A Seven-Day Journal

A Turkish Power Station

THE power station at Catalagzi, north of Ankara, which was recently officially opened in the presence of the Prime Minister of Turkey, Monsieur Hassan Saka and members of the Turkish Government, is the largest power station in Turkey, and it was designed and built by British firms. There are three 20,000-kW turbo-alternators, of which two sets are in actual operation, while the third is due for completion before the end of 1948. The steam plant comprises three Babcock and Wilcox water-tube boilers, each with a designed output of 220,000 lb of steam per hour at a pressure of 595 lb per square inch and a final temperature of 840 deg. Fah. The plant uses pulverised coal on the unit system. Each of the three turbines has a designed continuous maximum rating of 20,000kW and an 80 per cent rating for maximum economy. The turbines are equipped with three-stage feed heating, gland heating, drain-coolers and unit evaporators. Each set exhausts at 28·9in vacuum, and the cooling water for the condensers is obtained from an artificial lagoon on the Black Sea, which is non-tidal. Each turbine drives a 20,000-kW main alternator generating at 11kW, and a 1500-kW house-alternator, generating at 3kW. For standby service for the station auxiliaries, a 500-kW oil engine-driven generating set, with 1875-kVA transformers, is provided. The main alternators are directly connected to 11/66-kV step-up transformers, which are controlled by air-blast switchgear of 750-MVA rupturing capacity. There is a double circuit transmission line 9 miles long to three sub-stations at Karadon, Zonguldak, and Kozlu. These stations are equipped with 66/15-kV step-down transformers and 66-kV air-blast and 15-kV metalclad switchgear. The main contractors for the scheme are the Metropolitan-Vickers Electrical Export Company, Ltd., and the principal sub-contractors for the boilers and coal-handling plant are Babcock and Wilcox, Ltd.; for buildings and civil engineering work, including the cooling-water intake, Holloway Bros. (London), Ltd., and for the overhead transmission line and all the cabling for the scheme, British Insulated Callender's Cables, Ltd.

A Highland Railway Jubilee

THE fiftieth anniversay of the opening of the direct line from Inverness to Perth, via Carr Bridge, which has recently been celebrated, recalls some interesting engineering features. In the early 1880s the Highland Railway directors proposed a scheme for a direct line from Aviemore, by Carr Bridge, to Inverness, which shortened the distance from Perth by 25¾ miles, that reduction in mileage being achieved by crossing the valley of the Dulnain, Findhorn, and Nairn rivers, a route involving steep gradients and heavy constructional works. The Act authorising construction received the Royal Assent on July 24, 1884, and deviations and extensions of the time for the construction of the line were authorised in later Acts. The line from Aviemore to Carr Bridge was opened on July 8, 1892, from Carr Bridge to Daviot on July 19, 1897, and from Daviot to Inverness on November 1, 1898. It leaves Aviemore station, now an important junction, which is 697ft above the sea level, and rises to the Slochd summit, at a height of 1315ft above the sea, at a distance of 12½ miles from Aviemore. From the summit, the line falls practically the whole of the way to Millburn Junction, less than half a mile from Inverness. The largest works on the line are the viaducts over the rivers Findhorn and Nairn. The Findhorn viaduct has nine steel spans of 130ft, mounted on granite piers, with two 24ft masonry spans, one at each end, all on a curve of half-a-mile radius, while the Nairn viaduct is built in red sandstone, with twenty-eight arch spans of 50ft, and one river arch span of 100ft. Other works include the Slochd viaduct, with eight spans, and the Tomatin viaduct of nine spans, while with important bridges must be included the twin-span bridge covering 180ft between abutments over the River Dulnain. The smaller bridges are characterised by their simplicity of line and choice of stone. The scheme for the new line was prepared by Mr. Murdoch Paterson, then engineer-in-chief to the Highland Railway, who supervised the carrying out of the work. Sir John Fowler, engineer of the Forth Bridge, was the consulting engineer.

A Scottish Industries Exhibition

PLANS are now well advanced for the Scottish Industries Exhibition, which is to be held in the Kelvin Hall, Glasgow, from September 1 to 17, 1949. This exhibition is being promoted by the Scottish Council (Development and Industry), the main objects being to promote Scotland's export trade and attract overseas buyers to Scotland; to increase knowledge of Scotland and her products in every part of the world; to promote inter-trading between Scottish firms; to stimulate productivity by showing the workers the final results of their efforts; and to promote interest in good-quality workmanship and design. A symbolic lion rampant, turning the wheels of industry around the world, has been adopted as the motif for publicising the exhibition. It has been designed by Mr. A. B. Imrie, of Edinburgh, and will be displayed on all the literature issued in connection with the exhibition. Administrative offices have been established at 351, Sauchiehall Street, Glasgow, and all inquiries relating to the exhibition should be sent to Mr. R. M. Donaldson at that address.

Mutual Aid in the Engineering and Motor Industries

THE Minister of Supply, Mr. G. R. Strauss, spoke at a press conference on Friday last on the steps that are being taken to increase the productivity of engineering firms and on plans for mutual aid and standardisation in the motor industry. He said that discussions which he had had with representatives of trade and research associations and professional institutions had produced an encouraging reaction in the engineering industry generally, and many sections of that industry were now practising schemes for mutual aid, which included the exchange of technical advice and, in some cases, of technicians. The motor-car industry in particular, the Minister continued, had welcomed the productivity drive, and had created a plan of its own, which it was making available to all sections of the engineering trade. The motor industry's plan, Mr. Strauss explained, was divided into two main sections, the first of which provided that British car and commercial vehicle builders should strengthen the liaison already existing between them and their suppliers of raw material and equipment by making available to other manufacturers and suppliers for inspection, not only their factory premises and plant, but also their technical and administrative resources. By this arrangement factory planning staffs were made available to assist those whose concern it was to supply materials and components. The second part of the plan, the Minister stated, was that the motor manufacturing concerns—Austin, Ford, Nuffield, Rootes, Standard and Vauxhall—should take steps to speed the use on their models of common accessories and components and generally improve the whole sphere of standardisation. These matters were to be the subject of regular meetings between the responsible executives in each organisation. The Minister explained that the Society of Motor Manufacturers and Traders, Ltd., had set up a Production Efficiency and Standardisation Committee under the guidance of which this scheme for furthering mutual aid in the motor industry had been devised.

Decontrol of British Shipping

AT a meeting of the Chamber of Shipping of the United Kingdom, held on Thursday, December 2, 1948, under the chairmanship of the President, Sir George Christopher, reference was made to the recent announcement by the Ministry of Transport about the further substantial relaxation in the control of British shipping, which took effect as from Wednesday, December 1st. This relaxation was, he said, in pursuance of the Minister's policy to promote a return to the normal processes of shipping business as rapidly as possible. With regard to the Shipping Advisory and Allocation Committee, it became apparent during recent discussions that that committee was no longer required by the Ministry, and it would accordingly be disbanded. It was a matter of great satisfaction to the industry, Sir George said, that it had been possible in just over twelve months in effect to restore the freedom of the freight market, and to decontrol the industry, subject only to the formal retention by the Minister of his powers under the Control of Trade by Sea (No. 2) Order, and the issue of general trading licences in place of the restricted licences hitherto in operation. It is intended to ensure that the chartering of tonnage and the booking of space would in future be governed solely by normal commercial considerations, and accordingly, all freight control, except in the coasting trade, had been withdrawn. The tanker sections had also been included in the general measure of relaxation of control, including the lifting of freight control. The terms of these new arrangements for the remainder of the transitional period, i.e., for the next six months, have been communicated to all ship owners.

The Union Castle Mail Steamship "Edinburgh Castle"

ON Thursday, December 9th, the new Union Castle mail steamship "Edinburgh Castle" left Southampton on her maiden voyage to South Africa, under the command of Captain T. W. McAllen, who was recently in command of the "Warwick Castle." The ship was built and engined by Harland and Wolff, Ltd., at Belfast, and she was launched on October 16, 1947, by Princess Margaret. Her principal dimensions are: Length overall, 749ft.; breadth moulded, 83ft 6in, and gross tonnage 28,700. Like her sister, the "Pretoria Castle," she is designed to carry 227 first-class and 478 cabin-class passengers, and the public rooms and cabins are arranged on six decks. In general the lay-out and design of the accommodation is similar to that of the "Pretoria Castle," which was fully described and illustrated in our issue of August 6th last and the two following issues. The propelling machinery consists of twin-screw Parsons double-reduction geared turbines, taking steam from three oil-fired Babcock and Wilcox water-tube boilers at a working pressure of 600 lb per square inch and a temperature of 850 deg. Fah. at the superheater outlet. Weir's regenerative feed heating and Howden-Ljungström regenerative air heating are installed. The current for lighting and domestic services, and for deck and engine-room auxiliaries is furnished by three British Thomson-Houston turbo-generators, with two Harland and Wolff oil engine generating sets for port use. An oil-engine-driven emergency set is also installed, which works in connection with an emergency battery. The refrigerating equipment embodies several new features, and is similar to that described in our issue of August 20th last.

Water Supply of Greater London

By H. W. DICKINSON, D.Eng., M.I.Mech.E.

No. XXIII—(*Continued from page 561, December 3rd*)

Distribution

THE eight companies' separate distribution systems inherited by the Board in 1904, were only connected at a few points. During the intervening years these have been gradually merged and by means of an elaborate system of intercommunication, alternative supplies are now available for most areas.

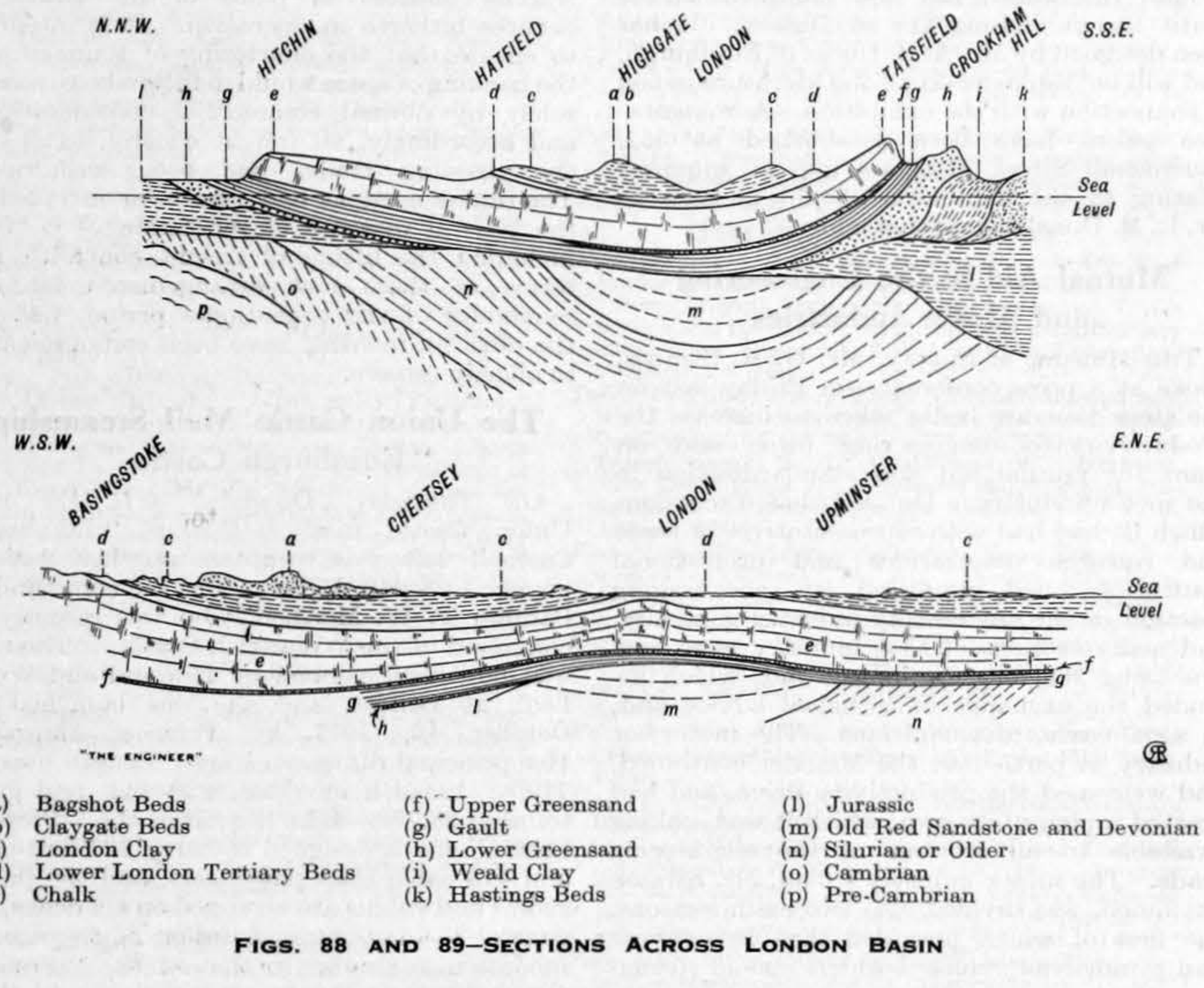
Practically the whole of the 8400 miles of trunk, distribution and service mains owned by the Board are of cast iron. The largest size of pipe laid in the streets is 48in diameter and although 2in and 3in mains still exist no pipe smaller than 4in is now laid. There are 569 miles of mains of 24in diameter and over but the greatest proportion of the distribution network is composed of 4in pipes, of which there are no less than 4230 miles, or 50 per cent of the total length.

Since neither the London water nor the soil—except in the case of certain clay areas—has any markedly deleterious effect on cast iron or lead, there are to-day cast iron mains of over 100 years of age in service and in excellent condition. "Spun," that is, centrifugally cast, iron pipes, are also used with satisfactory results, and where cast iron mains are laid in clay areas the pipes are protected by a sheathing of bituminous composition.

In order to meet particular and unusual service conditions, which arise from time to time, steel pipes lined internally and sheathed externally with bituminous composition, are used for service, and it is now the practice to use such pipes for all trunk mains of 24in diameter or over.

The principal trunk mains are those carrying water in an easterly and north-easterly direction from the Thames Valley and western stations, and they include no fewer than twenty-seven mains of diameters between 21in and 48in. Another important group of trunk mains conveys water southwards from the works on the New River and the Lee. Some of the pumping mains are of considerable length. For example the 48in main from Kempton to Bishop's Wood reservoir, Highgate, is 17 miles long; the length of the 36in main from the same station to Finsbury Park is 19 miles, and that of the 42in main from Hampton to Nunhead is 16 miles. The pressures in the trunk mains do not exceed 300ft, those in the three mains referred to being 295ft, 180ft, and 230ft, respectively.

Integral with the distribution system are eighty-five service reservoirs, situated on high ground and containing a total of 261 million gallons, but since the majority of the consumers are situated between the pumps and the reservoirs, the latter act mainly as "jack-heads." During the day, when the demand is greatest, water flows out of the service reservoirs to augment the supply from the pumping stations. Reservoirs fill up again at night, when the demand falls off. The highest service reservoir is that at Betsom's Hill, in Kent, which contains 313,000 gallons, the top water level being 818·00ft above O.D. The largest is at Honor Oak, in South London, which has a top water level of 144·00ft above O.D., and contains 56 million gallons.



(a) Bagshot Beds
(b) Claygate Beds
(c) London Clay
(d) Lower London Tertiary Beds
(e) Chalk
(f) Upper Greensand
(g) Gault
(h) Lower Greensand
(i) Weald Clay
(k) Hastings Beds
(l) Jurassic
(m) Old Red Sandstone and Devonian
(n) Silurian or Older
(o) Cambrian
(p) Pre-Cambrian

FIGS. 88 AND 89—SECTIONS ACROSS LONDON BASIN

New Works

A new reservoir at Staines was completed in 1947, when it was inaugurated by H.M. The King, and was named King George VI reservoir. This reservoir has a capacity of 4450 million gallons and is the second largest of those owned by the Board. Situated immediately to the west of the two original reservoirs at this place, it is served by the same intake, pumping station and aqueducts, and forms an integral part of the existing works. It cost over £1,250,000 to build.

A storage reservoir at Chingford is at present (1948) under construction. This reservoir will have a capacity of 3400 million gallons with a top water area of 334 acres. It will have a connecting main from the existing King George's reservoir, but provision has been made for separate pumping plant to raise water into it from the River Lee.

A scheme for remodelling the Hampton group of works was commenced in 1936. By the provision of thirty-two primary filters to operate in conjunction with 35 acres of reconstructed slow sand beds, a new pumping station and new conduits, the remodelled station will be able to supply 120 million gallons per day of filtered water.

A new filtration station at Ashford Common, Middlesex, is also being constructed. The works will consist of a filtration plant, having an output of 90 million gallons daily, and a high-lift pumping station to pump the filtered water into supply. The first stage in the filtration process will consist of aeration basins, where the water will, when necessary, be cascaded to increase its oxygen content. From the aeration basins the water will pass through micro screens, already described, after which it will be passed to the slow sand beds. Provision is being made for thirty-two beds, each about ¾ acre in area, together with the necessary sand washing apparatus, sand storage bins, roads, mains and drains. To avoid any possible contamination from ground water the slow sand beds will be raised above the existing ground level. After filtration, activated granular carbon treatment will be provided for, followed by chemical treatment. The water will then pass through combined contact and balancing tanks, being retained for a sufficient time to allow for chemical sterilisation. The volume of the tank will be sufficient to allow a reserve volume to even out variations in the pumping requirements.

It is intended that the station shall be driven by purchased electricity, with heavy oil alternators for peak load-relieving purposes, and combustion turbine alternators to form, with the diesel alternators, a complate standby source of power in case of failure of the grid.

Future of London's Water Supply

Now what of the future? To-day the stage has been reached when it is realised that water supply is not merely a local matter, as it has been in the past, but that it is of vital concern to every part of the country. It is not in doubt that there is ample water in this country for all needs and that water famines might become a thing of the past. The possibilities of a water grid for England has even been envisaged. At present, although water undertakings supply about 500,000 million gallons to the public, spend £30 million in running costs, and about £11 million in new works yearly, yet by no means is everyone served.

The problem is complex, but an approach to it has been made: in 1944 H.M. Government issued a White Paper entitled "A National Water Policy," outlining proposals for ensuring a planned and economical use of the water resources of the country and for efficient administration of supply services. After some general remarks on the situation, the import of which is familiar to engineers, the White Paper proceeds to set out and elaborate proposals based on three overruling provisions, as follows:—

(*a*) To establish and increase control of

water supply services, changes in them to be justified only where greater efficiency or reduction in costs can be effected.

(*b*) To attach responsibility for water supply to democratic bodies—at the highest level to the Minister responsible to Parliament, and at lower levels to statutory undertakers and local authorities, without unnecessary change.

(*c*) To subordinate sectional interests to the national interest, but all those whose interests are affected to have the right to be heard by the Minister or if appropriate to appeal to Parliament. A Bill embodying these provisions is now before the House of Commons.

Amongst suggested ways of implementing these desiderata, the one that concerns us principally here is the suggestion that a Central Advisory Water Committee for England and Wales should be reconstituted as a statutory body, as set out in a White Paper on National Water Policy, issued in 1946.

In view of the possibility that Regional Advisory Water Committees will be set up for all areas in these islands, the M.W.B. has given detailed consideration to a scheme, conformable to the above basic provisions and based on hydro-geological grounds, embracing the area extending from Baldock in the north to Horley in the south, and from Maidenhead in the west to Gravesend in the east. Had the population of London not advanced so phenomenally in the last century, the supply of water would have proved adequate, but the demands have led to competitive and uncontrolled exploitation of the sources; thus, some areas are overpumped and other areas are left with a surplus of water. As will be seen from the geological stratified sections repeated herewith in Figs. 88 and 89, and already given in the first article of this series, the London basin — or trough — for it is more of the nature of the latter than of the former—is inclined at a slight angle towards the east, where it dips towards the North Sea basin, while towards the west it is partially closed by the Chiltern Hills and the North Downs, merging with the Berkshire Downs. Actually in this basin or trough there exists, as described in our opening article, a reservoir in each of the principal formations—the chalk and the lower greensand, separated as they are from one another by a bed of impervious clay—the gault formation. Of the two, the chalk formation, seeing that it is present in places to a thickness of 700ft, is the most proliferous of water. It is this formation that is the cause of the relatively high ground around London and it constitutes a valuable catchment area, because of its absorbent nature, which enables it to retain moisture, and because of its thin and poor surface soil that is less liable to contamination. The lower greensand yields appreciable quantities of good water but does not extend continuously under London and therefore is not a source of water within the central area. Water flows underground, as it does overground, from nearly all directions towards London. Another feature of the area in question is that in it there is a rough balance between the rainfall soakage in the sparsely populated catchment area and the water supply that is wanted in the densely populated central area. No more satisfactory hydro-geological condition exists elsewhere in England.

The area to be covered is approximately 2754 square miles, drawing from 1025 square miles of outcrop. The population to be served is estimated approximately at 10,700,000 persons. The average daily supply envisaged is 558 million gallons, of which 465 million gallons will be derived from public supplies and 93 million gallons from private supplies, averaging 52 gallons per person per day. Of the total supply envisaged, 46 per cent will be contributed by underground sources and the remaining 54 per cent from the Rivers Thames, Lee and Stour. The number of water supply authorities in the area in question is sixty-five, made up of thirty-six water boards or local authorities and twenty-nine private water companies. A Departmental Committee, appointed by the Minister of Health, has examined the scheme.

The report has now been published and was referred to in our[87] columns on August 13th. As regards the technical problem with which alone we are concerned, the report is unanimous (page 4): "We are convinced, therefore, that a full and exhaustive enquiry is urgently required into the water resources and the prospective demands for water throughout the area, so that the best possible use can be made of available resources; and that simultaneously there should proceed the preparation of plans for a new major source of supply, which will undoubtedly be required in the not far distant future. *It is essential and just that the area should be treated as a single unit for this purpose* (our italics). While some relief may be afforded by the development of new underground sources or by the giving or taking of bulk supplies, we do not regard this as a complete solution of the problem, which is one of a potential overall shortage, and for which a new major source is, so far as we can judge, the only remedy."

The Committee was unable to agree on the constitution and powers of the authority or authorities to be established to give effect to the general conclusions. One view is that there should be a single authority, while the other view is that there should be four joint boards with a central water authority, which seems unduly cumbrous.

The extension of the present practice of establishing giant storage reservoirs has already met with violent opposition from the inhabitants of the areas where such reservoirs could be established, not only because of their effect on public amenities, but also on the grounds that a large amount of good agricultural land will have to be requisitioned. It is yet to be seen also whether the provision of satellite towns is going to slow down the rate of growth of the London area.

We cannot close these articles without acknowledgments to those who have assisted in their preparation; many of these have been mentioned in their place, but we must record the wholehearted co-operation from start to finish that we have received from the officers of the Metropolitan Water Board.

[87] Ministry of Health, Report of the Departmental Committee on Greater London Water Supplies, 1948.

Hydrogen-Cooled Alternators

By W. D. HORSLEY, M.I.E.E.

No. I

Advantages of Hydrogen as a Cooling Medium

THE application of hydrogen to the cooling of alternators has been dealt with exhaustively in many papers and articles in the American technical press, and it is unnecessary to give more than a brief *résumé* of the characteristics of hydrogen and its advantages in the present article.

The properties of hydrogen are outstanding in comparison with other gases, and it is well suited as a cooling medium for rotating electrical plant. The density of pure hydrogen is one-fourteenth of that of air, while its specific heat is fourteen times as great. Its heat capacity is therefore practically the same and the same quantity of gas is required for a given loss. The heat conductivity of air is comparatively low, and as it is impracticable to eliminate all gas spaces between conductors and slots, and between laminations, the temperature gradient from the copper to the iron surfaces is greatly increased. This effect is much less with hydrogen, which has a thermal conductivity 6·7 times as great as air.

The heat transfer coefficient of hydrogen is also greater than that of air. The ratio between the theoretical values is 1·51, which seems to be confirmed by American experience with hydrogen-cooled machines.

Other gases, such as helium and methane, have advantages compared with air, but they are not sufficiently great to justify the complication of an enclosed gastight cooling system. Helium is non-inflammable and its thermal conductivity is similar to hydrogen, but its density is higher and its specific heat much lower. Its thermal capacity is only about 72 per cent of that of air or hydrogen, and the rate of flow required is greater. Helium is more costly and difficult to obtain. Methane has a thermal conductivity only a little greater than air, while its density is about 55 per cent and the saving in loss is much smaller.

Assuming that the quantity of cooling gas for an air-cooled alternator is 100 per cent, the amount of hydrogen for a machine of the same output would be 60 per cent owing to the reduction in windage and fan losses. The high-speed integral fans are thus smaller and the design is simplified. If helium were used, the size of the fans, owing to the lower heat capacity, would be about 40 per cent larger than with hydrogen.

Efficiency.—Assuming that the purity of gas in a hydrogen-cooled machine is maintained at about 97 per cent, its density is about one-tenth that of air and the windage and fan losses are correspondingly reduced. The total losses for an air-cooled, 60,000-kW, 3000 r.p.m. alternator are about 1600kW, including a windage and fan loss of approximately 600kW. With hydrogen, the latter losses are reduced to 60kW and the corresponding gain in efficiency, allowing for the seal loss, is about 0·8 per cent. On whatever basis it is worked out, the reduction in loss represents a considerable saving, even allowing for the extra cost of the heavier stator casing, oil seals and auxiliary equipment.

Output.—The higher thermal conductivity and greater heat transfer coefficient of hydrogen both reduce the temperature gradient in an alternator or conversely permit a greater output to be obtained from the same frame. An important consequence of the use of hydrogen cooling is an increase in the limiting size of alternators which can be built

for speeds of 3000 r.p.m. and more particularly at 3600 r.p.m.

Alternators having a rated output of 112,000kVA at 3600 r.p.m. are now under construction in America.

The increase in output obtained with hydrogen cooling can be shown theoretically to be of the order of 20 per cent to 30 per cent,

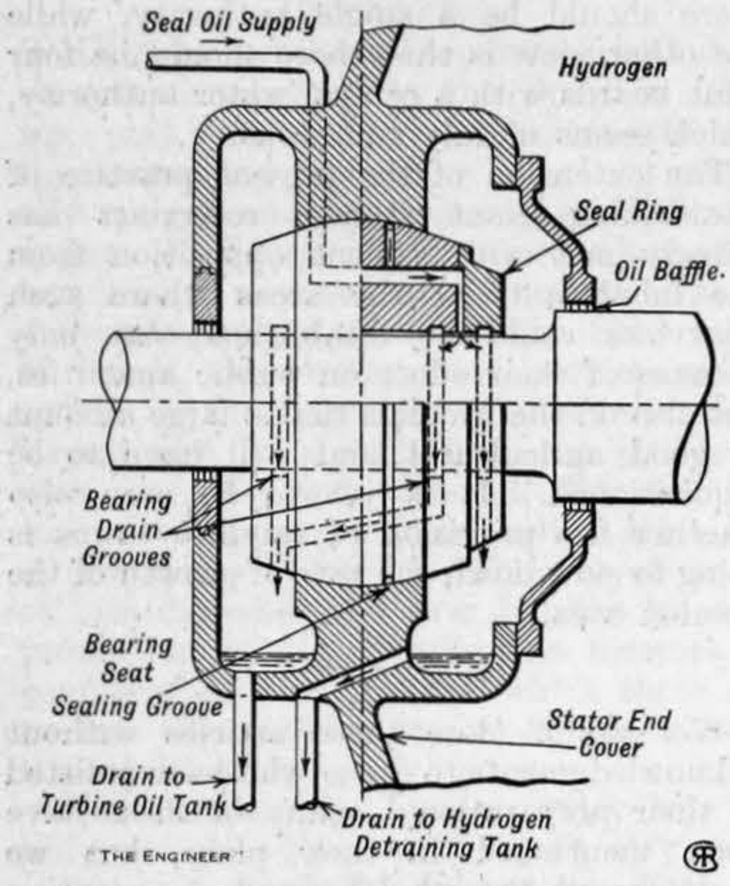


FIG. 1—ARRANGEMENT OF FIXED RING SEAL

and experience has shown that 20 per cent may be obtained easily in practice.

