments, Burlington House, Piccadilly, W.1. "Strain Measurements by Electronic Methods," by Mr. S. F. Smith.

INSTITUTION OF MECHANICAL ENGINEERS.—*North-Eastern Branch:* Monday, November 3, 6 p.m., Mining Institute, Westgate-road, Newcastle-upon-Tyne. "Explosions in Enclosed Crankcases of Reciprocating Engines: Their Cause, Effect and Possible Remedy," by Mr. John Lamb. *Automobile Division:* Tuesday, November 4, 5.30 p.m., Storey's-gate, St. James's Park, S.W.1. James Clayton Lecture on "Automatic Transmissions in America," by Mr. Charles A. Chayne. Also at the *Scottish Branch:* Thursday, November 6, 7.30 p.m., Royal Technical College, Glasgow. *North-Western Branch:* Thursday, November 6, 6.45 p.m., Engineers' Club, Manchester. "Considerations of Bogie Design, with Reference to Electric Railways," by Mr. W. S. Graff-Baker, to be read by Mr. A. W. Manser. *Institution:* Friday, November 7, 5.30 p.m., Storey's-gate, St. James's Park, S.W.1. Meeting in conjunction with the *Hydraulics Group.* "Water Turbine Governors," by Mr. N. G. Dennis.

INSTITUTION OF ELECTRICAL ENGINEERS.—*South Midland Centre:* Monday, November 3, 6 p.m., James Watt Memorial Institute, Birmingham. "275-kV Developments on the British Grid System," by Mr. D. P. Sayers, Dr. J. S. Forrest and Mr. F. J. Lane. *Western Centre:* Monday, November 3, 6 p.m., South Wales Institute of Engineers, Park-place, Cardiff. "Logical Approach to the Problems of Electric Space Warming," by Mr. D. H. Parry. *Merseyside and North Wales Centre:* Monday, November 3, 6.30 p.m., Royal Institution, Liverpool. "Domestic Electrical Installations: Some Safety Aspects," by Mr. H. W. Swann. *London Students' Section:* Monday, November 3, 7 p.m., Victoria-embankment, W.C.2. "Lightning," by Mr. J. H. Gridley. *Measurements Section:* Tuesday, November 4, 5.30 p.m., Victoria-embankment, W.C.2. Discussion on "Circuit Applications of Cold-Cathode Trigger Tubes," opened by Mr. K. Kandiah. *North-Western Centre:* Tuesday, November 4, 6.15 p.m., Engineers' Club, Manchester. "Economic Basis of Battery-Electric Road-Vehicle Operation and Manufacture," by Mr. H. W. Heyman. *East Midland Centre:* Tuesday, November 4, 6.30 p.m., Loughborough College, Loughborough. (i) "Inhibited Transformer Oil," by Mr. W. R. Stoker and Mr. C. N. Thompson. (ii) "Stability of Oil in Transformers," by Mr. P. W. L. Gossling and Mr. L. H. Welch. *North Midland Centre:* Tuesday, November 4, 7 p.m., Royal Station Hotel, York. "Economic Plant Sizes and Boiler-Set Groupings on the British Grid," by Mr. B. Donkin and Mr. P. H. Margen. (Postponed from October 28.) *Southern Centre:* Wednesday, November 5, 6.30 p.m., Polygon Hotel, Southampton. (i) "Equipment of Battery-Electric Vehicles," by Mr. W. D. Sheers. (ii) "Economic Basis of Battery-Electric Road-Vehicle Operation and Manufacture," by Mr. H. W. Heyman. *Institution:* Thursday, November 6, 5.30 p.m., Victoria-embankment, W.C.2. "Telemetering for System Operation," by Mr. R. H. Dunn and Mr. C. H. Chambers.

INSTITUTION OF THE RUBBER INDUSTRY.—*Newcastle Branch:* Monday, November 3, 7 p.m., Mining Institute, Newcastle-upon-Tyne. "Processes and Materials for Rubber Cables," by Mr. B. B. Evans.

INSTITUTE OF ROAD TRANSPORT ENGINEERS.—*Scottish Centre:* Monday, November 3, 7.30 p.m., North British Hotel, Edinburgh. "Trends of Vehicle Design as Indicated by the Commercial Motor Show, 1952," by Mr. L. J. Cotton.

INSTITUTE OF BRITISH FOUNDRYMEN.—*Sheffield Branch:* Monday, November 3, 7.30 p.m., College of Commerce and Technology, Pond-street, Sheffield, 1. "Outlook and Attitude of Management and Workers of British and American Foundries," by Mr. R. F. Horton. *Slough Section:* Tuesday, November 4, 7.30 p.m., High Duty Alloys, Ltd., Slough. "Pattern Making," by Mr. B. Levy. *West Wales Section:* Friday, November 7, 7 p.m., Richard Thomas and Baldwins, Ltd., Landore. "Making a Rotary Filter Drum Casting by Core-Assembly," by Mr. J. D. F. Yuille. *Scottish Branch:* Saturday, November 8, 3 p.m., Royal Technical College, Glasgow. "Casting Design in Relation to Production," by Mr. J. H. Pearce and Mr. G. D. Whitehouse. *Newcastle Branch:* Saturday, November 8, 6 p.m., Neville Hall, Newcastle-upon-Tyne. Film on "Flow of Metal into Moulds." *East Midlands Branch:* Saturday, November 8, 6 p.m., Gas Board's Showrooms, Nottingham. "Quantity Production of Malleable Castings," by Mr. H. Hayden.

INSTITUTON OF SANITARY ENGINEERS.—Tuesday, November 4, 3 p.m., Olympia, W.14. Public Works Congress. "Rural Water Supplies and Sewerage from the County Viewpoint," by Mr. F. M. W. King.

INSTITUTION OF CIVIL ENGINEERS.—Tuesday, November 4, 5.30 p.m., Great George-street, S.W.1. Presidential Address, by Mr. H. F. Cronin.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—Tuesday, November 4, 6.30 p.m., 39, Elmbank-crescent, Glasgow, C.2. "The Plant Engineer in Industry," by Mr. A. J. MacIntyre.

SHEFFIELD METALLURGICAL ASSOCIATION.—Tuesday, November 4, 7 p.m., Grand Hotel, Sheffield. "Steel Castings for the Chemical Industry," by Mr. R. W. Stobbs.

INSTITUTION OF PRODUCTION ENGINEERS.—*Halifax, Sheffield and Yorkshire Sections:* Tuesday, November 4, 7 p.m., George Hotel, Huddersfield. "Development of Engineering Metrology," by Mr. F. H. Rolt. *Leicester Section:* Thursday, November 6, 7 p.m., Bell Hotel, Leicester. "Choice of Turning Equipment," by Mr. R. C. Fenton. *Reading Section:* Thursday, November 6, 7.15 p.m., Great Western Hotel, Reading. "Modern Developments in Heat-Treatment Practice," by Mr. K. J. B. Wolfe. *Glasgow Section:* Thursday, November 6, 7.30 p.m., 39, Elmbank-crescent, Glasgow, C.2. Open Discussion.

INCORPORATED PLANT ENGINEERS.—*London Branch:* Tuesday, November 4, 7 p.m., Royal Society of Arts, John Adam-street, W.C.2. "Maintenance of Aircraft," by Mr. R. A. Tidd. *South Wales Branch:* Tuesday, November 4, 7.15 p.m., South Wales Institute of Engineers, Park-place, Cardiff. Discussion on "Chrome and Nickel-Plating Processes." *Southampton Branch:* Wednesday, November 5, 7.30 p.m., Polygon Hotel, Southampton. "Steam Utilisation," by Mr. J. C. Chynoweth. *Peterborough Branch:* Thursday, November 6, 7.30 p.m., Offices of Eastern Gas Board, Church-street, Peterborough. "Anti-Corrosives," by Mr. L. Evans.

INSTITUTION OF WORKS MANAGERS.—*Sheffield Branch:* Tuesday, November 4, 7.30 p.m., Grand Hotel, Sheffield. "Industry and the Law," by Mr. Stuart Shields.

INSTITUTION OF ENGINEERING INSPECTION.—*Coventry Branch:* Tuesday, November 4, 7.30 p.m., Technical College, Coventry. "Precision Mechanisms," by Mr. A. Hardman. *Institution:* Thursday, November 6, 6 p.m., Royal Society of Arts, John Adam-street, W.C.2. "Manufacture and Inspection of Paper," by Mr. G. Thompson.

ROYAL SOCIETY OF ARTS.—Wednesday, November 5, 2.30 p.m., John Adam-street, W.C.2. "The Centenary of the Society's Journal: A Unique Record in Print," by Mr. E. Munro Runtz.

INSTITUTE OF FUEL.—*North-Western Section:* Wednesday, November 5, 2.30 p.m., Municipal Annex, Dale-street, Liverpool. "Automatic Control," by Mr. G. Millington.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS.—Wednesday, November 5, 6 p.m., Institution of Mechanical Engineers, Storey's-gate, St. James's Park, S.W.1. "Whitehall Gardens and the Whitehall District Scheme," by Mr. T. R. Keeley.

ILLUMINATING ENGINEERING SOCIETY.—*Newcastle Centre:* Wednesday, November 5, 6.15 p.m., Minor Durrant Hall, Oxford-street, Newcastle-upon-Tyne, 1. "The Architect's Approach to Artificial Lighting," by Mr. R. G. Cox. *Glasgow Centre:* Thursday, November 6, 6.30 p.m., 39, Elmbank-crescent, Glasgow. "The Lighting of Shipyards," by Mr. J. S. McCulloch.

BRITISH INSTITUTION OF RADIO ENGINEERS.—*London Section:* Wednesday, November 5, 6.30 p.m., London School of Hygiene and Tropical Medicine, Keppel-street, W.C.1. "Standardised Units for Electronic Computers," by Dr. A. D. Booth.

JUNIOR INSTITUTION OF ENGINEERS.—*Midland Section:* Wednesday, November 5, 7 p.m., James Watt Memorial Institute, Birmingham. "Oil-Fired All-Basic Furnaces," by Mr. James Mitton. *Institution:* Friday, November 7, 7 p.m., Townsend House, Greycoat-place, S.W.1. Films.

INSTITUTE OF METALS.—*Birmingham Section:* Thursday, November 6, 6.30 p.m., James Watt Memorial Institute, Birmingham. "Metallurgical Problems Imposed by Stratospheric Flight," by Major P. L. Teed. *London Section:* Thursday, November 6, 7 p.m., Royal School of Mines, South Kensington, S.W.7. "Approach to Theory of Ternary Alloys," by Professor G. V. Raynor.

PERSONAL.

THE HON. M. F. P. LUBBOCK, a director of Rolls-Royce Ltd., and MR. M. D. N. WYATT, chairman of Airwork Ltd., have been appointed to the board of directors of Saunders-Roe Ltd.

MR. C. S. GARLAND, A.R.C.Sc., B.Sc., F.R.I.C., M.I.Chem.E., chairman of Stream-Line Filters Ltd., relinquished the office of honorary treasurer of the National Union of Manufacturers at the annual general meeting held on October 16. He has served in this capacity for 27 years and was re-elected a vice-president.

MR. W. H. PURDIE, director of William Doxford & Sons Ltd., Sunderland, has been re-elected chairman of the National Association of Marine Enginebuilders for 1952-53. MR. EWEN H. SMITH, director of David Rowan & Co. Ltd., Glasgow, has been re-elected vice-chairman.

PROFESSOR M. B. DONALD, M.Sc., A.R.C.Sc., F.R.I.C., has accepted the invitation of the Council of the Institution of Chemical Engineers, 56, Victoria-street, London, S.W.1, to become once again the honorary secretary of the Institution in succession to the late MR. L. O. NEWTON.

MR. W. CAMPBELL ALLAN until his retirement in 1948, secretary of Richardsons, Westgarth & Co., Ltd., and associated concerns, and still a director of the company, has been appointed honorary treasurer of the North-East Coast Institution of Engineers and Shipbuilders, succeeding to the late MR. W. H. PILMOUR.

MR. JAMES LENAGHAN, director and manager of William Gray & Co. Ltd., West Hartlepool, has been appointed shipbuilding director, Fairfield Shipbuilding and Engineering Co. Ltd., Govan, Glasgow.

MAJOR W. BERRY, J.P., chairman and managing director of Henry Berry & Co. Ltd., Croydon Works, Hunslet, Leeds, 10, is relinquishing his position as managing director, but is retaining the chairmanship of the company. MR. P. G. CORIN, M.A., M.I.C.E., and MR. A. WALKER have been appointed joint managing directors.

MR. Bonner W. A. DICKSON, who recently relinquished his seat on the board of Vickers-Armstrongs Ltd., has become a director of Oliver Pell Control Ltd. (incorporating the Varley Magnet Co.)

MR. E. R. HOWLETT, director and general works manager, Aveling-Barford, Ltd., Invicta Works, Grantham, and MR. C. J. RITCHIE, director and general sales manager to the company, are retiring from their positions and from the board of directors at the end of February, 1953.

MR. R. C. FLOWERDEW, district passenger superintendent, London Midland Region of British Railways, Manchester, a nominee of the British Transport Commission, has been appointed a member of the Transport Users Consultative Committee for the North-Western Area, in place of the late MR. J. E. RIGBY.

MESSRS. J. D. AND D. M. WATSON, 18, Queen Anne's Gate, London, S.W.1, have now taken into partnership MR. H. ROY OAKLEY, M.Sc., A.M.I.C.E.

MR. F. R. L. BARNWELL, O.B.E., A.M.I.C.E., hitherto district engineer, British Railways, Inverness, Scottish Region, has been made district engineer, Shrewsbury, Western Region.

MR. H. HUBBARD has been appointed a director of Oakley Brothers Ltd., Cradley Heath, Staffordshire, a subsidiary company of W. T. Henley's Telegraph Works Co. Ltd. Mr. Hubbard is manager of the engineering sales department of the holding company.

The Ministry of Civil Aviation, Ariel House, Theobald's-road, London, W.C.1, announce that MR. C. G. PHILLIPS, O.B.E., B.Sc.(Lond.), has been appointed director of navigational services (telecommunications) as from November 1, in succession to MR. R. W. J. SULLIVAN, B.Sc.

Following the recent death of MR. H. W. CAIN, material controller of George Kent Ltd., Luton, Bedfordshire, MR. J. F. WILLSHER, formerly production controller, has been appointed production manager, responsible for both material control and production control.

MR. E. T. S. HOFFMAN, head of the department of commerce and professional studies, Cambridgeshire Technical College, Cambridge, has been appointed principal of Halesowen Technical College, as from January 1, 1953, in succession to MR. JOHNSON BALL.

BULL'S METAL AND MELLOID CO., LTD., have changed their name to BULL'S METAL AND MARINE LTD., Yoker, Glasgow, W.4.

THE AIRSCREW COMPANY AND JICWOOD LTD., Weybridge, Surrey, have transferred their Manchester office from 24, Mosley-street, to more extensive premises at 175-177, Oxford-road, Manchester, 13. (Telephone: Ardwick 4924.)

THE BELMOS CO. LTD., Bellshill, Lanarkshire, announce that the telephone number of their London office, at Columbia House, Aldwych, W.C.2, has been changed from HOLborn 7676 to CHAncery 5855.

EXHIBITS AT THE PUBLIC WORKS EXHIBITION, OLYMPIA.

(*For Description, see Page 573.*)

FIG. 1. OVERHEAD LOADER; MACKAY INDUSTRIAL EQUIPMENT, LTD.

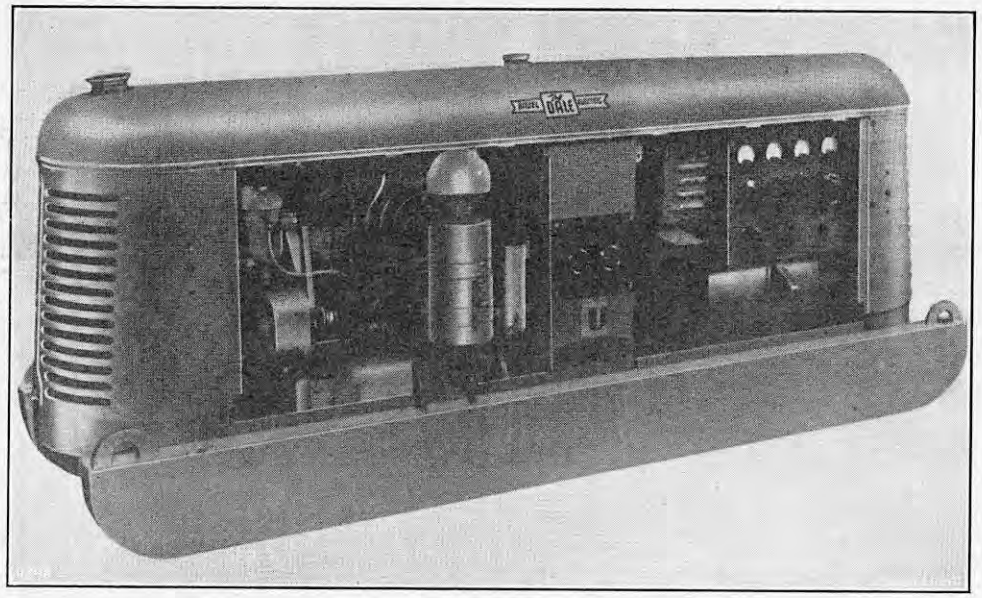


FIG. 2. PORTABLE GENERATING SET; DAVID BROWN TRACTORS, LTD.

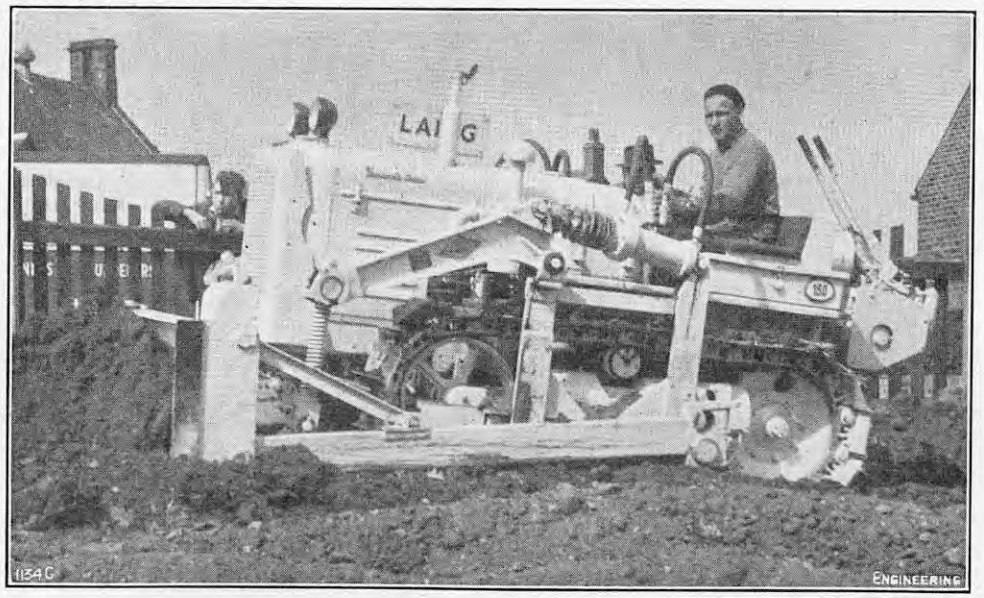


FIG. 3. TRACTOR WITH ANGLE-DOZER; DAVID BROWN TRACTORS, LTD.

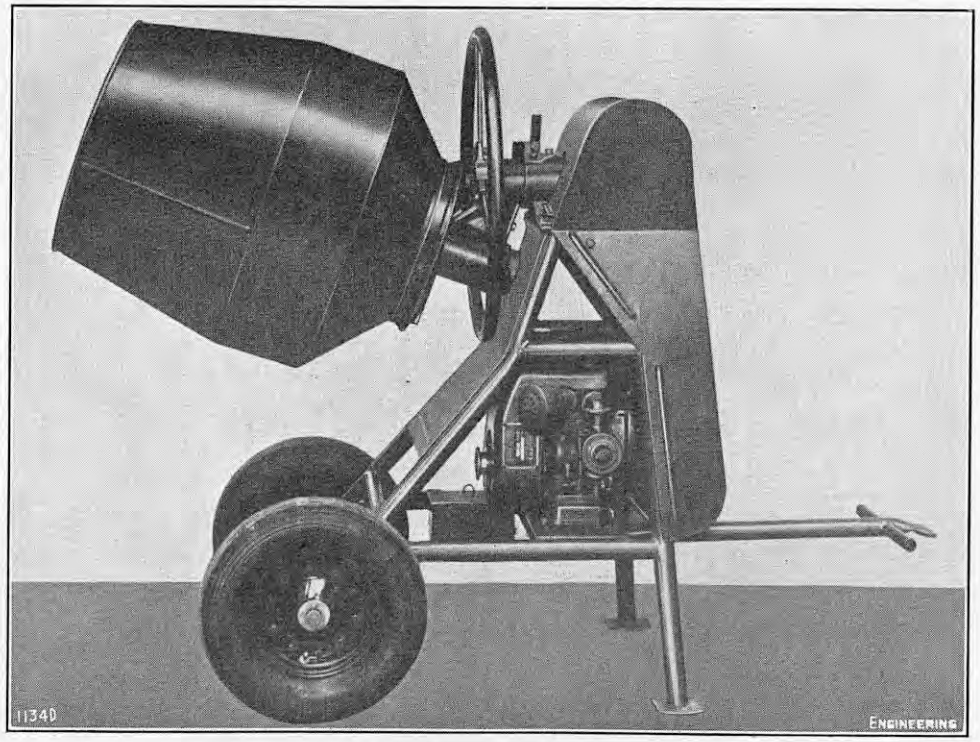


FIG. 4. "2T" CONCRETE MIXER; WINGET, LTD.