These figures are based upon a normal hydrogen pressure of ½ lb per square inch gauge and a further increase in output may be obtained by raising the pressure of hydrogen in the alternator. Experiments have been made with pressures up to 25 lb per square inch, and alternators are regularly operated up to 15 lb per square inch. The additional gain in output is about 1 per cent for each additional increment in pressure of 1 lb per square inch above atmosphere.

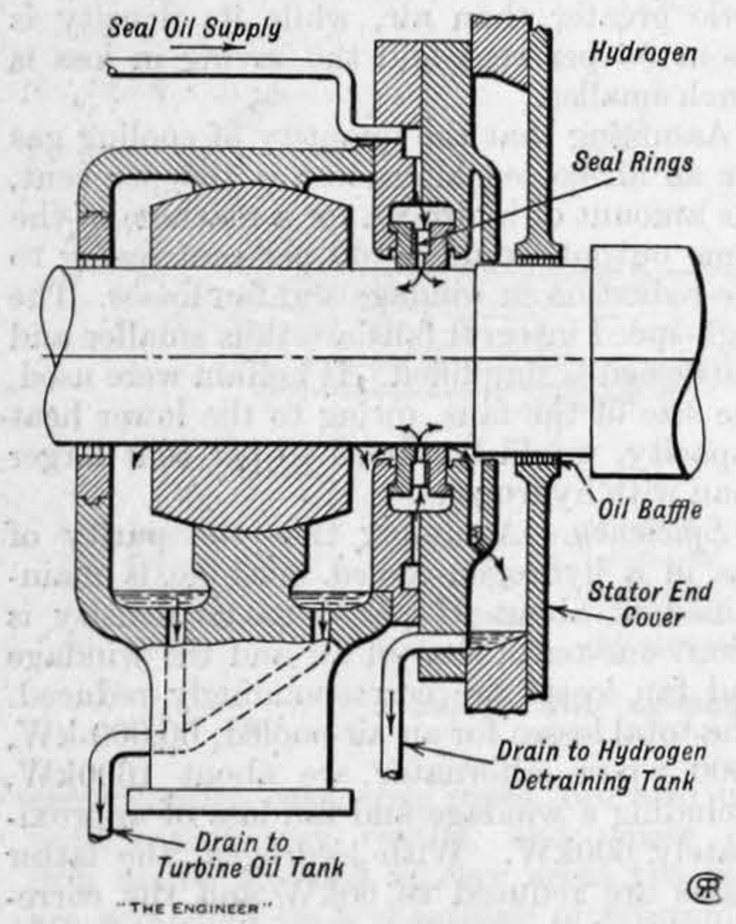


FIG. 2—ARRANGEMENT OF FLOATING RING SEAL

Operation under this condition is recognised in the latest American recommended standards. The overload capacity may only be obtained at the expense of an increase in hydrogen consumption, but the additional expenditure is relatively small, and some operating engineers in America consider this reserve capacity to be an outstanding feature of hydrogen cooling.

American alternators are usually designed to have a high short-circuit ratio compared with European practice, and the ampere turn loading is not high. Full advantage may therefore be taken of the better cooling properties of hydrogen and the maximum saving in materials obtained. With a more highly rated design the value of the stray losses at higher ratings may impose a limitation.

Hydrogen has the advantage that it will not support combustion and the fire hazard is thereby reduced. The insulation is not subject to oxidation and although corona is greater in hydrogen at N.T.P. than in air, it has no deteriorating effect. The alternator is virtually hermetically sealed and the windings are therefore maintained indefinitely in a clean condition. The life of the insulation is prolonged under these conditions and may no longer be a limiting factor.

The foundations for a hydrogen-cooled alternator may be greatly simplified as there are no external fans and ductwork.

Hydrogen-cooled alternators have some advantage for sets installed at high altitudes, as the pressure of gas in the casing may be maintained at the desired figure independently of the atmospheric pressure.

Disadvantages.—Amongst the disadvantages of hydrogen as a cooling medium, the danger of explosion has been most frequently stressed. Experience in America has shown that these fears were unfounded and that if ordinary precautions are taken there is no danger. Nevertheless, in designing the first hydrogen-cooled machines, every possible precaution was taken to eliminate this possibility and to minimise the consequences of explosion should it occur.

The commissioning and operation of hydrogen-cooled machines is more complicated than with air cooling, but no great difficulties have been experienced and operating engineers in America now appear to accept it as normal practice.

The stator of a hydrogen-cooled alternator is larger and heavier than with air cooling, which increases transport difficulties with the largest sets. As experience is gained the difference in weight and dimensions will be reduced.

The dielectric strength of hydrogen at N.T.P. is lower than that of air, and for the same voltage stress corona is more pronounced. As already mentioned, no chemical reactions take place and corona in hydrogen does not appear to have any harmful effect on the insulation, either directly or indirectly.

Construction of Shaft Seals

Shaft Seals.—The provision of suitable glands or seals for the rotating shaft at the ends of the stator was probably the most difficult problem to solve in applying hydrogen cooling to alternators. At an early stage in the investigation it was decided that a liquid seal using lubricating oil was the most practicable solution. Three different forms of oil seal have been developed and used by the large American manufacturers.

Early experience with oil seals revealed that the quantity of make-up hydrogen is not proportional to the leakage from the casing, auxiliary pipework and apparatus unless it is excessive.

Oil has the property of absorbing gases and will take up about 10 per cent of air or 6½ per cent of hydrogen by volume at an oil temperature of 120 deg. Fah. The quantity of absorbed gas increases with temperature. If the normal lubricating oil supply is used for the seals a proportion of the air which it contains is given up and replaced by hydrogen. The amount of air in the hydrogen enclosure thus gradually increases and when the degree of purity of the hydrogen-air mixture has fallen below a predetermined value, usually 95 per cent, a quantity of the contaminated mixture must be discharged and replaced by pure hydrogen. Even if the system is made completely gastight, make-up hydrogen is therefore still necessary. The quantity of air carried into the stator depends upon the quantity of oil flowing to the hydrogen side of the seal, which should be kept to a minimum. The consumption of hydrogen may still be high and pre-treatment of the seal oil under vacuum to remove air and moisture has been employed and is described later in the article.

The oil seal in its simplest form is shown in Fig. 1. A seal ring is provided at each end of the shaft on the alternator side of the bearing and may be considered as an extension to the bearing. Treated lubricating oil is supplied to a groove in the centre of this ring at a pressure a little higher than the pressure of hydrogen in the stator. The pressure difference is usually maintained at about 5 lb per square inch. The oil flows along the shaft in both directions and on the bearing side is

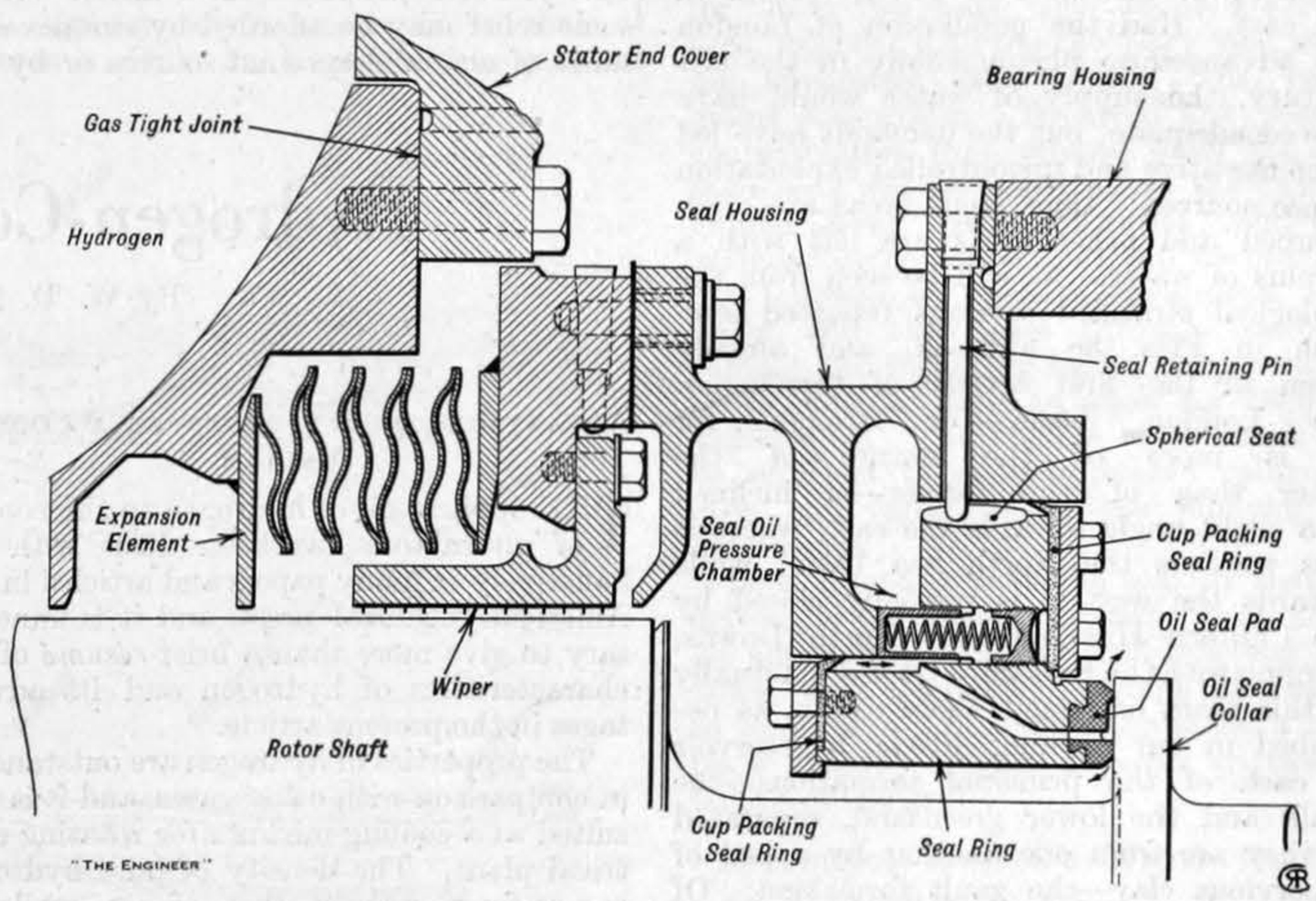


FIG. 3—ARRANGEMENT OF THRUST SEAL

discharged through the bearing lubricating oil drains. The flow of oil to the hydrogen side is led through a separate drain pipe into a detraining tank. The latter forms one leg of a U pipe and serves the dual purpose of sealing the hydrogen enclosure from the atmosphere and of allowing entrained bubbles of hydrogen in the oil to escape and return to the stator. The drain pipe is made of ample size to permit a free passage for oil and gas.

The seal ring may be constructed as shown in Fig. 1 with grooves on either side of the centre oil supply groove, into which the oil passes, whence it is taken direct to the drain. On the hydrogen side this additional groove virtually forms an oil baffle, which may be supplemented by additional baffles and oil throwers to prevent oil from entering the stator casing. In addition a gland of the labyrinth type is fitted between the seal and the stator enclosure to trap oil vapour.

An end-shield type of bearing is shown in Fig. 1 and where pedestal bearings are used, it is necessary to have a flexible gastight joint between the seal housing and the stator end covers to allow for expansion. Various forms of flexible connections are in use.

As long as an adequate flow of oil is maintained through the seals at a pressure in excess of the gas pressure in the casing, there is no possibility of escape of hydrogen through the seals.

In this form of seal, the clearance between the seal ring and the rotating shaft must be at least equal to the bearing clearance. The quantity of seal oil required for this gland may be appreciable.

The sealing gland shown in Fig. 2, which is also in use in America, is designed to reduce the flow of seal oil while still maintaining an effective seal. Two rings are mounted in a separate housing on the hydrogen side of each journal and fit closely round the shaft with a relatively small clearance. The rings are free to move radially and float upon the shaft. They are located axially in the housing and are prevented from rotating by suitable stops. Oil at a higher pressure than the hydrogen in the generator is admitted between the two rings and flows along the shaft in both directions.

The clearance between the rings and the shaft can be made smaller than the bearing clearance and the amount of oil flowing to the hydrogen side is therefore reduced. Vacuum treatment of the oil to remove air and moisture is still necessary with this arrangement but the hydrogen consumption is less.

A thrust ring form of seal has been developed by the Allis Chalmers Manufacturing Company of Milwaukee, U.S.A., which has considerable advantages and has given very satisfactory results.

This form of seal has been adopted for twelve 60,000-kW hydrogen-cooled alternators now under construction at Heaton Works and is illustrated in Figs. 3, 4, and 5.

A collar forming part of the solid shaft is provided on the hydrogen side of each of the main bearings. A ring with a white-metal face, similar to a thrust ring, as shown in Fig. 4, is maintained in contact with the inboard surface of each collar by means of spring and oil pressure. Oil is fed to a small annular groove in the white-metal face, from which it flows radially in both directions. The outer portion of the white-metal face is provided with radial grooves to provide adequate lubrication; the greater proportion of the seal oil flows radially outwards and is discharged into the main bearing oil drains. The inner periphery of the seal ring, which is plain, presents a continuous surface to the collar and forms the hydrogen seal. The clearance between the ring and the collar is equal to the thickness of the oil film and is small. The oil pressure at the

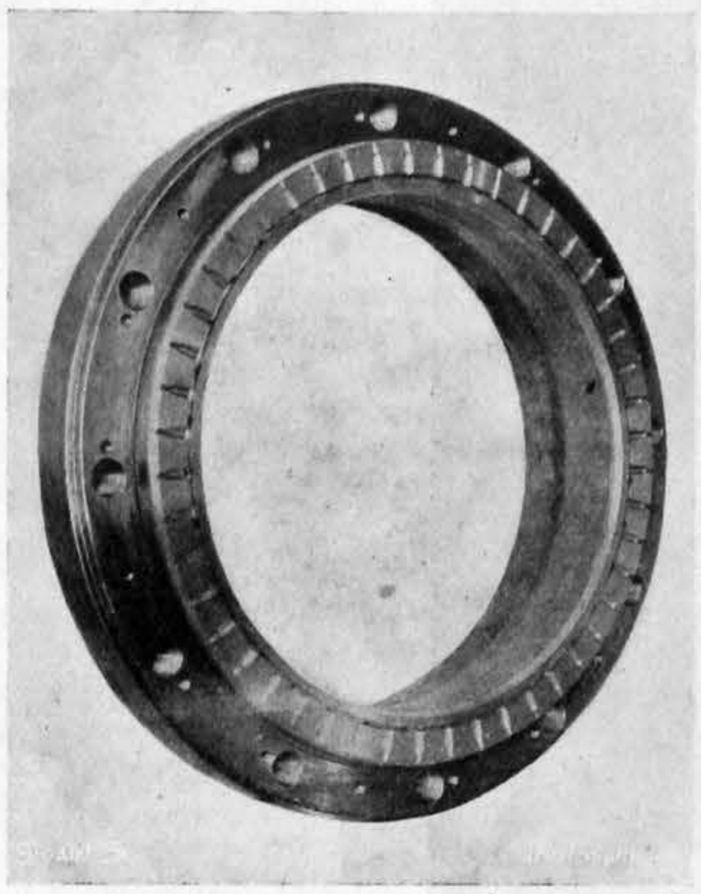


FIG. 4—RUNNER FOR THRUST SEAL

seal is a little higher than that of the gas in the stator and provided that the flow of oil is maintained, the seal is gastight. The quantity of oil passing over the plain surface of the inner periphery of the ring is very small, owing to the restricted clearance. Consequently the amount of air carried into the hydrogen space is small and the quantity of pure hydrogen necessary to maintain the purity of the gas mixture at the required level is low.

The outer perimeter of the main body of the seal ring is radiused and the ring is

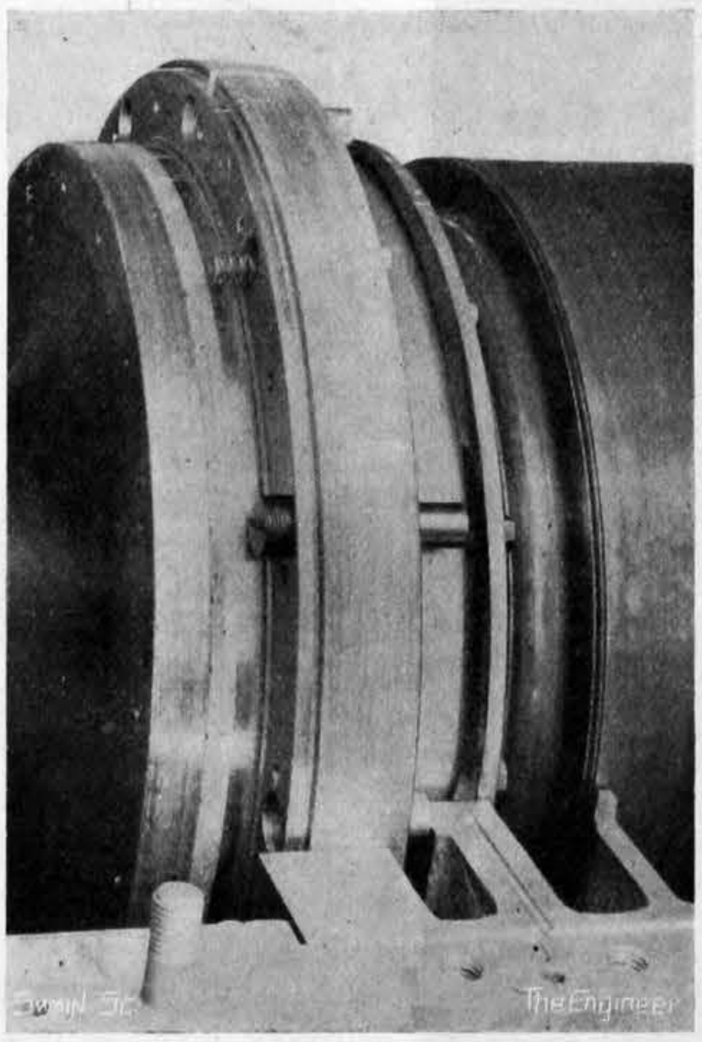


FIG. 5—DETAIL OF THRUST SEAL

self-aligning, thus maintaining a uniform pressure on the seal face. A pin is fitted to the seal housing, which engages in a slot in the seal ring, to prevent rotation. An oil chamber to which the seal oil is supplied is formed in the seal housing behind the seal ring. Synthetic rubber cup washers are incorporated, which form oil seals and, at the same time, provide adequate flexibility for self-alignment. A number of oil passages are drilled in the ring to convey the oil from the oil chamber to the annular groove in the seal face. The springs which hold the ring against the collar are fitted in the ring body, the reaction being taken by a web in the seal housing. The greater part of the force on the seal ring is provided by the pressure of oil in the feed chamber. This force automatically increases with the oil pressure when operating at increased hydrogen pressures.

The total quantity of oil required for the lubrication and cooling of two thrust-type seals is 30 to 40 gallons per minute, depending upon the size of the alternator. The quantity of oil passing to the hydrogen side of the seal is less than one-tenth of a gallon per minute. This oil passes to the detraining tank through a drain pipe of ample size. Sight flow-indicators are provided at a convenient position in the drain pipes. Oil throwers and baffles are fitted on the hydrogen side of the drain-oil chamber to prevent oil or oil vapour being carried into the stator windings.

In the arrangement shown, the seal housing is mounted on the main bearing pedestal and a flexible connection in the form of a steel bellows is made between the housing and the stator end shield to allow for expansion and contraction of the stator casing. The bellows are designed to withstand an explosive pressure without leaking.

The hydrogen consumption with this type of gland is low and experience has shown that vacuum treatment of the oil and its associated equipment is unnecessary. The normal lubricating oil supply may therefore be used for the seals.

The seal also had the additional advantage over earlier sets, where vacuum treatment equipment for the oil is provided, that vacuum scavenging can be employed. Tests have shown that air and hydrogen mixtures of any proportions are not explosive at pressures below one-fifth of an atmosphere. The gas pressure in the casing can readily be reduced to and maintained at this pressure with the type of seal just described.

(To be continued)

Electricity in Switzerland

THE annual report of the "Association Suisse pour l'Aménagement des Eaux" contains interesting data on the development of electric energy in Switzerland. During 1947 seven power stations were completed, with an aggregate capacity of 104,260kW and an annual output of 180,000,000kWh. By the end of 1947 the total capacity of Swiss hydro-electric plants amounted to 2,602,000kW. During the period 1946–47 Swiss power stations produced 9,822,000,000kWh, practically entirely supplied by hydro-electric plants. At the end of 1947 eight power stations were either under construction or undergoing important extensions. These are Letten (2800kW), Meiringen II (1500kW), Palü (extension), Aletsch (16,000kW), Châtelot (30,000kW), Usine de la Chute du Rhin (1975kW), Wildegg Brougg (42,000kW), and Rheinau (34,000kW). All these plants will be completed between 1949 and 1953. Electricity supplies in Switzerland depend largely on the weather. To meet the growing requirements both of industrial (including railways) and domestic users, whose consumption increased from 5,613,000,000 kWh in 1938–39, to 9,295,000,000kWh in 1946–47, Swiss authorities prepared an extensive scheme for the increase of electric supply. When this plan is completed for the winter 1952–53, the capacity of Swiss hydro-electric and thermal power stations will be sufficient to meet all needs of the country, whatever weather conditions may be.

DOCKING AND LIFTING THE GERMAN BATTLE CRUISER "DERFFLINGER"

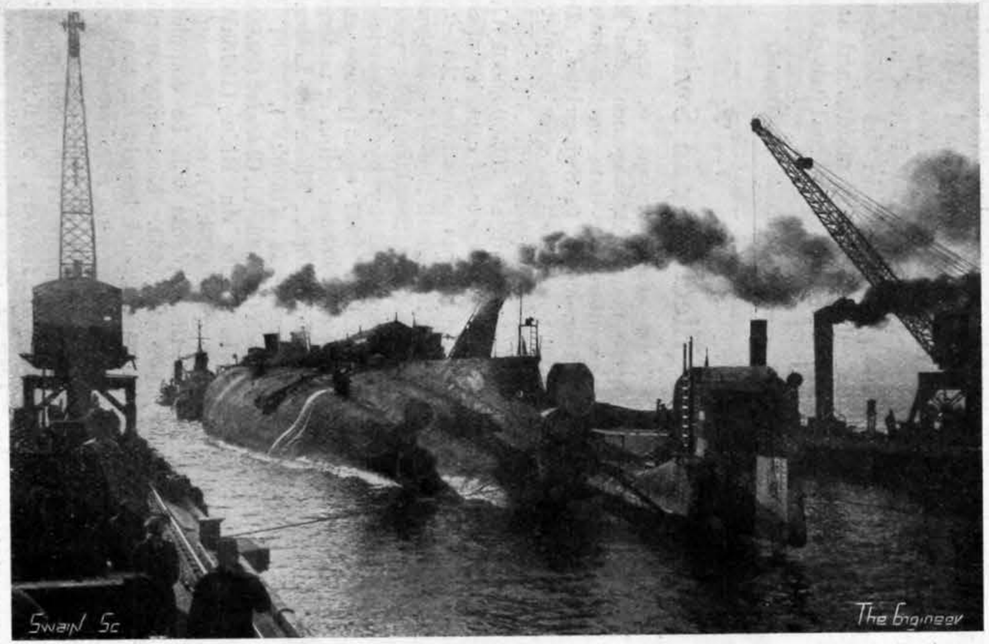


FIG. 16—WARPING "DERFFLINGER" INTO DOCK

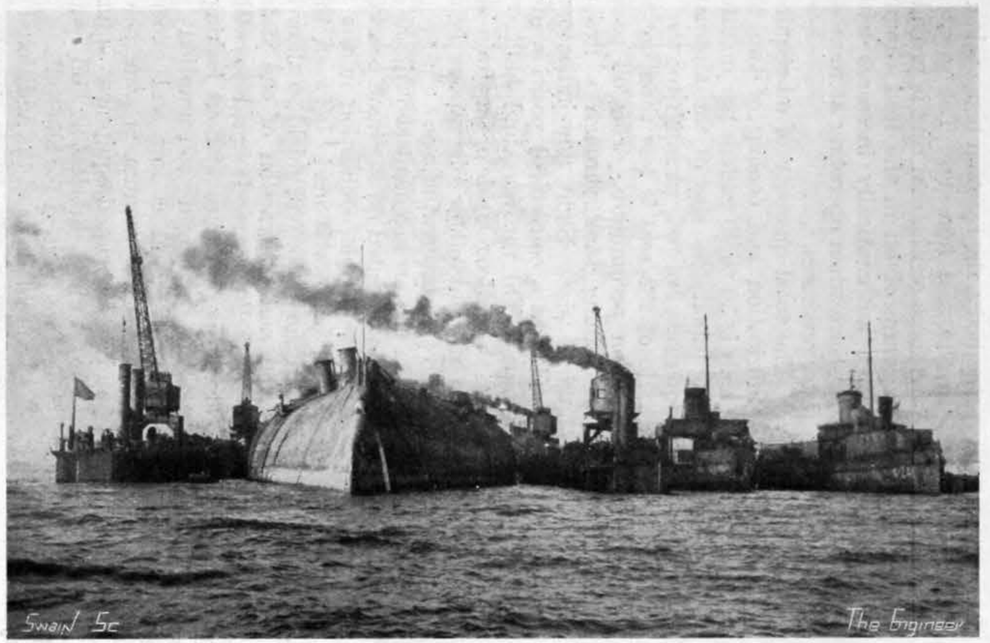


FIG. 17—BEGINNING OF LIFT

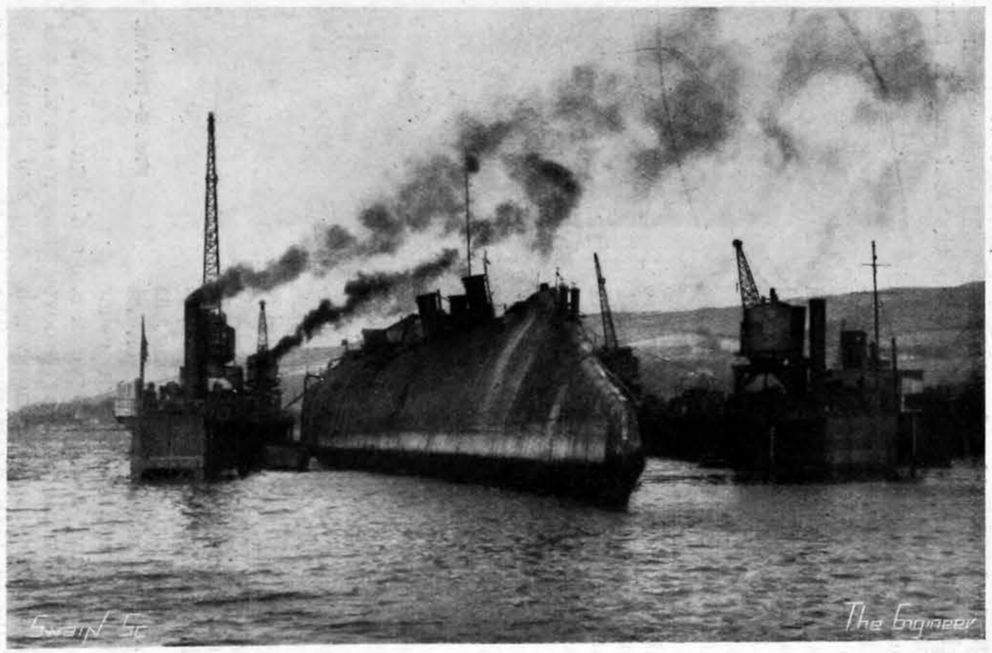


FIG. 18—DOCK PARTIALLY LIFTED

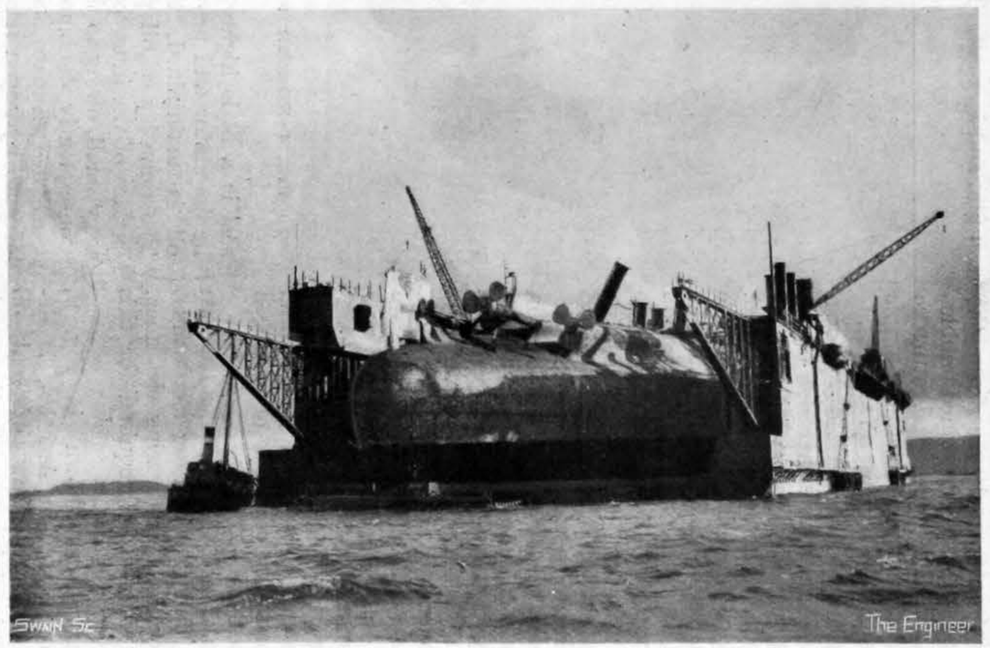


FIG. 19—DOCK FULLY LIFTED

Work of a Shipbreaking Yard

No. III—(*Continued from page 565, December 3rd*)

Lifting the "Derfflinger"

But even when the manner in which the ship was to be carried had been solved the shipbreakers' problems were not over. Since the draught of the ship was too great to permit her to enter through the narrows at the entry to the sheltered Gareloch, the work of docking her had to be done in the more open estuary of the Clyde. With conning tower and upper gun turrets removed, the part of the ship which hung deepest beneath the water and was to have, therefore, the least clearance over the dock bottom when the ship was docked, was the heavy tanklike structure amidships. Measurement indicated that even when lifted as high as was safe by compressed air, the draught of the ship was such that the floating dock would have to be sunk deeper than it was designed to go and that, in fact, it would have less than 6ft of freeboard left. The business of entering the ship into the dock became, therefore, a tricky one and one not without hazard for all concerned. For, when lifted high by compressed air the ship was not very stable. Were the bow then to lift slightly air might spill from beneath the hull at the fore end. The bow then dropping would lift the stern, allowing air to spill from the after end with the result that the whole ship might settle relatively deeper in the water. It can well be imagined that if this had happened when the ship was floating freely within the dock (whose stability and buoyancy when sunk below designed level were less than usual), the resulting load falling upon the dock, particularly if unequally distributed, might have led to disaster. The entry of the ship into the dock and its subsequent lifting are illustrated in Figs. 16 to 19.

The lifting, of course, could not be undertaken until divers had gone down within the dock to place the supports under the various chosen parts of the hull. That work, during the carrying out of which the dock had to remain sunk at almost its deepest level, took a whole month; but as soon as possible after the entry and proper placing of the ship, blocks were placed under the 'midships structure, where the draught was greatest, and some additional buoyancy given to the dock in order to obtain a "nip" between dock and ship and prevent relative movement. Once the ship had been lifted the dock was towed into Faslane port and moored against the quayside, as illustrated in Fig. 20.

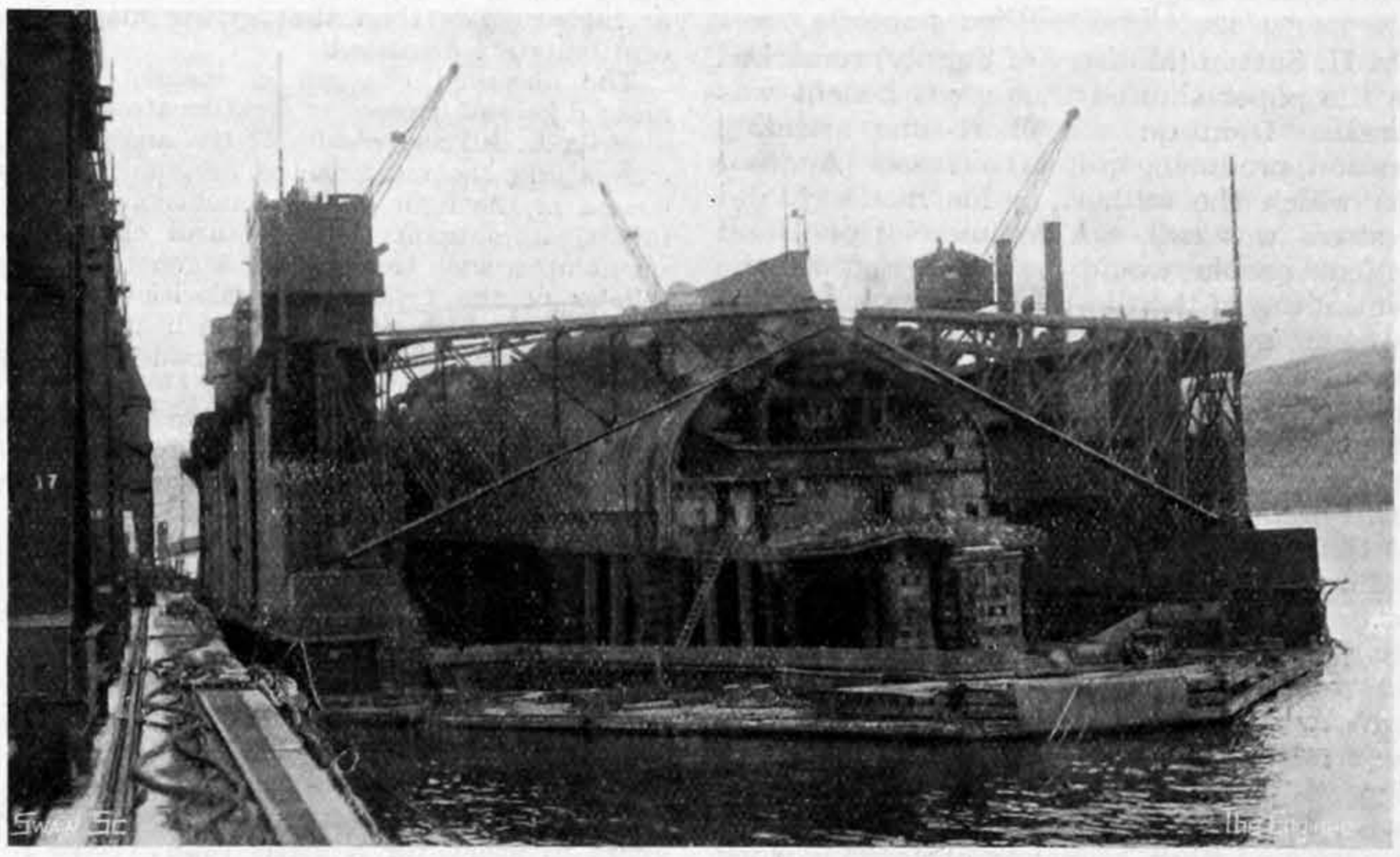


FIG. 20—"DERFFLINGER" IN DOCK AT QUAYSIDE WITH STERN REMOVED

Dismantling the "Derfflinger"

Even then, the troubles of her breakers were not over. The 6-ton quayside cranes had not sufficient reach to be able to handle directly material cut out of the ship. At first work could be carried on rapidly by the use of a 60-ton floating crane in the dismantling of the projecting bow and stern. Thereafter, until such time as sufficient space could be cleared at the ends of the dock to accommodate more powerful cranes mounted on its floor, use had to be made of the 3 and 5-ton cranes mounted on the walls of the dock, with the result that for some months work could proceed only slowly. Apart from that trouble, the cutting-up of the ship proceeded on normal lines. Special provision was made for lifting off her armour plate which, as mentioned before, was supported by bolts projecting through the water-tight hull. A length of railway track was laid inside the dock to carry a truck fitted with a steel rack, into which each section of the armour plate was lowered by the sheer legs when detached from the hull. The truck was then warped to the end of the dock, where it was within reach of the floating crane, which lifted the armour plate ashore.

"Iron Duke" and "Derfflinger"

Interesting comparisons could be made at the time of our visit of the design of British and German warships of the same period. The "Iron Duke," of about the same displacement as the "Derfflinger," carried ten 13·5in and twelve 6in guns, compared with the latter's eight 12in guns and twelve 5·9in. The British ship had engines of 29,000 h.p. for 21 knots, the German 63,000 h.p. or more for over 26·5 knots. Armour was comparable. That of the "Iron Duke" was a 12in belt amidships with 4in belts at bow and stern and 2½in deck armour. The "Derfflinger" had the same thickness of main belt but her deck armour was 4in and 3in in thickness. Such statistics, of course, were not obvious from viewing the ships, but it was strikingly clear by observation that the "Derfflinger" was the more sturdily built of the two, and that she was much more completely subdivided than her British counterpart. None of her compartments, except at the extreme bow and stern, stretched right across the beam of the ship. Unquestionably, she would have been more difficult to sink than the "Iron Duke." Probably, so far had protection and subdivision been carried, she was also much less comfortable to live in and less easy to work.

Codes of Practice

The Codes of Practice Committee for Civil Engineering, Public Works and Building and Constructional Work is under the ægis of the Ministry of Works. Codes are issued on behalf of the Committee by the British Standards Institution, 24–28, Victoria Street, London, S.W.1.

ELECTRIC LIGHTING IN SCHOOLS

Code 324.102. "Provision of Electric Lighting in Schools." This Code, previously issued as a draft for comment, has been completed and revised in the light of comment received by a committee convened by the Institution of Electrical Engineers. The Code deals with the provision of adequate electric lighting for schools, including all types of educational establishments and, while primarily intended for new schools, is also applicable to the modernisation of systems in existing buildings. It makes recommendations for minimum satisfactory illumination for various purposes, and suggests how these can be achieved by the use of suitable lamps and shades suspended at certain minimum heights above the floor, by the arrangement of the lights, whether tungsten filament or fluorescent type, and by consideration of these points in connection with of the Code may be obtained from the British Standards Institution, 24–28, Victoria Street, the colouring of walls, floors and ceilings. Price 2s.

TIMBER FLOORING

Code 201. The Codes of Practice Committee has issued as a draft for comment Code 201, "Timber Flooring," prepared by a committee convened by the Royal Institute of British Architects. This code has three sub-codes of which 201.101 "Hardwood and Softwood Board and Strip Flooring," and 201.103, "Plywood Flooring," are included in this document. The sub-code, 201.102, "Woodblock Flooring," which completes this particular group of floor finishes, has already been published separately for comment.

Code 201, "Timber Flooring," gives the general principles of design for timber flooring, the species of timber available, the essential factors to be considered in the choice of timber for a particular situation and the precautions to be observed in laying on suspended sub-floors and on solid sub-floors in direct contact with the ground.

Particular reference is made to the prevention of dry rot and advice is given on treatment with preservatives, on seasoning and on prevention of moisture penetration. Information is included on types of sub-floor and base, and aid given in determining their suitability. A method of determining the dryness of a sub-floor or base is described and diagrams illustrate the apparatus for measuring dampness. Alternative methods of constructing solid floors subject to rising damp and methods of fixing types of timber flooring are described.

The sub-code on "Hardwood and Softwood Board and Strip Flooring" deals with the materials for, and the laying of hardwood and softwood in the forms of boarding, strip overlay and parquet, on timber sub-floors and on concrete sub-floors having a nailable screed or timber fixing battens.

The sub-code on "Plywood Flooring" deals with the laying of plywood as a flooring on timber sub-floors and on concrete sub-floors having timber fixing battens. Recommendations for the preparation of the base, laying the flooring and maintenance are included.

The code is in draft form and subject, before final publication, to amendment. Comments, which are invited, should be submitted by January 5, 1949. Price 5s., proof reference CP (B), 804.

Foundry Moulding Sand.—Responsibility for glass sand and foundry moulding sand has now been transferred from Raw Materials Department, Board of Trade, to the Ministry of Works. Enquiries should therefore be addressed to Ministry of Works, B.M.3, Lambeth Bridge House, Albert Embankment, London, S.E.1.

Iron and Steel Institute

AUTUMN GENERAL MEETING

No. IV—(*Continued from page 571, December 3rd*)

AT the final session, held on Thursday, November 11th, the first paper was :—

A NOTE ON THE DETERMINATION OF MOISTURE IN PRODUCER GAS

By J. Pearson, Ph.D., M.Sc., F.R.I.C., and R. Toye, B.Sc., A.M.I.E.E., A.Inst.P.

Synopsis

Control of the moisture content of producer gas may be essential for the correct working of gas producers. Very little information on methods of estimating this moisture has been published in English technical literature, and it is therefore hoped that this note, which describes several suitable methods, including one developed by the authors, will be of value to fuel technologists and to others engaged in the operation of open-hearth furnaces.

Discussion

Dr. G. W. C. Allen (B.C.U.R.A.) said that when his Association was given a job to work on gas producers they were put into touch with the authors and learned about their method of determining moisture, a most important feature of producer gas. Various firms in the boiler industry made use of a dewpoint meter. He believed that Messrs. Babcock and Wilcox had had one for some time but he considered the authors' meter a better one, although it could only be handled by research workers. It gave results which agreed with chemical methods of examination.

Mr. J. E. de Graaf (Dutch Iron and Steel Institute) remarked that one of the authors was responsible for the statement that moisture determinations at the producer told little about the condition of the fuel bed that could not be deduced from the CO_2 figures. That statement was true as such, but it should not be taken to mean that it was possible to do away with humidity measurements. The measurement of CO_2 did not give sufficient indication of humidity to justify doing away with humidity measurements. There was also a statement by Wesemann, quoted by the authors, which might give the impression that below a certain degree of humidity it was unnecessary to bother about it. He disagreed with that.

Dr. Pearson, replying to the discussion, said he was particularly pleased to hear that B.C.U.R.A. had adopted the authors' method of determining moisture in producer gas. At the same time, he congratulated B.C.U.R.A. on the development of the electrometric method of titrating, which, incidentally, was mentioned in the paper as being an obviously better method.

The next paper was :—

FATIGUE TESTS ON CRANKSHAFT STEELS

Part I.—The Effect of Nitriding on the Fatigue Properties of a Chromium-Molybdenum Steel

By P. H. Frith, A.Met., F.I.M.

Synopsis

The tests on the solid test-pieces showed that after nitriding for ten, twenty-two, or seventy-two hours at 485 deg. Cent., the fatigue fractures commenced in the vicinity of the junction between the case and the core, but with the nitrided, hollow-with-oil-hole specimens, the fractures commenced on the surface of the nitrided case.

From the test results obtained it was calculated that by nitriding crankshafts and airscrew shafts for ten instead of for seventy-two hours at 485 deg. Cent., a reduction in the fatigue limit of approximately 0·7 per cent would be obtained for the sections of the components which were approximately 3·0in diameter without any form of stress concentration, whilst the fatigue limit of the oil-hole sections of the components would be slightly increased. Therefore, from a fatigue point of view, it appeared that the ten-hour nitriding treatment at 485 deg. Cent. was more suitable for crankshafts and airscrew shafts than the seventy-two-hour nitriding treatment at 485 deg. Cent. The depth of the nitrided case, as determined by a fracture test after the ten-hour nitriding treatment, was 0·004in, and this appeared to be quite adequate for crankshafts and airscrew shafts, from a wear-resisting point of view.

It seemed highly probable that by nitriding crankshafts and airscrew shafts for ten hours at 485 deg. Cent. instead of for seventy-two hours at 485 deg. Cent., the grinding operation after nitriding might be replaced by a honing or lapping operation. This appeared to be a possibility because after nitriding for the shorter period the surface hardness was increased, and the amount of distortion and growth obtained during nitriding will most likely be reduced. The substitution of a honing or lapping operation for the grinding operation for finishing nitrided engine components, would eliminate the possibility of grinding cracks being formed, and would therefore simplify the manufacturing process.

Discussion

Dr. H. Sutton (Ministry of Supply) remarked that the paper showed that great benefit was realisable from quite a short-time nitriding operation, producing quite a thin case. Another point which the author, in his modesty, did not stress was rather a commercial one, and practical people would be interested in the potentialities of the ten-hour surface hardening treatment at a modest temperature, which was attained much more cheaply than the more or less fashionable carburising temperature and with very little distortion of the work. The paper brought out the point that oil holes, notches, &c., produced harmful effects, but that they were greatly alleviated by nitriding, which improved the resistance quite a lot.

Mr. L. W. Johnson (Mond Nickel Company, Ltd.) said that what was wanted now was information to enable the engineer to use these steels to the best advantage. From the designer's point of view, he was wondering whether a word of caution was not necessary, viz., that in other branches of fatigue work it had been shown that scale effect was very important. A value of 20 tons per square inch might be obtained with a very small specimen, but when the size of the specimen was increased to 2in or so, there might be a very pronounced drop in the fatigue value. Therefore, he wondered whether the next stage for Mr. Frith was not to carry out some work on a large-size specimen and find out whether there were then the same advantages from nitriding.

Mr. D. A. Oliver (William Jessop and Sons, Ltd.) said he could accept the author's suggestion that by nitriding small crankshafts and airscrew shafts for ten hours, grinding might be replaced by a honing operation. At the same time, in the case of a diesel engine crankshaft it was necessary to be very careful how it was supported in the furnace when nitriding, owing to the possibility of small distortions occurring during the nitriding process.

Mr. J. Woolman (Brown-Firth Research Laboratories) remarked that whilst most of the speakers had been referring to the apparent advantage of the nitriding treatment, he had been wondering whether there was any theoretical justification for it. It was rather difficult to see why there were the peculiar changes which the author reported, particularly for the tests in pure torsion, due to the difference in the times of nitriding. There was an increase in resistance after ten hours and then a drop and then a rise again. Had the author not taken into account sufficiently experimental errors ? He did not think these errors lay in the technique of determining the fatigue stress, but it was difficult to fatigue a long bar or several bars with a great degree of uniformity such as was required for an investigation of this character. That might account for some of these discrepancies. Had the author determined the diamond hardness of the core material of the test specimens ? It would be very useful to have that data in deciding the theory lying behind the changes which the author had observed.

Mr. Frith replied shortly.

The next paper was :—

A MAGNETIC STUDY OF STAINLESS-STEEL WIRES

By P. T. Hobson, E. S. Chatt, and W. P. Osmond, B.A., B.Sc.

Synopsis

After a brief reference to a method developed for the examination of very fine single wires for magnetic properties, the results of experiments on iron-nickel-chromium wires are described, and suggestions are put forward for the crystal structure of these two-phased cold-worked alloys.

Typical remanence (B_r-H) curves for such wires are analysed by a modification of the method developed by Richer, and reasonable values for preferred directions of crystal-orientation and domain-orientation are obtained. After a description of differential susceptibility curves, and a note of their importance in detecting minute irregularities of magnetisation, possible factors governing the acquisition of irreversible magnetisation at higher fields than that giving maximum susceptibility are discussed.

The observed changes in magnetic properties after different degrees of heat-treatment are next described, and the results of the analysis of B_r-H curves and the incidence of irregularities are discussed in the light of the conclusions of previous investigators upon the structural changes consequent upon such treatment. A general description follows of the type of irregularities observed in some wires which have not been heat-treated after cold work, and suggestions are made of the factors leading to their appearance.

Finally, a tentative equilibrium diagram of the 12 per cent nickel alloy is shown for varying small amounts of carbon, based on the results of experiment and on existing diagrams for the 18 per cent chromium, 8 per cent nickel alloy.

Discussion

Mr. D. A. Oliver (William Jessop and Sons, Ltd.) said this paper was a penetrating metallurgical study of something that arose from an unexpected direction. The recording of sound from a wire had been a great mystery for a great many years ; just how did it work and what did one do to remove background ? The apparatus described would be extremely valuable, and he was very interested in the point made that what mattered in recording the sound of steel wires was the ratio of coercivity to remanence. At first sight that might appear wrong, but his conception was that the alpha particles, which actually took the magnetic sound recording, were discreet little permanent magnets, as it were, buried in a non-magnetic matrix. He suggested that they were making a wire with thousands and thousands of little permanent magnets buried in it from end to end, with varying radial distribution. He asked if that was the authors' mental picture of the process.

Mr. Hobson, in the course of his reply, said the only method of reducing background noise to the absolute minimum was by scrupulous attention to uniformity of the magnetic value of the wire, whether in long or short lengths. The only information available with regard to the distribution of the alpha phase was by X-ray analysis. In most of the cases relating to the 18/8 and 12/12 alloys, the wires were drawn specially for the job from one particular cast and the analysis was available. From the production point of view, it was necessary to come to a compromise between a very strict control and practical considerations of what the wire-drawer could do. Therefore it was necessary to lay down a standard that the chromium and molybdenum content should be held within ± 1 per cent in each case, and the carbon between 0·08 and 0·12. The authors would have liked to carry out some work on other alloys but the two in question were readily available from the wire-drawers. He did not think there was any choice between the two alloys from the recording point of view, but from sheer practical considerations,

and the conditions involved in continuous heat treatment, the authors found the 18/8 was better. In general, he agreed with Mr. Oliver's suggestion of the structure being a series of little permanent magnets in a non-magnetic matrix, but there was a lot more to it than that.

The final paper of the meeting was :—

INTER-RELATION OF HARDENABILITY AND ISOTHERMAL TRANSFORMATION DATA

By W. I. Pumphrey, M.Sc., and F. W. Jones, Ph.D.

Synopsis

In view of the widespread use of the isothermal transformation method for studying the breakdown of austenite, the relation of such data to the hardenability of steel, which from the practical point of view is of major importance, has been considered.

It has been suggested by previous workers that during continuous cooling, the fractional nucleation times (i.e., the time spent at a given temperature divided by the induction period at that temperature) are additive in any one transformation range, and that transformation begins when the sum of such fractional nucleation times attains a value of unity. By an extension of this concept, continuous-cooling data have been calculated from the isothermal transformation diagram, and in particular the method has been used to calculate the hardness along a Jominy bar. For the three steels considered, a hypereutectoid chromium-molybdenum steel and two hypo-eutectoid nickel steels, the hardenability curves calculated in this way were found to be in reasonable agreement with those determined experimentally.

Discussion

Dr. C. B. Pfeil (Mond Nickel Company, Ltd.) said that a very great interest was being taken in this country in S curves and one result was that the Thermal Treatment of Alloy Steels Committee established some time ago a group to consider the determination of S curves and to take a series of the more important British steels. That group, before commencing work, rather wisely, he thought, gave some considerable attention to the question of what to do with an S curve when it was obtained. This led to a rather surprising conclusion. All those concerned with this group agreed that the major import of an S curve was the presentation of a qualitative picture of what was going on during the treatment of steel. It was fully appreciated, of course, that an S curve could be used quantitatively but they were interested in the isothermal treatment of steel for machining purposes or holding it at a certain temperature, but apart from such special cases, the state of our knowledge seemed to be that, for the rest, the import of an S curve was the qualitative picture. The work of the present authors had carried us a step in the right direction and there seemed some possibility that there was a method of converting isothermal data in an S curve into a knowledge of what was going on when the steel was continuously cooled. Therefore, he hoped the authors would be encouraged to go on with this work aud provide information which would be likely to render S curves of still greater value.

Mr. E. H. Bucknall (Mond Nickel Company, Ltd.) said a shortcoming of the end-quench hardenability test was that it did not distinguish between small degrees of transformation at high temperatures (giving soft transformation products) and larger degrees of transformation at lower temperatures, where transformation products were harder. In their earlier work the authors had shown that interruption of the end-quench provided a means of resolving this question, and in so doing they had made an important contribution to the subject of hardenability. In the present paper they took up the question of the connection between isothermal transformation diagram of a steel and its end-quench hardenability characteristics and showed, on certain assumptions, that the hardness distribution along an end-quenched bar could be derived from isothermal data to a reasonable approximation for both hypo and hyper-eutectoid steels. It would be easy, however, to read more into the present paper than was justified or than the authors probably intended. As the authors had illustrated, a variety of assumptions could be made in the derivation of continuous cooling results from isothermal data without substantial alteration of the hardness value finally computed. The authors must not, therefore, be taken to have proved that their assumptions were valid. Indeed, he suggested they had made assumptions not explicitly referred to in the text which reduced the possibility of substantial error in the computed hardness. Isothermal transformation studies had shown that in the pearlitic range a stage of pro-eutectoid reaction preceded the final stage in both hypo and hyper-eutectoid and that multi-stage transformation sometimes occurred also in the intermediate stage. An example was afforded by the 3 per cent chromium, 0·7 per cent carbon steel studied by Lyman and Troiano and referred to by Professor Mehl in his Hatfield Memorial Lecture. In this steel, transformation at 200 deg. to 400 deg. Cent. had a rapid first stage, which involved the rapid formation of needles, which later disappeared from the structure and therefore could hardly be regarded as contributing to the final hardness. A rather striking example of the hardness aspect of the two-stage transformation was afforded by the behaviour of an EN.56 steel, containing 13 per cent chromium and 0·3 per cent carbon. This steel was characterised by its ability to transform isothermally only within the pearlitic range and transformation proceeded in two stages—carbide separation followed by pearlitic formation. At 650 deg. Cent. transformation started in five minutes and completed itself in thirty minutes. If austenitised specimens of the steel were exposed in a lead bath at 650 deg. Cent. and quenched to room termperature after progressive intervals of time, a room temperature hardness curve was obtained which fell smoothly from 600 to 240 D.P.H. over the period of twenty-five minutes. If, on the other hand, the hardness was measured, after the same intervals of time, by means of a test applied above the martensitic reaction onset temperature for this steel, viz., 280 deg. Cent., the hardness was shown to increase in the first stage and only began to fall when the second stage of transformation got under way, after about fifteen minutes.

This experiment, admittedly carried out to test the authors' ideas, revealed an instance where transformation did not proceed in a single stage, where there was not a progressive change of hardness and the hardening action of the transformation product was dependent on the hardness of the remainder of the structure. In this experiment, incidentally, the hardness tests above the Ms were made by a dynamic method—a means of isothermal transformation study which had recently been used by Enos, Peer and Holzworth at Purdue University.

It was intimated that the authors would reply in writing, and after they had been thanked for their paper, the meeting terminated.

The Manchester-Sheffield-Wath Electrification Scheme*

The Manchester-Sheffield main line is one of the most difficult to operate in the country. It has very heavy gradients and near its summit the Pennine ridge is pierced by the Woodhead twin tunnels, which are more than 3 miles long.

Over this route an extremely dense traffic has to be worked, about six out of every ten trains conveying coal. Nearly 100 trains daily each way pass through the Woodhead tunnels. These tunnels are difficult to ventilate adequately and the smoke and fumes have always been troublesome to enginemen and destructive to the tunnel linings and rails.