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ENGINEERING

FRIDAY, OCTOBER 31, 1952.

VOL. 174. No. 4527.

THE FUTURE OF THE FUEL EFFICIENCY SERVICE.

IN our issue of September 19, on page 378, *ante*, we outlined the main points contained in the report of Lord Ridley's committee on national policy for the use of Britain's fuel and power resources. The outline was necessarily brief, for the report, extensive enough in itself, is supplemented by no fewer than 15 appendices, some of which go into considerable statistical and other detail ; but, having studied it with some care, we came to the conclusion that the nation would probably have to wait for quite a long time before either industrialists or domestic users could enjoy either the freedom of choice or the unrestricted use of fuel that, before the war, they possessed and accepted as a matter of course. To a certain extent, it must be admitted, no absolutely true comparison can be made between the conditions then and now, without taking into account a variety of factors affecting the economic background of the individual consumer. Electricity then was not so widely available as it is to-day ; coal, on the other hand, was relatively much more plentiful, and the ordinary supplier of solid fuel to the ordinary consumer could and did offer a wider choice than he has been able to do since, and to guarantee a steady supply of the kind eventually chosen. Fuel-burning appliances were less efficient than they subsequently became as a result of scientific research, scientifically applied to the design of improved products ; but much less attention was paid to efficiency of combustion and of heat transmission, merely because the fuel, whether solid, liquid or gaseous, was easy to obtain and not so expensive as to constitute a serious burden on production.

Some of these points, it would seem, were not sufficiently brought out in the debate on the report in the House of Commons on October 28 ; more, we suspect, because their significance was not appreciated than because of any desire on either side to score cheaply off the other side for purely political reasons—though the debate provided a few examples of that too-prevalent weakness, as was to be expected. In general, however, it was obviously well-intentioned, and if, during the six hours that it occupied, there were moments when some speakers seemed to have forgotten what it was that they were debating, this was, perhaps, no more than a natural outcome of the very general terms of the resolution.

The actual wording of the motion which was introduced by the Minister of Fuel and Power (Mr. Geoffrey Lloyd, M.P.) was : "That this House takes note of the Report of the Committee on National Policy for the Use of Fuel and Power Resources and also takes note of the last Annual Reports of the nationalised Fuel and Power Industries." In the course of his opening speech, which lasted rather more than half an hour, the Minister made two statements of policy which aroused a certain amount of subsequent discussion. One was his disclosure of the Government's intention, as from December 1, to free from all restrictions the sale of the untreated small coal (below ¾ in.) which remains when the large coal and the graded varieties of the smaller sizes have been extracted, and to increase from 20 cwt. to 30 cwt. the amount of boiler fuel that a householder is permitted to buy between November and April, provided that the whole of the extra allowance is taken in coke. The second point was his expressed agreement with the recommendation of the Ridley Committee that the Fuel Efficiency Service of his Ministry should be expanded, but that the greater part of its work should be transferred—as the Committee also recommended—to an independent organisation, to be controlled and financed by industry. He added : "I propose to move as fast as I can in this matter. . . . I have discussed it already with the chairman of the National Coal Board, who has assured me that such an organisation could count on a substantial contribution from the National Coal Board." It appeared, however, that he would retain some part at least of the Ministry's organisation, which would concentrate on improving the fuel-using efficiency of Government Departments.

Several Members seized upon this latter point, and charged the Minister with having indicated an intention, in effect, to duplicate the present service —which, of course, is available equally to Government departments and to industry as a whole, though, naturally, its most successful interventions have been in the industrial field, where the largest consumers are to be found. Mr. Lloyd, in his replies, was a little vague, and it would be understandable if the technical and administrative staffs of the service now operated by the Ministry were to ask him, through the appropriate channels, to be rather more explicit. Evidently, the organisation as it now exists could hardly find full employment in dealing with Government fuel consumption alone, so that, presumably, some of the staff would have to be transferred to the new industrial service. Equally certainly, the "established" officials would be reluctant to transfer unless their pension rights were safeguarded ; yet to start an entirely new service, without drawing men of seniority and experience from the Ministry, hardly commends itself as an efficient procedure.

The Parliamentary Secretary to the Ministry of Fuel and Power (Mr. L. W. Joynson-Hicks, M.P.), who replied to the debate on behalf of the Government, endeavoured, as he said, to "get this matter

quite clear." The extent to which the proposals for a new fuel efficiency service could be implemented depended entirely, he explained, on the supply of competent fuel technologists. "If we are to start in accordance with the recommendations of the Ridley Committee," he continued, "an industrial fuel efficiency branch is going to draw upon the existing pool of fuel technologists until the time when we can succeed in obtaining a greater number of these experts. . . . We do not want to have two competitive bodies of this description covering the same ground. Our tendency will be to concentrate on the non-industrial field and the more highly technical research field and so forth, without in any way doing away with the Fuel Efficiency Branch itself, which, clearly, we want to keep going."

This declaration drew from Mr. P. Noel-Baker, who was one of those who had queried the original statement by Mr. Geoffrey Lloyd, the reasonable question, "Is the Minister telling us that the Government are throwing over the recommendations of the Ridley Committee in paragraph 177: 'We therefore recommend that the Ministry Service should continue to give advice on fuel efficiency to industry'; and, in paragraph 178, which suggests that the work should not be confined only to solid fuel, as hitherto, but extended to work on electricity for power in industry?" Mr. Joynson-Hicks replied that "We are certainly not throwing over the recommendation mentioned in the second quotation" . . . and went on to say that, "while the Ridley Committee go so far as to recommend two fuel-efficiency advisory bodies, both functioning in the same field in industry, we considered that that is not a desirable objective, but that the objective would better be accomplished, in time, when the resources permit, by one branch in any one particular field. In the industrial field, the Ministry's branch will gradually be tapered off, but the degree and extent of the tapering-off will clearly depend on the cirsumstances as they arise."

Replying to a lengthy debate is seldom an easy undertaking, because of necessity it must be largely, if not entirely, impromptu; we do feel, however, that Mr. Joynson-Hicks did not quite succeed in his attempt to "get this matter quite clear," for his statement that, in the opinion of his Ministry, the objective would be better accomplished by having one branch in "any one" particular field would appear to presage a possible creation of, not one or two, but an indeterminate number of fuel efficiency services. If there is to be a separate service for Government departments, it would be possible to adduce equally powerful arguments in favour of having others for the railways, the gas industry, the mining industry, or any of the nationalised industries which are now relatively self-contained entities and are likely to remain so. Every such case, however, in which there is felt to be justification for special consideration, must introduce complication and, almost inevitably, overlapping; because the efficient utilisation of fuel is as much a matter of design as of the use of appliances—whether these are power-station boilers or space-heating stoves—and many of these appliances are used in a diversity of fields. It would be wholly wrong to assume, as some of the speakers, by implication, appeared to do, that the promotion of fuel efficiency was something that the Ministry of Fuel and Power initiated; all that the Ministry did was to emphasise its growing significance and to facilitate its better attainment in quarters where previously it had not always received sufficient attention. That function it has discharged with a success that should not be under-rated, but Her Majesty's faithful Commons should recognise also that a vast amount of useful work in this field has been carried on for many years by the Institute of Fuel and other professional bodies, as well as by the technical staffs of the fuel-using industries.

CHEMICAL RESEARCH.

Many of the activities of the Chemical Research Laboratory are concerned with matters which lie outside the interests of this journal but there are some which impinge directly on engineering problems. An example is the investigation of the corrosion of boiler tubes. This might appropriately be described as an example of chemical-engineering research, but as the Department of Scientific and Industrial Research does not as yet operate a chemical engineering laboratory, it is well that the chemical laboratory should concern itself with some aspects of engineering work. A committee appointed by the Advisory Council in 1949 issued a report* towards the end of last year in which the establishment of a chemical-engineering laboratory was strongly urged. This report may possibly be acted on in time but the present outlook is hardly promising. It has been agreed in principle that the Fuel Research Station, the Road Research Laboratory, and the Water Pollution Research Laboratory shall be moved to new sites and provided with new establishments and this programme would appear likely to absorb the capital expenditure which the Department will be permitted to incur for many years.

In addition to the work on boiler tubes, the report of the Chemistry Research Board for the year 1951† contains information of engineering interest on a wide range of work on the general subject of the corrosion of metals. The work on Scotch-boiler tubes, which is a branch of this work, is conducted for the British Shipbuilding Research Association, and has been in progress for some years; the model boilers used in the investigation, we may mention, were illustrated and described on page 7, of our issue of July 7, 1950. The present report, referring to tests of eight-week periods, states that there is much irregularity in the distribution of corrosion in any one boiler tube, and between the six tubes of a boiler, making it difficult to estimate the useful life of a tube in service. The boilers were fed with condensate, losses being made up with sea water. With 5-per cent. sea water, that is, five parts by volume of artificial sea water made up to 100 parts with distilled water, corrosion was slight (pitting from 0·2 to 0·35 mm.), in the normal conditions of partial saturation of the feed water with air and also when the oxygen content of the water was increased about four-fold by injecting oxygen into the condenser. Increase of sea-water content to 50 per cent. and 100 per cent. caused pitting to maximum depths of 0·4 to 0·55 mm., and 0·45 to 0·75 mm. respectively, although the average depth of pitting for the two sea-water contents was the same. A four-fold increase in oxygen concentration with 50 per cent. sea water caused a considerable extension and intensification of pitting, the maximum depth being the same as that with 100 per cent. sea water without oxygen injection.

The information about work on the corrosion of metals occupies 28 pages of the report. Probably all engineers are concerned with some aspect of metal corrosion and each may study with profit the section dealing with his particular interest. Atmospheric corrosion is a subject of the first importance in the building and civil-engineering fields and although much investigation has been carried out on the matter by various institutions and authorities, the information about field tests on mild steel, given in the report, will be studied with interest. Specimens of various thickness, ranging from 5·8 cm. to 0·013 cm., were exposed under sheltered outdoor conditions. Specimens were examined at intervals of three months to assess the influence of seasonal fluctuations. Final results showed a connection between corrosion rate and specimen thickness, the maximum corrosion occurring on the thickest specimens. This effect was not observable on test pieces less than 0·5 cm. thick. The reason suggested for this is that the thinner specimens were subject to considerable movement even under light winds, so that the conditions for thick and thin specimens were not similar. This possibility of movement and occasional shock had not been foreseen.

The matter of different rates of corrosion for thick and thin specimens appears to be of practical importance. The report states that it is not difficult to explain. Corrosion depends on change of atmospheric temperature associated with humidity conditions. When warm-humid weather follows cold-dry or cold-humid weather, heavy condensation occurs, and is retained for a longer period on thick than on thin specimens; the latent heat released on condensation on thin specimens raises their temperature to a greater extent than on thicker ones. Briefly, the thin specimens adjust themselves more rapidly to temperature changes and the difference in temperature between the metal and the atmosphere is the important and critical factor in inducing condensation. It was observed that when warm-humid weather followed cold-dry or cold-humid weather, the thin specimens were dry all over, whereas the thicker ones were only dry at the edges.

Some information is given about field tests of steel temporarily protected with a coating of lanoline. This matter is of importance in connection with the shipping of machinery of almost any type. Specimens were coated by dipping in solutions of lanoline in white spirit of concentrations varying from 0 per cent. to 35 per cent. by weight and were exposed for six months. The tests showed that there is a marked reduction in the protective power of lanoline when its proportion in white spirit is less than 12·5 per cent. The effect of oil additions to lanoline solutions is now being investigated.

The work on what is termed "immersed corrosion" has a bearing on many fields of mechanical engineering. Investigations have covered both "high-speed rotor technique" and "low-speed rotor technique." The former concerns the corrosion of mild steel in rapid movement when immersed in a solution of sodium chloride, comparative tests being made with sea-water and mains-water. The detail results given are too extensive to be quoted here, but one conclusion reached was that in artificial sea-water the corrosion rate was considerably less at 25 deg. C. than at 15 deg. C. This is explained as being due to the rise in temperature accelerating the formation of deposits of magnesium and calcium compounds on the steel. These deposits are known to reduce corrosion rates.

Work at low speed of movement was carried out on several types of iron and steel, the specimens having turned surfaces. The general conclusions were that in mains-water there is little difference between the corrosion rates of 0·5-per cent. copper steel, wrought-iron, 4-per cent. silicon iron and mild steel. The rate for Swedish pure iron is approximately 25 per cent. higher and for nickel-chromium-molybdenum steel 50 per cent. lower; 18/8 chromium-nickel steel is not corroded. In artificial sea-water, mild steel and copper steel corrode at approximately the same rates, but the corrosion of wrought-iron is about 15 per cent. less. The corrosion of Swedish pure iron and 4 per cent. silicon iron is about 30 per cent. less and that of nickel-chromium-molybdenum steel about 55 per cent. less than that of mild steel; 18/8 chromium-nickel steel is not attacked. A notable feature of the year's work has been the assistance given to Service and other Government departments, as well as to industry.

* See Engineering, vol. 173, page 49 (1952).

† *Report of the Chemistry Research Board with the Report of the Director of the Chemical Research Laboratory for the Year* 1951. H.M. Stationery Office. [Price 4*s*. 6*d*. net.]

NOTES.

THE HARNESSING OF THE RHÔNE.

AN important step in the extension of hydro-electric power generation in France was taken on Saturday, October 25, when the President of the Republic, Monsieur Vincent Auriol, formally inaugurated the Donzère-Mondragon dam on the river Rhône and set in motion the turbines of the André Blondel power station. When it is completed—at present only three turbines are available for use—this power station will contain six water-turbines with their generators, each of 70,000 h.p. and passing 255 cub. m. of water a second. The total extent of the works is about 28 km., from Donzère in the north to Mondragon in the south, and the effect is to direct a large proportion of the flow of the river through the André Blondel power station. A lock has been provided to enable river traffic to by-pass the power station. This lock—the deepest in the world—is 195 m. (640 ft.) long and 12 m. (39 ft. 6 in.) wide, and has a fall of 26 m. (85 ft.). It can be filled or emptied in 17 minutes. Both the intake canal, supplying the power station, and the discharge channel which returns the water to the river, have cross-sections appreciably greater than that of the Suez Canal. The works have been carried out for the Compagnie Nationale du Rhône under the direction of their chief engineer, Mr. P. Delattre.

DUNSTON "B" GENERATING STATION.

The British Electricity Authority's most efficient generating station in 1951—Dunston "B," in the North Eastern Division—was the subject of a paper presented at a joint meeting of the Institution of Mechanical Engineers and the Institution of Electrical Engineers held at the former Institution's headquarters on Friday, October 24. The paper was "The Design and Operation of Dunston 'B' Generating Station with Particular Reference to 50-MW Turbo-Alternators Unitized with Reheat Boilers," by Mr. A. Howell, M.I.Mech.E., M.I.E.E., and Mr. J. B. Jackson, M.I.Mech.E., M.I.E.E. The plant was commissioned towards the end of 1950, and in their paper, which was in two parts, the authors first described the changes in design compared with the original plant which was commissioned 17 years previously; they then discussed staffing and staff training, and details of operating experience, including methods adopted for overcoming the initial plant troubles, the procedure evolved for starting-up and shutting-down and, in particular, the method adopted to permit full load to be achieved in 1½ hours from starting-up. They concluded that one of the most significant features of the plant was its flexibility. Running-up a machine and loading it was no more difficult than with a straight cycle. Experience had shown that, in future plant of this kind, further economies in capital and operating expenditure could be achieved by omitting the partition wall between the boiler and turbine, and by bringing the boiler and turbine control points closer together. It seemed, however, that, where wide variations in the properties of the fuel were to be expected, the boiler furnace demanded closer attention than could be given from a remote operating room. Most of the shorter "outages" were attributed to the fact that the detail design or workmanship of pipe joints, etc., was not up to the required standard. Moreover, it was clear that with those high-pressure bolted joints which could not be avoided, there should be more attention to detail in making the joints and pulling up the bolts. "Unitisation" could only be fully successful if all parties to the venture, including the manufacturers, realised what they had undertaken and made appropriate changes in their established practice. Nevertheless, unitised generating plant would be controlled so closely as to achieve test conditions and test performance in commercial operation. The discussion which followed the presentation of the paper dealt more with operation and failures than with design; it was, nevertheless, searching and extensive, and when it is published by the Institutions (it would require more than 20 columns of ENGINEERING to report it verbatim) it should prove to be, in conjunction with the paper, a mine of data, opinion and comment for the many mechanical and electrical engineers concerned.

THE AUSTIN MOTOR-SHOW DINNER.

Some trenchant criticisms of the Government and Government Departments were made by Mr. Leonard P. Lord, when speaking at the annual Motor-Show dinner of the Austin Motor Company, Limited, of which he is chairman and managing director. In a hard-hitting speech, Mr. Lord referred to Britain's dwindling exports of cars, the lack of customers for the home market, and the immediate threat of unemployment if the full production of cars could not be taken up either here or abroad. He was perfectly aware, he said, of the need to export, particularly if the present standards of living were to be maintained. Competition in the world markets, however, was increasing and in many cases the products of other countries were subsidised either directly or indirectly; but matters were worse than that as, in some cases, present trade agreements were far from satisfactory. We were, for example, excluded from exporting to France although France could send cars to this country, and he wondered, to use his own words, "When are our Government officials going to get out in the world and stop allowing England to be a doormat for everybody to wipe their boots on?" So far as the home market was concerned, he was far from happy. There was, he said, no use talking about a recession coming; it was here. Mr. Lord then referred to the crippling effect of purchase tax, and, quoting figures to show the enormous sums involved in this tax, stated that they would not be able to sell cars in Britain unless the purchase tax was eased.

THE SHIPBUILDING RETURNS.

The Shipbuilding Returns compiled by Lloyd's Register of Shipping, for the quarter ended September 30, 1952, show that the merchant shipping under construction in the world at that date, excluding vessels of less than 100 tons gross, were 1,207 in number and amounted to a gross tonnage of 5,864,873. Of these, 325, totalling 2,533,161 tons gross, were steamships and 876, of 3,330,814 tons, were motorships. The grand total shows a slight increase over that of the previous quarter, which was 1,190 ships of 5,614,183 tons. The tonnage which was being constructed under the inspection of Lloyd's Register amounted to 65·5 per cent. of the world total; but in Great Britain and Northern Ireland, where 2,062,482 tons were being built, 94·7 per cent. was under the inspection of the Society. As has been the case for a long time, no figures are available for China, Poland, and Russia. The United Kingdom had by far the largest tonnage under construction, Japan coming second with 603,500 tons, the United States third with 600,173 tons, and Germany fourth with 472,971 tons. No other country showed a total as high as 400,000 tons, though the Netherlands approached closely to that figure with 381,138 tons, and Sweden returned 375,958 tons. Oil tankers under construction in the world (excluding those of less than 1,000 tons) numbered 250, of 2,926,974 tons, of which 96, of 1,321,496 tons, are to be propelled by steam machinery, and 154, of 1,605,478 tons, by oil engines. Britain has the largest number of tankers in hand (100), with Sweden second (26), Japan third (25) and the United States fourth (19). Oil tankers represent 55·7 per cent. of the tonnage building in the United Kingdom and 46·7 per cent. of that building abroad. Partly because of the restricted supplies of steel, the total tonnage of merchant ships in hand in the United Kingdom shows a decrease of 13,759 tons by comparison with the previous quarter, whereas the total building abroad has increased by 264,499 tons.

JUBILEE OF WILLIAMS AND WOMERSLEY, LIMITED.

Fifty years ago, two young mechanics, George Williams and Herbert Womersley, who had received their training in the same works in their native city of Bradford, decided to pool their modest financial resources and start in business for themselves. They managed to acquire, for a trifling sum, the goodwill and plant of a small general-engineering business in Wakefield and set up in business as engineers and millwrights, specialising in the production of equipment for power transmission, such as shafting, pulleys, bearings, etc. By hard work and long hours, in which the partners shared equally with their small staff of workmen, the business prospered and soon the partners were able to install a lathe capable of turning shafting in lengths up to 30 ft. Starting by supplying transmission plant for British textile mills, the firm also developed an important export trade, and at the end of the first three years found it necessary to increase their workshop accommodation, install new plant and electric drives for their machinery. Just before the first World War they joined with Mr. W. Hepburn to form the Hepburn Conveyor Company, to act as mechanical, consulting and general engineers for the construction of conveyors and elevators. This company started business in King-street, Wakefield, first as designer-consultants and erectors, but seven years later commenced to undertake constructional work, from which time the business expanded rapidly. During the war, the Williams and Womersley works were engaged mainly on the production of shell punches, dies for cartridges, the rough machining of propeller-shaft forgings, and other war work, although their normal production was continued on a reduced scale. Shortly after the war, the original works were taken over by the Hepburn Conveyor Company, and Williams and Womersley acquired their present premises in Ings-road, Wakefield. Despite the post-war depression, the firm continued to thrive and added other products to their standard range of manufactures. In 1921, Mr. Williams retired and Mr. Womersley continued as sole proprietor. Shortly after, he acquired the firm of A. G. Barrett and Company, of Bradford, who also manufactured power-transmission equipment, and, in 1927, the firm of Marsden and Naylor, of Skipton, was absorbed. As the business extended, branches were opened successively in Glasgow, London and Birmingham, while in 1937, the goodwill and patterns of Samuel Carver, Limited, Nottingham, were purchased. Shortly before the second World War the firm was converted into a private limited liability company under its present title of Williams and Womersley, Limited. When the war commenced, their efforts had again to be directed to munitions. The centreless turning plant was engaged for 24 hours daily in producing bars for making 2-pdr. anti-tank ammunition and stainless-steel propeller shafts for patrol boats. Numerous machines for working light alloys for the aircraft industry were also designed and made by the company. Herbert Womersley died in February, 1941, but his family is still represented on the board. Mr. Williams died two years later, but the principles instilled into the business by the two founders are still followed by the present firm, of which Mr. A. W. Boulton is chairman, Mr. Cyril Newton is managing director, and Mr. F. G. Beard is general manager. Their range of products now includes, in addition to all kinds of power-transmission equipment, plant for flour milling, food preparation, mining, metal rolling, concrete making, lifting, hauling and winding, etc. Their jubilee was celebrated in London on October 22.

TRAINING IN WORK STUDY.

Commencing on November 3, the Department of Industrial Administration in the Birmingham College of Technology is offering courses of training in work study—comprising lectures on motion study, time study, job evaluation and incentives—as a means of promoting the more effective utilisation of man-power and productive machinery. The courses are full-time ones, extending over six weeks and consisting of 102 hours of instruction, and the fee charged is 50 guineas. The direction is in the hands of Mr. Geoffrey P. Wade, B.Sc., A.M.I.E.E., M.I.Prod.E., and Mr. Victor N. Picken, A.M.I.E.E., and the courses will be restricted to ten students each, who must be training for, or already holding, positions of responsibility for work study in manufacturing industry. It is stated that "the objective . . . is to establish a thorough understanding of the principles of work study through practice in an extensively equipped work-study laboratory, exchange of experience with teaching staff having many years of practical experience in the field, and through observation of the introduction and management of work study in various Midland companies." Forms of application for admission may be obtained from the Registrar, the College of Technology, Suffolk-street, Birmingham, 1.

LETTER TO THE EDITOR.

WATER HAMMER IN PIPE-LINES.

To the Editor of Engineering.

Sir,—I have hesitated a long time before replying to Mr. Adams' latest attempt to produce a rational formula for water hammer (page 380 of your issue of September 19, 1952). The difference between this and his formula (1), given on page 212 of your issue of August 15, is not merely a matter of adding a small correction; it represents a fundamental change, as shown clearly by his pressure coefficient C_p, which originally amounted to 0·973 and is now quoted at the very much smaller value of 0·001 when the flow is cut off in 0·1 second.

Unfortunately, Mr. Adams has not found it possible to let me see his actual calculations, so that it is difficult to know how he has arrived at a conclusion differing so markedly from test results and accepted theory. Some of his remarks appear to indicate that he may have made the mistake of basing his formula on the principle of conservation of energy, which applies to steady conditions. Whenever elastic bodies are concerned, all dynamic problems must be based on Newton's Second Law and on the conservation of momentum. In the case of pressure and velocity waves travelling along a pipe, the kinetic energy of the water column when it is stopped is not wholly expended in extending the pipe since a certain part of it is always lost.

In case my impression should be wrong, I shall look forward to a full publication of Mr. Adams' calculations and their comparison with test results.

Yours faithfully,

P. Linton.

The British Hydromechanics
Research Association.
October 28, 1952.

OBITUARY.

PROFESSOR J. G. LAWN, C.B.E.

We note with regret the death of Professor James Gunson Lawn, which occurred at his home at Eshowe, Zululand, South Africa, on October 21. Professor Lawn, who was a late director of, and consulting engineer to, the Johannesburg Consolidated Investment Company, Limited, was born at Dalton-in-Furness, North Lancashire, on January 4, 1868. His father, the late Mr. John W. Lawn, was manager of several iron-ore mines in Cumberland, and, as a youth, James Lawn worked for some six years in these mines before coming up to London, in 1888, at the age of 20, to study at the Royal School of Mines. He obtained a Royal Scholarship at the School and the Tyndall Prize in 1889, nd passed out an A.R.S.M. in 1891, having also won the De la Beche Medal, awarded to the best student in mining, and a Murchison Prize for geology. The years 1891 and 1892 were spent as surveyor and engineer at the mines of the Barrow Steel Company and the subsequent two years as lecturer on mining to the Cumberland County Council. In 1893, Lawn returned to the Royal School of Mines as instructor in mine-surveying. His long connection with South Africa commenced in 1896, when he was appointed the first professor of mining at the then newly-formed School of Mines at Kimberley. Six years later, he joined the staff of the Johannesburg Consolidated Investment Company as assistant consulting engineer, but relinquished this post three years later to become head of the Mining Department, Camborne School of Mines, Cornwall.

In 1909, Professor Lawn returned to South Africa as Principal and Professor of Mining at the South African School of Mines and Technology, Johannesburg, but in the following year, he again entered the service of the Johannesburg Consolidated Investment Company as consulting engineer. In 1920, he was made a C.B.E. for his services as Controller of Explosives, Ministry of Munitions. He went back to South Africa in 1919, on appointment as joint managing director of the Johannesburg Consolidated Investment Company. He retired in 1924, but continued as a director and consulting engineer for a number of years. He was President of the Institution of Mining and Metallurgy in 1930-31.

THE ROYAL GREENWICH OBSERVATORY.

Not the least unfortunate effect of the post-war building situation and the present need for stringent economy in national expenditure, is the slow progress in the transfer of the Royal Observatory from Greenwich to Herstmonceux, which the Astronomer Royal, in his annual report for the period May 1, 1951, to April 30, 1952, describes with some justice as the cause of disappointment and a sense of frustration. Although it is now four years since the first sections of staff were moved to Herstmonceux, the only instruments yet installed there are the photoheliograph and the spectrohelioscope. Two refractors, of 26 in. and 28 in. diameter respectively, have been removed to the new site, but they remain dismantled in storage pending the erection of their new housings, and on the score of actual building construction at Herstmonceux there is little to report beyond maintenance repairs to the exterior walls of the Castle, plans for the scientific buildings in prospect, and surveys, including trial borings, of the sites intended for the heavy astronomical apparatus.

Meantime, at Greenwich Observatory, certain urgent repairs of war-damaged buildings, aggravated by subsequent neglect, are in progress and it is a matter for widespread satisfaction that the old observatory is to become an astronomical and navigational annexe to the National Maritime Museum. In particular, the Wren building has been taken over by the Ministry of Works and will henceforward be treated as a historic monument. Very appropriately, also, the historic Observatory instruments, most of which have figured importantly in the development of astronomical science, will eventually be displayed for public inspection in their original surroundings, which include Flamsteed's original observatory and the famous Octagon Room. Especially noteworthy among the instruments are a number of mural quadrants, one of them made by Flamsteed's assistant, Abraham Sharp, and two others known respectively as the Iron and the Brass Quadrants. Also on exhibition will be the 12½-ft. zenith sector, with which Bradley discovered the aberration of light and the mutation of the earth's axis; and Airy's transit circle, installed in the Observatory in 1851, which by international agreement defines the prime meridian. This last-mentioned, famous instrument is still in use and will remain in the position it has always occupied, marking the zero of longitude. The Shepherd 24-hour electric clock will remain in its place outside the main gate of the Observatory. The old custom of dropping the time ball daily at 13.00 hours is to be continued. When the ball was introduced, in 1833, it provided the first public time-signal in Great Britain. War damage interrupted its regular use until May 3, 1951, when it was dropped to mark the opening of the Festival of Britain. For some time subsequently, it was dropped daily at noon but its use at present is in abeyance pending the completion of repairs to the Octagon Room.

The principal equatorial instrument still in regular use at Greenwich is the Yapp 36-in. Reflector with a spectrograph designed primarily for work in the ultra-violet. This range of the spectrum suffers most heavily from absorption, and the examination of the fainter sub-giant stars for luminosity effects correlated with anomalous trigonometric parallaxes, which constitutes the present main programme for this telescope, is consequently rendered somewhat difficult. Moreover, the Yapp reflector works with very low efficiency at Greenwich, for the sky has deteriorated there since the end of the war and night observations are additionally impaired by recent installations of bright street lighting in the near neighbourhood. Nevertheless, the 36-in. reflector must remain in use at Greenwich for an unspecifiable length of time, the next instrument scheduled for transfer to Hertsmonceux being the Cooke Reversible Transit Circle, for which a new coma-free objective has recently been obtained and is at present undergoing appropriate tests. The pavilion at present housing the Cooke instrument at Greenwich is to be dismantled and eventually re-erected at Herstmonceux, where it is to house the Melbourne reversible transit circle. The circle microscopes of the Cooke transit circle are to be fitted with cameras so that the circle readings can be photographically recorded. It is this instrument which has for some time been the subject of a meticulous investigation to discover, and correct, the causes of certain relatively large thermal effects on collimation error. A small proportion of the observed errors has been traced to temperature itself, but the major trouble is attributed to rate of change of temperature and is associated, about equally, with the eye-half of the telescope tube and with the combination of objective end and central cube. Slight warping of the two portions of the tube probably occurs when inevitable temperature fluctuations take place, and a feasible method of arranging the instrument has been devised such that the two component errors practically cancel one another. In this condition, the slight residual collimation error changes by only 0·003 sec. of arc per degree F. change of temperature per hour, and the transit is thus capable of being used satisfactorily.

The new Photographic Zenith Tube, now approaching completion, has been assembled along with its sole plate and supporting pillars, and subjected to mechanical performance tests in the works of the makers, Sir Howard Grubb Parsons and Company. Slight trouble with the reversing mechanism and some undesirable vibration of the stellar plate carriage have been overcome. Vibrations, originating in the driving motors, have been reduced within tolerable limits by additional bracing of the supporting pillars, while the motors, clutches and reversing solenoids have all been enclosed in air-cooled casings. Chronographic records and other observations made with the reversal autocollimator were measured both in the Observatory laboratory at Abinger and at the National Physical Laboratory. They confirm that the mechanical performance of the zenith tube is generally satisfactory and delivery of the instrument to Herstmonceux should not be long delayed. Meanwhile, the control and indicating console is already at the new Observatory, where the design of a machine for measuring stellar plates taken with the photographic zenith tube is in active progress. To assist development and discussion of the project, a full-scale model is used in which settings can be made either visually or by means of a microphotometric criterion. Although the advantages, in principle, of the latter method (based on the system of scanning due to Dr. Furth) are well known and fully appreciated, the decision to adopt a microphotometric method was reached only after inspection of a double-trace scanning microphotometer, which was demonstrated by Dr. Rymer, of Reading, after the Physical Society's Exhibition in 1951. With this apparatus, the criterion of setting is the co-incidence, on a cathode-ray oscillograph screen, of two traces, one of which is the mirror image of the other. Other features of the measuring machine are being designed to conform with the microphotometric principle. They include a ruled glass scale as the basis of measurement and a turntable to rotate the plate-holder and fiducial optical square through 90 deg. The turntable is located on the Y-carriage and moves between two adjustable stops, the actual angle of rotation being measured with high precision on the autocollimator. The plate is lined up by means of a bench jig before its holder is located on the turntable.

The Astrographic Telescope has been used on a large number of occasions throughout the year for systematic observations of Ceres, Pallas, Juno and Vesta, which are the brightest of the minor planets. In response to an appeal by the Copenhagen Observatory, observations have also been made of the minor planet Nemausa, while exposures on Eunomia and Iris have enabled errors in the ephemerides of these planets to be corrected. The best observed comet of the year was 1951 IP/Schaumasse, of which 17 plates were secured over a period of nearly three months. A considerable saving of plates and observing time with this telescope is expected to follow the use, in future, of a camera designed and constructed in the Observatory workshop around a 5½-in. Ross aircraft reconnaissance lens. It will be mounted on the astrographic telescope and will cover, on a single plate, a field 10 deg. in diameter. Star-field tests

have shown that the Ross lens suffers from appreciable coma at 3 deg. off axis, so that its use for accurate positional work is restricted within the smaller field. It will, however, be most useful for search purposes—for example, when a newly-discovered comet is reported but no ephemeris is available; or when an asteroid is reported seriously off its predicted course.

The solar eclipse of February 25, 1952, occurred too late in the Observatory year for any of the results obtained to be described in the present report. The Astronomer Royal has a good deal to say, however, about the purposes and preparations of the British team, and the following points are of special interest as lying outside the scope of most of the descriptions published at the time of the eclipse. The primary programme of the eclipse expeditions was to apply, for geodetic as well as purely astronomical purposes, a technique first tried at Mombasa in 1948, in which, by means of cinema cameras stationed just outside the belt of totality, several thousand accurately-timed pictures are taken of the thin remaining crescent of the sun over a period when its position angle is changing very rapidly. From the combined standpoints of weather prospects with good visibility and of locating observing stations as far apart as practicable, it was decided to have four stations altogether, two in the Sudan and two near the Persian Gulf, one station of each pair being on each side of the belt of totality. The precise situations were: (1) 27 miles north-west of En Nahud; (2) at Tendelti, in the Sudan; (3) at Bat'ha, Iraq; and (4) near Al Jahara, in Kuwait. One observer from Greenwich went to each station, assistance being given at the Persian Gulf stations by the Basra Petroleum Company and the Kuwait Oil Company, while additional observers from the Helwan Observatory co-operated at the Sudan stations where, as a secondary objective, it was hoped to take large-scale photographs showing the profile of the moon's limb at the exact libration of the eclipse.

For this last-named purpose, each of the Sudan stations had a photoheliograph type camera, fed by a coelostat and using topographic base film $5\frac{1}{2}$ in. wide. These cameras were intended to take about one picture per minute for some 20 minutes before and after mid-eclipse. The four ciné-cameras for the major observations were fitted with electrical contacts in phase with the pressure plates of the cameras to record the time of each exposure. In addition, it was arranged for three fiducial points to be photographed on each frame, and for time factors during the eclipse to be determined by electrical contacts fitted to occulting shutters.

At all four stations the equipment was set up and rehearsals carried out well ahead of the important date. The operation of the equipment was, however, seriously hampered by dust, which came intermittently as strongly-driven dust storms, but was also deposited more or less continuously in almost imperceptibly fine and penetrating form. As a result it was found impracticable to lubricate many exposed mechanisms, such as coelostat drives, and they had to be cleaned at frequent intervals and run dry. In some cases the rates of chronometers were very badly affected. The most unfortunate consequences, however, were unforeseen jammings of camera magazines during the actual eclipse, which had not occurred at all during rehearsals and were correspondingly difficult to surmount during the cinema programme time, which lasted only four minutes. At Station No. 1 only about the last minute afforded successful exposures, while at Station No. 3 visibility was impaired by cloud. At the other two places fairly satisfactory films were obtained, and it is believed that only one or two exposures were lost on the photoheliograph at Station No. 2.

(To be continued.)

INCREASE IN STEEL ALLOCATION.—As forecast by the Civil Lord of the Admiralty, Mr. Simon Wingfield Digby, M.P., in the course of an adjournment debate in the House of Commons on October 14, there will be an increase in the allocation of steel for shipbuilding as from January 1, 1953. The allocation for the first quarter of 1953 will be 9 per cent. higher than the allocation for the current quarter.

PUBLIC WORKS AND MUNICIPAL SERVICES CONGRESS AND EXHIBITION.

THE Public Works and Municipal Services Congress and Exhibition, which are to be held at Olympia, London, from November 3 to November 8, will be opened next Monday, November 3, by the Rt. Hon. Harold Macmillan, M.P., Minister of Housing and Local Government. This is only the second occasion—the first was in 1950—that this joint Congress and Exhibition has been held; prior to that year, there were the two independent functions known, respectively, as the Public Works, Roads and Transport Congress and Exhibition, and the Public Health and Municipal Services Congress and Exhibition, each held in alternate years. This year, as in 1950, about 250 British exhibitors will be showing their latest equipment for use in the construction and operation of public works and municipal services. The exhibits will include industrial tractors, heavy-duty motor graders, portable pile-driving plant, cranes, the latest types of industrial Diesel engine, protective clothing for workers and office equipment.

The congress will be held concurrently with the exhibition and during the course of the forthcoming week about 25 papers will be submitted on a variety of subjects ranging from prevention of coast erosion to the planning of parks and cemetries. Among the papers of particular interest to engineers, as opposed to architects and builders, will be four papers on the design and construction of roads, a paper on public lighting and one on sea defences. This paper, "Sea Defences," by Mr. C. H. Dobbie, M.I.C.E., to be given in a session held under the auspices of the Institution of Civil Engineers, is concerned with recent developments in the use of open-work permeable groynes of the type now being laid down around the East Anglian coast and elsewhere. The papers on the subject of roads are as follow: a survey of capital expenditure and maintenance costs in "Road Construction and Maintenance," by Mr. R. Nicholas, C.B.E.; "Why America Builds Better Roads," by Mr. E. W. W. Richards; "Research on Road Traffic," by Dr. G. Charlesworth; and "Soil-Cement Roads," by Mr. K. E. Clare and Mr. J. S. Tanner. The paper "Public Lighting: Operation and Maintenance," is to be presented by Mr. Charles Smith.

Our report of the Exhibition is limited to those items which are new or have not been previously mentioned in detail in ENGINEERING.

OVERHEAD LOADER.

Messrs. Mackay Industrial Equipment, Limited, Faggs-road, Feltham, Middlesex, will be showing an overhead loader manufactured by the Merton Engineering Company, Limited, Feltham; this machine is illustrated in Fig. 1, on page 568. Designed for use with the Fordson Major Tractor, this loader has several advantages over the standard forward-loading shovels; first of the advantages is that the bucket, with a capacity of 14 cub. ft., loads in a straight line from stock pile to truck or dumper, thereby eliminating any slewing or other changing of direction. A second feature is that the drive to the winch operating the bucket is taken from the front of the engine and is therefore completely independent of the main clutch, so saving in wear and cost of renewal. The time taken to complete the cycle of operation from loading the bucket, tipping and returning to the loading position, is 15 seconds. Simultaneously, the machine can travel between the stockpile and lorry in a straight line with no more involved than a change from forward to reverse gear, thereby avoiding undue wear on the front axle and steering gear. That the machine can operate without turning means that it can be used effectively in narrow cuts and confined spaces limited to the width of the machine, which is 6 ft. 10 in.; furthermore, the absence of continual manœuvring avoids making a quagmire of the ground under the wet conditions in which these machines often work. Overhead protection is given to the operator and, despite frequent loading cycles, operator fatigue is small as no arduous full-lock steering is necessary and the combined clutch-brake lever requires only light pressure for its control. The design of superstructure adopted gives an even displacement of load which has made counterweights unnecessary.

TRACTOR WITH ANGLE-DOZER.

Messrs. David Brown Tractors, Limited, Meltham, Yorkshire, are to exhibit for the first time at the Public Works Exhibition. Three tractors will be shown fitted with appropriate muck-shifting equipment, together with a version of the company's well-known industrial power-pack engine. The latter unit is built around a four-cylinder engine such as has been fitted to the company's industrial and agricultural tractors for many years, and may be obtained either as petrol, petrol/paraffin or as Diesel models. Each of these variations have many parts in common, all of them having overhead valves, wet cylinder liners, and replaceable steel-lined main bearings and big-end bearings. The Diesel, petrol and petrol/paraffin versions all have a $3\frac{3}{8}$-in. bore with a 4-in. stroke, and develop 34, 41 and 32 brake horse-power, respectively, at maximum speed. A typical application for which these machines are now being supplied is the 18-kVA generating set, manufactured by Dale Electric (Yorkshire), Limited, Filey, Yorkshire, which is to be exhibited and is illustrated in Fig. 2, on page 568. This self-contained unit forms a convenient and portable source of power for use on constructional sites.

The most powerful of the David Brown crawlers, the Trackmaster 50, will be shown equipped with a Blaw-Knox hydraulic angle-dozer and double-drum power control unit for use with a 4-yard scraper. This tractor is powered by the company's six-cylinder direct-injection Diesel engine with overhead valves; this engine develops 50 brake horse-power at a maximum governed speed of 1,800 r.p.m. The six-speed gearbox, with both high and low reverse gears enables the weight and power of the tractor to be used to the best advantage. The Blaw-Knox blade is 8 ft. 7 in. wide by 2 ft. $3\frac{1}{2}$ in. deep, and can be "angled" to 25 deg. either side of the direction of travel; it is hydraulically operated, the power being provided by a forward-mounted pump driven from the engine crankshaft, and the control valve incorporates a "floating" position. The compactness of the unit, 12 ft. 5 in. by 8 ft. 7 in. (with the blade straight), makes it an ideal medium-sized bulldozer for use in restricted space; it can easily be carried on standard vehicles as its all-up weight does not exceed 5 tons. A similar but somewhat smaller machine, illustrated in Fig. 3, on page 568, the Trackmaster 30, also fitted with Blaw-Knox equipment, will be another of the exhibits on this stand.

"2T" CONCRETE MIXER.