In 1936 the directors of the L.N.E.R. announced plans for electrifying the Manchester-Sheffield line, together with certain branches, including that to Wath via Worsborough Dale. It was estimated that electrification would increase the capacity of the Woodhead tunnels by at least 25 per cent, whilst the rails in the tunnels would have a much longer life. At present, owing to the atmospheric conditions, the life of the standard 95 lb rails is about three to three and a half years as compared with a normal life of fifteen to seventeen years in the open, under average traffic conditions.

Preliminary work on this project was well in hand before the war, when it had to be suspended, and was resumed in the late summer of 1947. The following lines now being electrified cover 75 miles of route and a total of 330 miles of track :—

(1) Manchester (London Road) to Sheffield and Woodhouse (Rotherwood sidings).

(2) Penistone (Barnsley Junction) to Wath via Worsborough.

(3) Glossop branch.

(4) Stalybridge branch as far as Dukinfield.

(5) Oldham, Ashton and Guide Bridge branch up to and including Ashton Moss sidings.

(6) Fairfield to Manchester (Central) and Trafford Park sidings.

(7) Ashburys to Ardwick goods yard and Midland Junction.

The overhead line conductor system, using direct current at 1500V, will be employed. This system is similar to that in use on the Manchester-Altrincham line for the past eighteen years, and is now being installed on the main and suburban lines from Liverpool Street and Fenchurch Street to Shenfield.

When the job is finished practically all classes of passenger, goods and mineral trains will be worked by electric traction and steam locomotives will generally be confined to shunting duties in marshalling yards and sidings.

The local passenger services between Manchester (London Road) and Hadfield and Glossop will be provided by eight three-coach, multiple-unit trains of the open saloon type, and the train mileage will be increased by some 48,000 per annum. Other train services, and banking duties, will be performed by eighty-five electric locomotives capable of a speed 65 m.p.h.

The change-over points from electric to steam traction and vice versa will be as follows in the case of passenger trains :—Manchester Central, Guide Bridge, Godley, Penistone, Sheffield (Victoria). Change-over points for freight trains will be at Trafford Park, Ashburys (Midland Junction), Ashton Moss, Guide Bridge, Mottram Yard, Sheffield (Bernard Road), Wath, Godley, Woodhouse (Rotherwood sidings), Wombwell. Additional sidings are being laid in at some of these places.

New sheds for both steam and electric locomotives at Darnall, a small electric locomotive shed at Wath and a large electric running and repair depot at Reddish are being built, the steam locomotive shed at Darnall having been completed and brought into use in April, 1943. At Sheffield also the track lay-out in the vicinity of Victoria Station will be improved.

Associated with the electrification scheme are the boring of a new double-line tunnel at Woodhead and a new single-line tunnel at Thurgoland. The new Woodhead tunnel will be lined in concrete and provided with three ventilating shafts. It is hoped that the preliminary work on the tunnel may be started before the end of this year. If all goes according to plan the down line through the new tunnel will be brought into use in October, 1951, and the up line about April of the following year, when the old down line tunnel will be closed. The former up line tunnel may be retained as an auxiliary for eastbound freight traffic.

At Thurgoland the existing double-line tunnel has been in use since July 14, 1845, and in it the lateral clearances are limited because the tunnel was not accurately driven when it was built. This has imposed restrictions on the occupation of the opposite track during the passage of the larger type restaurant cars and quite modest out-of-gauge loads. Owing to the difficult operating conditions it was decided to drive a new single-line tunnel to accommodate the down line and reposition the up line approximately in the centre of the old tunnel.

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* Abridged from an address by Mr. George Dow, Press Relations Officer, British Railways (Eastern and North-Eastern Regions), to the Rotary Club of Ashton-under-Lyne, November 29, 1948.

The work was started at the beginning of November, 1946, and the new 330 yards tunnel was brought into use on Sunday, October 3rd.

At present about 30 per cent of the foundations for the overhead line equipment have been completed and 15 per cent of the structures erected. About 12 route miles out of a total of 60 miles of posts and brackets for high-tension and pilot cables have been installed. The foundations and pits for the electric locotive shed at Darnall are complete, as are certain of the works at Rotherwood and Wombwell.

There is a considerable number of masonry arch bridges which at present do not give sufficient clearance at the quarter points of the span to accommodate the overhead equipment. In some cases the tracks will be lowered, but in others the arch will be demolished and replaced by a superstructure of the flat-deck type. This latter course is already being adopted in the case of five bridges on the main line near Penistone and Hazlehead and on the Worsborough branch. For the superstructures or spans pre-stressed concrete beams are being used, and the composite type bridge decks to be provided at Gilroyd Lane and Hound Hill will be the first of their type to be erected in this country.

The multiple-unit trains are to be built by Metropolitan-Cammell Carriage and Wagon Company, Ltd., and the Birmingham Carriage and Wagon Company, Ltd., and the electrical equipment for them by the General Electric Company. The electrical equipment for the electric locomotives is being provided by Metro-Vickers and the mechanical parts by British Railways. One of the locomotives, " No. 6701," was completed in 1941, and the erection of the next one is expected to begin at Dukinfield in July of next year, after which the others will follow quickly.

Locomotive " No. 6701 " (now " No. 6000 "), after performing satisfactory trials in 1941 and 1947 on the Manchester-Altrincham line, was conveyed to Holland in 1947 and lent to the Netherlands Railways. Very useful data is being obtained from her performances overseas, and up to the present time the locomotive has run no less than 100,000 miles on Dutch lines, hauling passenger trains of about 350 tons at 55–60 m.p.h. and freight trains of up to 1750 tons.

The Manchester-Sheffield-Wath electrification scheme will be introduced in three stages. It is planned to complete the Wath-Dunford section in March, 1951, and the Dunford-Manchester (London Road) section, including the Glossop branch and Reddish depot, in March of the following year. In December, 1952, the final stages, Rotherwood-Sheffield-Barnsley Junction and Fairfield Junction-Manchester (Central) will be brought into use.

Manchester and Sheffield will then be served by the most modern electric railway in the country, which will have cost about £6 million and will save 100,000 tons of coal a year.

The Nuffield Agricultural Tractor

A NEW agricultural tractor is now in production by the Nuffield Organisation, and the greater part of the initial output is to be offered to British farmers. Known as the " Nuffield Universal " tractor, it is an all-purpose machine with either three or four wheels, convertible on the farm, if need be. At its working speed of 1400 r.p.m. the engine is designed to give 35 b.h.p. on vaporising oil, and to give more than 40 b.h.p. at 2000 r.p.m. It therefore fills a gap in the range of farm tractors built in Great Britain, having the power to do the work of tractors which have hitherto been imported. Its power and weight make it suitable for pulling a four-furrow plough under average conditions, whilst a high ground clearance and small turning circle, together with hydraulic implement lifting arrangements and track adjustable from 52in to 88in, adapt it for row-crop work on large or small fields.

Accompanying illustrations show the tractor in its three and four-wheeled form. With four wheels and front axle it is known as the " M4 " model; with single front wheel, the " M3." The engine is the long-stroke, four-cylinder Morris-Commercial unit, with side valves, bore 100mm and stroke 120mm and with swept volume of about 3¾ litres. Starting is by an electric motor, on petrol, but vaporising oil is used when the engine is hot. Contrary to the usual arrangement, there is a main carburetter for vaporising oil and an auxiliary carburetter for starting on petrol. A control admits petrol and replaces the conventional choke, thus eliminating the need to change the fuel in the main float chamber.

The drive is taken through a single-plate clutch to a gearbox giving five forward speeds and reverse, the vehicle speeds ranging from less than 1 m.p.h. to nearly 18 m.p.h. Independent wheel brakes are operated by separate pedals, but they can be latched together when running on the road.

The tractor is designed to operate almost every type of farm machinery, as there is a belt pulley on the nearside of the tractor frame, giving a belt speed of 3100ft per minute at 1500 r.p.m. engine speed; a power take-off unit at the rear, available to give a rotational speed of 532 r.p.m. at 1400 r.p.m. engine speed, or, alternatively, a combined power take-off and hydraulic unit, comprising hydraulic lifting arms for tractor-mounted implements and two hydraulic power tappings controlled by independent levers. The hydraulic lift for a tractor-mounted rear implement can therefore be used in conjunction with a hydraulically operated implement mounted at the front; alternatively, two independent cylinders can be operated or an external double-acting cylinder.

The power lift linkage is of the now conventional three-link type, and is designed to permit many existing types of tractor-mounted implements and equipment to be used. The top link and off-side lift-rod are adjustable in length for setting ploughs, and each lift-rod can be adjusted to any one of four lengths to suit different equipment. In addition, freedom to oscillate transversely is provided, for example, for toolbars controlled by ground-engaging wheels. Lateral stabilisers are provided for use with implements in which lateral movement must be restrained.

A swinging drawbar, reversible to give four positions and provided with lateral stop-pins, is fitted as standard and remains in place when the hydraulic lift is in use.



FOUR-WHEELED "UNIVERSAL" TRACTOR



TRACTOR CONVERTED TO THREE-WHEELS

Technical Reports

Tracking in Solid Insulating Materials : A Critical Résumé. By V. E. Yarsley, D.Sc., F.R.I.C., and W. J. Grant, B.Sc., A.M.I. Chem. E., F.R.I.C. The British Electrical and Allied Industries Research Association (Ref. L/T177). Price 9s., postage 3d.—This *résumé* begins with a critical review of the various definitions of the term " tracking " and a definition is suggested for universal adoption. An account of investigations into the carbonisation of the surface of the dielectric is investigated, and tests for the susceptibility of materials to tracking are listed.

Methods of Maintaining Atmospheres of Known Temperature and Humidity. By C. G. Garton, A.M.I.E.E., F. Inst.P. The British Electrical and Allied Industries Research Association (Ref. L/T176). Price 6s., postage 3d.—This report describes methods of obtaining conditioning or testing atmospheres of known temperature and relative humidity, compares the advantages of different methods, and indicates various sources of error or difficulty.

Attainment of a given temperature and relative humidity is not difficult for a skilled worker under laboratory conditions, but for industrial purposes the methods used must be reasonably simple, should preferably not involve measurements other than that of temperature, and should not be dependent upon skilled attention for maintenance of sufficient accuracy.

No method is ideal in respect of all the desirable properties, nor has any one method a very marked balance of advantage over all others. The choice between them, therefore, depends largely on the characteristics considered most important in any given instance, on available apparatus, and to some extent on personal preference. Certain sources of error are common to all methods, and these are discussed in this report before description of individual methods.

The Conditioning of Industrial Dielectrics. The British Electrical and Allied Industries Research Association (Ref. L/T175). Price 6s., postage 3d.—An earlier report, Ref. L/T167, deals with foreign conditioning procedure. The present report gives the conclusions and recommendations of a body of independent experts which was set up to investigate the present position of conditioning procedure for the testing of industrial dielectrics in this country. It includes a table of conditioning procedures intended for general application.

Radar for Tilbury-Gravesend Ferry

A RADAR station has been established by the London Midland Region of British Railways to provide an improved ferry service between Tilbury and Gravesend during foggy weather. As the masters gain experience with the use of radar, an improvement in the service can be expected and it is hoped by the beginning of 1949 to provide a fairly regular service in foggy weather.

In the past, fog has slowed down the service (which conveys 3,000,000 passengers and 150,000 vehicles a year) and on occasion has stopped it altogether. The effect of such interruptions has been most keenly felt by people living in Gravesend and working at the Tilbury Docks of the Port of London Authority. While even radar cannot guarantee a full service in fog, considerable improvements are expected.

The radar equipment has been installed by Cossor Radar, Ltd., in Riverside Station, with the transmitter and scanner on the clock tower above and the indicator in an operating room below. A Marconi radio-telephone enables the radar operator to communicate direct with the masters of the ferry steamers. The radar operators are recruited from the masters and mates of the vessels, and are, in consequence, fully appreciative of the problems of navigation.

In future, when fog descends on the river, the radar station will be manned and from the time each vessel sails until it is safely berthed at the other side, the master will receive over loud-speakers on the bridge a detailed commentary on his progress and the movements of all other traffic in the river, as seen on the indicator screen of the radar installation. The master can, if necessary, speak to the radar operator, though this is normally confined to a few brief remarks on the accuracy of the operator's estimates of distances, and so on, as included in his commentary. These corroborative remarks are usually exchanged after the vessel has safely reached her destination.

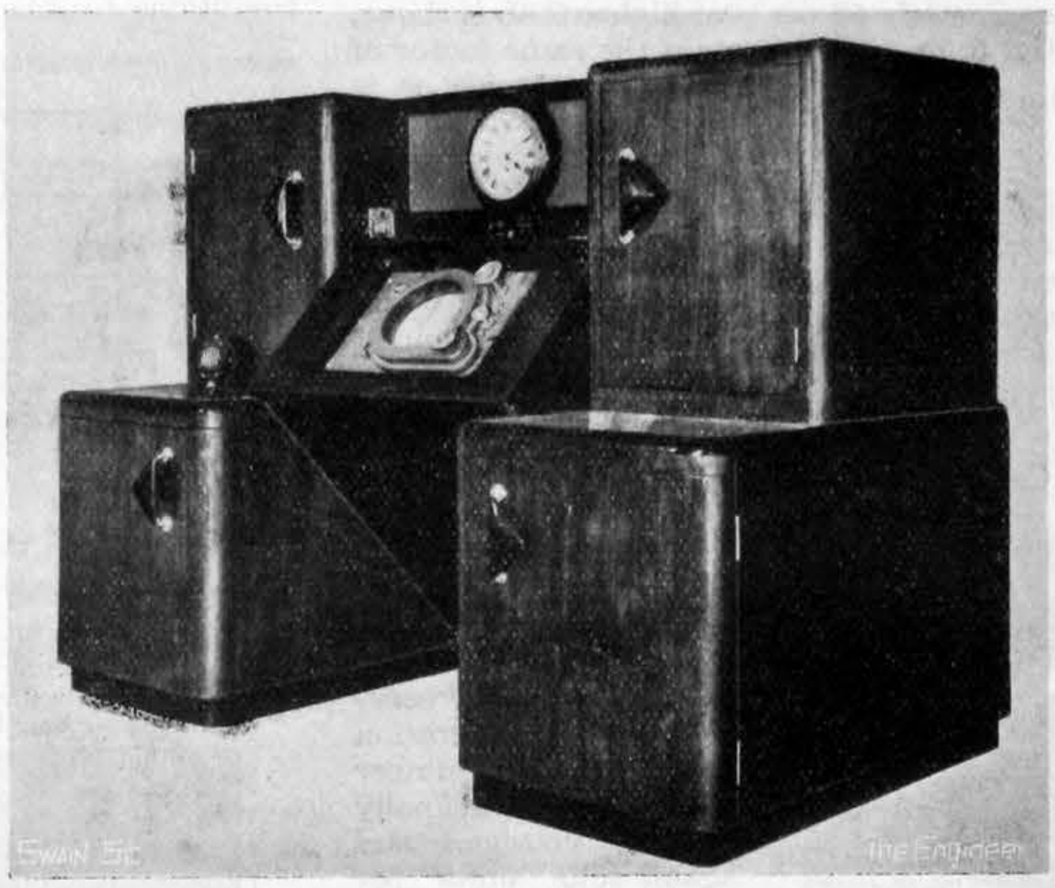
Siting the Equipment

The indicator unit (P.P.I) at Tilbury has ranges of 0·8, 1·2, and 3 nautical miles. With these scales the operator can observe the ferries themselves at close range or alternatively he can see them in relation to other vessels in the river some miles away. Thus, if during foggy weather a radar equipped ship is approaching the crossing place, the operator can warn the ferry captain in ample time.

The indicator mechanism is enclosed in a console of functional design, as illustrated herewith. This console, in polished walnut, comprises a special fitting supporting the indicator screen at an angle which permits the P.P.I. display to be studied from a comfortable sitting position. Immediately over the indicator are switches for the Marconi simplex transmission equipment, together with remote controls for the normal room lighting, whilst the panel above frames an 8in diameter marine timepiece, flanked by dual matched speakers. Cupboards on each side of the centre unit contain the ancillary electrical equipment. A small wooden desk holder is provided for the R/T. microphone hand set, the cable for this being concealed when not in use.

The indicator console is accommodated in a room which has been specially provided at ground level, immediately adjoining the booking-hall at Tilbury station. In the centre of this hall is a booking and luggage office on top of which has been placed the alternator, rectifier and other electrical equipment. In the clock tower over the station roof the main rack is housed and above this again, on the top of an 18ft tubular mast, is the scanner unit. Many points had to be borne in mind before the most suitable site for the scanner was found, but here, 80ft above ground level and at a horizontal distance of some 120 yards from the ferry arrival platform, it is in a position which enables it to satisfy all requirements.

Transmission to the scanner is by a 30ft run of standard waveguide. The aerial beam width is ±1 deg. on the horizontal beam and ±15 deg. on the vertical beam, and the speed of rotation is approximately 32 r.p.m. The transmitter equipment works on a frequency band between 9425 and 9525Mc/s, output power 30kW, pulse width 0·2 microseconds, repetition 2000 pulses per second. The band width of the receiver is ±4Mc/s at 3 decibels. The indicator utilises a special 9in cathode ray tube operating at a voltage of 8kV. The screen material is a special fluoride composition, having long "after-glow" and almost total absence of primary flash.



INDICATOR CONSOLE

Range readings are made with the help of concentric calibration rings on the screen, suitably scaled to suit the range scale (0.8, 1·2 or 3·0 miles) in use. Bearing readings are made by illuminated cursor and bearing scale.

It is claimed that discrimination can be made between two objects differing in bearing by more than 2 deg., or in range by more than 40 yards. The juxtaposition of the various component parts have resulted in a good minimum range performance, and the minimum range, in practice, is said to be approximately 45 yards.

The cable run between the main rack and the indicator is 75ft. The entire equipment operates from 180V, 500 c/s, obtained from a rotary converter, running inverted, and fed from a three-phase a.c. supply via a mercury arc rectifier. The power consumption is 2·5kW, plus an additional 1kW for scanner heaters, when the atmospheric temperature drops below 0 deg. Cent.

INSTITUTION OF MINING ENGINEERS.—The Council of the Institution of Mining Engineers has unanimously re-elected Professor J. A. S. Ritson as President for the year 1949–50. Awards announced by the Council include a "Mavor and Coulson" Students' Prize to Mr. Donald Hindson for his paper, "Some Aspects of Dutch Coal Mining."

Factors Influencing the Design of High-Voltage Air-Blast Circuit Breakers*

By C. H. FLURSCHEIM, B.A., M.I.E.E., and E. L. L'ESTRANGE, M.Eng., A.M.I.E.E.†

SUMMARY

THIS paper reviews some of the factors influencing air-blast circuit-breaker design, more especially in the range 110kV to 264kV and 1500MVA to 5000MVA. The influence of air-pressure range on excess breaking capacity at normal pressure, and methods of achieving economy in air consumption, are described. Limitations and advantages of multi-break interruption are discussed with reference to constructional, voltage grading, and air-flow problems. Design limits of shunts for voltage control and the advantages of non-linear resistors for this purpose are given.

Methods of short-circuit testing are examined, and the severity of test-plant restriking rate, both for tests made on complete and sub-divided breakers, is compared with that for actual systems. The performance of a double-break 3500-MVA, 132-kV circuit breaker incorporating parallel air flow and non-linear resistor voltage control is presented in graphical form, showing the effect of voltage, current and restriking rate in terms of air pressure, and the behaviour of n.l.r. (non-linear resistor) shunting. The facilities offered by air-blast breakers for high-speed reclosure and service maintenance are outlined, and also the manner in which these requirements are executed in the designs referred to in the paper. Finally, conclusions are drawn as regards design, test and future possibilities, based on the combined effect of the factors discussed.

Short-Circuit Tests on a 3500-MVA, 132-kV Circuit Breaker

Object of Tests.—A series of tests was made on a 132-kV air-blast breaker equipped with two double-flow interrupters per phase, shunted by non-linear resistors, and provided with symmetrical air flow, as in Figs. 1 and 2. The purpose of the tests was to prove a rating of 3500MVA, and to investigate the effect of 50 c/s voltage and r.r.r.v. on performance with a view to establishing the limits of satisfactory operation for the higher regions of breaking current.

Standard and Unit Tests with Maximum Available Recovery Voltage.—The complete three-phase breaker was tested at 77 per cent normal air pressure, with maximum available recovery voltage and restriking rate, throughout the range of current, the total break times being

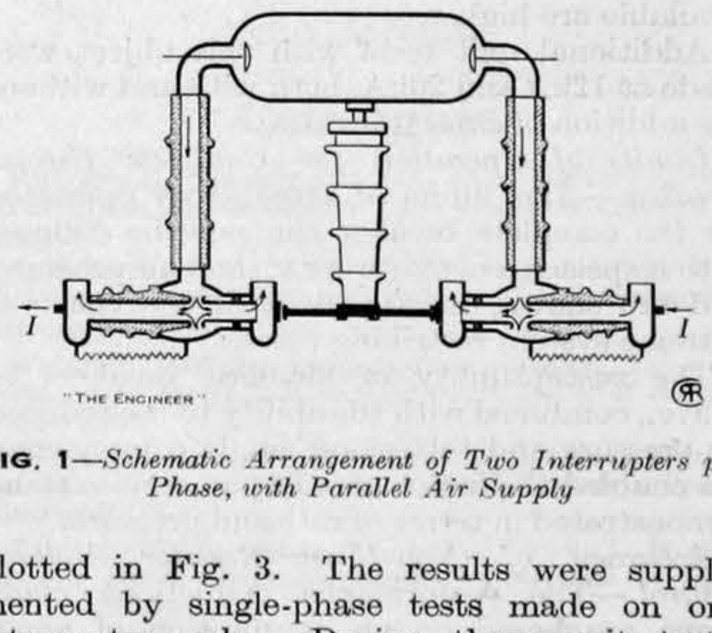


FIG. 1—*Schematic Arrangement of Two Interrupters per Phase, with Parallel Air Supply*

plotted in Fig. 3. The results were supplemented by single-phase tests made on one interrupter only. During these unit tests, shown in Fig. 4, the service voltage associated with the first phase to clear (57kV per interrupter) was maintained up to 10kA, or 65 per cent rating, 30kV being available thereafter up to 20kA. The restriking rate at this latter current was limited by capacitance to approximately 2·5 times extreme system condition (curve C, Fig. 6).

Unit Tests to Show Effect of 50 c/s. Voltage.—Since 100 per cent voltage was not available for currents above 10kA, further unit tests

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* Abstract. Supply Section paper, Institution of Electrical Engineers, London, December 8, 1948.

† Metropolitan-Vickers Electrical Company, Ltd.

were carried out to determine the influence of 50 c/s voltage on performance.

The effect of raising voltage from 20kV to 60kV on one interrupter in terms of air pressure, for various conditions of current and restriking rate, is given in the three curves of air pressure required for satisfactory operation reproduced in Fig. 5. These show that interruption at 60kV requires a minimum pressure of the order of 50 to 60 per cent normal, almost independent of current or r.r.r.v. up to the maximum provided by the test plant. This minimum pressure is, therefore, a function of electric strength of the nozzle gap and not of current or rate. The curves also show that, provided current and r.r.r.v. severity are sufficiently onerous to require 60 per cent or more pressure at 20kV or 30kV, then no higher pressure is necessary for similar current and r.r.r.v. conditions at 60kV.

It follows that extrapolation as regards voltage within the above range is justified with this design at heavy currents where full voltage is not available on test. The extrapolation required, from 30kV to 57kV, for breaking currents above 65 per cent of rating, is within the permitted limits.

Unit Tests to Show Effect of R.R.R.V.—Although the effect of r.r.r.v. on performance cannot be segregated at 60kV, it can be shown at reduced voltages of 20kV to 30kV, where the minimum pressure necessary for dielectric reasons is lower and the short-circuit currents available are higher.

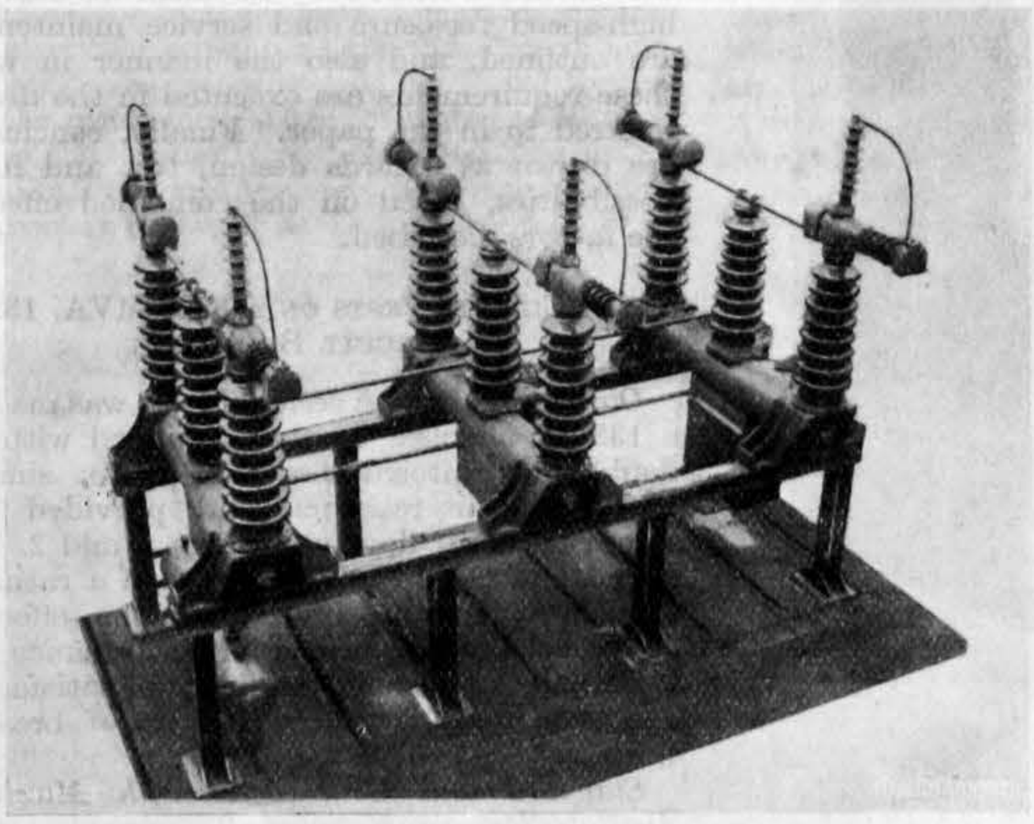


FIG. 2—*132-kV Double-Break Circuit-Breaker of Parallel Air-flow Construction*

Additional unit tests with this object were made at 12kA and 20kA, both with and without the addition of capacitance.

Limits of Operation for Complete Circuit Breaker.—The limits of satisfactory operation for the complete breaker can now be defined, with respect to current, r.r.r.v., and air pressure, and are shown, in Fig. 6, with the curve of extreme system restriking rates.

The susceptibility of air-blast breakers to r.r.r.v., combined with the ability to use reduced air pressure and to test on single components, has enabled the factor of safety in service to be demonstrated in terms of rate and pressure.

Accuracy of Non-Linear-Resistor Voltage Control.—The performance deductions made above are based on an assumption of equal voltage distribution, under short-circuit conditions, between the two interrupters per phase. Justification of this assumption is provided by Fig. 7, extracted from a typical cathode-ray oscillogram taken during tests at 76kV on one phase with one end of the breaker earthed. The control exerted by the resistors is shown to be effective within 2½ per cent of balance for both restriking and recovery voltage, an error within the accuracy of measurement.

Design Basis for Circuit-Breaker Ratings Up to 5000MVA and 264kV

The performance of the 3500-MVA, 132-kV circuit breaker given above can be used to determine the basic requirements for designs of higher MVA or voltage.