Messrs. Winget, Limited, Rochester, Kent, will be showing, amongst others, the four following items of plant on their stand. The Winget power barrow, or "mechanical moke," as it has been named, will be exhibited again, for experience has shown that it has applications in wider spheres than the building trades for which it was originally designed. For the manufacture of stabilised soil blocks used in the construction of buildings in tropical areas, the company have manufactured and will show a blocking machine which is hydraulically powered. The two concrete mixers that are to be on the stand are both new. The 2T—a 3/2 cub. ft. mixer, illustrated in Fig. 4, on page 568—is the smallest machine of this kind that the company have yet produced and it is expected that it will prove useful both to the building trade on housing sites and also to those who have to deal with maintenance and repair work. It is a compact machine, less than 2 ft. 6 in. in width, which can be supplied with three alternative driving arrangements: a Villiers Mk. 10 petrol engine, a single-phase electric motor with suitable reduction gear incorporated in the power unit, or, with an adapted frame, the mixer may be belt-driven from a tractor. A strong tow-bar, welded to the tubular steel frame, enables the machine to be readily transported from site to site.

WEIGH-BATCHING CONCRETE MIXER.

In contrast to the small mixer, the company will exhibit an entirely new 14/10 mixer, the 10HTH,

EXHIBITS AT THE PUBLIC WORKS EXHIBITION, OLYMPIA.

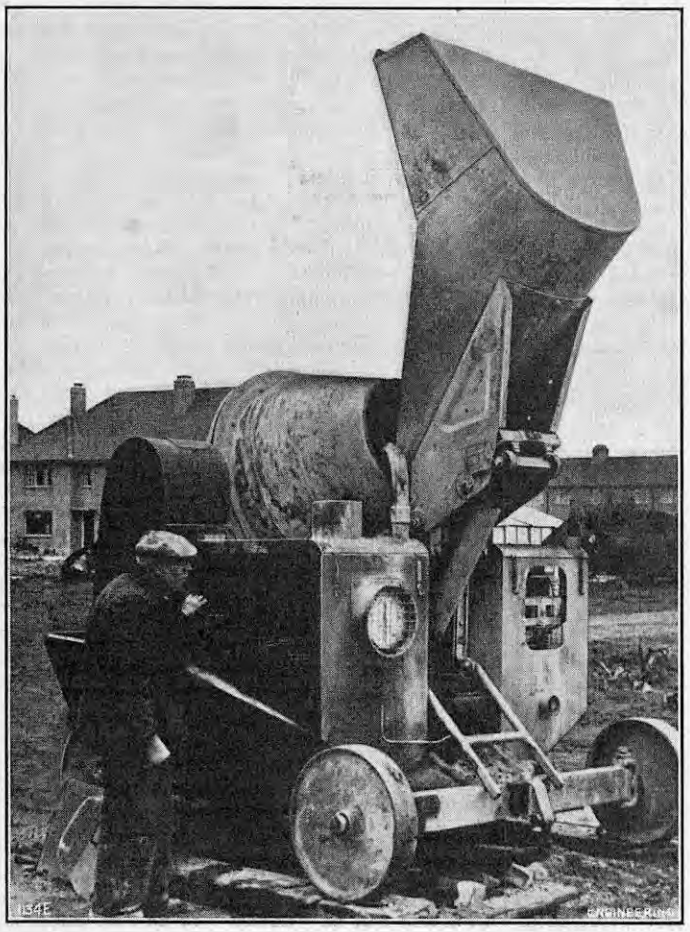


Fig. 5. Weigh-Batching Concrete Mixer: Winget, Ltd.

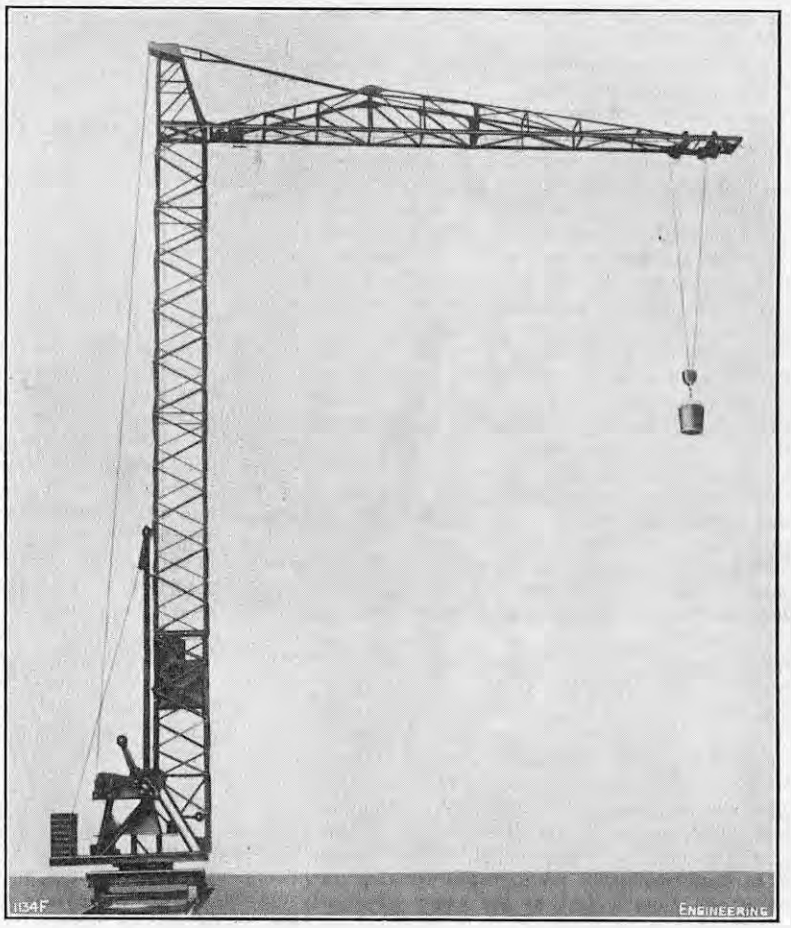


Fig. 6. Travelling Tower Crane: R. H. Neal & Co., Ltd.

illustrated in Fig. 5, herewith, which has a weigh-batching mechanism built into the machine. The water, injected into the drum under pressure, can be accurately gauged in increments of 1 lb., which represents a negligible factor in the water/cement ratio. The very high angle to which the hopper can be raised, 65 deg. elevation, ensures that all the weighed materials are fed into the drum, which works at a particularly flat angle of mix. This flat angle gives the advantages of both tilting and non-tilting mixing, together with a ready discharge. All the movements are hydraulically operated and the complete mixing cycle from loading the hopper to discharging the drum is controlled by three movements of a single lever. When the hopper is lowered to the ground, the drum swings automatically to the mixing position and the water dispenser is charged. When the correct amount of dry aggregate has been weighed into the hopper a single movement of the control lever causes the hopper to lift and the drum to tilt into the filling position; the hopper is then held in the high position, and the water injected into the drum. A second movement of the control lever causes the hopper to return to the loading position, the drum to move into the mixing position and the water dispenser to be recharged. The third position brings the drum to its angle of discharge.

Travelling Tower Crane.

R. H. Neal and Company, Limited, Plant House, Ealing, London, W.5, will be showing four mobile cranes, including two "G.M." models, one with a 40-ft. self-erecting telescopic mast and the other with a 20-ft. straight lattice jib. A particular feature of these two cranes is that they can be steered with the fully-revolving superstructure in any position. A much heavier machine, also being shown, is their well-known "QM" 6-ton crane, running on large pneumatic tyres, equipped with a 45-ft. straight lattice jib, and driven by a Ruston Diesel engine. A new travelling tower crane, with an 80-ft. tower and a 50-ft. cantilever jib, which can be raised into the working position by its own motor in a few minutes, is to be exhibited by the company for the first time and is illustrated in Fig. 6, herewith. The tower, which can be rotated by power through a full circle in either direction, is mounted on a self-propelling steel undercarriage carried on double-flange rail wheels with a wheelbase of 9 ft. 3 in. and at track centres of 8 ft. 6 in. All four motions—hoisting, slewing, travelling and moving the hoisting trolley—are operated by separate electric motors controlled from the driver's cabin, which can be raised inside the tower and so be set at the most convenient height to give the driver a good view of his work. Electric power is taken through a trailing cable, either from 415/440-volts 3-phase supply mains or a portable 15-kW generating set. This crane is self-erecting and, when it is assembled and connected to the power supply, the tower and boom can be raised and lowered in a short time, utilising the main hoisting winch and a short temporary jib mounted on the undercarriage. The undercarriage with this short jib mounted in position forms a useful ancillary of itself, capable of being used as a small depot crane with a capacity of 1 ton. The main horizontal boom is fitted with an automatic cut-out device, actuated by the hoisting trolley, to prevent the lifting of a load in excess of the safety load for the particular position of the trolley. The working capacity of the crane, at a maximum height of lift of 66 ft., is 0·6 ton at 53-ft. radius, with a maximum load of 2·5 tons at 16 ft. Two hoisting speeds are available: 100 ft. per minute for loads up to $\frac{3}{4}$ ton and 30 ft. per minute for greater loads. Full-circle slewing is developed at a rate of 1 r.p.m. and the hoisting trolley has a travelling speed of 100 ft. per minute, which is also the maximum travelling speed of the crane itself. The all-up weight of the crane, in working order, is approximately 17 tons.

Department of Scientific and Industrial Research.

The stand that is to be occupied by the Department of Scientific and Industrial Research will show exhibits from both the Building Research Station, Garston, Hertfordshire, and the Road Research Laboratory, West Drayton, Middlesex. The B.R.S. exhibit will concentrate on domestic plumbing; in particular, on one-pipe plumbing, which is accepted practice in America and on the Continent but which has yet to be adopted in this country, where the two-pipe system is traditional. It is claimed for the one-pipe system that the use of a single stack pipe to receive the discharge from the basin, bath, sink and water-closet of a two-storeyed house gives an improved appearance, especially when the system is so designed that bent pipes can be omitted. A full-scale installation built from transparent piping is to be shown and it will be possible to trace the flow and so observe the ways in which the breaking of the water seal by self-siphonage and induced siphonage can be prevented.

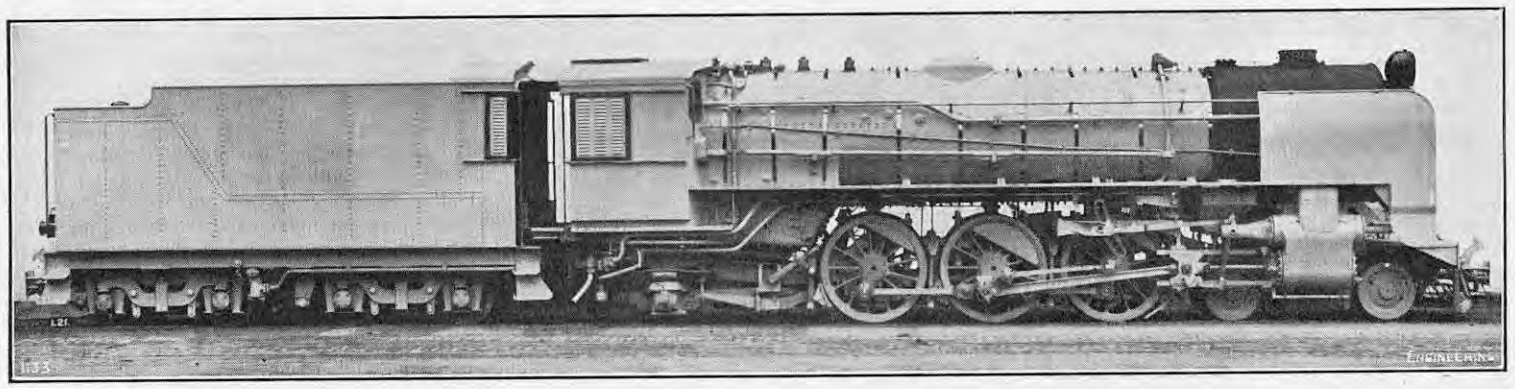
Diagrams, photographs and models will be used to illustrate the work of the Road Research Laboratory on road safety. The relative risk of accidents when crossing roads of different types, the motor-accident rates on main roads and the risks involved in the use of inefficient rear lights will be demonstrated. To show the operation of snow fences in preventing the formation of snow drifts on rural roads, a closed-circuit wind tunnel will be used to provide an imitation snowstorm.

The Laboratory's exhibits will also deal with road making and maintenance, including the use of soil-cement stabilisation of the sub-grades, the laying and testing of tar carpets and other surface dressings. A prototype of a machine that has been designed to reseal the joints in concrete roads will also be available for inspection.

(To be continued.)

Watertight Pendant Switch.—A water-tight pendant push-button switch, which is being marketed by Asea Electric Ltd., Fulbourne-road, Walthamstow, London, E.17, has a body moulded entirely from rubber, except for an inset metal ring. The push buttons are fixed in an aluminium frame covered with moulded rubber, and the mechanism is sealed behind a flexible rubber diaphragm. The switches are available with double-pole contacts which are capable of handling the full current of 400-volt three-phase squirrel-cage motors up to 2 h.p.

PASSENGER LOCOMOTIVE FOR INDIAN METRE-GAUGE RAILWAYS.



PASSENGER LOCOMOTIVES FOR INDIAN METRE-GAUGE RAILWAYS.

THE passenger locomotive illustrated above, though its proportions are suggestive of considerable power, has only a modest tractive effort, namely, 18,450 lb. at 85 per cent. of the working pressure. The reason is that it is designed for metre-gauge tracks and the maximum weight of the engine alone, in working order, is only 57·15 tons; with the tender the total weight is 98·2 tons. The maximum coupled-wheel axle load is 10·6 tons. The overall dimensions are correspondingly small: 11 ft. 2 in. to the top of the chimney and 62 ft. 7½ in. over the engine and tender couplings. The restriction imposed on the maximum weight has led to the use of aluminium plates and sections for the locomotive platforms and cab. The boiler works at a pressure of 210 lb. per square inch and its grate area is 28 sq. ft.; the cylinders are 15¼ in. by 24 in., and the coupled wheels are 4 ft. 6 in. in diameter. The firebox is of steel, completely welded, and is provided with a thermic syphon and two arch tubes. The frames are made of rolled-steel slabs, 3½ in. thick.

The first of these class-YP Pacific locomotives for the Indian Railways, of which 100 are being built, was delivered by the North British Locomotive Company, Limited, Glasgow, last June for passenger-train operation. They are being built to the design and requirements of the Central Standards Office, Ministry of Railways, Chittaranjan, and under the supervision of the consulting engineers, Messrs. Rendel, Palmer and Tritton, 125, Victoria-street, London, S.W.1.

The boiler barrel consists of two rings, the front one tapered in external diameter to 4 ft. 9 in. at the front and 5 ft. 2 in. at the seam with the second ring. Longitudinal seams are treble-riveted, with inside and outside butt straps, and circumferential seams are double-riveted. The distance between the tubeplates is 12 ft. 10¾ in. There are 67 boiler tubes of 2-in. outside diameter, giving a heating surface of 456 sq. ft.; 26 superheater flue tubes of 5¼-in. outside diameter, with a heating surface of 459 sq. ft.; the thermic syphon and two arch tubes with a heating surface of 196 sq. ft.; and a 26-element Melesco superheater with a heating surface of 331 sq. ft. The total evaporative heating surface is therefore 1,111 sq. ft., and the combined evaporative and superheat surface is 1,442 sq. ft. The inner firebox is stayed to the roof of the round-top outer firebox by direct steel stays and four rows of flexible stays at the front. Flexible water-space stays are fitted at the combustion chamber and at the sides and back of the firebox in the breaking zones. A Joco regulator is mounted in the dome and the superheater header is fitted with an anti-vacuum valve. Steam fittings include two I.R.S.-pattern injectors, three 2½-in. Ross "pop" safety-valves, two sets of water gauges and two Evrit blow-off cocks.

The main frames (of rolled-steel slabs, as already noted) are stayed by cast-steel cross-stretchers, and are attached at the rear to a one-piece cast-steel cradle by turned and fitted bolts. The coupled axleboxes are of bronze, with Ajax keeps and grease lubricators. The laminated bearing springs used throughout the locomotive are overhung and are compensated between the leading coupled wheels and the trailing truck wheels. The two cylinders are of cast iron, with renewable liners in the barrels; steel castings are used for the cylinder and steam-chest hind covers and iron castings for the front covers. Walschaerts valve gear actuates 9-in. piston valves, which have a travel of 7 in. Skefko roller bearings are fitted to the crank ends of the eccentric rods, and Timken roller-bearing axleboxes on the engine bogie and truck, those for the bogie being of the split cannon type. Vacuum brakes apply blocks on all coupled and tender wheels, and gravity dry sanding equipment delivers sand in front of the leading coupled wheels. Stone's electric lighting equipment and a B.T.H. speed indicator are provided.

The tender is of the double four-wheel bogie type and carries 3,000 gallons of water and 9½ tons of coal. The tank and bunker are of welded construction and the underframe is built of channel section longitudinals and cross members, with cast-steel drag-boxes at the front and rear. The bogie side frames consist of flanged plates welded together to form a box section—a design evolved originally for the tender bogies of the Indian class-WG locomotives built recently by the North British Locomotive Company, and obviating the need for large steel castings. Skefko roller-bearing axleboxes are used on the tender.

Other principal dimensions are as follow: engine and tender carrying wheels, 2 ft. 4½ in. diameter; engine coupled wheelbase, 10 ft.; engine total wheelbase, 29 ft. 9 in.; and combined engine and tender wheelbase, 53 ft. 7 in.

FORTHCOMING EXHIBITIONS AND CONFERENCES.

THIS list appears in the last issue of each month. Organisers are invited to send to the Editor particulars of forthcoming events.

PUBLIC WORKS AND MUNICIPAL SERVICES CONGRESS AND EXHIBITION.—Monday, November 3, to Saturday, November 8, at Olympia, London, W.14. Organised jointly by the Municipal Agency, Ltd. and the Congress Organising Council. Applications to the Municipal Agency, Ltd., 68, Victoria-street, London, S.W.1. (Telephone: VICtoria 9132.) See also page 143. *ante.*

BUSINESS EFFICIENCY EXHIBITION, GLASGOW.—Tuesday, November 4, to Friday, November 14, at Kelvin Hall, Glasgow. Organised by the Office Appliance and Business Equipment Trades Association, 11-13, Dowgate-hill, Cannon-street, London, E.C.4.

TOOL AND EQUIPMENT SHOW.—Tuesday, November 11, to Friday, November 14, at the Show Mart, Montreal. Organised by the Montreal Tool and Equipment Show, 4585, Sherbrooke-street West, Montreal, Canada.

24TH ROYAL AGRICULTURAL WINTER FAIR.—Friday, November 14, to Saturday, November 22, at Toronto. Apply to the offices of the Fair, Royal Coliseum, Exhibition Park, Toronto 2b, Canada.

27TH INTERNATIONAL CYCLE AND MOTOR-CYCLE SHOW.—Saturday, November 15, to Saturday, November 22, at Earl's Court, London, S.W.5. Organisers: British Cycle and Motor Cycle Manufacturers' and Traders' Union, Ltd., The Towers, Warwick-road, Coventry. (Telephone: Coventry 62511.)

BREWERS' EXHIBITION.—Monday, November 24, to Friday, November 28, at Olympia, London, W.14. Particulars obtainable from the organisers, Trades, Markets and Exhibitions, Ltd., 623, Grand Buildings, Trafalgar-square, London, W.C.2. (Telephone: WHItehall 1371.)

20TH NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING.—Monday, December 1, to Saturday, December 6, at the Grand Central Palace, New York. Organised by the American Society of Mechanical Engineers, 29, West 39th-street, New York 18.

CONFERENCE ON PREVENTION AND SUPPRESSION OF DUST IN MINING, TUNNELLING AND QUARRYING.—Monday, December 1, to Wednesday, December 17, at Geneva. Arranged by the Industrial Safety Division, International Labour Organisation, Geneva, Switzerland.

SYMPOSIUM ON LIGHT-METAL HEAVY FORGINGS AND EXTRUSIONS FOR MODERN AIRCRAFT.—Tuesday, December 2, at New York. Organised by the American Society of Automotive Engineers. For further information, apply to the secretary of the Society, 29, West 39th-street, New York 18, U.S.A.

SMITHFIELD SHOW AND AGRICULTURAL MACHINERY EXHIBITION.—Monday, December 8, to Friday, December 12, at Earl's Court, London, S.W.5. Details obtainable from the Smithfield Show Joint Committee, 148, Piccadilly, London, W.1. (Telephone: GROsvenor 1040.)

RAMSAY CENTENARY EXHIBITION.—Open until Saturday, January 3, 1953, at the Science Museum. Arranged, in collaboration with University College, London, by the Science Museum, South Kensington, London, S.W.7. (Telephone: KENsington 6371.) See also page 475, *ante.*

NETHERLANDS PACKAGING FAIR.—Thursday, January 8, to Friday, January 16, 1953, at Amsterdam. Apply to N.V. Het Raedhuys, Tesselschadestraat 5, Amsterdam, Holland.

PACKAGING EXHIBITION.—Tuesday, January 20, to Friday, January 30, 1953, at Olympia, London, W.14. Held in collaboration with the Institute of Packaging. Organised by Provincial Exhibitions, Ltd., City Hall, Deansgate, Manchester. (Telephone: Deansgate 6363.) Apply as above, or to London office, 167, Oakhill-road, Putney, London, S.W.15. (Telephone: VANdyke 5635.)