For a 5000-MVA, 132-kV rating a breaker would require a limit of satisfactory operation with respect to r.r.r.v. at 100 per cent current approximately 50 per cent higher than is shown in Fig. 6, in order to retain the same factor of safety in service as is given at 3500MVA by the double-break design. The r.r.r.v./current characteristic of the interrupters becomes the limitation, and to improve the performance a four-break construction is needed, employing similar elements, but each dealing with one-quarter of the restriking rate, shown schematically in Fig. 8, and physically in arrangement A, Fig. 9.

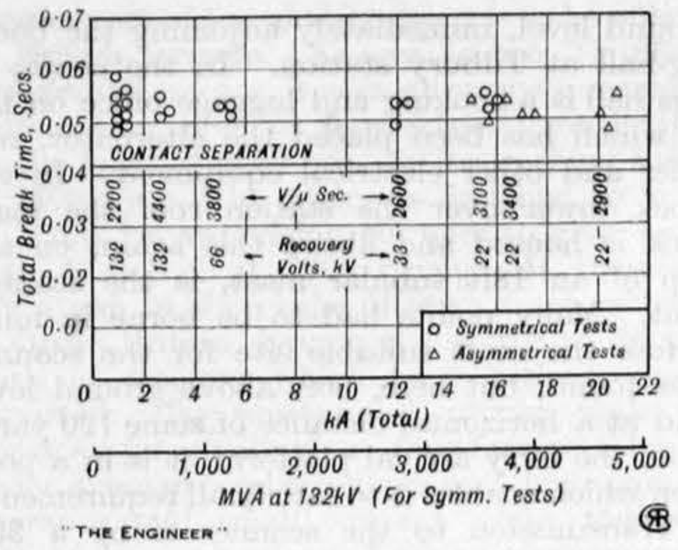
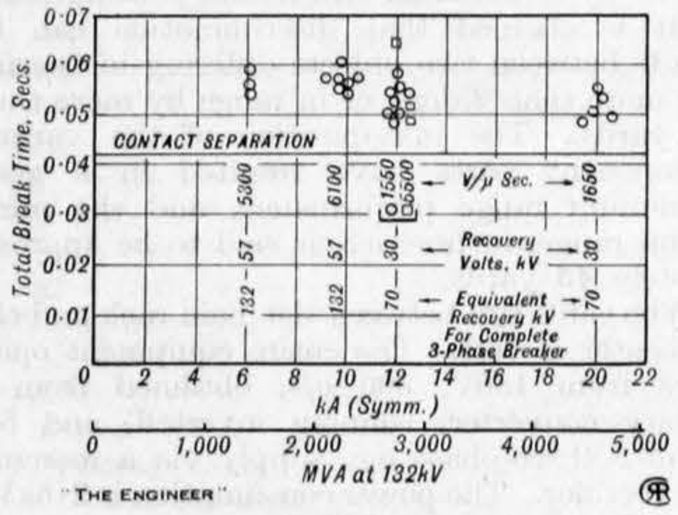


FIG. 3—*Operation at 77 per cent Normal Air Pressure for Three-Phase Tests on Complete 132-kV Circuit Breaker*

For 220/264-kV service the consideration determining the number of breaks is principally one of voltage, and again four units per phase are required, but of 55/66kV voltage level. The MVA rating can then be adjusted over a wide range according to the operating pressure and the rate of air flow permitted by the breaker's pneumatic system. A design suitable for 3500MVA to 5000MVA at 220kV is shown in arrangement B, Fig. 9.

Maintenance

In the quest for improved performance the maintenance engineer sometimes receives too little consideration, with the result that an otherwise attractive design becomes criticised in service owing to the number and inaccessibility of parts requiring attention. One of the features of high-voltage air-blast breakers, in which insulating oil is eliminated, can be the simplicity of maintenance. The main components which may require inspection or check tests are insulation, interrupting contacts, and valve gear, the accessibility of all of these being influenced by the structural arrangement of the breaker.

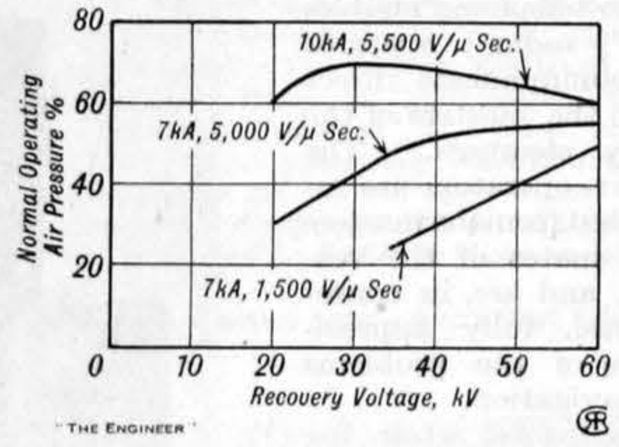


R.R.R.Vs are equivalent rates for two interrupters in series

FIG. 4—*Operation at Air Pressures not Exceeding 77 per cent Normal for Single-Phase Unit Tests on One Interrupter*

Insulation.—The principal cause of dielectric trouble with h.v. insulation is moisture absorption, leading to surface breakdown or puncture. Air-blast breakers can be designed to eliminate this weakness by the exclusive use of porcelain for both permanently stressed insulation to earth and intermittently stressed insulation across interrupter elements and shunts. By this means all power-factor or similar check testing is rendered unnecessary.

Internal porcelain surfaces exposed to compressed air or atmospheric conditions, however, require precautionary measures, since they cannot normally be arranged with rain sheds as on corresponding outer surfaces. The air tubes between live metal and earth, together with the intermittently stressed insulators required for the interrupters, present the only unavoidable surfaces in this respect, and the conditions for their safe performance are pre-



R.R.R.Vs are equivalent rates for two interrupters in series

FIG. 5—*Minimum Air Pressure for Satisfactory Operation for Single-Phase Unit Tests on One Interrupter*

vention of excessive condensation and exclusion or removal of contamination.

This can be achieved, with tubes normally at atmospheric pressure, by bleeding through them dry air derived by expansion from the compressed-air storage. As an expansion ratio of the order of 40 : 1 is obtainable, condensation can be prevented even with severe and sudden drop in ambient temperature. When the air tubes are normally under pressure, with live valve gear, the air supply in the breaker receiver itself requires to be dry enough to meet possible ambient conditions. Since in this case the air has been subjected to a much smaller expansion ratio of about 2 : 1, chemical or refrigeration drying is required.

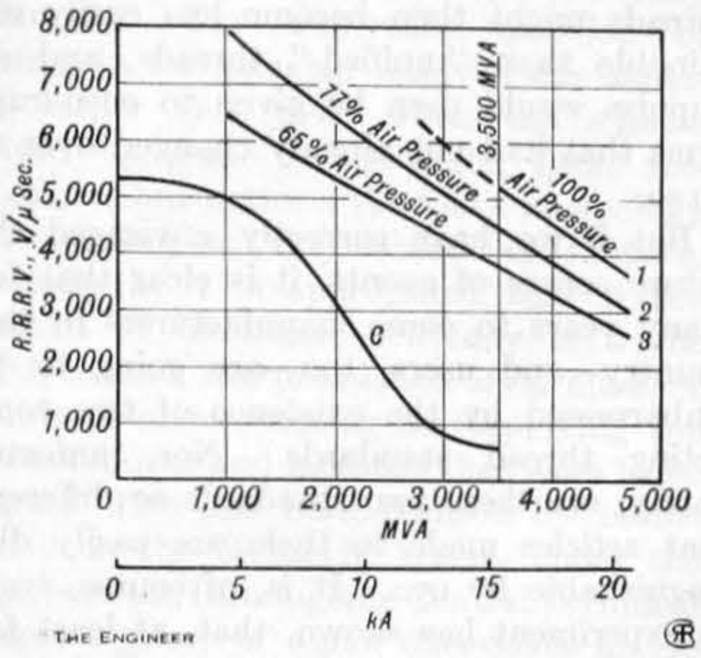
If either of these precautionary measures is applied, internal cleaning is needed only at infrequent intervals, but should be made a simple operation by provision of access to the tubes. With the construction shown in Figs. 8 and 9 this is arranged by removing either the blast valves or the inspection covers situated centrally in the parallel-air-flow manifold between the interrupters.

Interrupting Contacts.—With short arc durations a large number of short circuits can be cleared without contact replacement, a number which is probably not exceeded in the life of an average breaker. It is, nevertheless, desirable to be able to inspect contacts in their operating position, and to remove them without difficulty for cleaning. Inspection facilities are provided, in one design, by an aperture in the interrupter housing through which check inspection can be made without dismantling. Simple contact removal is ensured by the use of parallel-air-flow construction, as in Fig. 9. In this arrangement all the interrupters are separately and horizontally mounted at minimum height from ground level, and accessibility is unaffected by the number of units in series.

Valve Gear.—The reliability of compressed-air mechanisms depends largely on the valve

design. Valve seatings must provide a high degree of airtightness without risk of sticking in the closed position or creeping under prolonged pressure.

Metal-to-metal valve seatings have given good service performance over a number of years without deterioration, and the pressure-drop rate for circuit breakers so equipped can be less than 1 per cent per hour. Synthetic



Curves 1, 2 and 3.—Limits of satisfactory operation determined by test.
Curve C.—Estimated envelope of extreme system r.r.r.v.

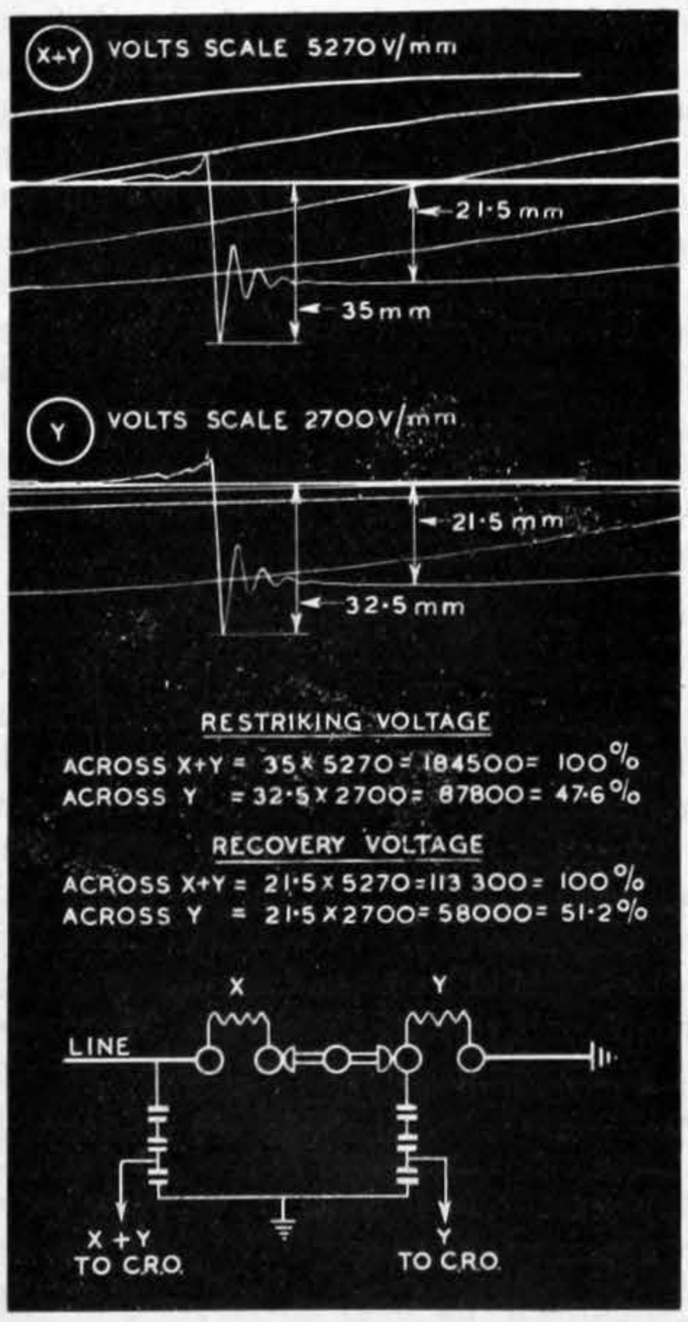
FIG. 6—*Comparison of 3500-MVA, 132-kV, Double-Break Circuit-Breaker Performance and System Characteristics*

or natural rubber valve seatings, while excellent as regards air sealing, lack the other essential qualities for satisfactory long service.

It is desirable, even with metal seats, to be able to overhaul each valve separately and to return it to service as a fully tested component.

Conclusions

(*a*) Simple construction and maintenance of high-voltage air-blast breakers can be achieved by employing the minimum number



Breaks shunted by non-linear resistors.

FIG. 7—*Distribution of Voltage Across the Two Breaks "X" and "Y" of a 132-kV Circuit Breaker*

of series breaks consistent with short contact travel, arranged with independent access to each unit; by avoiding air-economy devices or methods of automatic reclosing which involve additional mechanism, and by the exclusive use of porcelain insulation with the minimum of exposed internal surfaces requiring cleaning facilities.

(*b*) The use of capacitors for control of voltage across series breaks is not satisfactory in all circumstances, especially at 50 c/s voltage, and does not provide the overvoltage damping

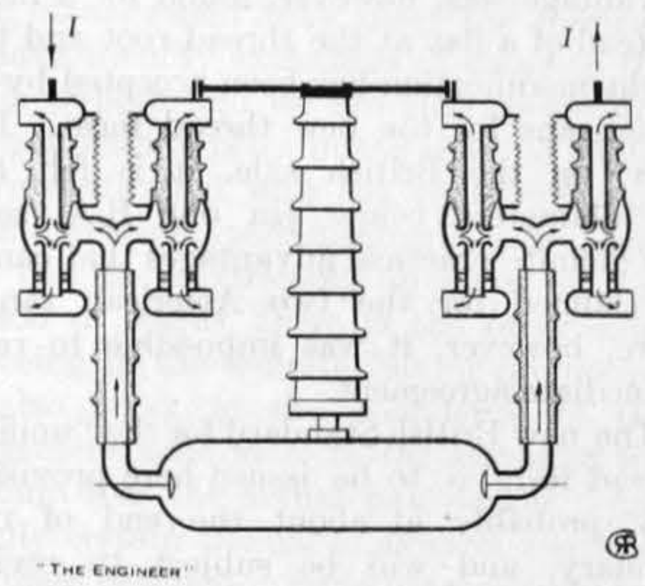


FIG. 8—*Schematic Arrangement of Four Interrupters per Phase with Parallel Air Supply*

feature desirable with forced-blast interruption of small inductive currents.

(*c*) Control of voltage by linear resistors can be effective, but if sufficient shunt current is employed to ensure overvoltage damping, additional interrupters are required to break the resistor current, with consequent structural complication. The use of greater currents for reducing system r.r.r.v. at high MVA is of doubtful value.

(*d*) Non-linear resistors can provide a positive means of voltage control, combined with the ability to damp overvoltage associated with

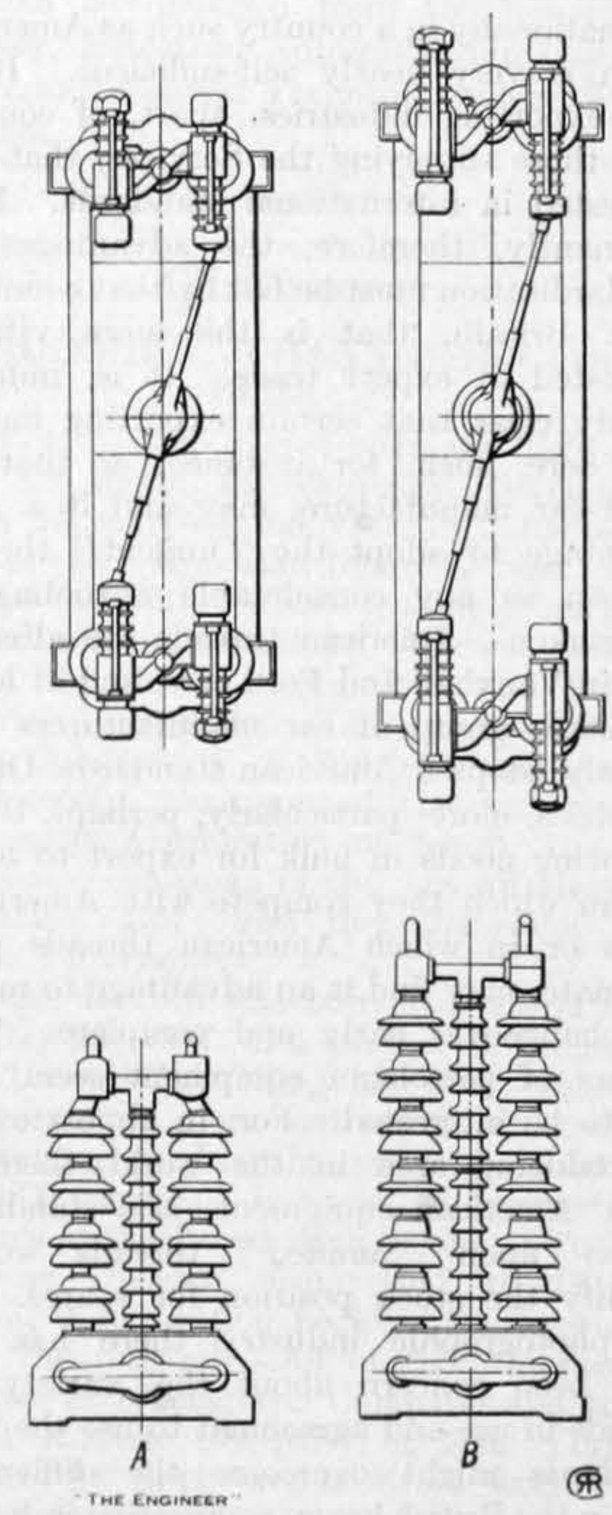


FIG. 9—*Arrangement of Four-Break 132-kV and 220-kV Circuit Breakers*

switching small inductive currents. They also reduce the probability and extent of overvoltage when switching capacitive currents. Their V/I characteristic enables the shunt current to be broken by the sequential isolator without additional interrupters.

(*e*) Unit testing can be an effective method for extrapolation beyond the range of available test plants, provided justification of validity is afforded for each basic design, particularly with reference to air flow and voltage control. Unit tests can then demonstrate the factor of safety in service of air-blast breakers in terms of r.r.r.v. and air pressure.

The ability to apply unit tests does not, in itself, warrant an increase in number of series breaks beyond the optimum required for other reasons.

(*f*) Air-blast breakers can be built with two breaks per phase for 3500MVA at 132kV, and with four breaks for 5000MVA at 132kV to 264kV. The type is capable of being developed to meet higher ratings when these are required.

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THE ENGINEER

DECEMBER 10, 1948

VOL. CLXXXVI No. 4846

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NOTICE TO READERS

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"UNIFIED" SCREW THREADS

IT cannot be denied that in reaching agreement with the United States and Canada upon the "Unified Screw Thread" system, Britain's representatives have had very largely to give way to American opinions. Thirty years ago, after another war, in which Americans, Canadians and the British fought side by side in France, had brought the need for standardisation of screw threads into prominence, the Americans suggested that their own national standards should form the basis of an international series. That suggestion was quickly rejected at that time. Yet now anyone who studies the limited information at present available about the new international "unified" threads can see that that thirty-year-old suggestion has, in fact, been carried out as between Britain and America. For all through the lengthy discussions that have taken place over the last six years, the American position has been very strong. Only by one means would it have been possible to persuade the Americans materially to alter their existing standards. That means would have been to show that some other thread form than their own had positive theoretical and practical advantages. But researches undertaken jointly in all three countries concerned have failed to show that any preference can be given to threads with angles differing over a wide range, so that the American 60 deg. thread is at no disadvantage as against the British 55 deg. Whitworth thread. Moreover, the adoption of a compromise of 57½ deg., as had often been suggested in various discussions, notably in those held at the Institution of Mechanical Engineers in 1945, would have offered no advantage. It would, in fact, have made the worst of both worlds by requiring tools and gauges to be changed on both sides of the Atlantic. A positive advantage was, however, found for a radius instead of a flat at the thread root and that slight modification has been accepted by the Americans for the new thread form. Further, on the British side, it is felt that for diameters below ¼in our B.A. series has definite practical advantages that cannot be claimed for the two American ranges. Here, however, it was impossible to reach immediate agreement.

The new British Standard for the "unified" thread form is to be issued here provisionally, probably at about the end of next January, and will be subject to review. But it can hardly be expected that any substantial modification can now be made. British industry will have to accept the standards substantially as they are—a slight modification of existing American standards. Nor, retrospectively, can we really regard that conclusion to the difficult and tiring work of repeated international conferences as anything but inevitable. It is not merely that the quantity of production here is so much smaller than in America that the overall disturbance caused by re-tooling and making new gauges will be limited by confining it to this country. There is clearly a lesser impulse towards unifying standards internationally in a country such as America, which is very nearly self-sufficient. It is only exporting industries, apart, of course, from those supplying the Services, that are interested in international standards. Predominantly, therefore, the advantages of standardisation must be felt by that country, Great Britain, that is the more vitally interested in export trade. It is, indeed, already clear that certain exporting industries here, such, for instance, as that of motor-car manufacture, may find it a real advantage to adopt the "unified" thread as soon as any considerable re-tooling is undertaken. American threads are already used in Vauxhall and Ford cars, and at least one other group of car manufacturers has recently adopted American standards. Other industries, more particularly, perhaps, those producing goods in bulk for export to markets in which they compete with American goods or in which American threads predominate, may find it an advantage to make the changeover early and complete. The makers of petroleum equipment seem certain to be interested. For, in almost every oil-producing area in the world, there is much American equipment, and standardisation upon "unified" threads would simplify the stock position for spares. In the photographic industry there has for long been concern about the variety of threads in use and agreement to use the new standards might overcome the difficulty. But, in the British heavy engineering industry it cannot be said that there seems to be much advantage in making a change. Only those firms that receive substantial Government orders for plant of new design in which "unified" threads will be called for are likely therefore readily to "standardise" upon such threads in the near future. Other firms, it seems likely, will continue to use Whitworth threads until such a time arises that the makers of bolts and nuts, tools and gauges, who already supply to order a small proportion to American standards, are predominantly concerned in manufacture to the "unified" standards. Whitworth threads might then become less easily obtainable than "unified" threads, and an impulse would then be given to encourage firms that had not already changed over to do so.

But if we have correctly envisaged the future course of events, it is clear that for many years to come manufacturers in this country—and users, too—are going to be embarrassed by the existence of two competing thread standards. Nor, unfortunately, are these two standards so different that articles made to them are easily distinguishable by eye. It is, of course, true, as experiment has shown, that, at least for the less finely finished articles, a bolt and nut made to the different standards can be easily mated. Yet it is obviously desirable that threads of differing angle should not be so mated and presumably, if they are so mated, the load-carrying ability is lowered. Moreover, for some time at least manufacturers, more particularly those in heavy engineering and those making to Service requirements, will have to carry two sets of stocks of tools and gauges, corresponding to the Whitworth and unified systems respectively, with all the possibility of confusion and error that such a situation implies; and for many years to come storekeepers and suppliers of nuts, bolts, tools and gauges will be embarrassed by the need to keep separate stocks that are not easily distinguishable the one from the other. We believe that in the longer run the attainment of an international standard for screw threads will prove an advantage, especially if the "unified" system is adopted by the other nations of the Commonwealth. It is, however, unfortunate that the dislocation consequent upon the change should fall only upon British manufacturers, and that they should experience it just at the time when the need to increase production is particularly strong.

THE STATUS OF THE FOREMAN

IT is no new thought of ours to consider the position in industry of the foreman, and in the past we have likened him to the intrepid sailor steering his craft to avoid the jagged rocks of Scylla, but at the same time remembering that on his other side lay the no less deadly whirlpool of Charybdis. He might also be pictured as finding himself uncomfortably placed between the upper and nether millstones of management and labour respectively. For these very reasons we have more than once expressed our sympathy with this individual, and suggested the necessity for giving him a square deal and fitting him for his arduous position before he is actually appointed. Some eight or more years ago we stressed the importance of the foreman realising that he held a post of trust and responsibility, and of his superior officers showing their respect for him before his subordinates. We further examined the position when war broke out as it was felt that perhaps a

new type was necessary to cope with the problems of mass production and maximum effort, while again, in 1944, we returned to the subject particularly dwelling on the changes incident to functional organisation, and it was definitely stated that "we believe that the time has arrived when the status of the foreman should be carefully reviewed." The important question of training in foremanship received our attention earlier this year, when the scheme evolved by Tube Investments, Ltd., was brought to our notice. We make no apology for returning to the subject once more, especially as it is appreciated that if the standard of industrial efficiency is to be raised, men at the production level must be capable of understanding and applying the new techniques and methods that have to be adopted. This has been realised by industrialists in the Midlands, where, under the auspices of the Birmingham Central Technical College, a group of senior executives in the Midlands has drafted a code of management practice relating to the status of the foreman, a copy of which lies before us.

That the function of foreman cannot be exercised effectively over more persons than those with whom he can reasonably be expected to make contact in the working day is an important principle, which could well be extended to every official in an industrial concern, while the necessity for selecting the right man for each post must always be a *sine qua non*. The standard set in the code is definitely a high one, and we agree that although good craftsmanship is desirable, personal qualities are of far greater importance; indeed, many years ago a leading industrialist asserted that good foremanship was "a matter of organised common sense," while another expressed a similar conviction when he said that his "ideal foreman had 10 per cent technical knowledge and craft skill and 90 per cent common sense." Training for foremanship is very desirable but it should be undertaken before rather than after appointment, although admittedly, training is never complete as it must continue indefinitely in the school of daily experience. We have maintained in the past that the position of a foreman in a factory run on functional lines must be clearly defined, and there must be no overlapping of duties, while the workman must fully appreciate that his foreman is his only chief; the code definitely takes the same line. When we come to the personal relationship of the foreman to trade unions and other bodies we reach an aspect that has not before been covered; indeed, it is one that merits very careful handling, particularly as foremen may have been associated with some form of union all their lives, but it is thought that the code strikes the right note in suggesting that it is the responsibility of the management to create such relations with foremen through recognition of their status and responsibilities, and through the support they receive, that all legitimate reasons for a second kind of association cease to exist. The necessity for ensuring that foremen are in possession of all the information they require to make their own spheres efficient is often overlooked, whereas too often such information does not readily come into their hands. Indeed, some boards seem to withhold details of policy, whereas the more a foreman is told the more intelligent a servant of the company he will be. Again, although this code does not refer to the subject, it is felt that frequent visits to other firms are desirable, tending to widen the vision and to increase his status in industry. We have in the past stressed the great value of conferences in which the upper management may meet the foremen and have friendly exchanges of views to the benefit of both and we are glad to see this finding a definite place in the code. Finally, we are confronted with the vexed question of remuneration, and although many consider this is inextricably involved in the question of status, there is the other side, that being in the definite line of promotion and also being in the confidence of the management adds more to the status of the job than does the actual pay packet. Admittedly certain anomalies exist in wartime, when mass production gives big money to the operative.

We feel that it is all to the good that a body of men have set out clearly their findings in a code of management practice relating to the status of the foreman, and much that we have advanced in the past finds corroboration in the light of their practical experience; although there can be no royal road to success, for the variables are too many and too complicated, much can be done by weighing up the arguments and proposals of those who have paid a good deal of attention to an all-important subject. For those who are interested, copies of this code can be obtained from the honorary secretary, Industrial Administration Group, Birmingham Central Technical College, Birmingham.