FRANKFURT INTERNATIONAL SPRING FAIR.—Sunday, February 22, to Thursday, February 26, 1953, at Frankfurt. *Agents:* Lep Transport Ltd., Sunlight Wharf, Upper Thames-street, London, E.C.4. (Telephone: CENtral 5050.)

RADIO AND TELEVISION EXHIBITION.—Friday, February 27, to Sunday, March 8, 1953, at Düsseldorf. *Agents:* John E. Buck and Co., 47, Brewer-street, London, W.1. (Telephone: GERrard 7576.)

HANOVER FAIR.—*Light Industries Fair:* Sunday, March 1, to Thursday, March 5, 1953, at Hanover. *Heavy Industries Fair:* Sunday, April 26, to Tuesday, May 5, 1953, at Hanover. *Agents:* Schenkers, Ltd., 27, Chancery-lane, London, W.C.2. (Telephone: HOLborn 5595.)

33RD INTERNATIONAL SPRING FAIR.—Sunday, March 15, to Sunday, March 22, 1953, at Vienna. Apply to the British-Austrian Chamber of Commerce, 29, Dorset-square, London, N.W.1. (Telephone: PADdington 7646.)

ROYAL NETHERLANDS INDUSTRIES SPRING FAIR.—Tuesday, March 17, to Thursday, March 26, 1953, at Utrecht, Holland. *Agent:* Mr. W. Friedhoff, 10, Gloucester-place, London, W.1. (Telephone: WELbeck 9971.)

FRANKFURT INTERNATIONAL MOTOR SHOW.—Thursday, March 19, to Sunday, March 29, 1953, at Frankfurt-am-Main. Organised by the Versand der Deutschen Automobilindustrie, Westendstrasse, Frankfurt-am-Main.

Factory Equipment Exhibition.—Monday, March 23, to Friday, March 27, 1953, at the New Horticultural Hall, Greycoat and Elverton Streets, Westminster, London, S.W.1. Further particulars obtainable from Mr. J. E. Holdsworth, Exhibition Offices, 117, Kingsway, London, W.C.2. (Telephone: HOLborn 1414.)

Second National Electrical Engineers' Exhibition.—Wednesday, March 25, to Saturday, March 28, 1953, at Earl's Court, London, S.W.5. Organised by the Association of Supervising Electrical Engineers. Apply to Mr. P. A. Thorogood, 35, Gibbs-green, Edgware, Middlesex. (Telephone: MILl Hill 3528.)

Radio Components Show.—Tuesday, April 14, to Thursday, April 16, 1953, at Grosvenor House, Park-lane, London, W.1. Organised by the Radio and Electronic Component Manufacturers' Federation, 22, Surrey-street, Strand, London, W.C.2. (Telephone: TEMple Bar 6740.)

British Industries Fair.—Monday, April 27, to Friday, May 8, 1953, at Earl's Court, London, S.W.5, and Olympia, London, W.14; and Castle Bromwich, Birmingham. Particulars obtainable from the director, British Industries Fair, Board of Trade, Lacon House, Theobald's-road, London, W.C.1. (Telephone: CHAncery 4411); or the general manager, British Industries Fair, 95, New-street, Birmingham, 2. (Telephone: Midland 5021).

Royal Sanitary Institute Health Congress.—Tuesday, April 28, to Friday, May 1, 1953, at Hastings. Particulars obtainable from the secretary, Royal Sanitary Institute, 90, Buckingham Palace-road, London, S.W.1. (Telephone: SLOane 5134.)

Royal Ulster Agricultural Show.—Wednesday, May 27, to Saturday, May 30, 1953, at Balmoral Showgrounds, Belfast. Organised by the Royal Ulster Agricultural Society, The King's Hall, Balmoral, Belfast.

Bath and West Agricultural Show.—Wednesday, June 3, to Saturday, June 6, 1953, at Bath. Organised by the Bath and West and Southern Counties Society, 3, Pierrepont-street, Bath. (Telephone: Bath 3010.)

British Plastics Exhibition.—Wednesday, June 3, to Saturday, June 13, 1953, at Olympia, London, W.14. Organised by *British Plastics*, Dorset House, Stamford-street, London, S.E.1. (Telephone: WATerloo 3333.)

Three Counties Agricultural Show.—Tuesday, June 9, to Thursday, June 11, 1953, at The Racecourse, Hereford. For further particulars, apply to the Three Counties Agricultural Society, Berrington House, 2, St. Nicholas-street, Hereford. (Telephone: Hereford 3969.)

Business Efficiency Exhibition.—Tuesday, June 16, to Friday, June 26, 1953, at Olympia, London, W.14. Organised by the Office Appliance and Business Equipment Trades Association, 11-13, Dowgate-hill, Cannon-street, London, E.C.4. (Telephone: CENtral 7771-2.)

Second British Instrument Industries' Exhibition.—Tuesday, June 30, to Saturday, July 11, 1953, at Olympia, London, W.14. Apply to F. W. Bridges & Sons, Ltd., Grand Buildings, Trafalgar-square, London, W.C.2. (Telephone: WHItehall 0568.)

Royal Agricultural Show.—Tuesday, July 7, to Friday, July 10, 1953, at Stanley Park, Blackpool. Organised by the Royal Agricultural Society of England, 16, Bedford-square, London, W.C.1. (Telephone: MUSeum 5905.)

19th Engineering, Marine and Welding Exhibition and Chemical Plant Exhibition.—Thursday, September 3, to Thursday, September 17, 1953, at Olympia, London, W.14. Apply to F. W. Bridges & Sons, Ltd., Grand Buildings, Trafalgar-square, London, W.C.2. (Telephone: WHItehall 0568.)

International Textile Machinery and Accessories Exhibition.—Wednesday, October 14, to Saturday, October 24, 1953, at Belle Vue, Manchester. Organised by the Textile Recorder Machinery and Accessories Exhibitions, Ltd., Old Colony House, South King-street, Manchester, 2. (Telephone: Blackfriars 7234-6.)

Building Exhibition.—Wednesday, November 18, to Wednesday, December 2, 1953, at Olympia, London, W.14. Apply to the organisers: Building Trades Exhibitions, Ltd., 4, Vernon-place, London, W.C.1. (Telephone: HOLborn 8146-8.)

"Ten Years of R.E.M.E.": Erratum.—Owing to an error in transcription, the words "War Office," instead of "Whitehall," were printed in the letter from Lieut.-Colonel Stewart Blacker which appeared on page 539 of last week's issue. The sentence concerned, which starts in line 20, should read: "Few people realise that since that year [1793], with one exception (Maida) no army commanded by a Whitehall general, administered by Whitehall and armed with Whitehall weapons, has ever been successful in an independent campaign."

LABOUR NOTES.

Secret ballots should be the rule in determining trade-union policy, in the opinion of Mr. W. G. Hatch, C.C., the chairman of the special (labour) committee of the City of London Corporation. Speaking at the committee's annual luncheon on October 21, Mr. Hatch pointed out that only a relatively small proportion of the best working men attended trade-union meetings and put forward the suggestion that no resolution should be put to the vote at trade-union branch meetings, except by means of a secret ballot. In his view, the Corporation had a firm duty to protect decent working people from the extravagance of extremists. As to wages, the Corporation was anxious to pay the right wages for the right job, but the system of basic wage rates had raised a number of difficulties.

Much had been done by the special (labour) committee during the past two years, Mr. Hatch said, to improve the liaison between those committees of the Corporation which employed manual labour. An intimate connection between them was very desirable and this had previously been somewhat lacking. Sir Godfrey Ince, G.C.B., permanent secretary of the Ministry of Labour and National Service, speaking on the same occasion, said that the Ministry firmly believed in collective bargaining and in the system of joint negotiation. Self government in matters relating to wages and conditions of employment remained the policy of the Ministry.

Reductions in purchase tax, which have taken place in connection with some manufactures, are favourably commented on in the October issue of *Federation News*, published last Friday. This periodical is the official journal of the General Federation of Trade Unions. It emphasises that purchase tax has never been popular and considers that, in some cases, the longer any tax is imposed upon the purchase of British manufactures, the greater becomes the handicap in meeting the present and future prices of goods imported from overseas. This is especially the case with manufactures which require considerable skill and craftsmanship, in that it creates a psychology that is most harmful to the trades concerned. Many employers have already complained to the Federation, the journal records, that they are much concerned about their supply of skilled craftsmen when normal times return to their trades. They fear that workpeople with the requisite skill may no longer be available when needed. The journal feels that this state of affairs has happened too often before.

A new industrial climate was being created, in the opinion of Mr. Lincoln Evans, C.B.E., the general secretary of the Iron and Steel Trades Confederation, in which the whole tone of Britain's industrial relationships was undergoing such a transformation that it was rapidly making old hostile attitudes completely out of place, and something of an irrelevance. In the course of a special article on "Trade Unions To-Day" published in the November issue of *Ingot*, the house magazine of Messrs. Richard Thomas and Baldwins, Limited, 82, Brook-street, London, W.1, Mr. Evans states that people were now living in a rapidly changing world in which the old patterns were giving way to new, and that in this country, within a period of a little over ten years, they had seen what amounted almost to a revolution, with a consequent shift in the sources of influence and power in the community. Trade unions had now moved into powerful strategic positions. Their status in industry and in the life of the nation had been greatly enhanced and their influence considerably widened.

Although the trade-union movement had been born out of conflict and grew up in that atmosphere, it was feeling its way towards a system of better relations in industry even before the battle for its survival had been won. The pioneers of trade unionism in the iron and steel industry, Mr. Evans declares, had had the sense to see that, in the last resort, little was to be gained by trying to resolve industrial disputes by trials of strength, because such battles usually imposed needless suffering on workpeople and their families, and often did grave damage to the industry itself. They believed that, as at some time discussions between the two sides would have to take place, it was better that these should be held before a strike began, rather than in the embittered atmosphere which prevailed after one.

The underlying thought behind that reasoning was the knowledge that managements and workpeople shared equally in the efficiency and prosperity of the industry. Although managements were regarded as the agents of the employers, the fact was that their interests lay closer to those of the workpeople than to those of the shareholders. Inefficiency in any plant, Mr. Evans affirms, might affect only a small part of a shareholder's investments, but, for managements and workpeople, it was a question of their whole livelihood. Differences as to how the proceeds of an industry were to be shared had sometimes tended to obscure those facts. These same differences had generated the idealogical conception that industry was a place where managements and employees belonged to opposite camps engaged in a ceaseless class struggle, although to what end no one had yet made clear.

To the young trade unionist Mr. Evans says that there is a growing realisation of the hard truth that the standard of living which any country could afford for its people depended on the total amount of goods and services which, by the full use of its resources, it could produce. As far as Britain was concerned, all the signs indicated that no significant increase in the country's living standards was likely to be obtained by any further distribution of the proceeds of industry. One of these signs was that every time the level of wages was increased, the gain was swallowed up by increases in prices. These left the position the same as it was before, if not worse. It was the recognition of this position that compelled trade unions to take an interest in higher productivity. The time had passed when trade unions could be concerned only with wages and conditions.

The award of the Railway Staff National Tribunal, announced on October 22, has now been accepted by all the parties concerned. The Tribunal recommended increases varying from 3*s*. to 7*s*. a week for various grades of railway employees, and about 450,000 men, women and juveniles in the service of British Railways will benefit from the award, which, it is estimated, will add approximately ten million pounds a year to the industry's wage bill. Both the National Union of Railwaymen and the Associated Society of Locomotive Engineers and Firemen announced their acceptance of the Tribunal's award shortly after its terms were made public. The executive committee of the Transport Salaried Staffs' Association, the third railway union concerned in the joint wage claims which gave rise to the award, met in London on Sunday, to consider the Tribunal's recommendations. All the unions, when announcing their acceptance, have expressed their disappointment at the amount of the increases. The Railway Executive announced on Tuesday that, with the approval of the British Transport Commission, it had decided to accept the award.

Some opposition to the offer of the engineering employers of a wage increase of 7*s*. 4*d*. a week, equal to an advance of 2*d*. an hour, was reported at the end of last week. At a mass meeting in Glasgow on Friday, stated to have been attended by more than 1,500 men in the employment of Messrs. G. and J. Weir, Limited, a resolution was carried rejecting the offer and demanding the immediate imposition of the ban on overtime and the restriction of piecework. On the same day, the offer was rejected in full at a meeting of the national executive council of the Amalgamated Union of Foundry Workers in Manchester. A statement issued at the close of the meeting described the offer as "quite inadequate" and called for the application of bans on overtime and piecework to be put into operation on November 3 and to be continued until satisfaction was obtained.

RESCUE LAUNCH FOR THE ROYAL AIR FORCE.

VOSPER, LIMITED, PORTSMOUTH.

FIG. 1. PROTOTYPE LAUNCH AT SPEED.

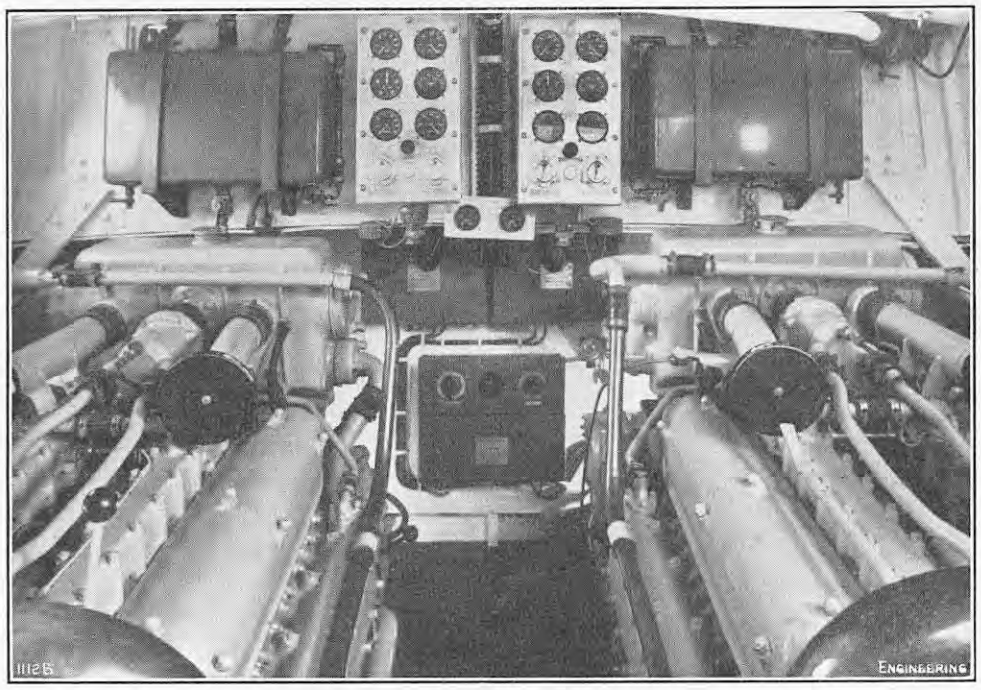


FIG. 2. ENGINE ROOM.

46-FT. AIR-SEA RESCUE LAUNCH.

THE 46-ft. crash rescue tender illustrated above has been designed for rescuing survivors from crashed aircraft, fighting aircraft fires and assisting in the salving of crashed flying boats or marine craft generally. The tender was built by Vosper, Limited, Portsmouth, and has a top speed of 28·8 knots, some 10 knots faster than any known similar craft. The vessel can operate at this speed for five hours or cruise for 11 hours. The hull is of the high-chine type with beech-ply framing and double diagonal mahogany planking. Four bulkheads divide the hull into five compartments and it is decked with a raised casing over the engine room, sick bay and fore cabin. An after cockpit provides stowage for rescue equipment. The five compartments consist of a forepeak, a forecabin and wheelhouse, sick bay, engine room, cockpit and after peak. The forepeak is formed by a watertight bulkhead fitted with an access panel and is arranged as an anchor-chain locker. Immediately abaft the forepeak is a toilet and abaft this again the galley and a wireless recess. The wheelhouse is situated between the galley and the sick bay. Forward of the engine room bulkhead is a gas-tight compartment for the fuel tank. The engine room, shown in Fig. 2, is separated from the sick bay and the cockpit by water-tight bulkheads access being gained through a hatchway in the coach roof. The cockpit is formed by a flat over the afterpeak, and foam-compound tanks are installed along the port and starboard sides. The twin rudders are in line with the propeller shafts; the blades and stocks are single-piece castings of nickel-aluminium-bronze, mounted in bearings and glands of the same metal. The tillers are linked to a positive cam-type steering box. The car-type steering wheel is connected by chains to control rods along the port side and thence to the steering box in the afterpeak. The single-strut propeller brackets are nickel-aluminium-bronze castings, fitted with Cutless rubber bearings.

The craft is propelled by twin screws, each driven by a Rover "Meteorite" Mark 203 petrol engine. The Meteorite engine is an eight-cylinder unit with the cylinders arranged in two banks of four, set at 60 deg. to each other. It has a bore and stroke of 5·4 in. and 6·0 in., respectively, and for this particular duty is rated to develop 375 brake horse-power at 2,400 r.p.m.; the maximum possible output, however, is far in excess of this. Each engine is fitted with a Mathway reversing gearbox, the two forming a single unit, each of which is supported through resilient mountings on two longitudinal rails, at the forward end of which are the lubricating-oil service tank, oil filters, oil thermostat and a combined oil and water cooler. Engine cooling is effected by an enclosed fresh-water circuit which incorporates a heat exchanger, the fresh water and salt water being circulated through their respective systems by engine-driven pumps. On leaving the cooler, the sea water passes through the exhaust-pipe jacketing and is then injected into the exhaust pipe. The engines are lubricated on the dry-sump principle, each system incorporating a gear-type pressure pump and two scavenge pumps. The oil is directed into each system through a pressure regulator which divides it into two streams, a high-pressure stream for lubricating the main and big-end bearings and a low-pressure stream for supplying the valve mechanism and auxiliary drives. A carburettor is fitted to each bank of cylinders and two magnetos are provided, one serving the exhaust-side plugs and the other the inlet-side plugs. A wheelcase at the after end of each engine houses the flywheel and the drives for the auxiliary components, and provides a mounting for the gearbox.

Direct drive is employed, the gearboxes giving astern movements only. The drive is transmitted to each unit through a driving plate provided with a number of Silentbloc bushes to give a cushioning effect. In the gearbox the drive is taken through a pair of bevel crown wheels and three planetary pinions of a differential gear. Each crown wheel is attached to a multi-plate clutch and the output crown wheel is also splined to the propeller shaft. This complete assembly is mounted within a gear-case to which is bolted the drum of an internal-expanding brake. The two clutches are operated in unison and for ahead drive are engaged, thus locking the assembly and turning the propeller shaft. For astern drive, the clutches are disengaged and the brake applied; this causes the gearcase to be held stationary and the input crown wheel to revolve relatively to the gearcase, the drive, as a consequence, being transmitted through the planetary bevel pinions to the output crown wheel, which, of course, rotates in the opposite direction. The clutches and reverse brake are operated by a hydraulic unit controlled remotely from the wheelhouse, the hydraulic unit incorporating an interlocking device which prevents engagement of the ahead clutches and astern brake when the throttle is open.

The main function of the tender is to carry out rescue operations at sea and the equipment installed for this purpose is, therefore, exceptionally comprehensive. It includes scrambling nets, a portable davit and winch, line-throwing rockets and breaking-in tools, such as axes, crowbars, wire-cutters, etc. The fire-fighting services are exceptionally comprehensive and comprise two $3\frac{1}{2}$-in. hand-operated monitors, capable of delivering water or foam, hinged 1-in. nozzles being brought into use for the former duty. Foam is delivered by a pump of the rotary-vane type; this is situated at the after end of the engine room and is chain-driven from a Ford V.8 petrol engine. The engine is fitted with a standard Ford clutch and gearbox, but the selector mechanism is arranged so that only second and third gears can be engaged, third gear being used for foam production and second gear when pumping water.

The pump was supplied by The Sun Engineering (Richmond) Limited, of Kingston-on-Thames, and is designed to deliver from 2,250 to 2,500 gallons of foam and 500 to 600 gallons of water per minute with the speeds of 1,800 r.p.m. and 500 r.p.m., respectively. The suction line is fitted with a branch line which terminates in a connection at the cockpit for use when the vessel is employed on salvage work. At the outlet side of the pump two branch deliveries each incorporate a mixing chamber for emulsifying the foam, each branch serving a monitor. To avoid losses when water only is being pumped, each mixing chamber is provided with a by-pass line. The monitors operate through 360 deg. in the horizontal plane and up to 90 deg. in the vertical plane.

"PIP"-PLACING MACHINE FOR THE POTTERY INDUSTRY.

GEORGE H. WHITEHOUSE AND SON, LIMITED, GREAT BRIDGE, STAFFORDSHIRE.

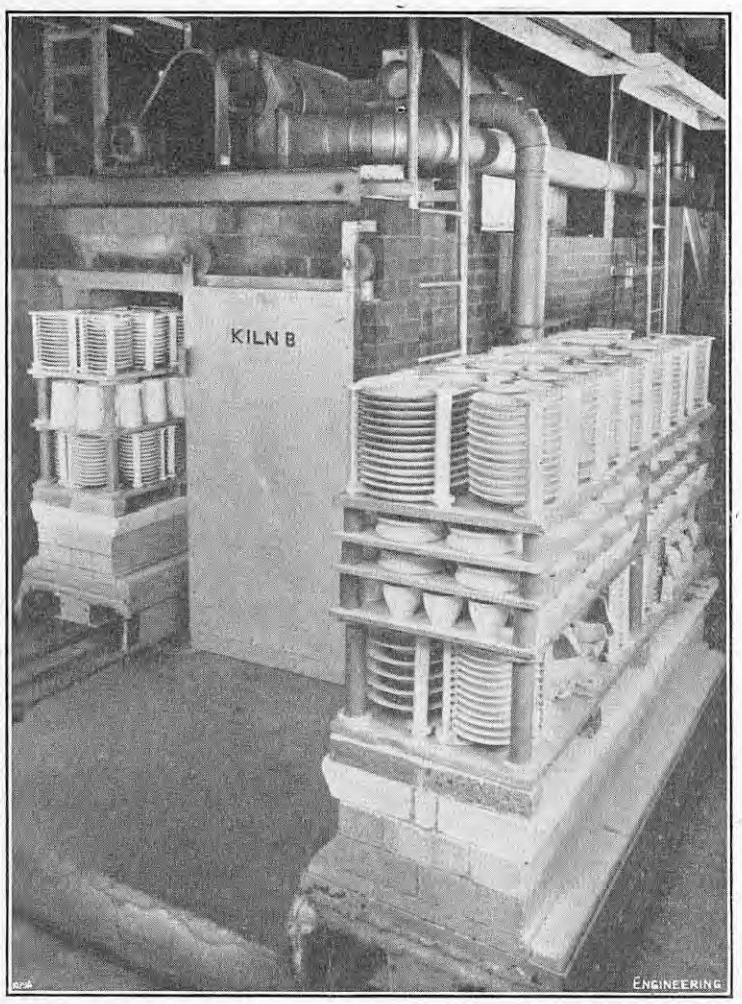


Fig. 1. "Crank" of Pottery ready for Kiln.

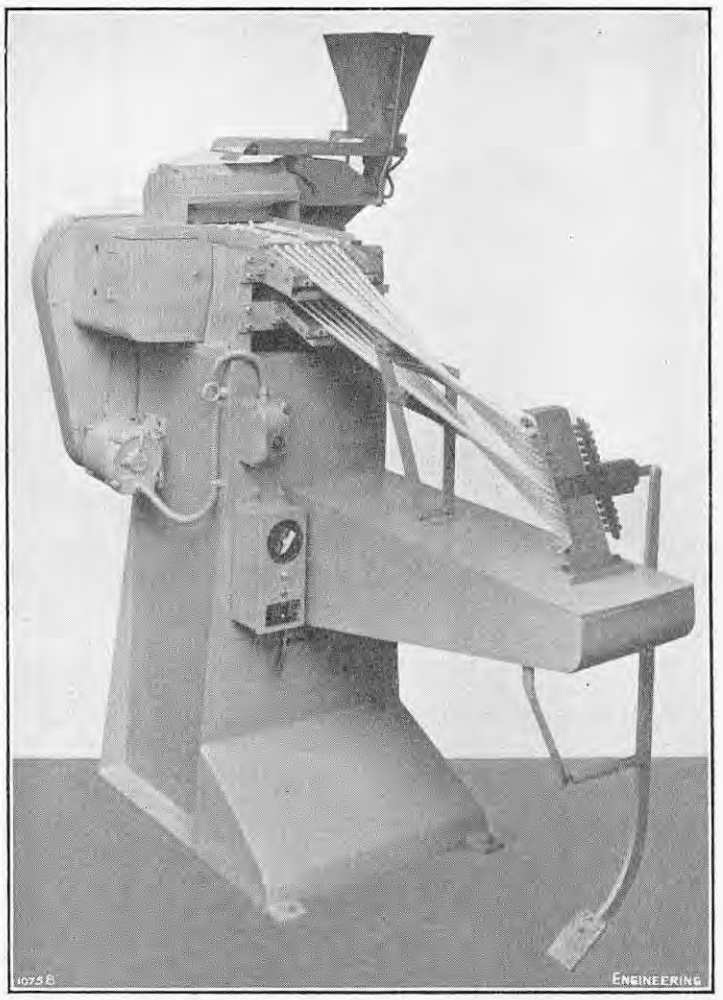


Fig. 2. Operating Side of Machine.

"PIP"-PLACING MACHINE FOR THE POTTERY INDUSTRY.

In the "glost" firing of pottery (that is, when the glaze has been applied), it is obviously necessary to support the ware in such a way that the pieces cannot touch each other. The supports must also have the minimum area of contact with the pieces, so that the marks on the finished products are as small as possible. It is the custom, therefore, to support the ware on pointed pieces of fired clay. In the older type of kiln, saggars, or fireclay containers, are used to protect the ware from the products of combustion, and the pointed pieces of fired clay, known as "thimbles," are attached to the inner walls of the saggars by plastic clay. A considerable amount of pottery, however, is now fired in continuous electric kilns or gas muffle-type kilns, in which the products of combustion cannot come into contact with the ware. This method of firing has developed greatly in the past few years, and is rapidly becoming the standard for the industry. As the ware can now be fired without the protecting saggars, new methods of supporting it had to be found.

Fig. 1, herewith, shows a type of support designed for use in modern kilns. It is an assembly of five components; a base, three identical pillars, and a top. Spigots on each end of the pillars fit into sockets in the bases and tops, and the sockets are arranged in steps so that the pillars can be set to accommodate several different diameters of pottery pieces. The complete fitting is known as a "crank." The pillars, which can be seen in the illustration have a number of projecting arms. Each of these arms carries at its extremity a renewable fired clay "pip," which is a piece of clay about $\frac{15}{32}$ in. in diameter and $\frac{3}{16}$ in. high, in the form of a flat hollow cone with a sharp point. These form the actual supports for the pottery. The crank assembly has a long life, passing through the kiln many times, but the pips are so low in cost that they can be thrown away after they have been used once. The use of new pips each time that pottery is placed on the crank ensures that the ware always rests on sharp clean points. Shallow pockets are provided on the pillar projections to accommodate the pips, and it is possible to place them in position by hand; but, to take full advantage of the low cost of the pips, a mechanical method of placing them on the pillars is necessary.

The machine shown in Figs. 2 to 4, on this and the opposite pages, has been designed for this purpose by Messrs. George H. Whitehouse and Son, Limited, Great Bridge, Staffordshire, in conjunction with the makers of the cranks, Messrs. J. Hewitt and Son (Fenton), Limited, of Fenton Low, Stoke-on-Trent. It is operated by unskilled labour, and the speed of working is only limited by the rate at which the operator can place empty pillars in position in the machine, and remove the filled ones. Experience has shown that ten pillars a minute can be handled with ease.

From the point of view of automatic feeding, the pips present certain difficulties. They are fairly easily damaged if roughly handled, and if the point is destroyed the value of the pip is lost; they must, therefore, be handled as little, and as gently, as possible. When allowed to fall freely, as from a hopper, the pips will rest either way up; but they are relatively unstable when resting on their points, and are not difficult to overturn by mechanical means so that the point is upwards; but, because of their shape, one pip may ride on the top of another, and when they are in this position it is not easy to remove the top one. Accordingly, provision is made in the design of the placing machine to prevent any riding from occurring as the pips leave the feed hopper.

The machine has four principal units, namely, a feed hopper; a feeding device which not only controls the rate of feed, but also arranges the pips in a single layer, one pip high; sorting trays, which ensure that all the pips are resting on their bases; and a mechanism for placing the pips in position on the pillars. The general appearance of the machine is shown by Figs. 2 and 3. It is constructed mainly of fabricated mild-steel plate, $\frac{3}{8}$ in. and $\frac{1}{4}$ in. in thickness. The pips, as received in quantity from the makers, are placed in the feed hopper, which can be seen at the top of the machine in Figs. 2 and 3. There is no discharge gate, the rate of feed from the hopper being controlled by a variable-speed electric tray-type vibrator, which draws the pips from the hopper at a speed which is set to match the rate at which they are disposed of by the placing mechanism. A hand-set control (which can be seen on the main body of the machine in Fig. 3, below the feed hopper) is provided to adjust the speed of the vibrator. Once this adjustment has been made, it is not necessary to alter it so long as the conditions remain unchanged. The vibrator tray is set close to the bottom of the feed hopper, thus ensuring that only a thin stream of pips will issue when the machine is running, and that the pips will be held at their natural angle of repose when it is switched off. As the pips leave the vibrator they fall into a divided chute, which sends approximately half the stream to each of two reciprocating trays, mounted one above the other at right angles to the direction of feed flow. The discharge ends of the divided chute are brought to within about $\frac{5}{16}$ in. of the surfaces of the trays, and this ensures that the pips pass on to the trays in a single layer, so preventing one pip from riding on another.

The discharge ends of the divided chute extend over the whole width of the trays, and the pips are thus scattered singly over the surfaces. The trays,

"PIP"-PLACING MACHINE FOR THE POTTERY INDUSTRY.

GEORGE H. WHITEHOUSE AND SON, LIMITED, GREAT BRIDGE, STAFFORDSHIRE.

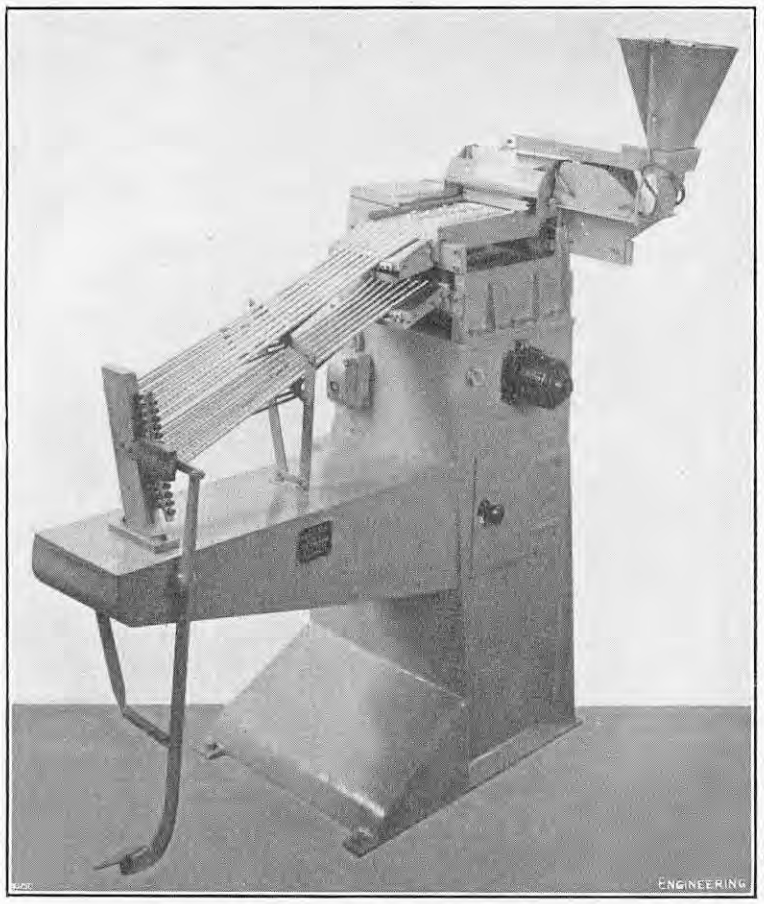


FIG. 3. REAR OF MACHINE.

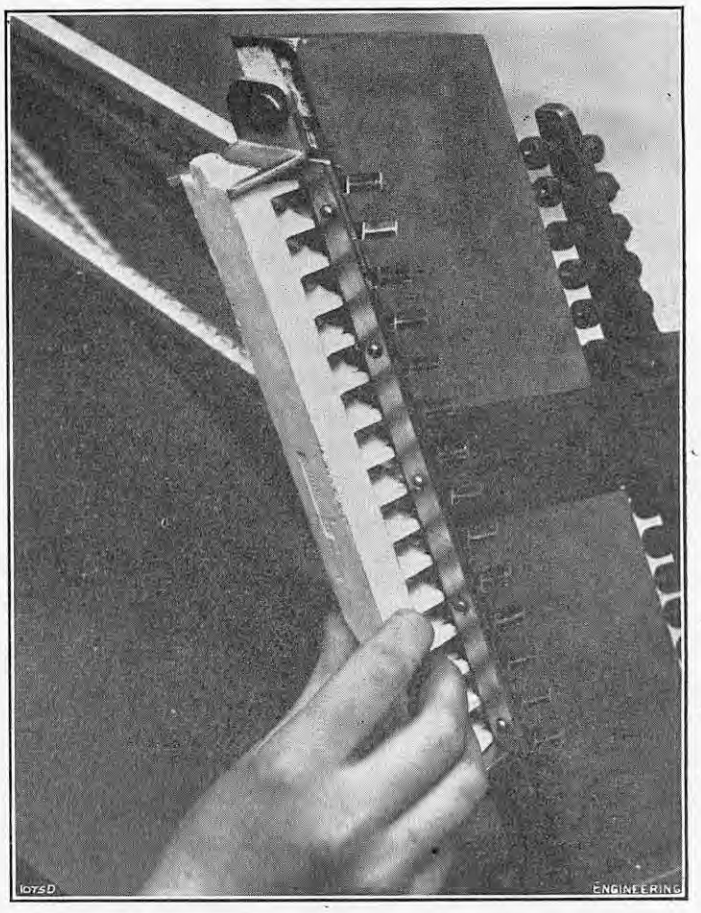


FIG. 4. PILLAR WITH "PIPS" INSERTED.

the upper one of which can be seen in Figs. 2 and 3, are both inclined downwards at a small angle towards the placing mechanism at the extreme end of the machine. As the trays are reciprocated, the pips travel along them in the direction of the placing mechanism, and the trays, though primarily intended as a sorting mechanism, also act as conveyors. Hardwood is used for the surfaces of the trays, which are reciprocated at right angles to the direction of travel of the pips. Any pips which fall on to the trays point downwards are caught by their points in the fibrous structure of the wood, and the reciprocating motion causes them to overturn and rest on their bases. Those which fall on their bases as they leave the divided chute, remain in that position, and all the pips are thus point upwards when they reach the ends of the trays.

The trays are each carried on two rows of $\frac{7}{8}$ in. diameter needle rollers, and are guided by two strips of oil-impregnated sintered phosphor bronze. A $\frac{1}{4}$-h.p. electric motor drives, by means of a V belt, a shaft connected to a second and identical shaft beneath it by a light roller chain. On each of these shafts is an eccentric, which is connected to a bracket on the underside of the tray by means of a short connecting-rod. All the rotating parts are carried on plain phosphor-bronze bearings, for which grease-gun lubrication is provided. The trays reciprocate at 350 strokes a minute, the stroke being $\frac{3}{4}$ in., and, as the eccentrics are set at 180 deg. to each other, the movements of the trays are balanced. This balancing, coupled with the fact that the main bodies of the trays are of aluminium, prevents unnecessary vibration. A push-button starter, visible in Figs. 2 and 3, is provided for the motor, and this also controls the feed vibrator, so that feeding and sorting are started and stopped together.

When the pips reach the discharge ends of the trays, they are all in a single layer, and point upwards. It now remains to marshal them into single lines and lead them to the placing mechanism. Marshalling channels are provided at the discharge ends of the trays. There are 16 channels, eight for each tray, and they are slotted so that they not only arrange the pips in single lines, but also eliminate broken pieces, dust, and imperfect pips, which fall through the slots into receptacles beneath. From the marshalling channels there are 16 chutes, which fan out from the horizontal plane and lead the pips into a vertical single line at the placing mechanism. The angle of fall on the chutes is important. Too steep an angle would cause over-running of the pips, and consequent jumping out of position, while, if the angle were not steep enough, the pips would not travel at all. It is obvious that the angles of all the chutes will be different, and it is necessary to have an average angle of fall which will allow feeding without over-running. This is achieved by duplicating the sorting trays in the vertical plane. To ensure that the chutes shall be "alive," an electric vibrator is built into the arm of the machine which carries both the placing mechanism and the chute support bracket, and single-leaf springs are fitted beneath each chute. These springs are partly visible in Figs. 2 and 3. By varying the pressure of the springs on the undersides of the chutes, and by adjusting the speed of the vibrator, it is possible to obtain just the degree of vibration required to keep the pips moving steadily. The control for the chute vibrator can be seen below the motor starter in Fig. 2.

At the ends of the chutes the pips pass into separate compartments in the placing mechanism, shown in Fig. 4. Each compartment is designed to be just large enough to hold one pip, and is open at the front to allow the pip to be pushed forward on to the pillar projection when a pillar is in position. As soon as the machine is switched on, the pips travel down the feed vibrator, across the reciprocating trays, and down the feed chutes into the placing mechanism. The machine is then ready for use. An operator seated at the front of the machine places a pillar in position in the two open-fronted guides on the placing mechanism, and depresses the pedal. This brings forward 16 plungers, which enter the compartments in the placing mechanism, and so push all the pips forward and allow them to fall into the shallow cavities in the pillar projections. The pedal is then released, the plungers are returned by a spring acting on the pedal lever, and the compartments are immediately re-filled with pips from the chutes. Meanwhile, the operator has removed the filled pillar and placed it in a rack. Another empty pillar is placed in the guides, and the cycle is repeated. The empty pillars, before they are brought to the machine operator, are dipped, projections downwards, into a shallow vessel containing adhesive, which thus coats the ends of the projections. The pips therefore fall on to a thin film of adhesive, and this, after it has been allowed to set for about an hour, fixes them firmly in position. The pillars are now ready for assembly into the cranks, and as soon as this is done, the pottery can be placed in position ready for firing. During firing, the adhesive is destroyed, and after the ware has been unloaded, it is only necessary to remove the pillars from the bases and give them a single shake sideways to cause the pips to fall off, leaving the pillars ready for re-use.

The machine described deals with pillars having 16 projections. To meet the requirements of the pottery industry, other pillars are made, with different numbers of projections, and the machine can be modified to feed pips on to these pillars in exactly the same way. The only alteration needed is to provide a different placing mechanism, with the appropriate number of pip compartments, and the same number of feed chutes and marshalling channels. At present, the machine is made to deal with pillars having 12, 14 or 16 projections.

AUTOMATIC PROCESS TIMER.—Electrical Remote Control Co., Ltd., Harlow New Town, Essex, have produced a fully-automatic multi-unit process timer, which can be used to open or close an electrical circuit for a pre-set time. In addition, it can be employed to close or open a circuit after the elapse of a predetermined interval. It consists essentially of a synchronous motor, electromagnetic clutch and the necessary time setting and re-setting mechanisms. Maximum time settings for any period from 60 seconds up to 12 hours are available.

SHOT PEENING AND THE FATIGUE LIFE OF STEEL.

Fig. 5. ESTIMATION OF PENETRATION OF BENEFICIAL DEPTH.

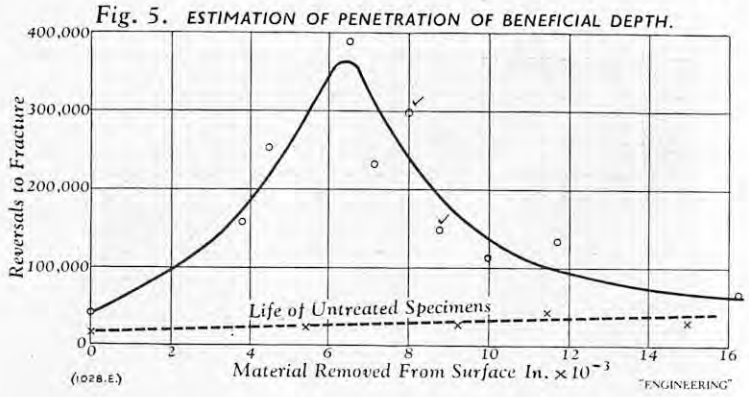


Fig. 8. EFFECT OF PEENING PRESSURE ON PENETRATION.

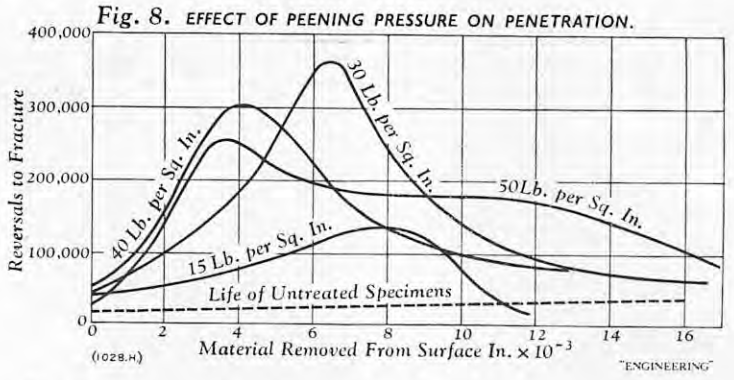


Fig. 7. EFFECT OF REMOVAL OF SURFACE.