Obituary

Dr. HENDRIK JOHANNES VAN DER BIJL

IT is with deep regret that we have to record the death, on Thursday, December 2nd, in his sixty-second year, in Johannesburg, of Dr. Hendrik Johannes van der Bijl, one of South Africa's leading scientific engineers and industrialists. He was chairman of the South Africa Iron and Steel Industrial Corporation, Ltd., the Electric Supply Commission of South Africa, and, until recently, chairman of the Industrial Development Corporation of South Africa. He was also chairman of the African Metals Corporation, Ltd., and the Chancellor of Pretoria University.

Dr. van der Bijl was born in Pretoria on November 23, 1887, and studied at Stellenbosch University, taking his B.Sc. degree with honours, later continuing his technical training at Leipzig, where he gained the Ph.D. degree. He was an instructor in physics at the Royal High School of Technology at Dresden, from 1912 to 1913, and from that position he went to America to join the research staff of the American Telephone and Telegraph Company and the Western Electric Company of New York, where he did important research work on radio-telephony.

In 1920 General Smuts persuaded Dr. van der Bijl that his services were needed in the interests of South Africa, and he returned to become Technical Adviser on Industrial Development to the Department of Mines and Industries of the Union of South Africa; subsequently he was appointed chairman of the Electricity Supply Commission.

With the unification of steel interests in 1928, Dr. van der Bijl was made chairman of the South African Iron and Steel Industrial Corporation and his work for that Corporation was outstanding. In 1937 he was appointed chairman of the African Metals Corporation, and in 1940 chairman of the Industrial Development Corporation of South Africa, Ltd.

On the outbreak of war in 1939, Dr. van der Bijl's services were immediately called upon, and he served as Director-General of War Supplies from 1939 to 1942, and was appointed Director-General of Supplies in 1943, to co-ordinate both war and civil requirements.

In 1944 he became the chairman of the Vanderbijl Engineering Corporation, Ltd., and the Vanderbijl Park Estate Company, a company which was formed to develop an industrial township in connection with the development of Iscor, the Vanderbijl Engineering Corporation, Ltd., and other allied industries. It may be recalled that it was recently announced that through Vickers-Armstrong, Ltd., the Vanderbijl Engineering Corporation has arranged to manufacture in South Africa certain engineering and electrical machinery specially suited for mining and heavy engineering industries.

In the earlier part of this year Dr. van der Bijl was appointed chairman of the South African Marine Corporation, which operates its own vessels between the Union and the United States of America.

In addition to his many activities in the industrial life of South Africa, Dr. van der Bijl found time to do much for education. He was elected Chancellor of Pretoria University in 1934. His work was also recognised by Stellenbosch University by the bestowal on him of the Honorary D.Sc. Degree and by Capetown University, which gave to him the Honorary LL.D. degree. He was a member of many scientific societies and institutions, which included a Fellowship of the Royal Society, and the Royal Society of South Africa. He was a Foreign Associate of the National Academy of Science, U.S.A., and a member of the American Institution of Electrical Engineers, also a Fellow of the Institution of Radio Engineers. He was, too, an Honorary Member of the Koninklijke Institut van Ingenieres of Holland.

His death, at a comparatively early age, will be mourned by many industrialists, not only in South Africa, but in this country, where his counsel on many occasions proved invaluable. It may be recalled in this connection, that in 1946, the British Government sought his advice on the future of the steel industry in Great Britain, and at the same time invited him to become the first chairman of the Iron and Steel Board, a position which, however, he did not find it possible to accept.

33-KV TRANSMISSION SCHEME FOR BRISBANE.—The Brisbane City Council has started work on the 33-kV scheme for the transmission of energy from the new power station at Tennyson. A main feature of the scheme will be a duplicate interconnector between the existing New Farm power station and Tennyson, a distance of approximately 6 miles. There will also be a ring main between the New Farm station and the northern suburbs of the city. This main will feed 33/11-kV, 7500-kVA transformers in sub-stations at Kedron, Northgate and Hendra. Contracts for all the cables for the scheme, which have been awarded to Pirelli-General Cable Works, Ltd., of Southampton, include over 50,000 yards of 33-kV super-tension cable and over 40,000 yards of pilot cables. The total value is approximately A. £400,000.

Literature

Factory Administration in Practice. By W. J. HISCOX and JAMES STIRLING. London: Sir Isaac Pitman and Sons, Ltd. 1948. Price 8s. 6d. net.

A BOOK that is based on practical considerations is likely to commend itself to the engineer more than a theoretical treatise, and the book before us is essentially practical, being based on the actual experience of the authors, and we can commend it to the student who is anxious to gain an understanding of the basic principles of modern factory administration, while the seasoned manager will find a good deal that is arresting and worthy of careful consideration. Several educational institutions have adopted this as a textbook, and it is calculated to cover the ground required for some of the professional examinations. But it can claim to be more than a textbook in that it comprises nothing that is arbitrary, being suggestive in character. The book is divided into two parts, the first dealing with the different spheres of administration, and the many branches to be found in a modern factory, while the second is occupied with buildings, plant, power, ancillary services and labour problems.

Very wisely the first point touched is the real scope of administration, and the dividing line between it and management, a subject that is often none too clearly understood by senior executives of many years' standing. Three aspects of administration are described as determinative, directive and co-ordinative, the first being concerned with policy, the next with shaping the organisation to suit that policy, and the third with the maintenance of equilibrium between divisions. On the other hand, the function of management may be stated in brief to be to carry out the administrative policy. While most of the branches in an engineering concern are clearly described, we are somewhat surprised to find no description of the estimating department or of that of the cost accountant, both of which are essential to a modern engineering factory, and when used judiciously can be of immense value to the organisation. The prominence given to the progress department is very noticeable, and, we feel, justifiable, but many will not agree as to the desirability of placing purchasing under progress, although it is a proposal that deserves careful thought, especially when it is remembered that satisfactory progressing is only possible when reliance can be placed on the receipt of the right materials at the proper time. We fully endorse the authors' suggestion that in a large factory inspection should not be under the works manager, but we cannot agree that in a small one the chief inspector may report to the works manager, as it is of the utmost importance that in no circumstances should the producer be his own inspector.

The authors confess that "the matter is incomplete, and must be so of necessity," but that being so it would be a real help to the student if reference had been made to suitable books for the study in further detail of the branches necessarily superficially handled or even ignored. Again, the graphical representation of the whole structure of an organisation by means of a "family tree" would crystallise the general lay-out in the mind of the reader. Certainly the authors have succeeded in "exciting the interest of those upon whom the future of industry depends," and also of awakening new trains of thought in those who have been longer in the field.

SHORT NOTICES

Telephony. Vol. I. By J. Atkinson, A.M.I.E.E. London: Sir Isaac Pitman and Sons, Ltd., Parker Street, Kingsway, W.C.1. Price 35s. net.—This book, which is described as a new edition of Herbert and Procter's "Telephony," is a worthy successor to that standard work on the subject. The task of revising the text to reflect technical progress began some years before the war, and, with the death of Mr. T. E. Herbert in 1943, the work of preparing a new text-book devolved solely upon his new collaborator, Mr. J. Atkinson. Like its predecessor, the new book should appeal primarily to engineers concerned with the installation and maintenance of telephone exchange equipment and subscribers' apparatus. The author has deliberately refrained from explaining basic electrical principles on the assumption that the reader will be familiar with elementary d.c. and a.c. theory. Likewise, the highly specialised subjects of external line and telephone transmission have been omitted from the text. Accordingly, the new edition is mainly concerned with the signalling and switching side of telephony. Volume I, which is here under review, deals with general principles and manual exchange systems, while Volume II, which is under preparation, embraces automatic exchange systems. Both volumes together are intended to cover grades I, II and III of the new City and Guilds examinations in telephone exchange systems, and the telephone aspects of elementary telecommunications practice. So that the readers should be equipped to understand the new and complex circuits that are frequently introduced in modern telephony, the author's aim in Vol. I has been to concentrate mainly on fundamental circuit elements and then to show how these are applied to practical circuit design. In pursuit of this policy the first thirteen chapters of Vol. I are devoted to principles rather than practical circuits. The next five chapters show how these principles are applied specifically to manual exchange systems. Finally, there are two chapters devoted to telephone exchange power plant and the principles and practice of testing.

Radio Laboratory Handbook. By M. G. Scroggie, B.Sc., M.I.E.E. London: Iliffe and Sons, Ltd., Dorset House, Stamford Street, S.E.1. Price 12s. 6d. net.—To keep the fourth edition of this book within the proper bounds of a handbook, intended to appeal to amateurs as well as radio engineers, a good deal of discrimination has been exercised in revising the text. Accordingly, the subject matter has been extended so as to include v.h.f. laboratory work, without attempting to encroach on the highly specialised techniques associated with decimetre and centimetre waves. Much useful general information is given in a chapter dealing with a variety of matters such as musical scales, wire tables, decibels and the significance of "Q." The author has included an appendix explaining the rationalised M.K.S. system of units, which may appeal to those who find difficulty with "practical" and "absolute" units. Another appendix gives some information on the construction of measurement bridges.

Electronic Engineering. Edited by E. Molloy. London: Geo. Newnes, Ltd. 5s. net.—By the use of small type it has been possible to compress a considerable amount of information on electronic devices into this book, which is very reasonably priced. The chapters, each written by an expert, include valves, gasfilled triodes, ignitrons, cathode-ray tubes, electron microscopes, photo-cells and h.f. heating. Whilst a certain amount of theory is included, the main emphasis of the book is on the practical side, and it will be a useful reference for engineers who require an up-to-date survey of the subject.

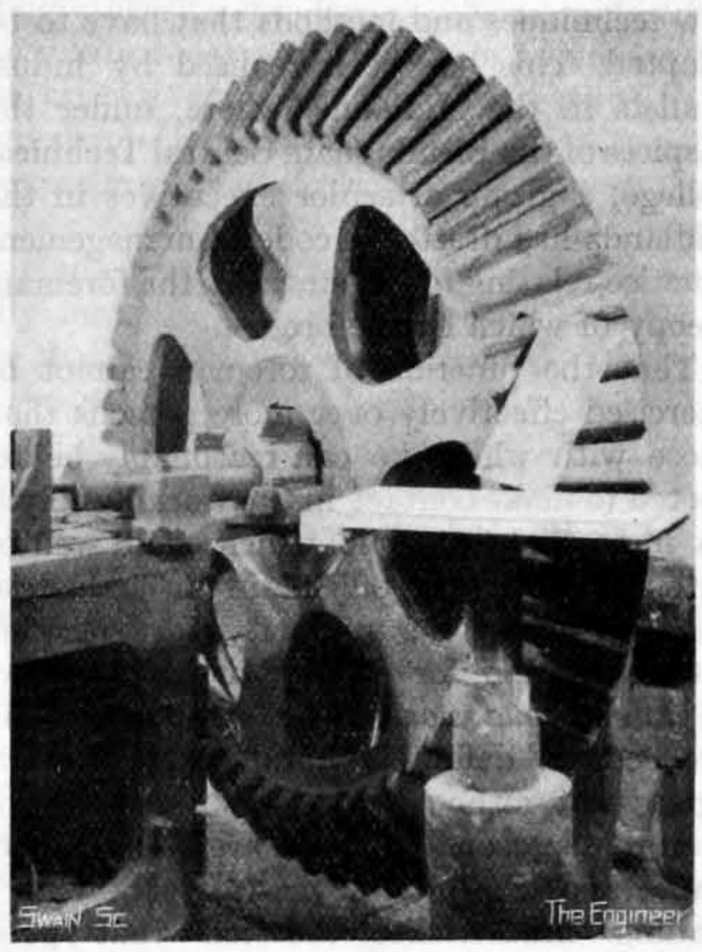
Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

THE STAKING OF LARGE WHEELS

SIR,—We notice in THE ENGINEER of October 29, 1948, under the heading "Letters to the Editor," on page 445, the interesting contribution by Mr. R. H. Parsons, on "The Staking of Large Wheels."

During the same week as the publication appeared, we were staking in our millwrights' department a pair of machine-moulded cast steel bevel wheels for a cotton manufacturing firm in this district. These wheels have fifty-six and forty-two teeth respectively, 3½in circular pitch, 9in face, and 10in through the boss. The large wheel is approximately



62in diameter and the smaller one 47in diameter, each wheel being prepared for four keys 2in wide. Respective weights of the wheels are: the large wheel, 25½ cwt, and the other 18 cwt.

During the process of staking the wheels on the mandrel, we photographed the large wheel, showing the staking board, &c., the boss and mandrel, and the staking wedges and the keyways, ready for fitting the keys to the required flats.

We feel sure Mr. Parsons will be glad to know that the old millwrights' art of staking wheels is not quite obsolete, especially in the manufacturing districts of Lancashire and Yorkshire and that he will be reminded of his millwrighting days.

H. A. RISHTON
(Director)

S. S. Stott Ltd.,
Haslingden, Rossendale, Lancs,
November 22nd.

BOOKS RECEIVED

Drainage and Sanitation. Ninth edition. By E. H. Blake. London: B. T. Batsford, Ltd., 15, North Audley Street, W.1. Price 15s.

Alternating Current Machines. By Thomas C. McFarland. London: Macmillan and Co., Ltd., St. Martin's Street, W.C.2. Price 35s.

Power from the Wind. By Palmer Cosslett Putnam. London: Macmillan and Co., Ltd., St. Martin's Street, W.C.2. Price 33s.

International Maritime Dictionary. By René de Kerchove. London: Macmillan and Co., Ltd., St. Martin's Street, W.C.2. Price 55s.

Fletcher's Quantities. Twelfth edition. Revised by A. E. Baylis. London: B. T. Batsford, Ltd., 15, North Audley Street, W.1. Price 30s.

British Catalogue of Plastics. London: The National Trade Press, Ltd., Tower House, Southampton Street, Strand, W.C.2. Price 60s.

Production Control

THE INSTITUTION OF MECHANICAL ENGINEERS

AT an extra general meeting, held at the Institution, London, on Friday, December 3, 1948, a paper " Control of Production," by S. W. Lister, was presented. An abstract of the paper is printed elsewhere in this issue. From the discussion after the paper we have abstracted the following :—

Discussion

Mr. J. M. Newton, who opened the discussion, dealt in some detail with the planning of production, and pointed out in his final remarks that planning was inherently impossible unless the time of response to correction was short. Engineers, who were almost the only professional men who had to guarantee their results under penalty, were thereby forced to face the facts and to compare their promises with performance, and they at least should have a clear idea on these matters, and should realise the advantages, the disadvantages and the limitations of planning and the conditions in which it could be successful.

Major-General W. S. Tope paid a tribute to the author for a masterly exposition of a most important problem, a problem about which, in his view, not enough was known in this country.

The application of the principles expounded in the paper were, of course, dependent on the facts of each case. An assessment must be made of the factors for and against, and a decision made as to the extent to which it was worth while to plan a particular job. Planning of this nature was at its best in production where the repetition of operations was large and long runs might be expected, and, of course, all the materials were available. There were many engineering firms where such conditions prevailed but seldom, and perhaps not at all.

Colonel L. F. Urwick said it was nearly a quarter of a century since the Institution first took an interest in management subjects. It was in 1924 that management was introduced into the Institution's professional examinations, and since then Section C had been compulsory. He thought that the Institution was unique among the great professional engineering institutions in this country in insisting that its members should have some acquaintance with the problem of how engineering work should be done, in addition to their technical knowledge of what should be done. As the author pointed out—and, personally, he thought it was the most important point in the whole paper—every system of production control had to answer the four basic questions : what, how, when and where ?

In his opinion, one of the central difficulties which we faced in our industrial civilisation was a deterioration in men's ability to co-operate with each other. One of the factors which contributed to this situation was the increasing tendency towards specialisation in education. Even highly trained people found it more difficult to work together because they had been submitted to different and contrasting technical disciplines : they lacked a common culture, and therefore a common doctrine. If, however, men were to work intimately together—and a mechanised economy demanded greater and greater refinement of co-operation—one of the first essentials was that they should have a common doctrine. His personal interest in education for management was largely based on this conviction.

As emerged from every paragraph of the present paper, management was primarily a co-ordinating activity. It seemed to him, therefore, of great national importance that the concepts of management entertained by those discharging different functions should be identical. He would therefore suggest that this long-period national interest was more important from the standpoint of the coming generation than any immediate technical advantage or institutional loyalty which the Institution might serve by adopting or retaining an individual and different syllabus in its own management subjects.

Mr. H. B. Ferguson said that, inasmuch as the entire efforts of the nation should be focused on ways and means of increasing production with the limited industrial manpower available, the present was an appropriate time for the mechanical engineering industry, more than any other body, to discuss all the factors which had a bearing on increased production.

The author had very ably and fully covered the scientific approach to the economic planning of any large works engaged in the mass production of standard articles, and there was little which could be added to what he had said on this subject, or to what Mr. Newton had said about planning. It must not be overlooked, however, that there were in Great Britain 233,000 separate establishments in the manufacturing industries, employing 7,250,000 workers, and that only 18·1 per cent of those workers were engaged in works which individually employed over 2000 hands, and 81·9 per cent were engaged by firms employing less than 2000. In fact, half the workers, or, to be more exact, 3,620,000, were employed by firms engaging less than 500 workers each. Many of these smaller firms were jobbers, carrying out a great variety of work, not only for home consumption, but for export.

It would appear, therefore, that an elaborate system of control, as visualised by the author, could not be installed in its entirety in organisations employing about 80 per cent of the industrial labour of the country, as the necessary staffing and overheads for the paper work involved would not be warranted. The question arose, therefore, of what advice could be given to these numerous smaller firms towards increasing their efficiency and production.

Some small establishments might think that the basic principles outlined by the author could not be modified and applied successfully to smaller works. There was, however, a major difference between a very large works and a small works. A large establishment could afford to incur the overhead expenses to break down to the minutest detail the operations, even to man-hour minutes, and the employee had no option but to follow the pace set by the management. In smaller works it was more essential to rely on the operators to carry out their work in the man-hours that the foreman and the men agreed beforehand, the foreman endeavouring to keep within the original estimated times or works labour costs visualised by the estimator in the tendering stage ; and it was necessary that he should have this information.

Mr. R. G. Morrison was pleased to note the importance which the author attached to the problem of material, i.e., of stores. The suggestion that stores control records should be kept by a special clerk, not the storekeeper, was in keeping with his own experience ; he had found it possible to make these store control records—was the author correct in calling them accounts ?—part and parcel of the production planning or the material control department, or, if it was a small concern, the progress office. He had known many instances where it had been impossible to obtain the available stock position because, quite rightly, the bin stock cards had not taken into account works orders issued against contracts in progress, but not yet drawn from stores. He was also in favour of some form of perpetual inventory of the total stock. This was not always possible, and might increase overhead expenses by employing an extra clerk, but if it was linked with the work of the accounts department it could become the official stock record.

In this country there was not nearly as close a connection between sales and production as there was in America, and he had been surprised at the complete absence of any control link between these departments of large works which had in other respects adopted modern methods.

Mr. G. A. Lemon, speaking as one who was primarily interested in a large jobbing works, and dealing with the author's references to planning, submitted that it was necessary to look on planning, not as one operation, but as an item which had to be divided into phases. Pre-planning, he suggested, was necessary when an order was placed on the active list, as a means of ascertaining roughly what the works had in store for itself. Intermediate planning, he suggested, was also necessary when the job had been designed and the drawings were available, so that the people concerned knew what faced them. Final planning was necessary when they knew when those materials which were so difficult to obtain in these days were going to arrive.

Another point which was very important, but which was not mentioned specifically in the paper, was the need to marshal the materials which were going to be used for any piecework job, great or small, so many days or weeks ahead of the time for the issue of the job itself. Only by that means, in these days of difficulty in obtaining materials, would shortages be brought to light, instead of, as in the old days, people discovering that they were short of something only when the actual item itself was wanted.

Finally, he would like to refer to the author's reference to the loading of jobs on to the works. The author seemed to favour loading work on to the shops centrally, but he himself felt that that was a matter which should be left to the foreman.

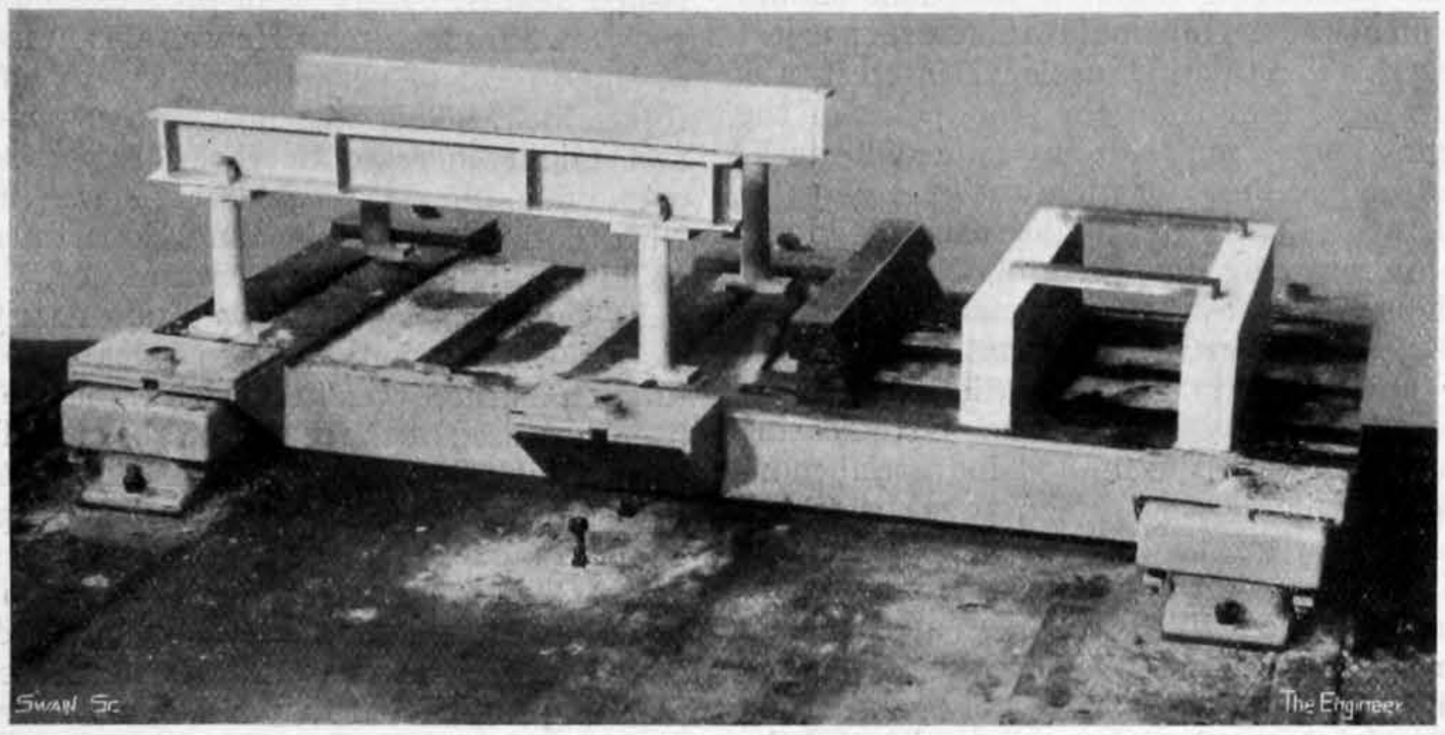
British Automobile Production.—The Society of Motor Manufacturers and Traders states that during October, the British automobile industry produced a weekly average of over 6500 cars and 4000 commercial vehicles, the phase of transition to new models still effecting a small though inevitable reduction in the car output level. Motor vehicle exports during October totalled nearly 19,000 cars and almost 7000 commercial vehicles. The United States of America again took the lead as the largest buyer of cars with a complement of nearly 2700 units. Although comparatively small, British exports of cars to the South American countries of Argentina, Brazil, Chile, Uruguay and Venezuela showed a marked increase over the preceding month. Over the first nine months of this year—the latest period for which detailed figures are available—exports of agricultural tractors totalled 47,000 units. It is significant of the efforts of British manufacturers that in this sphere, also, the U.S.A. accounted for a far greater share than any other overseas market.

Engine Test Beds at Esso European Laboratories

DELAYS and shortages may be unavoidable under present conditions, but the enterprising engineer regards them as a challenge to his inventiveness. It sometimes turns out that the unorthodox solution has advantages over established practice, and an example is a novel design of test bed for multi-cylinder engines up to 150 b.h.p., which is now in use at Esso European Laboratories, Abingdon.

The traditional form of engine test bed is, of course, a massive iron casting with tee slots, the whole being set in a block of concrete extending to a depth of several feet below the floor of the test house. In recent years it has been more usual for this heavy reinforced concrete block to be insulated from the foundations of the building by cork or rubber strips in order to reduce the transmission of vibration from the engine to a minimum. Test beds of this design are in use at the laboratories and are very satisfactory, but to continue this form of construction at the present time would have involved serious delays in obtaining and machining the castings.

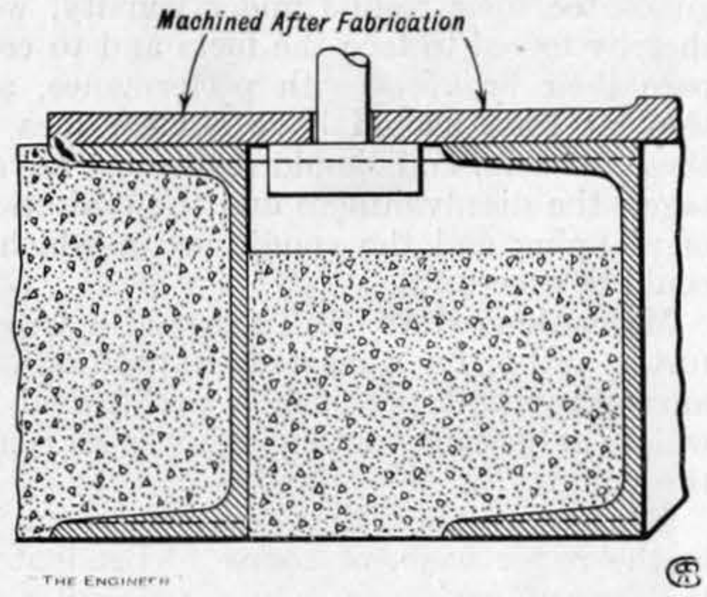
The engineering staff of the laboratories, after studying the problem, evolved a spring-mounted structure which could be largely prefabricated by electric welding from stock sizes of mild steel plate and rolled sections. The general form of this structure is illustrated herewith ; the right-hand end of the bed has the requisite mass in the spring-mounted structure the prefabricated steelwork is filled in with concrete, after the anti-vibrators are placed in position and immediately before mounting the bed thereon.