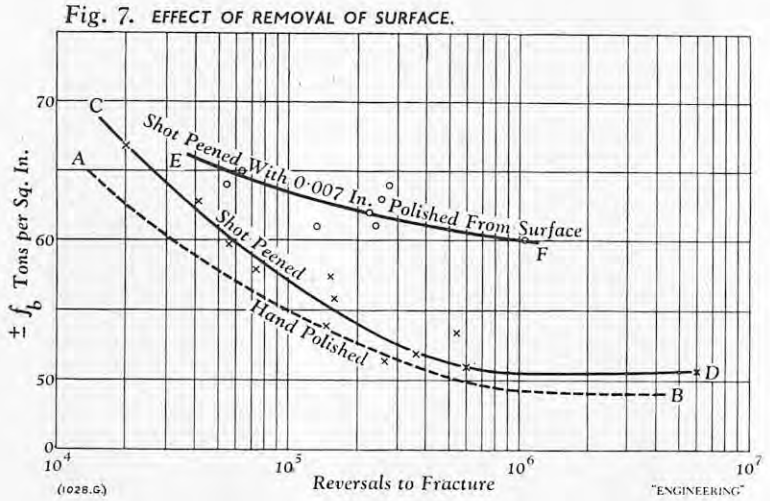
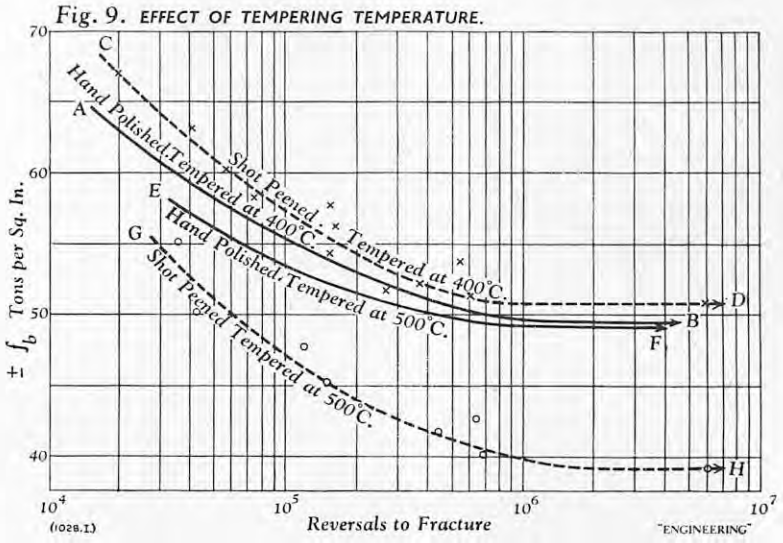


Fig. 9. EFFECT OF TEMPERING TEMPERATURE.



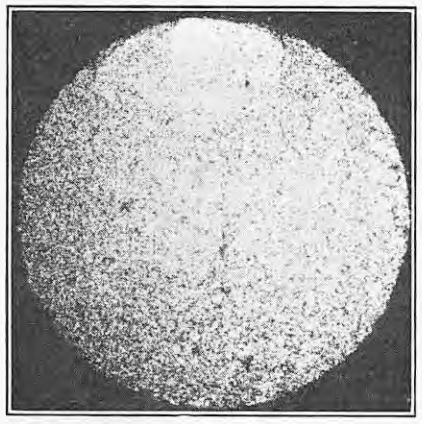


FIG. 6. SUB-SURFACE FRACTURE.

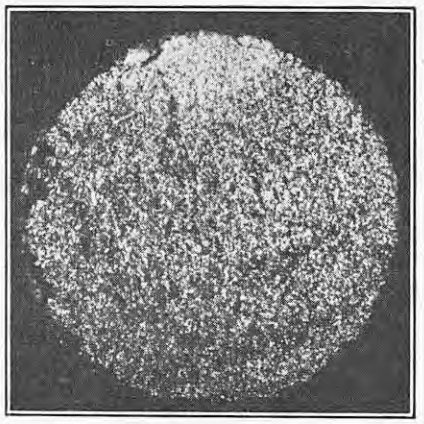


FIG. 10. FRACTURE OF PEENED SPECIMEN TEMPERED AT 400 DEG. C.

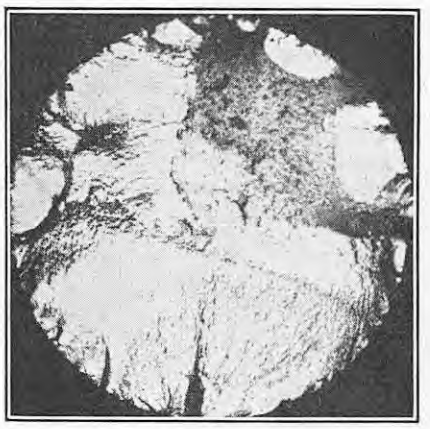


FIG. 11. FRACTURE OF PEENED SPECIMEN TEMPERED AT 500 DEG. C.

THE EFFECT OF SHOT PEENING ON THE FATIGUE LIFE OF STEEL.*

By A. G. H. COOMBS, Ph.D.

(*Concluded from page* 546.)

Test Results.—Fig. 5 shows the variation of fatigue life in shot-peened specimens having varying amounts polished from the surface and tested at constant stress in rotating bending. These specimens were peened at 30 lb. per square inch gauge nozzle pressure, with a mean shot flow of 14½ lb. per minute of No. 14 gauge shot and an exposure of 35 seconds. The range of stress ± 63 tons per square inch is located near the top of the sloping portion of the fatigue-life curve for shot-peened specimens. This procedure not only ensures that all specimens will fail, but also has some advantage in reducing the scatter of the test results. The curve shows that as material is removed from the surface of successive specimens, the fatigue life increases to a maximum and then decreases again to values commensurate with those for plain polished specimens. The dotted line in the figure indicates the life of plain polished specimens as material is removed from the surface. The points which have been marked with a tick in Fig. 5 are for those specimens which exhibited a sub-surface type of failure. A typical fracture is shown in Fig. 6. The point of initiation of failure is the small white area, just below the surface of the material.

During the polishing of layers from the surface of the specimens the depth of the indentations produced by the peening was estimated. Pits could be observed in the surface up to a depth of approximately 0·003 in. Some of the increase can therefore be attributed to the removal of the stress-concentration effect of the surface roughening. The improvement in fatigue life with the removal of subsequent layers is seen to persist to layers below those in which the last traces of pitting was observed. In the early stages of the research it was considered that the distribution of residual compressive stress below the surface of the material was wholly responsible for the fact. It was therefore thought desirable to investigate the S-N curve for a series of peened specimens having sufficient material polished from them to bring the layer in which the maximum fatigue life was obtained (as shown in Fig. 5) into their surfaces. Later in the research, a third factor, which is considered very important, in that it emphasises the dangers of over-peening, was uncovered. This problem will be discussed after the S-N curve for shot-peened and polished specimens has been presented. These specimens each had 0·007 in. polished from the surface and were all finished with No. OOO emery paper.

The curve is shown in Fig. 7, together with S-N curves for as-peened specimens and plain-polished specimens of the material. Considerable difficulty was experienced with fretting corrosion in the chucks in these tests and the fatigue limit for the series was not obtained. The improvement to be gained by this process, however, is clearly demonstrated. Only a small improvement is shown between the curves for as-peened and plain-polished specimens. For some components which are to be subjected to fatigue stressing it is possible that the rough surface left by the peening operation is a consideration which militates against shot peening. The specimens used for the curve EF, Fig. 7, all had the peening marks removed and the result shows that the removal of these layers has not

* Paper read before Section G of the British Association at Belfast on Tuesday, September 9, 1952.

SHOT PEENING AND FATIGUE OF STEEL.

FIG. 12. HARDNESS 640 V.D.H.; × 500.

FIG. 13. HARDNESS 560 V.D.H.; × 500.

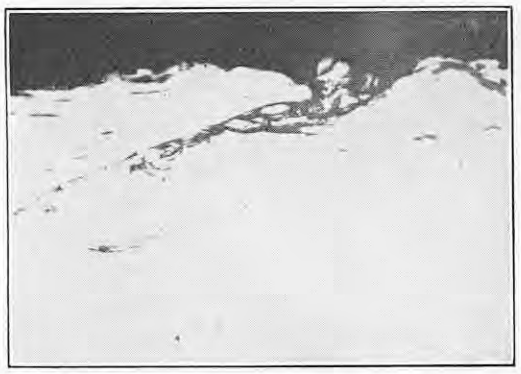


FIG. 14. HARDNESS 480 V.D.H.; × 500.

FIG. 15. HARDNESS 300 V.D.H.; × 500.

destroyed the advantages to be obtained by shot peening, but has, in fact, enhanced them. It is thought that where finish machining processes could be carried out after peening, this method could be used with advantage. It must be remembered, however, that this method could only be applied to parts where the peening and subsequent machining operations did not result in distortion of the component.

Before this can be done, however, some prior investigation, of the effect of various shot-peening conditions on penetration in the material to be used, must be carried out. Fig. 8 shows the effect on penetration of shot peening at four different pressures with a single shot size, the exposure being suitably varied to maintain the total kinetic energy of the shot stream approximately constant. It will be observed that as the pressure is reduced, the position of the maximum fatigue-life point occurs at a greater depth in the material. There is also a considerable variation between the maximum fatigue-life values obtained.

It is not proposed to deal with the effect of shot size and energy in this paper, as it is hoped to include these in a more comprehensive article. The remainder of the paper will be devoted to discussion of the third factor, which was found to influence the improvements obtained by polishing layers of the material from the surface after shot peening. The phenomena observed clearly show the detrimental influence of over-peening and emphasise the need for careful control of the shot-peening operation.

During the course of this investigation some apparently anomalous results were obtained for specimens of the material which had been tempered at 500 deg. C. and shot peened. In Fig. 9, the S-N curves for plain-polished and shot-peened specimens in the two temper conditions are shown. It will be observed that for specimens tempered at 400 deg. C., shot peening has resulted in an improvement in fatigue life over specimens in the plain-polished condition. On the other hand, for specimens tempered at 500 deg. C., there has been a definite lowering of the fatigue-life curve. The conditions for shot peening were the same in each case and it seemed remarkable that there should be such a marked difference in the relative positions of the curves. A small investigation was therefore undertaken to determine the reason for this difference.

The first fact which threw some light on the problem was obtained from studying the fracture characteristics. Figs. 10 and 11 show typical fractures of shot-peened specimens in each, tempered at 400 deg. and 500 deg. C., respectively. It will be observed that whereas the fracture in the harder specimens was initiated at one point only, several fracture zones are exhibited in the specimen of the softer material. This fact suggested that the peening was causing minute surface cracks which were serving as initiation points for failure. This effect seemed likely to be connected with the hardness of the material, and from examination of the characteristics of the fractures alone it was not possible to ascertain whether the cracks were present in specimens tempered at 400 deg. C. In view of the improvements shown in Fig. 7, it might have been possible that if cracks had been formed these would have been removed by polishing away the surface layers. In order to examine the range over which the cracking was found, a strip of the material was machined to the same thickness as the diameter of the fatigue specimens, hardened from 800 deg. C. and given a variable temper along its length. The resultant hardness variation was from 770 to 280 V.D.H. The strip was then shot peened, slit open longitudinally, and sections of the slit surface polished with metallographic papers. Examination of the unetched sections showed that surface cracks were present throughout the hardness range and increased in number and severity towards the soft end. Figs. 12 to 15 show representative samples taken from four sections of different hardnesses.

In Fig. 12, an example of a surface pit with a crack starting from its root is shown. This was the most severe case found in this region, where the hardness of the material was 640 V.D.H. Cracks in this section were isolated, and few were observed; the depth of the one shown in the illustration is a little more than 0·001 in. The surface of the material in this section was not greatly disturbed by the peening operation, in comparison with other sections. In this particular case a small piece of the material has been gouged out by the shot, but, in general, the appearance of the shot-peened surface at this hardness was that shown on each side of the main pit.

Fig. 13 shows a crack in shot-peened material where the hardness was 560 V.D.H. This hardness is somewhat greater than that of the fatigue specimens tempered at 400 deg. C. There has been a marked change in the disturbance of the surface layers in comparison with those shown in Fig. 12. The crack shown penetrates to approximately 0·001 in. Other marks, which can be seen in Fig. 13, are manganese-sulphide inclusions which were originally in longitudinal streaks and have been deformed, by the peening operation, to the shapes shown. Fig. 14 is representative of the cracks found in the hardness region 520-420. Several fissures are shown in this figure, which was taken from a section where the hardness was approximately 480 V.D.H. The hardness of the fatigue specimens which were tempered at 500 deg. C. was 470. This crack extends approximately 0·0015 in. into the material and is noticeably more severe than the cracks shown in the previous sections. Finally, Fig. 15 is taken from the softest material, where the hardness was only 300. This crack was the worst found in the investigation and extends nearly 0·003 in. below the surface.

The photographs reproduced in Figs. 12 to 15 illustrate the third reason for the improvement in fatigue life obtained by polishing off layers of material from the surface. It was observed that varying degrees of cracking did occur throughout the hardness range, and therefore some of the improvement shown by the curve E F, Fig. 7, was due to the removal of surface cracks. In this particular case, the over-peening was probably due to the use of too long an exposure of the specimen to the shot stream. Some tests carried out to estimate the penetration of beneficial depth for varying energy levels, did in fact show that the exposure used for the tests to determine the effect of velocity was one which produced saturation of work hardening in the material.

A commonly used method of controlling peening operations is to shot-peen a strip of material which has been machined to specified dimensions on one side only. The compressive residual stress system induced by the peening operation causes the originally flat strip to become curved. Measurements of the curvature of the strip plotted against the exposure increase initially and eventually become constant. While this method admittedly indicates the exposure required to produce maximum compressive residual stress in the material, it is considered that the investigation should be carried farther to determine whether that exposure has produced surface cracks. This can easily be done by slitting the strip open and examining it under a microscope.

In conclusion, the author wishes to acknowledge the guidance which he obtained from Professor J. A. Pope, under whose direction the work was carried out. He also thanks Dr. H. K. M. Lloyd for advice in connection with metallurgical problems, and the University of Nottingham for the research facilities provided and for permission to publish this paper.

CONTRACTS.

A.C.V. SALES LTD., Southall, Middlesex, have received an order from the Baghdad Passenger Transport Board for 100 A.E.C. "Regal" Mark III single-deck motor-vehicle chassis and 20 "Regent" Mark III double-deck chassis. Each type of vehicle will be driven by a 9·6-litre engine and fitted with a sliding-mesh four-speed gearbox. The single-deckers have a wheelbase of 17 ft. 6 in., and the double-deckers, 16 ft. 4 in. In both cases, the bodywork will be by PARK ROYAL VEHICLES, LTD.

LEYLAND MOTORS LTD., Leyland, Lancashire, have obtained an order for 150 omnibuses, furnished with 45 seats and fitted with underfloor engines, from the Empresa Nacional de Transportes Colectivos, Santiago, Chile. All the vehicles will be one-man operated and will have air-power operated doors. The sub-contractors for the bodies, which are to be 33 ft. in length, are METROPOLITAN-CAMMELL-WEYMANN MOTOR BODIES LTD., Vickers House, Broadway, London, S.W.1. Among other orders received by the Leyland Company is a contract for a fleet of 63 motor vehicles, comprising dumpers, self-loading machines and water-tank lorries for the Middle East.

SIR LINDSAY PARKINSON & CO., LTD., have been commissioned by the Director of Army Contracts, War Office, to construct the first phase of a cantonment, comprising various buildings and roads, storm-water and foul drainage, sewage-disposal, water-supply and other services, and district heating, at Dekelia, near Larnaca, Cyprus. The contract amounts to approximately 1¾ millions sterling and will take two years to complete.

STRUCTURAL ENGINEERING ON THAMESIDE.*

By E. Granter, B.Sc., M.I.C.E., M.I.Struct.E.

I shall describe, sometimes very briefly, works in connection with the River Thames which have been essential for the development and growth of London and shall generally confine my remarks to that important stretch of the river, 22 miles long, which passes through the administrative County of London.

Bridges.

Although actual proof is lacking, it is almost certain that the Romans bridged the Thames during the occupation of Britain. There is evidence that the settlement of land surface in London amounted to about 15 ft. in the past 2,000 years, indicating that the tide in Roman times did not extend so far up the river as it does to-day. With a shallower river and little or no tidal action, the construction of a bridge would have been simplified. There is a historical reference to a bridge in London in the second half of the Tenth Century, and from that time until the first stone bridge was built in the Twelfth Century there are many references to a timber bridge in London. The first stone bridge, now known as Old London Bridge, had 20 spans, and its construction took 33 years from 1176. During 1581 and 1582, Peter Morice, a Dutchman, established waterworks at the bridge for supplying the city with water, and there were also water-wheels for grinding corn at the Southwark side of the bridge. In 1820, the obstruction to the free flow of the water caused by the piers and starlings was so great that, on the occurrence of a spring tide and a high upland discharge, the difference at low tide in the level of the water, above and below the bridge, was about 5 ft. 7 in. The obstruction caused to the free flow of the river by the piers resulted in the water freezing in severe winters, and when this occurred it was the custom to hold fairs on the ice. The last one of any importance was held in 1814, and with the removal of the old bridge the freezing of the river ceased. The bridge, which had been in existence for 622 years and had suffered from neglect, fire and flood, was demolished in 1831-34 for the sum of 35,500*l*. It had played its part in sieges, rebellions, pageants and many historical events, and during its existence London had grown into the most important city in the world.

For over five centuries Old London Bridge was the only bridge over the Thames, and although London was extending westwards and growing rapidly in size and importance, a second bridge was not built until 1729, at Putney. This bridge was followed by the opening of old Westminster Bridge in 1750, old Blackfriars Bridge in 1769, and old Battersea Bridge in 1772. During the Nineteenth Century, nine new road bridges were built, and the five earlier ones were all rebuilt. Since 1900, although bridges on new sites have been proposed, none has yet been built, but five have been rebuilt.

All the Thames bridges built in the County before 1877, with the exception of London, Blackfriars, Westminster and Chelsea bridges, had been constructed by private companies for profit, and tolls were payable for both vehicular and pedestrian traffic. In 1877, the Metropolis Toll Bridges Act was passed, providing for the purchase by the London County Council's predecessors, the Metropolitan Board of Works, of all bridges, with the exception of Westminster, from Waterloo to Hammersmith inclusive, in order to open them to the public free of toll, and by the end of 1880 all the bridges had been freed. The amount of compensation paid by the Board to comply with the Act was 1,376,825*l*. Blackfriars and Southwark bridges had been freed from toll in 1811 and 1864, respectively. Most of the bridges purchased had to be strengthened in order to carry the greatly increased traffic which resulted from the removal of the tolls, and Hammersmith, Putney and Battersea had to be rebuilt.

There are now 14 road bridges over the River Thames in the County of London; ten are owned and maintained by the London County Council and the remaining four, Tower, London, Southwark and Blackfriars, by the Corporation of London. All the original bridges, with the exception of the Tower and Albert, have now been rebuilt.

Tunnels.

Though tunnels have been constructed since the earliest times, their construction for the crossing of rivers is comparatively modern. The modern system of sub-aqueous tunnelling is due to the invention of the tunnel shield by Marc Isambard Brunel in 1818, and the use of compressed air patented by Lord Cochrane in 1830. As early as 1798, there was a proposal for a tunnel under the River Thames at Gravesend, but this was abandoned. An attempt was next made in 1804 to construct a tunnel from Rotherhithe to Limehouse, when a shaft was sunk and a heading over 1,000 ft. in length driven under the river, but the difficulties encountered were so great that the work was suspended and, although continued later, it was finally deemed to be impracticable and abandoned. The first tunnel to be completed under the River Thames was constructed between 1825 and 1843 by Brunel between Rotherhithe and Wapping. It was for this work that Brunel invented the shield and used it for the first time. It differed from shields used later, as it was constructed of a number of separate sections, each of which could be moved forward independently of the others. There was considerable trouble from water, which broke into the tunnel on several occasions, and the work was suspended for lack of funds from 1828 until 1835, when the Government advanced money for the work to be continued with an improved shield. In 1865, the tunnel was sold to the East London Railway Company and is still in use, forming part of the Underground Railway between Whitechapel and New Cross. The construction of that tunnel was an outstanding engineering achievement of the Nineteenth Century, and that it was completed successfully is a tribute to the skill and indomitable courage of its builder. The Tower Subway, constructed in 1869, was the next tunnel to be driven under the Thames. It was only 6 ft. 7 in. internal diameter and was constructed in the London clay with the aid of a circular shield forced forward by six screw jacks. It is now used to carry water mains.

In the latter half of the last century, the immense growth of the districts south of London Bridge and the importance of the businesses which had grown up on each side of the river, together with the growth of the Port of London, all drew attention to the urgent need for further facilities for cross-river traffic in this area. As interference with river traffic had to be avoided, proposals were considered for tunnels, high-level bridges and low-level bridges with opening spans. The demand for additional river crossings continued for some 20 years, and to meet it Woolwich Ferry was opened in 1889, Tower Bridge in 1894, Blackwall Tunnel in 1897, Greenwich Footway Tunnel in 1902, Rotherhithe Tunnel in 1908, and Woolwich Footway Tunnel in 1912.

Embankments.

The River Thames passes through many low-lying areas which are liable to be flooded at high water in the event of failure of the embankments. Within the County of London there are about ten square miles below Trinity High Water Mark and about 22 square miles below a level of 16 ft. 9 in. above Ordnance Datum (Newlyn).