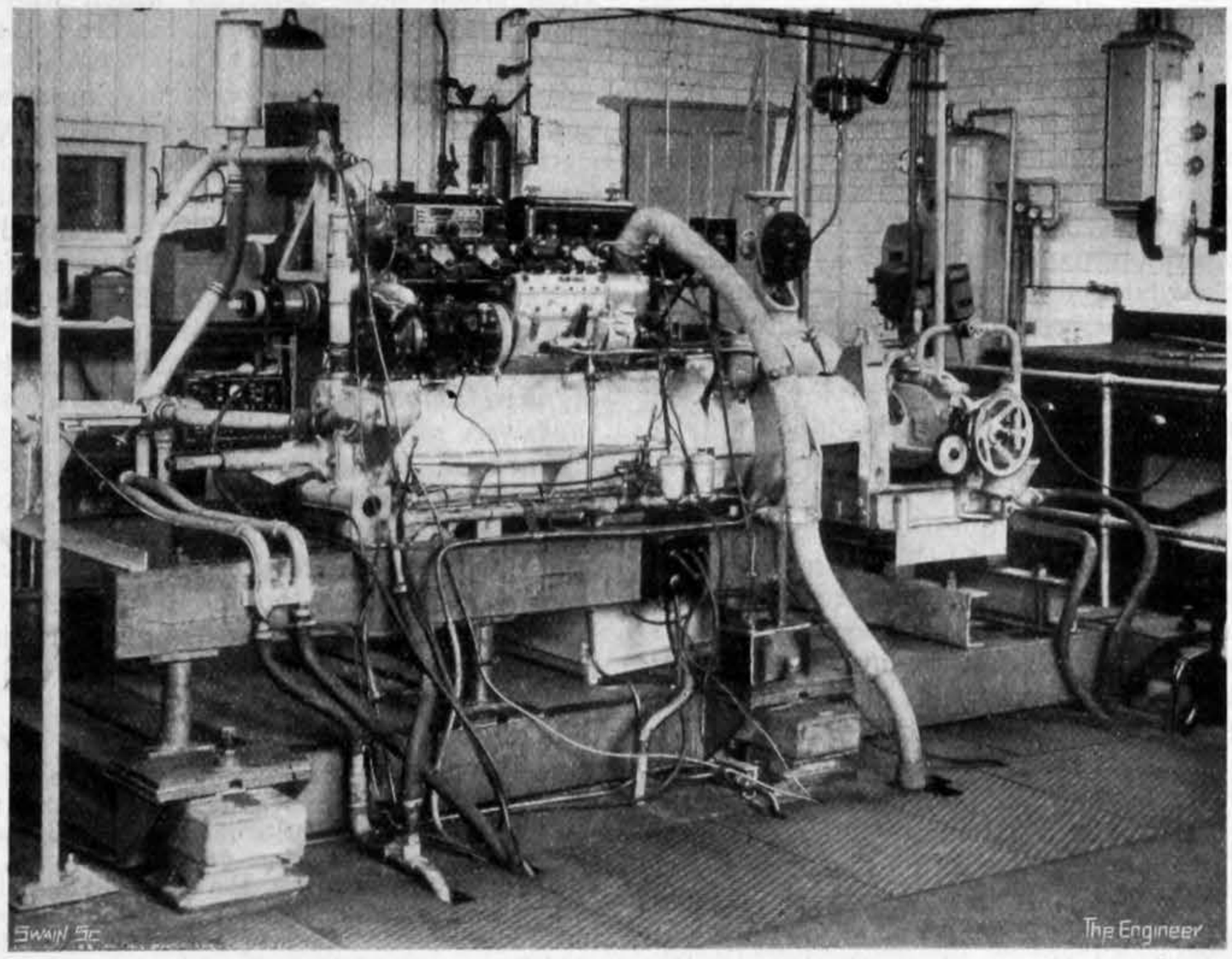
TEST BED FOR ENGINES UP TO 60 B.H.P.

The design illustrated is 7ft 6in overall length and 4ft 1in wide. The weight of the steel structure before loading with concrete is 8 cwt and the additional weight of concrete is 13 cwt. This design is particularly suitable for car engines up to about 60 b.h.p. A larger model, 11ft 6in long, has also been constructed having a total weight of 1½ tons. This can accommodate the largest type of automobile diesel engine and a representative installation is shown in another illustration.

The arrangement of the prefabricated steel structure is very simple, and the important operation of machining the top face can be readily performed in a planer. Care was taken to avoid the necessity for machining the insides of the tee slots ; the accompanying sketch shows a detail of the tee slot construction, from which it will be seen that an accurate cross-section has been obtained entirely by welding steel plates in a suitable manner. The level of the concrete filling is adjusted so as to prevent the tee-headed bolt from falling through the slot. The usual form of cast iron bed has longitudinal tee slots running the whole length with supplementary slotted castings bolted transversely, which in turn carry upright engine supports. Experience has shown that such an arrangement tends to make the bottom half of the engine inaccessible. The disposition of the tee slots at opposite ends of the bed in two directions at right angles permits easy alignment of engine and dynamometer with a minimum of obstruction.



DETAIL OF T-SLOT CONSTRUCTION



LARGE ENGINE TEST BED

Several of these test beds are now in use and they are proving, we understand, entirely satisfactory ; transmitted vibration is completely eliminated. It has been found possible to construct and complete the installation of such a bed in about a month with some saving in capital expenditure. Apart from the initial savings thus achieved, an incidental advantage is that the test bed can very easily be moved to a new position. This permits the grouping together of several beds within a test room to suit the convenience of a particular group of research workers.

"TOOLS FOR THE JOB."—An interesting new sound film, entitled "Tools for the Job," was recently presented in London for the first time by Arthur Balfour and Co., Ltd., of Sheffield. The film first deals with the various processes involved in the production of high grade tool steel and shows briefly but clearly how the scientific instrument is used to supplement the skill of the steelmaker. It goes on to show the tools made from the steels in actual use in customers' works, and some interesting scenes are included of coin stamping at the Royal Mint, the manufacture of propeller blades at the works of J. Stone and Co., Ltd., Deptford, work on the Bristol "Brabazon," &c. The firm states that the film will be used to show its own employees the uses to which its products are put, as well as for propaganda purposes. The commentary given with the film is being translated into a number of languages and copies are being sent abroad.

An Australian Electricity Supply Undertaking

THE distinctive character of electricity supply to rural communities in Australia is well exemplified in Mullumbimby, with its municipal electricity undertaking. Lying in the heart of one of the more fertile areas of New South Wales, Mullumbimby is a town of some 2500 inhabitants, about 10 miles from the mouth of the Brunswick River and 560 miles by rail north of Sydney.

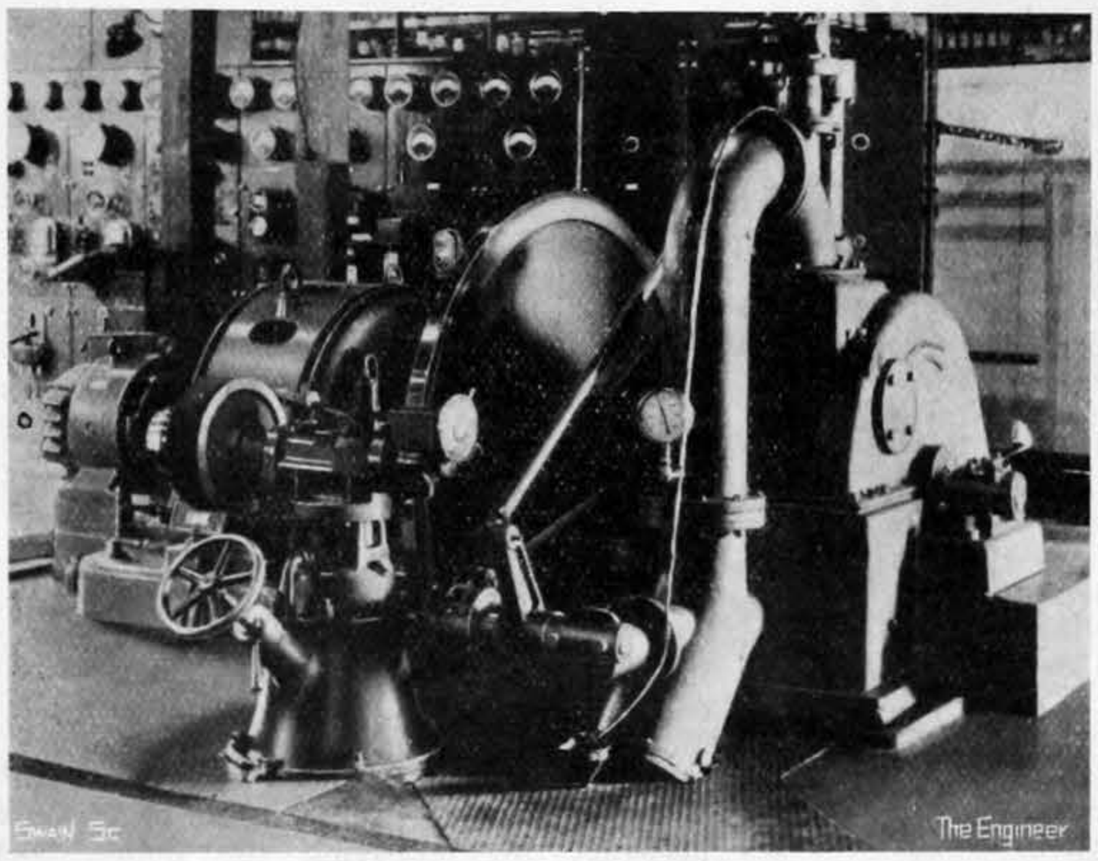
With a supply area covering the whole of the Byron shire, the electricity undertaking serves a number of towns, including Mullumbimby, Byron Bay, Bangalow and Brunswick Heads (all of which have electric street lighting), and rural areas such as Myocum, the Saddle, Tyagarah, Mullumbimby Creek, Billinudgel Road, Coorabell, McLeod's Shoot, Goonengerry, Federal, Ewingsdale, &c. The area is largely agricultural, its activities including dairy farming and pig raising, and the cultivation of bananas, beans, peas, timber, &c. There are, in addition, butter and cordial factories and timber mills. The town of Byron Bay, for example, supports a number of industries, such as meat works, butter factory and mining interests engaged in treating beach sands for the important products of zircon, rutile, monazite, &c.

This article gives a brief account of the electricity undertaking and its rapid growth since 1925, when the initial plant installation consisted of two 225 b.h.p. Boving Pelton wheels direct coupled to two 140-kW G.E.C. alternators. These sets, one of which is illustrated herewith, are still in use, generating at 660V, three-phase, 50 cycles, 600 r.p.m.

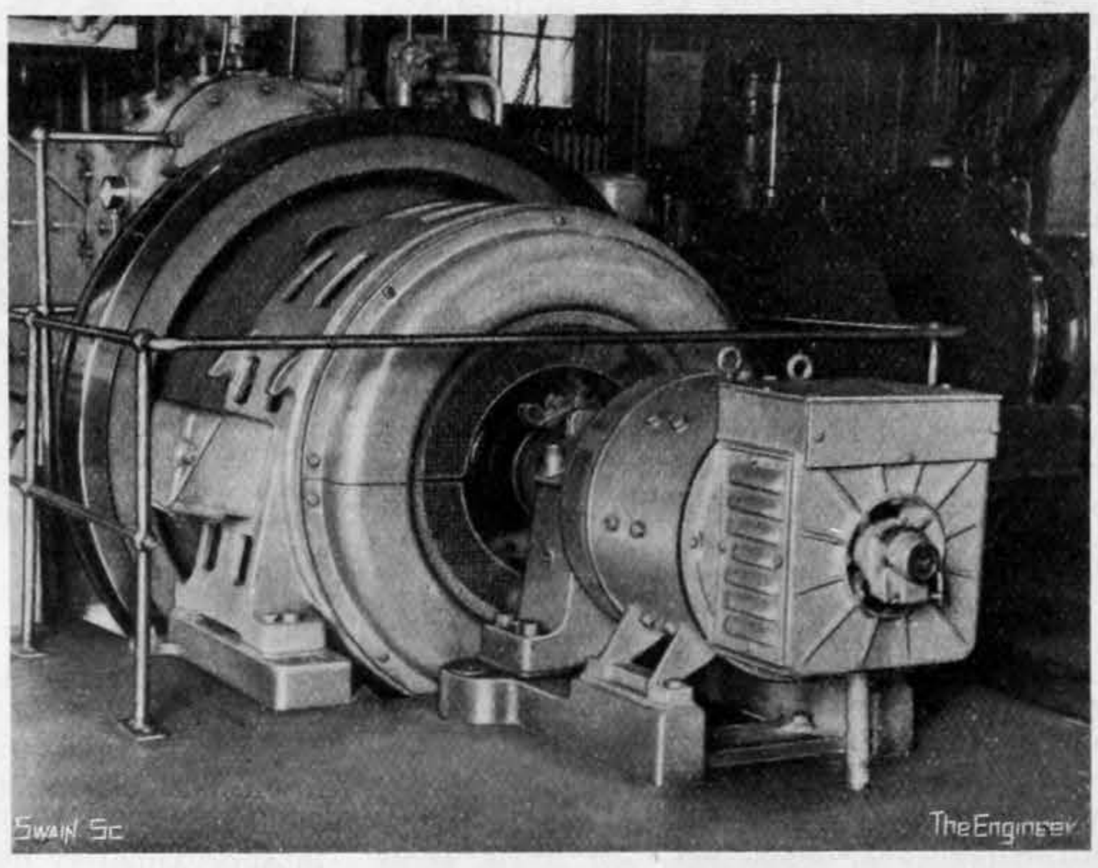
Water power for the Pelton impulse turbines is obtained from a storage of about 5½ million gallons at Wilson's Creek dam. The weir is 23ft high by 150ft on the crest. The hydraulic line is 2000ft long, with head-race of 1450ft and a tunnel 350ft long. At the far end of the tunnel the head-race is enlarged to form a pipe head reservoir, the head utilised being 300ft. Sufficient power is available to drive the two sets during the wet season, but is insufficient to keep them running continuously in the dry part of the year.

When the demand increased beyond the capacity of the available water power it was decided to augment the supply by installing oil engine-driven sets and in 1928 a further 135-kW, G.E.C. alternator, driven by a 200 h.p. Ruston and Hornsby heavy oil engine was put into service. Still more plant was necessary in 1934, and the fourth G.E.C. alternator, with an output of 230kW, was installed. This is driven by a 333 h.p. Mirrlees-Ricardo high-speed diesel engine.

Three years later, to cope with the rapidly growing load, arrangements were made to take marginal supply from the Clarence River County Council's electricity undertaking, the normal demand on this source being 600kW. In 1943 the installed capacity was again increased by the addition of the fifth G.E.C. alternator—a 344-kW machine (as illustrated herewith) driven by a 495 b.h.p., 375 r.p.m. Mirrlees diesel engine. To-day the demand has again outstripped the combined capacity of the station plant and the marginal supply, and a sixth and larger diesel alternator set, with an output of 750kW, is being built by the same makers.



140-kW Alternator and Pelton Wheel



344-kW Diesel Engine-Driven Alternator

Operation

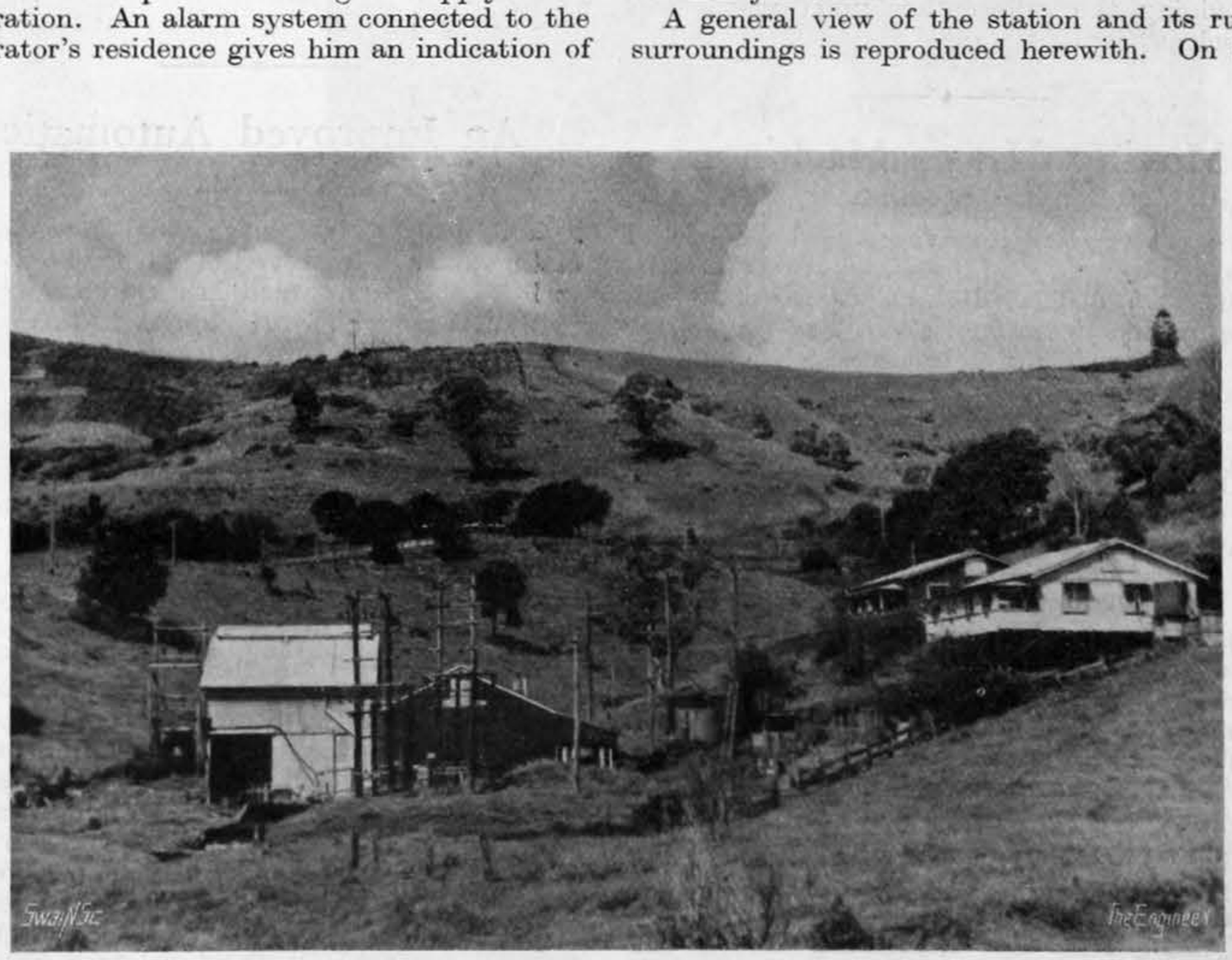
All the sets, both water and diesel driven, are operated in parallel with the marginal supply. The station is run unattended at night from 9.30 p.m. to about 4.45 a.m., when only the hydro-electric plant and marginal supply are in operation. An alarm system connected to the operator's residence gives him an indication of any faults in the station. The alarm system in the station readily shows faults connected with cooling water or oil on the engines, bus-bar voltage, maximum demand setting or feeder faults. Except in the case of bad weather or storms, however, the operators are seldom called out.

Distribution

Before distribution the generated 660-V supply is raised, by step-up transformers, at present to 6·6kV, but eventually to 11kV when voltage change-over is completed, the marginal supply, which is received at 33kV, being stepped down to 11kV. The whole of the h.t. system is in course of being changed to 11kV, and three of the outgoing h.t. feeders are already fed at this voltage. Low-tension distribution is, generally, at 415/240V, 50 cycles, three-phase, but some single-phase lines exist. The supply is frequency-controlled.

Overhead lines, run on wood poles, are employed for both h.t. and l.t. distribution. Lightning protection is provided, the district being subject to severe lightning storms in the summer months. Protection is on the h.t. side, but in urban areas some l.t. arrestors have been installed. Single-pole type sub-stations are mainly used in rural areas and the two-pole type sub-stations in the towns. The reticulated mileages are approximately primary 60 miles; secondary 125 miles.

A general view of the station and its rural surroundings is reproduced herewith. On the



Mullumbimby Power Station

extreme left is the terminal structure for the 33-kV overhead lines, carrying the marginal supply down to the 1000-kVA, 33/11-kV outdoor transformer. The white building immediately to the right is the new power-house (which is being extended to accommodate the sixth set referred to above), with the hydro tail-race in the foreground. In the centre of the view are the old power-house and the fuel and reserve cooling water tanks. On the extreme right are the residential quarters of the two operating engineers. The double-pole switch structures in front of the power-house control the two 11-kV outgoing feeders.

Tariffs and Statistics

A few examples of the undertaking's charges for electricity will serve to illustrate the tariff structure, bearing in mind that the distribution system is predominantly rural.

Typical Tariffs

	Pence per unit
Domestic lighting :	
First 12 units per month	5
Next 25 units per month	3
Additional units	1
Power :	
First 50 units per month	3
Next 2000 units per month	1½
Over 24,000 units per month ...	0·9
Over 74,000 units per month ...	0·8

Special rates are quoted for certain applications, including water heaters (continuous loading, 1d.; off-peak, ½d.), cookers, neon signs and time-switch controlled window lighting.

With a total of 2000 connected consumers in what is essentially a rural area having a total population of 10,000 the supply of electricity can be regarded as being well developed. Nevertheless, that the demand is still expanding rapidly is shown by the following figures :—

Year	Units generated and purchased	Units sold
1945	3,012,790	2,502,255
1947	4,120,785	3,289,483
1948 estimate ...	5,250,000	—

Between 1945 and 1947, therefore, the number of units sold increased at an annual rate of more than 15 per cent. An even steeper rise is foreshadowed in the estimate for 1948. The maximum demand on the system is about 1225kW, the load factor being 53 per cent.

The marginal supply is purchased at three different rates during the day, namely, 5 a.m. to 10 a.m., £15 per kVA of demand ; 10 a.m. to 9.30 p.m., £5 per kVA of demand ; night load, 9.30 p.m. to 5 a.m., no kVA charge. The energy charge additional to the kVA charges is 0·65825d. per kWh. Whenever possible, the 5 a.m. to 10 a.m. period is taken over by the station plant.

We acknowledge the assistance of Mr. R. Lehmann (chief engineer of the undertaking) in providing the information upon which this article is based.

Moving Heavy Machinery

We have received particulars of an interesting piece of work involving the movement of heavy machinery, from Machinery Installations, Ltd., of 60A, High Street, London, W.3. The machine concerned was a 5000-ton rubber die press, weighing 350 tons, which had to be dismantled and moved through the confined space of a production factory with a minimum dislocation of work.

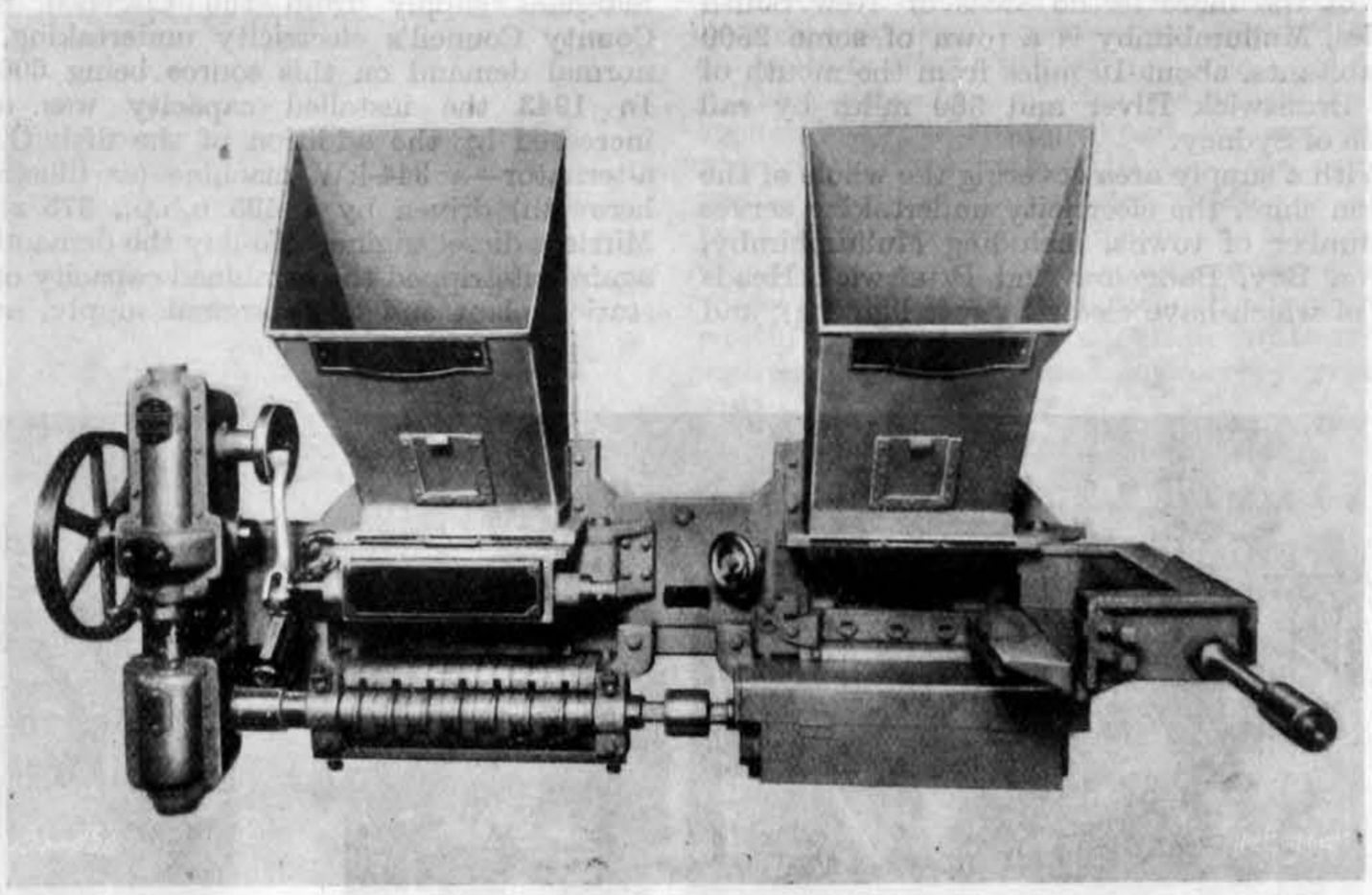
Owing to the very restricted space allowed for dismantling, it was decided that all the heavy parts should be lifted and, owing to the weight of the three main parts—headpiece 75 tons, platen 65 tons, and base 85 tons—substantial gear was required. For this purpose two heavy ships' derricks, 60ft long, were erected through part of the factory roof, which was removed directly above the press.

The derricks were rigged and the headpiece (75 tons) lifted 7ft to 8ft off the top of the columns, and lowered to the ground. Two 10-ton winches supplied the lifting power and two 6-ton winches the luffing power for the derricks. All the winches were hand-operated, and with them twelve men lifted the head up over the columns, and then lowered it some 20ft to the ground in 3½ hours. Comparatively little space was required, and the job was done in a minimum amount of time.

The difficulty in the removal of the heavy sections through the factory without disturbing any other machinery or interrupting production was another problem which had to be overcome. There were no trolleys available which were big enough to take the heavy pieces of plant and it was decided that, in order to move them quickly through the lines of machinery, old railway lines should be laid on their side, with steel balls inserted and heavy plates placed on top, to provide a roller base. By the method adopted it was found possible to move the press sections some 300ft to 400ft, including two 90 deg. turns, in approximately half a day.

The whole of the press was dismantled and moved through the factory without any interference whatever with production or the machinery in the immediate vicinity.

We understand that the above method of lifting machinery has been used several times since by Machinery Installations, Ltd., the largest lift in one piece being a 130-ton anvil block, which was lifted from its foundations, 13ft 6in below ground level, in just over four hours. Here, again, the equipment employed was two 10-ton and two 8-ton hand-operated winches.



"Low Ram" Stoker Unit

An Improved Automatic Stoker

We have received particulars of an automatic stoker of improved design for horizontal shell-type boilers, which has been introduced by James Hodgkinson (Salford). Ltd., Pendleton, Salford, 6, Lancs. This stoker is known by the makers as the "Low Ram" Coking Stoker. In it the ram is set relatively low in respect to the grate level and takes the place of the fire door in earlier stoker models. The low position it takes in the circular flue makes possible the use of a much wider ram than hitherto.

As in previous types of stokers made by the firm, the fuel is fed into a hopper mounted above the ram box and drops in front of a reciprocating ram, which pushes it over a spreader plate, whence it falls on to the bottom coking plate. Most of the volatile matter is given off at the front of the grate and the incandescent residue is then moved along the grate by reciprocating fire-bars. The speed of the grate and the rate of coal feed can be adjusted so that the combustible matter is burnt by the time the residue of ash and clinker reaches the back end of the fire-bars and falls into the rear of the ashpit.