There are records, extending over many centuries, of the Thames overflowing and causing great hardship and loss of property. The highest tide recorded occurred on January 6-7, 1928; the actual height of the tide at London Bridge in 1928 was 5 ft. 10 in. above the predicted height, and serious flooding occurred at many places, unfortunately with loss of life. Exceptionally high tides are caused by surges set up or propagated into the North Sea, but the height of the tide in the County of London is dependent upon the magnitude of the surge arriving at Southend and its relation to the time of high water of a spring tide and the volume of the upland discharge. In 1717, however, the river fell so low that people were able to walk across it.

The London County Council, under the Thames River (Prevention of Floods) Acts, 1879-1929, are responsible for exercising general supervision of all river banks within the County, but it is the duty of the riparian owners to provide and maintain the flood defence works. As a result of the flooding in 1928, the Council decided that the flood protection works within the County should be raised to a level of 17·00 ft. above Ordnance Datum (Newlyn) at the eastern boundary of the County, rising by steps to 18·17 ft. above Ordnance Datum (Newlyn) at the western boundary. A system of flood warnings has been devised whereby the public are notified by the police when the tide reaches a danger level which would affect a prescribed district.

Some of the embankments which now confine the tidal portion of the Thames and protect the low-lying areas are of ancient date, and we can only surmise the period in which they were built. Many attempts have been made in the past to improve the banks of the river within the County; Sir Christopher Wren proposed an embankment on the north side in connection with his plans for rebuilding London after the great fire in 1666, and an Act was passed to prevent any building within 40 ft. of the river from London Bridge to the Temple. This open space was afterwards known as the Forty-Foot Way, but numerous encroachments were made from time to time and the Act was repealed in 1821.

In the last century many proposals for embanking both sides of the river and reclaiming the large areas occupied by the mud banks were made, and many detached lengths of embankment walls were built. The three most important lengths of wall were built by Sir Joseph Basalgette between 1864 and 1874; they were the Victoria, Albert and Chelsea Embankments.

The South Bank.

For many years there was a marked contrast between the north and south banks of the river between Westminster and Blackfriars Bridges, and the construction of the Victoria Embankment and the imposing buildings on the north side accentuated the mean appearance of the south. The London County Council had for many years wished to improve the south bank, and it was partly for this reason that County Hall was built there. In order to provide a suitable frontage to the building a new river wall was built as a continuation of the Albert Embankment and 2½ acres of land were reclaimed from the river.

The London County Council had obtained Parliamentary powers in 1939 to extend the river wall to Waterloo Bridge and to acquire lands for the improvement of the area, but owing to the war and the conditions prevailing afterwards, it was not until 1948 that it was possible to proceed with the work in connection with the proposal to hold the Central Exhibition of the Festival of Britain at the South Bank. In the meantime, the appearance of the area had deteriorated further owing to bomb damage and the storing of material from demolished air-raid shelters and buildings. The new wall, which extends from County Hall to Waterloo Bridge, is about 1,700 ft. in length, and during its construction about 4½ acres of land were reclaimed.

* Presidential address to the Institution of Structural Engineers, delivered in London on Thursday, October 9. Abridged.

Concrete Roads.—The Cement and Concrete Association, 52, Grosvenor-gardens, London, S.W.1, have published an illustrated manual "Construction of Concrete Roads," by Mr. W. P. Andrews, M.C., B.E., A.M.I.C.E. Copies of the manual, which summarises current thought and practice, may be obtained free of charge from the Association.

City and Guilds of London Institute.—An exhibition entitled "Training for Industry," showing the work of the City and Guilds of London Institute, will be opened by the President (the Duke of Edinburgh) at the Goldsmith's Hall, Foster-lane, London, E.C., on Monday, November 3, and will remain open to the public until Friday, November 14. It will comprise models of scientific and engineering equipment and a pictorial presentation of the Institute's Department of Technology, which covers nearly 200 subjects.

OIL-WELL DRILLING BARGE FOR VENEZUELA.

FERGUSON BROTHERS (PORT GLASGOW), LIMITED.

FIG. 1. BARGE AFTER LAUNCHING.

FIG. 2. ERECTION OF 3-TON CRANE.

DIESEL-ELECTRIC OIL-WELL DRILLING BARGE.

WHAT is believed to be the first Diesel-electric drilling barge to be built and equipped in the United Kingdom was launched recently from the yard of Messrs. Ferguson Brothers (Port Glasgow), Limited, Newark Works, Port Glasgow. The vessel, shown in Fig. 1, will be employed on oil-drilling for the Shell oil interests on Lake Maracaibo, Venezuela. It will be used in conjunction with permanent drilling platforms erected at each well site and will be capable of drilling to depths of 15,000 ft. The vessel was launched with practically all the main machinery on board, and work is now in progress on completing the fitting out and testing the machinery. On completion of the tests, all the machinery will be sealed and preserved in preparation for towing to Venezuela.

When completed, the craft will accommodate the main Diesel-electric power plant together with other equipment associated with oil-well drilling, and will operate in conjunction with piled steel structures erected at the well sites. Construction is in accordance with Lloyd's rules and requirements to Class A for this special service and the displacement will be approximately 2,545 tons. The principal dimensions are: length, moulded, 158 ft.; breadth, moulded, 80 ft.; depth moulded to main deck at sides, 10 ft.; designed draft, approximately 7 ft. 6 in.; and moulded height of pipe deck above the main deck at centre line, 10 ft. The barge is intended to be self-sustaining on drilling operations for 30 days; substantial quantities of stores will have to be carried, therefore, and provision has been made for the stowage of 290 tons of well casing and drill piping, 550 tons of fluid drilling mud, 90 tons of dry sacked drilling-mud barytes, 150 tons of Diesel oil and 2 tons of lubricating oil, 25 tons of drinking water and engine circulating water, 3 tons of sanitary water, 75 tons of crude oil, and 150 tons of miscellaneous drilling stores. Limited accommodation is provided for the crew and engineers.

The main power plant consists of four twelve-cylinder V-type turbo-charged four-stroke Diesel engines, each of which is directly coupled to a 450-kW generator. The engines were supplied by Messrs. Mirrlees, Bickerton and Day, Limited, Stockport, and have a normal 12-hour rating of 910 h.p. and a continuous rating of 698 h.p., due allowance having been made for the temperature and humidity obtaining at the site. The generators are of the variable-voltage type and were supplied by the Metropolitan-Vickers Electrical Company, Limited, the full-load output being given at 450 volts. The generators supply the current for the main motors; these are variable-speed direct-current machines and comprise two of 800 h.p., one of 300 h.p. and two of 150 h.p., and, on the drilling platforms, one of 800 h.p. and another of 500 h.p. The 800-h.p. motors are suitable for running between 720 r.p.m. and 72 r.p.m., and are coupled through a quadruple chain of 2-in. pitch to the two main pumps which deliver the mud, or slush, to the drilling rig. The two 150-h.p. machines are identical; they are capable of operating at speeds of from 90 r.p.m. to 900 r.p.m., and drive an auxiliary mud pump and the coring-reel unit, respectively. The speed of the 300-h.p. motor can be varied between the limits of 75 r.p.m. and 750 r.p.m., and this machine is coupled directly to a high-pressure multi-cylinder pump used in connection with well-cementing operations. The two motors on the drilling platform, namely, the 800-h.p. and 300-h.p. machines, drive the "draw-works" and rotary table, respectively.

Two auxiliary generating sets are also installed, each consisting of a seven-cylinder normally-aspirated vertical Diesel engine operating at 600 r.p.m. and coupled directly to a 150-kW alternator and a 20-kW generator arranged in tandem. These engines have a normal 12-hour rating of 367 h.p., but on the site will operate at a continuous rating of 281 h.p. The two sets will be used to supply alternating current at 440 volts, three-phase, to the various auxiliary motors, such as those driving the circulating-water pump, blowers, etc., while the tandem-mounted direct-current generators will supply direct current at 250 volts for field excitation of the main motors. Although one of the sets is intended to act as a standby, provision is made for them to be run in parallel should additional power be required. Transformers incorporated in the auxiliary panels reduce the alternating-current supply to 110 volts for general lighting purposes.

The main mud-circulating pumps are of the horizontal duplex type and have a nominal input rating of 825 h.p. at 65 r.p.m., the suction and delivery manifolds between the two pumps being arranged for compound or parallel operation. The auxiliary pump, also of the duplex pattern, has an input rating of 165 h.p. at 65 r.p.m., and is used for mud-mixing and other utility purposes. The high-pressure multi-cylinder cementing pump is designed for a maximum working pressure of 10,000 lb. per square inch and is equipped with three $4\frac{3}{4}$-in. diameter plungers and three $3\frac{1}{2}$-in. diameter plungers, each bank of cylinders being arranged for compound, parallel or independent operation. Other equipment installed in the barge includes a central blower plant, a compressed-air plant, a fresh-water cooling system, anchor winches and two luffing cranes. The blower plant is duplicated and is capable of handling 18,000 cub. ft. of air per minute; it is installed for the ventilation of the main motors but also takes care of the general ventilation requirements of the barge. Compressed air for starting the Diesel engines is supplied by two compressors, one driven by a Diesel engine and used for intermittent duties only as normally required for charging the storage bottles, and the other driven by an electric motor for continuous duties, being fitted with an unloading valve. The fresh-water cooling system is capable of dealing with all engines when running simultaneously. It incorporates two heat exchangers, each of sufficient capacity to deal with the full cooling load. They are of Monel-metal construction with gunmetal water-boxes to counteract the highly-corrosive properties of the lake water. Duplicate fresh-water and lake-water circulating pumps are provided, all four pumps being identical in design and each capable of handling 45,000 gallons per hour. The two luffing cranes are provided for handling the drill pipes, casings, barytes, etc. They are installed port and starboard and each is capable of dealing with a load of 3 tons at a radius of 25 ft. One of the cranes is shown in the process of being installed in Fig. 2, herewith. Four anchor winches are provided; these are installed on the main deck and are fitted with dual-control equipment which enables them to be operated from a platform on the pipe deck or at the winch stations. They will be used in conjunction with 3,000-lb. Danforth anchors.

During drilling operations, the barge will be moored at a distance of from 25 ft. to 120 ft. from the permanent drilling platform. This is of unusual construction, consisting mainly of a prefabricated structure having four groups of three 20-in. diameter steel caissons, the groups being disposed one at each corner. This structure is fabricated on the shore and transported by a crane barge to the desired site and placed bodily in position on the lake bed, the lower end of the caissons becoming partially embedded. Tubular steel piles 13 in. in diameter are then inserted in the caissons and driven into the bed of the lake, finned guides spaced at intervals on the outside of the piles ensuring concentricity within the caissons. Concrete is then poured inside and around the 13-in. piles to form a solid reinforced structure. On top of this is placed a steel platform to accommodate the derrick, draw-

works, rotary table and their associated equipment. Flexible cables and control lines are used to connect the barge to the drilling platform, the control lines providing the driller with remote control of certain equipments on the barge. The two 800-h.p. mud pump motors, for example, will each have a master switch at the draw-works position and on the barge, thus permitting control from either position. A telephone system between the drilling platform and the barge will give the driller direct contact with seven operating stations on the barge. Communication with the base will be maintained by radio as the drilling stations may be up to 15 miles or more from the shore.

NOTES ON NEW BOOKS.

Atmospheric Pollution: Its Origins and Prevention.

By A. R. Meetham, D.Sc. The Pergamon Press, Limited, 2, 3 and 5, Studio-place, London, S.W.1. [Price 35*s.*]

When the late Dr. J. S. Owens first took an interest in the study of atmospheric pollution, the subject was one which had been investigated comparatively little and mainly by privately organised and individual effort. Since then, it has been examined on a much more extensive scale by public research organisations, and much of the contents of Dr. Meetham's book is due to their activities. A great deal of the work described was done at the Fuel Research Station at Greenwich. This, however, is by no means the only source that has been drawn upon, and students of atmospheric pollution will certainly appreciate the breadth, and the careful collation, of Dr. Meetham's authoritative survey. Improved methods of boiler-firing and of domestic heating have greatly reduced the pollution in recent years, but the chapter on "Effects of Pollution" provides ample evidence that there is still no justification for complacency on that score.

Factory Organization and Management.

By N. F. T. Saunders, B.Sc., M.I.E.E., F.C.I.S. Third edition. Sir Isaac Pitman and Sons, Limited, Parker-street, London, W.C.2. [Price 16*s.* net.]

The basis of this book is the fact, that by far the majority of factories in this country (and, for that matter, in others) are relatively small production units; only about 10 per cent. of the goods produced in the United Kingdom, it is stated, come from works employing 500 or more persons. The author has set himself, therefore, to consider the problems of organisation and management from the point of view of their application to small undertakings, but with due regard to the circumstances that many of them are engaged in production of a highly specialised character and that, "under modern conditions, the only loophole for profit-making is in the avoidance of waste of materials and human effort." The greater part of the book differs little from the text of the previous edition, published in 1946, but a chapter has been added on "Small-scale Mass Production," and should repay perusal by those who have to think twice about incurring capital outlay for new plant.

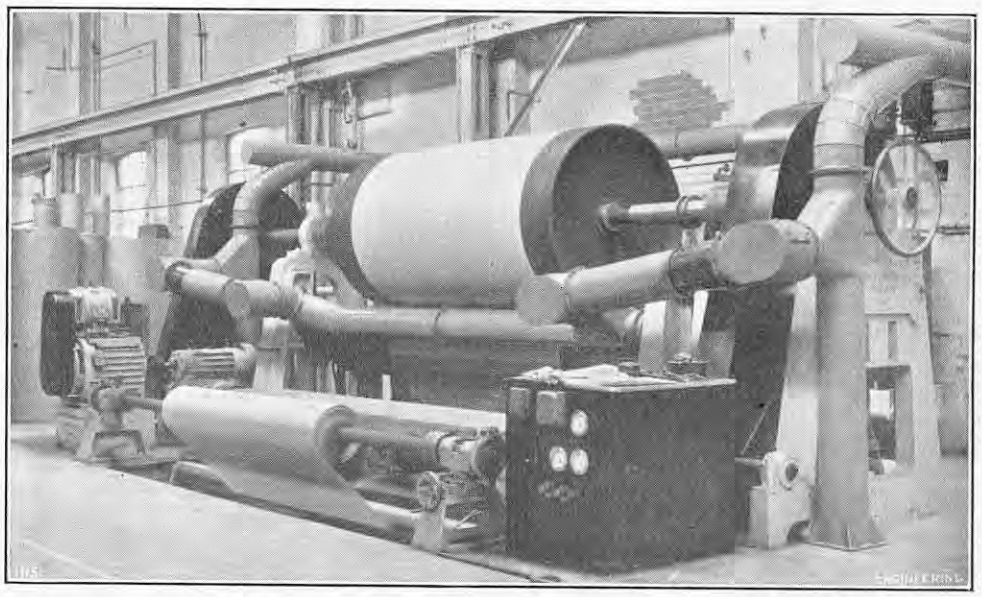
Modern Lighting Technique.

By Harry Hewitt, A.M.I.E.E. Edward Arnold and Company, 41, Maddox-street, London, W.1. [Price 21*s.* net.]

The author of this book, in addition to being the "lighting specialist" to the North Western Electricity Board, is lecturer in illuminating engineering at the Manchester municipal college of technology, and has prepared his text with regard to the requirements of students reading for the intermediate examination of the City and Guilds of London Institute. His prime purpose, as he states, is to deal with the technique and equipment used in the general lighting of interiors and of streets, but some attention is devoted also to flood-lighting, in which British practice is acknowledged to be second to none, and to display lighting. The four appendixes contain in a small compass a great deal of information likely to be useful to the designer of lighting installations.

30-KW ELECTRIC ROLLER HEATER.

METROPOLITAN-VICKERS ELECTRICAL CO., LTD., MANCHESTER.



30-KW ELECTRIC ROLLER HEATER.

The 30-kW electric roller heater shown in the accompanying illustration was manufactured by Metropolitan-Vickers Electrical Company, Limited, Trafford Park, Manchester, 17, and is installed in the Hollinwood factory of Messrs. Ferranti, Limited. It is incorporated in a machine for making resin-bonded paper tubes, which is capable of winding a laminated cylinder 9 ft. in diameter and 12 ft. long. For successful operation it is essential that the temperature of the pressure roller, which is 12 ft. 6 in. long and 2 ft. in diameter and is shown below the paper winding cylinder, should be maintained at 170 deg. C. $\pm$ 3 deg. along the length of the roll. In addition, the general temperature is controlled to within $\pm$ 3 deg. by a thermostat.

To achieve these close limits of temperature and at the same time to reduce the heating-up times, it was decided to split the heater into two 15-kW sections, each of which is distributed over the length of the roller. One of these sections was further split into three independent banks with loadings of 6 kW, 3 kW and 6 kW, respectively. The heater itself is made up of tubular sheathed elements, which consist of a spiral of heat-resisting wire tightly embedded by a special process in a mineral insulator. These elements are enclosed solidly in a tube of non-scaling, non-corrodible alloy. The result is that the spiral is held immovably in the centre of the bore so that it is separated from the sheath by an even thickness of insulation. The elements, which are carried on a fixed spider, are so arranged that there is a higher output of heat at the ends of the roller than in the middle. The greater thermal loss at the ends is thus compensated for and uniform heating along the entire length of the roller is ensured.

The temperature is controlled by ether radiation thermocouples which are mounted on the heater spider and measure the temperature of the internal roller faces. Tests showed that the maximum divergence from uniformity of temperature along the length of the roller was only $\pm$ 1½ deg. C.

Hand-Operated Sheet-Bending Rolls.—A new range of hand-operated geared bending rolls, both of the fixed-roll and slip-roll type, has been introduced recently by F. J. Edwards, Ltd., 359-361, Euston-road, London, N.W.1. They comprise an assembly of three bright-steel rollers, two of which are provided with grooves to take previously wired sheets. On the slip-roll machine, the bottom roll swings out to permit the removal of completed cylinders. The back roll can be adjusted by screws for various curvatures, and the pressure on the sheet metal can be varied by adjusting the top front roll. The machines are available in five roller sizes ranging from 25 in. long by 3 in. in diameter to 97 in. long by 4 in. in diameter.

BOOKS RECEIVED.

Ministry of Fuel and Power. Statistical Digest 1951. H.M. Stationery Office, Kingsway, London, W.C.2. [Price 21*s.* net.]

Re-Thinking Our Future. The Outlines of a New, Arduous, but Hopeful Policy for Britain. The Observer Limited, 22, Tudor-street, London, E.C.4. [Price 9*d.*]

Guide to the Excess Profits Levy. Federation of British Industries, 21, Tothill-street, London, S.W.1. [Price 1*s.*]

Mechanical Biology. Announcing the Discovery of Twelve Biological Rules or Laws. By the Rev. P. H. Francis. The Mitre Press, Mitre-street, London, E.C.3. [Price 30*s.* net.]

Architects', Builders', Civil and Highway Engineers' Reference Book. Edited by Evelyn Drury, A. C. Pallot and Edward Stead. Fourth edition. George Newnes, Limited, Tower House, Southampton-street, Strand, London, W.C.2. [Price 5 guineas net.]

American Society for Testing Materials. Symposium on Consolidation Testing of Soils. Presented at the Fifty-fourth Annual Meeting, June 18, 1951. *Symposium on Surface and Sub-surface Reconnaissance.* Presented at the Fifty-Fourth Annual Meeting, June 19, 1951. Offices of the Society, 1916, Race-street, Philadelphia 3, Pennsylvania, U.S.A. [Price 1.75 dols. each.]

Metalwork in Secondary Schools. Ministry of Education Pamphlet No. 22. H.M. Stationery Office, Kingsway, London, W.C.2. [Price 3*s.* 6*d.* net.]

Examples in Electrical Calculations. B.R. 158 (52). Naval Electrical Department, Admiralty. H.M. Stationery Office, Kingsway, London, W.C.2. [Price 17*s.* 6*d.* net.]

The Sydney County Council. Annual Report of the General Manager of the Sydney County Council for the Year 1951. Offices of the General Manager, The Sydney County Council, Queen Victoria Building, 457-479, George-street, Sydney, Australia.

Ohio State University. Engineering Experiment Station. Bulletin No. 147. *Proceedings of the First Ohio Water Clinic*, 1952. The Director, Engineering Experiment Station, Ohio State University, Columbus, Ohio, U.S.A. [Price 1 dol.]

Mathematics for Telecommunications. Vol. I. By D. F. Spooner and W. H. Grinsted. English Universities Press, Limited, St. Paul's House, Warwick-square, London, E.C.4. [Price 10*s.* 6*d.* net.]

The Resonant Cavity Magnetron. By R. S. H. Boulding. George Newnes, Limited, Tower House, Southampton-street, Strand, London, W.C.2. [Price 21*s.* net.]

Report on Cuba. Findings and Recommendations of an Economic and Technical Mission Organized by the International Bank for Reconstruction and Development, in Collaboration with the Government of Cuba, in 1950. The Johns Hopkins Press, Baltimore 18, Maryland, U.S.A. [Price 7.50 dols.]; and Oxford University Press (Geoffrey Cumberlege), Amen House, Warwick-square, London, E.C.4. [Price 60*s.* net.]

D-C and A-C Machines, Based on Fundamental Laws. By Professor Michael Liwschitz-Garik, assisted by Professor Robert T. Weil. D. Van Nostrand Company, Incorporated, 250, Fourth-avenue, New York 3, U.S.A. [Price 7 dols.]; and Macmillan and Company, Limited, St. Martin's-street, London, W.C.2. [Price 52*s.* 6*d.*]