With the new automatic stoker, a photograph of which we reproduce, the wide low ram not only enables the thickness of the fire-bed at the front of the grate to be reduced, but also serves to spread the fuel evenly over the full width of the grate, without any segregation, irrespective of the grading. The thin, even fuel bed obtained requires a relatively small draught and is stated to make possible good results when burning fuels containing a high percentage of fines.

As can be seen from the right-hand unit in the photograph, the ram and ram-box can be swung outwards from underneath the stoker hopper to give access to the fire. A slide damper can be fitted in the base of the hopper before the ram is swung clear to avoid necessity for emptying the hopper before opening up the furnace. Provision is made for hand-firing the grates in the event of power failure.

The stoker mechanism is driven through a vee-belt pulley by a three-speed electric motor. A vertical shaft, driven from this pulley, actuates the ram mechanism through gears and a crank. The crank is coupled to the ram-operating shaft by links, which incorporate means of adjustment for varying the length of the ram stroke. The main driving shaft is extended downwards and also operates the fire-bar reciprocating shaft. All of the driving gear mechanism is enclosed and effectively protected against damage and the ingress of dust, likely to cause excessive wear.

Dust Collector for Tool Grinding Machines

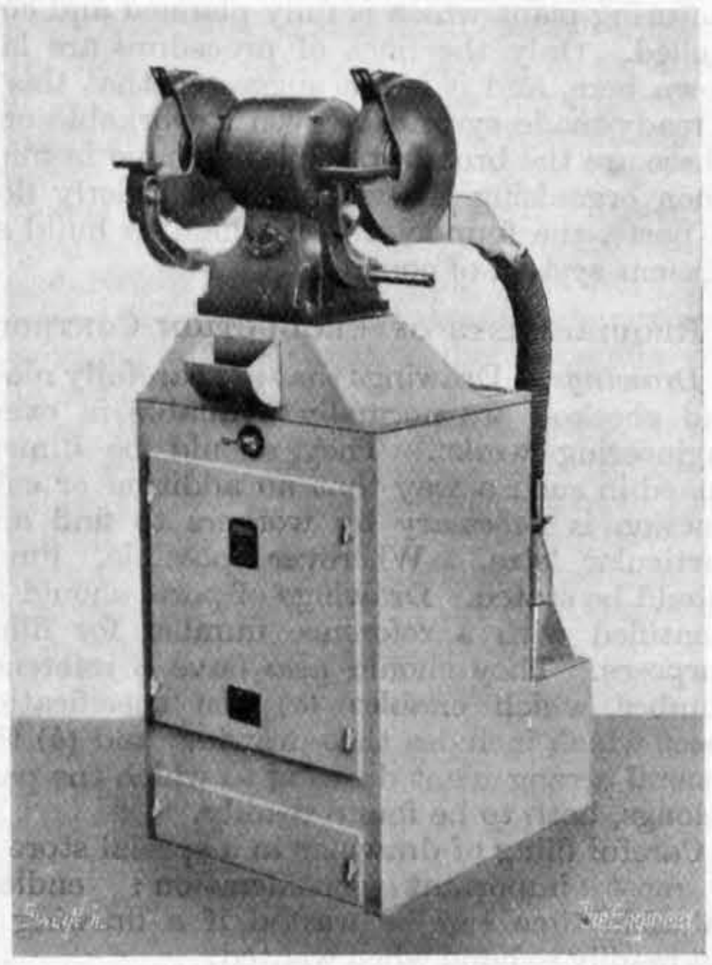
In order to provide adequate protection from dust for operators working in the proximity of bench-type tool-grinding machines, Dallow Lambert and Co., Ltd., of Spalding Street, Leicester, has introduced the unit we illustrate on the opposite page.

The new unit consists essentially of one of the firm's "Drytex" dust collectors, the top of which is arranged to form a base for the grinding machine. As can be seen, a bifurcated duct connects the shield housings of the grinding wheels to the dust collector in the base at the rear of the unit. The design is such that if required the grinding-wheel motor can be coupled to the ⅓ h.p. motor of the dust collector and one starter used for both motors. With this arrangement the dust collector is automatically put into operation when the grinding-wheel motor is switched on.

Large panels on the front of the unit can be removed to give free access to the dust receptacle and to the filter-shaker mechanism. A

water trough is incorporated for tool-cooling purposes.

We are informed by the makers that in



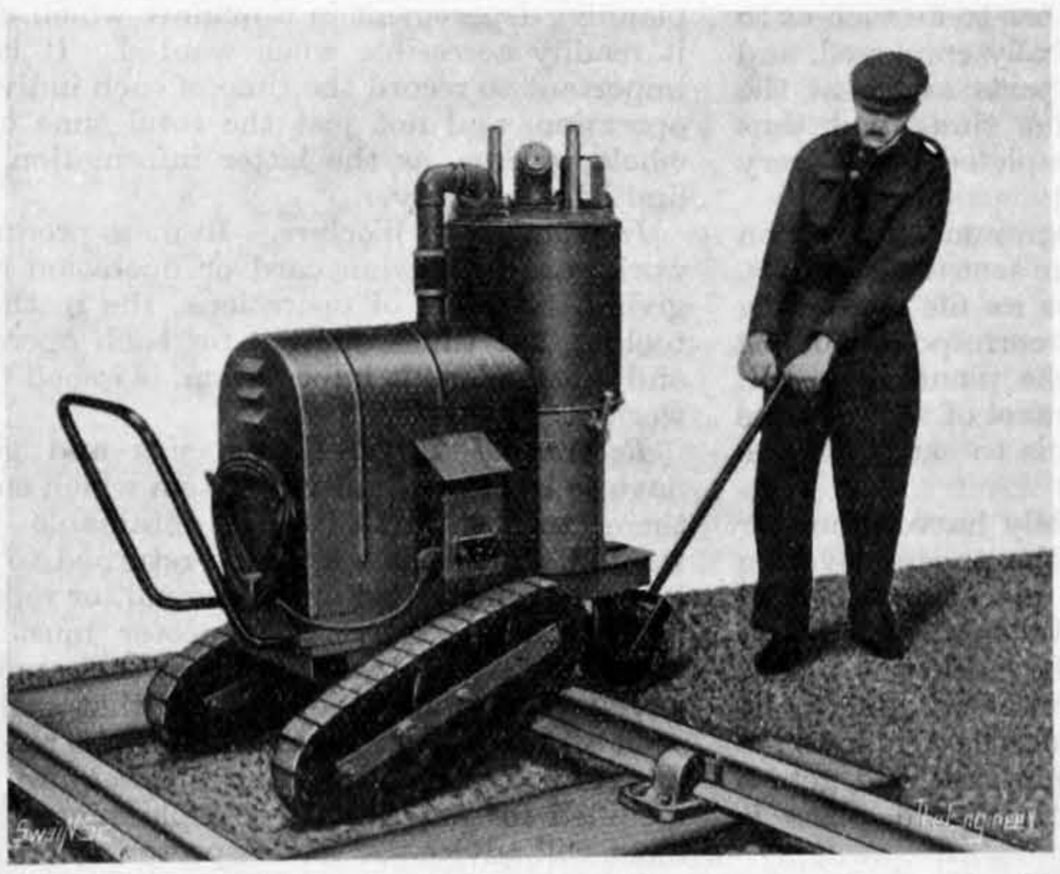
DUST COLLECTING UNIT

tests with special equipment on a machine grinding cast iron and hardened steel a dust retention efficiency in excess of 99 per cent was shown by the filtering unit.

A Mobile Vacuum Cleaner

WE reproduce a photograph of a new mobile industrial vacuum cleaner which has been specially designed by the British Vacuum Cleaner and Engineering Company, Ltd., of Leatherhead, Surrey, for cleaning railway coaches.

The cleaner is mounted on a rigid steel trolley carried in front on a single swivelling track with a drawbar, and having an elongated track



MOBILE VACUUM CLEANER FOR RAILWAY CARRIAGES

on each side. These tracks enable the cleaning equipment to be pulled over rails up to 9in high with relative ease, and to be hauled over rough ground.

The exhauster is driven through vee belt by a 1½ h.p. electric motor set in the trolley frame between the two rear tracks. Enclosed within the cast aluminium housing of the multi-stage, high-pressure exhauster are six mild steel impellers mounted on a shaft running in ball bearings. Two cleaning hose connections are provided on the top of the exhauster, and the equipment is designed to work with two 30ft lengths of 1½in bore reinforced hose.

The filter is of the inverted bag type and incorporates a bag-shaking device. Beneath the filter a removable 5¾-gallon capacity dust bucket is secured by quick-release cams.

On one side of a removable metal casing enclosing the power units is fitted the starting switch and combined isolator. A length of cable extending from the switch box is used to couple the cleaner to the electric supply mains.

We are informed that twenty-five of these cleaners have been ordered by the Eastern Region of British Railways to supplement the fixed cleaning installations at carriage depots.

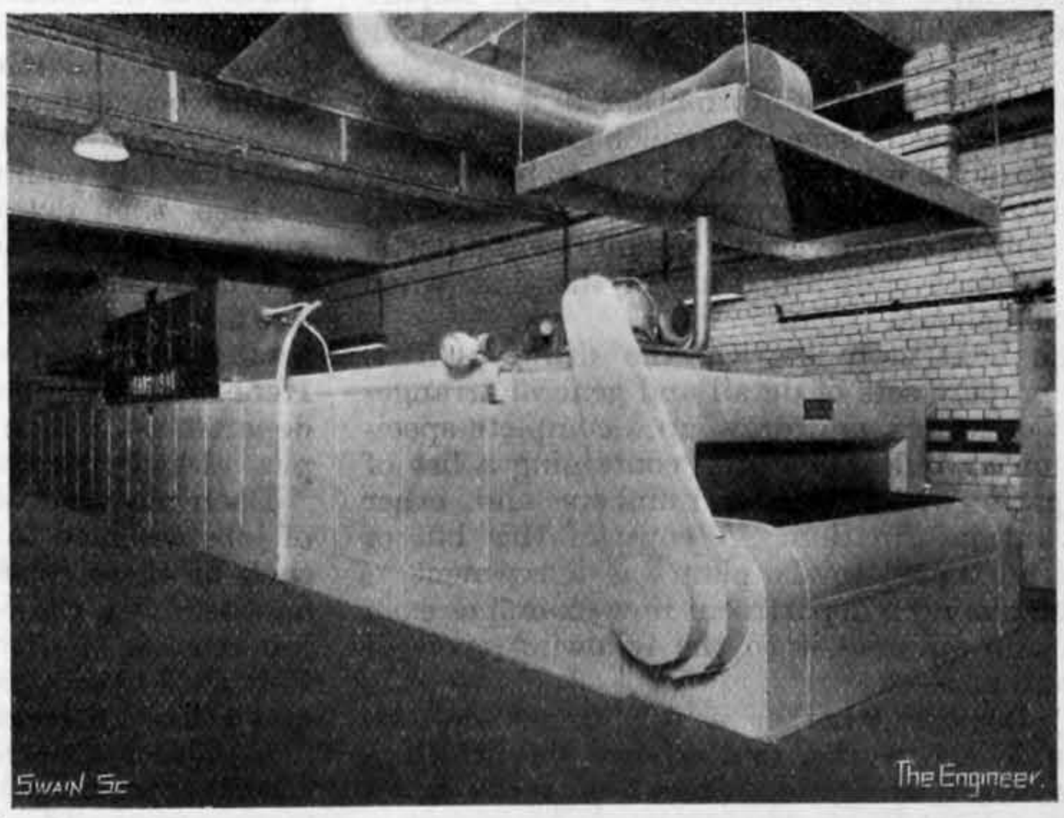
Electrification of a Bakery

WHEN fully equipped, the St. Helens Co-operative Society will have one of the largest all-electric bakeries in the British Isles. Although some time must elapse before the whole installation is completed, and full particulars made available, it is possible to give the following details of the plant.

Initially, the installation will comprise two 50ft travelling ovens, two double-deck drawplate ovens, an electrode steam boiler and storage water heaters of varying capacities. At a later date it is proposed to instal further drawplate ovens and a brick-built Vienna oven.

The two travelling ovens are already installed and the one illustrated herewith has been in constant operation for several months. They are of the straight-through travelling soleplate type. Each oven measures internally 50ft long by 8ft 3in wide, has a total electrical loading of 450kW, and has a maximum capacity of 1200 loaves per hour. Specially designed heating elements, adequately protected, are fitted throughout the length of the baking chamber above and below the travelling soleplate.

To ensure the correct temperature and at the same time provide the required temperature variation, the oven is divided into four sections, in each of which the top and bottom elements are separately controlled automatically. Mercury-in-steel indicating and automatic controllers, which have rigid bulb stems extending centrally into each section of the baking chamber, provide the means of setting the temperature which is required to be maintained in each section, and this in turn ensures the correct temperature sequence throughout the length of the oven. The controllers are preset by hand for the temperature required and operate through relays and air-break pattern contactors, which are mounted in enclosed cubicles (as illustrated), above the oven, together with the necessary overload releases. The main supply to each oven is taken from the substation through main and subsidiary controls to a triple-pole, non-drawout pattern, oil circuit breaker, which provides the master control for each oven. Each circuit breaker has a rupturing capacity of 25,000kVA at 440V.



50 FT TRAVELLING OVEN IN BAKERY

Steam supply to the oven and the automatic provers is provided by a fully automatic electrode steam boiler, which has a connected maximum loading of 70kW. The hot water storage heaters referred to comprise six units, one 300-gallon, one 200-gallon, two 50-gallon, and two 30-gallon, all of the pressure type. These have a total connected load of 99kW, and provide hot water for dough-mixing, tray-washing, and other general requirements. A number of electric unit heaters are also to be installed for maintaining the required temperature in the dough-room and flour store. These will have a total loading of 50kW, while the proposed installation of further drawplate ovens and the Vienna oven will provide an additional connected load of 290kW.

To ensure that the best results may be obtained from the improved production facilities and better working conditions, an up-to-date lighting system is being installed. The contract for the entire electrification scheme is in the hands of the General Electric Company, Ltd., Magnet House, Kingsway, London, W.C.2.

British Standards Institution

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria Street, London, S.W.1.

MEDIA FOR BIOLOGICAL PERCOLATING FILTERS

B.S. 1438 : 1948. This standard prescribes the requirements for media used in biological percolating filters for treatment of sewage, water, and certain trade waste waters. The function of the medium in a percolating filter is to provide an extended surface to serve as a support for the organisms, including bacteria and fungi, which bring about the purification of polluted liquids supplied to the filter. Many different materials have been used satisfactorily as filter media, including coke, clinker, gravel, crushed stone, and slag. Experience has shown that the most important factors governing the suitability of medium for use in a percolating filter are durability, uniformity of size, shape of the pieces of medium, cleanness, nature of surface, chemical inertness, and mechanical properties. The specification makes provision for assessing these qualities and provides methods of sampling, of analysis and of testing. At present there is a lack of quantitative data on some of these factors and it is not yet possible to lay down rigid requirements for all of them. Further experience in the field may make it desirable to amplify the present standard at a later date. Price 2s. 6d.

Control of Production*

By S. W. LISTER, M.A., B.Sc. (Eng.), A.M.I. Mech. E.†

Introduction

Organisation in an engineering works has the following objectives in view :—(1) to have material of the right kind available when required, and (2) to process it to the required standard of finish in such a way that costs of production are economic and delivery promises are maintained. The problem is one of stores control followed by control of manufacturing operations. Material must be purchased before it is needed, inspected on receipt, stored in a safe place, and be readily accessible.

Control of manufacturing is a more complex problem, and it is here that the most significant changes have occurred. Manufacture must be so organised that idle or wasted time forms only a small proportion of the working day.

In most large firms to-day planning has assumed great importance. The more accurate it becomes the smoother is the flow of parts through the works and the more steady and continuous is production. But accurate planning is a refined technique requiring great experience of manufacturing methods and a vast accumulation of data. It also needs to operate under a precise and carefully thought out mode of procedure, and requires the help of time study methods and a good bonus system.

[The author then dealt in some detail with works administration, the apportioning of material and stores control, planning, time and motion study, and the payment of bonus, &c.]

Production Control Procedure

Under full production control, procedure is briefly as follows :—

When an order is received, the first job is to make out a works order. This states the type of machine and gives general information about it and also specification numbers. One copy goes to the drawing-office and one to the planning department.

As there may be several different assemblies involved, the planning department makes out manufacturing orders for each of the assemblies. A general survey is also made of the manufacturing capacity likely to be available, bearing in mind the delivery promises that have been made. Assemblies which will require the longest time to make will have to be started first, whilst other assemblies may require material which can only be bought on long delivery dates.

To correlate this information it is usual to prepare a master schedule, which gives a general picture of the way the whole job is to be tackled. Approximate dates are given for the starting and completion of various assemblies and parts, and a rough estimate made of the time when erection should begin.

The next step is with the drawing-office, who prepare sets of detail and general arrangement drawings, and draw up a complete specification or bill of material containing a list of all parts with drawing numbers and other relevant information. A copy of this bill of material is sent to the planning department.

The planning department now examines each item and submits it to the following cycle of operations :—

(1) Decides whether it can or cannot be made in the works, and advises the drawing-office and buying department of those items which cannot be made.

(2) Prepares a route sheet, bearing in mind the amount and incidence of work already in the factory. On the route sheet all the operations are listed in consecutive order, and against each operation is the department, or sometimes the actual machine, which is to perform that operation.

(3) Decides what jigs, tools or fixtures are required for each of these operations, and advises jig and tool drawing-office of the approximate dates when these will be wanted.

(4) Works out quantity and type of material required, and finds out from stores ledger clerk whether or not this is available. If it is, the ledger clerk reserves it by apportioning it to the order ; if not, he instructs the buying department to put it on order and then advises planning of the delivery date.

(5) Writes out :

(*a*) Operation orders.

(*b*) Orders for the issue of jigs and tools.

(*c*) Orders for the issue of material from the stores.

(*d*) Instructions to the inspector.

(*e*) Orders to move the part from one machine to the next.

(6) The orders included under (5) are all specific manufacturing instructions relating to consecutive operations on one particular part. They may not, of course, be written out as so many orders by the planning department, but decisions respecting each of them must be taken in the planning department, and the information conveyed to the works in one form or another. What they really represent is the detailed journey which each part must make between the time when it starts out as raw material and the time when it appears in the store as a finished product. The instruction must go to the works in a manner which can be readily understood, and which can be easily recorded by the planning department.

(7) The rate-fixing department now determines the time required for each operation, and provides a bonus or time card. If operation sheets or instruction cards are used, it is now that they are issued.

(8) All these documents now pass to that section of planning which is responsible for loading work to the machines and controlling the movement of parts in the works. It is assumed that loading is done in great detail, and each operation is loaded on to the particular machine which is considered most suitable. In this department there will be a planning board, or some equivalent, containing the name and identification number of each machine in the works, and under each name there will be a file in which details of the work waiting to be done on that machine can be placed. Allocating the work to these machines is a complicated and exacting task ; many hundreds, or even thousands, of components, belonging perhaps to a number of quite different assemblies, have to be considered more or less simultaneously. The time each one will take to process has to be weighed against the machine and man-hours available in the works. The order in which the parts will be manufactured has to be such as to keep the machines economically employed, and yet ensure that the right parts arrive at the fitting benches at the right time, and thus enable assemblies to be completed by delivery dates already planned.

Once this detailed programme has been arranged, particulars of it are sent to the works, and each machine will have its file containing documents which exactly correspond to the arrangement laid out on the planning board. Here they are under the control of the progress department, whose duty it is to carry out the plan already prepared.

Each machine will normally have a number of jobs assigned to it, and the papers covering each of these jobs will be placed one behind another in the right order. When any particular job reaches the front of the pocket it means that that operation is the next one due to be done. The progress clerk proceeds as follows :—

He issues the order for material and gets a labourer to draw the material and place it beside the machine.

He then issues the order for jigs and tools, and again the labourer draws these from the tool store and places them beside the machine.

He next issues the operation order, which is the instruction to the worker to get the job under way, and if there is a time card in use he stamps this with the time of starting. When the job is finished he again stamps the time card and sends it, together with the operation order and drawing, to the planning department.

He then issues the order instructing the labourer to move the part to the next machine ready for its next operation.

The planning department, on receipt of an operation order and time card from progress, note on the route sheet, and again on the planning board, that the operation is finished. They then determine the bonus which the worker has earned, and pass the time card to the costing department.

This is the cycle of operations for a manufacturing plant which is fully planned and controlled. Only the lines of procedure are laid down here, and it is not suggested that this is a ready-made system or even a workable one. These are the broad principles to have in mind when organising the smooth and orderly flow of parts, the foundation on which to build an efficient system of control.

Requirements of Production Control

Drawings.—Drawings that are carefully made and checked are normally available in every engineering works. They should be dimensioned in such a way that no addition or subtraction is necessary by workers to find any particular size. Wherever possible, limits should be stated. Drawings of parts should be identified with a reference number for filing purposes. They should also have a reference number which enables (*a*) the specification sheet which includes that drawing, and (*b*) the general arrangement drawing to which the part belongs, both to be found readily.

Careful filing of drawings in a special store is a most important consideration ; endless valuable time can be wasted if a drawing is not readily to hand when wanted.

Stores Records.—A continuous record is required of the raw material, castings, and finished parts which are in stock at any time.

Data on Machining.—This comprises data on cutting tools, with feeds, speeds and depths of cuts on various metals, bearing in mind the quality of finish and accuracy required. Here previous experience will provide most of the information required. In the case of many operations, such as automatic machining, gear cutting, and some classes of milling, cutting data can be very exact, and of great value in planning, but with non-repetition work, such as is handled in centre lathes, the information may not be as useful. Here much of the operation time is spent on setting up, and cutting speeds may be governed by the rigidity of the part being machined, which is often an unknown factor until the work gets under way.

Records of Previous Production Times.—This information is automatically collected under the production control system already outlined. It is important to record the information in the planning department in a manner which makes it readily accessible when wanted. It is also important to record the time of each individual operation, and not just the total time of the whole process, as the latter information is of limited value only.

Instructions to Workers.—In mass production works an instruction card or operation sheet, giving the cycle of operations, the method of tooling, the times allowed for each operation, and other relevant information, is issued to the worker.

Records of Tools.—Tools, jigs and gauges have to be stored under a system which enables them to be immediately obtainable when wanted. Each time a tool is returned to store it must be inspected and reground, or repaired, if necessary. The tool inspector must issue the order for repair, and must at the same time advise the planning department that such and such a tool is under repair, and will be ready by a certain date. Should the tool require to be modified for any reason, the planning department will advise the tool inspector accordingly.

Special tools required for any job are usually recorded in the planning department on a master schedule, which gives all the relevant information relating to the manufacture of each individual part. Sometimes an instruction card is issued to the worker at the same time as the operation and time cards. The instruction card gives exact information as to how the job is to be done, together with tools to be used, and the exact time to be taken over each part of the operation.

Progress Reports.—Progress of work is automatically collected from the route cards and operation orders, but where a machine has many parts and is made on job production lines, a master schedule giving all parts, and

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* Excerpts, Institution of Mechanical Engineers, December 3, 1948.

† General Manager, Lister Brothers, Ltd., Woolwich.

to which information is posted from the cards, is useful. This information will normally be accumulated by the progress department, who will be aware of changes which have had to be made in the programme as originally planned.

Progress Follow Up.—Nothing ever goes exactly according to plan, and smooth working in the shop will depend very largely on the speed and accuracy of the progress department in revising schedules in the light of manufacturing needs.

Bonus or Piece-Work.—The need for financial incentive is now recognised by all industrialists. Not only is it useful in keeping costs down, but it is also invaluable to the planning department in working out details of production and giving delivery promises.

Tool Inspection.—This is done by a tool inspector, whose normal work is to test tools as they are returned to store, and have them repaired if necessary. He will also have the assistance of the foremen, whose reports on the behaviour of tools under working conditions are of vital importance.

Production Control in Practice

The principles of a comprehensive plan of production control have been stated here. The details will have to be worked out to suit individual cases.

In many firms the actual loading of work to the machines will be done by foremen with the help of chasers, and not worked out in detail by the planning department.

Some firms will not have the use of a time study department, and the fixing of standard times will be a more difficult proposition. This will have to be done by a mixture of experience and intelligent guesswork, and times will often have to be modified after the work has got under way.

In jobbing firms as opposed to firms on repetition work, rigid production control is much more difficult. Exact tooling methods will not be worked out in detail beforehand. Much will often be left for improvisation by the foreman. Exact task times cannot be decided, and tools cannot be got ready before the job is started.

In some works erection is carried out in a jobbing manner, particularly where the machines being built are not suitable for fine limit work. Parts will be offered up for marking out and then taken to the machining shop to be drilled or machined. Exact loading of work to the machines which have to do this work is not possible, and incentive payment and even progress control is difficult.

Time study procedure varies on different sorts of work. In some cases each job will be given a time study before the task time is set. In other cases it is possible to compile charts giving standard time elements covering a whole range of similar parts. From these charts task times can be built up with great accuracy, and there is no need for separate time study after the work is started.

Synchronising the many hundreds of parts required in an assembly is a difficult proposition; it is safer to accumulate them in a store and issue them when needed. If a job is wanted urgently this may not be possible, neither is it possible if fitters are actually waiting for work. This should be taken into consideration in planning, and those parts requiring the most operations should be released for process first.

Any system must be flexible enough to take care of the unexpected. Planning may be correct to the last detail, but a bad casting, a hard piece of steel, or a breakdown may throw the whole plan out of sequence.

In highly specialised mass production such as the motor-car industry, production control will be rigid and comprehensive, and machine loading and works programmes will be worked out in great detail. Here the great productivity of special plant makes it worth while to have an elaborate organisation just to ensure that machines are kept fully and continuously employed.

Usually the demand for spares in any business is fairly steady, and these requirements are allowed for in planning, but occasionally there is an excessive run on a particular part, and then planning has to be revised quite suddenly; otherwise assembly of new machines might be held up for lack of a few essential parts.

Those industries which can forecast their manufacturing requirements for a whole season in advance benefit in their planning department. Quantities of parts for the whole output can be worked out and broken down into batches of suitable size for economic production. These can be laid out on a master schedule to suit the assemblies which are to be built, and dates can be assigned for issuing operation orders. Once a month these operation orders can be issued, and parts will accumulate in the right amounts and at the right time for assembly, with a minimum of chasing and worry to the progress department.

Planning is easiest in a plant well stocked with orders, and most difficult when the order book is thin. The latter condition usually comes at a time when trading is most competitive and the booking of an order will often turn on the delivery that can be offered. Planning will be on a short-term basis, and the object will be to keep sub-assemblies of all descriptions in stock, so that a complete machine can be built in the minimum time.

Production control has these objectives in view:

To avoid operators wasting time by having to wait for material, parts, tools, &c.

To make the use of an incentive wage plan a practicable proposition.

To ensure the maintenance of delivery promises.

The advantages thus gained are manifest. They tend to cheapen production costs, and help to ensure the satisfaction of customers.

Against the economies obtained must be placed the cost of working the system; otherwise the law of diminishing returns may apply. This will be the influencing factor in every firm when deciding the refinement to which production control procedure is to be carried.

Continental Engineering News

Reconstruction of Rhine and Moselle Bridges (Germany)

According to a paper by Monsieur Fauconnier, Director of Public Works in the French Zone, Germany, published in the *Annales de l'Institut du Bâtiment et des Travaux Publics*, about 1500 bridges with a total damaged length of some 130,000ft, were destroyed or damaged in the French Zone. Reconstruction was carried out in such a way as to achieve the greatest possible saving of materials and to restore the traffic in the minimum time by the use of semi-permanent bridges, as well as of standard bays. Unusual solutions were found to the problem of spanning the Rhine and the Moselle. The reconstruction of the road-and-railway bridge over the Rhine at Maxau deserves a special mention. Before the war, the Rhine was crossed at Maxau by two bridges, placed side by side, one for a single-track railway and the other for highway traffic. These steel structures, of the lattice-girder type, were 984ft long and consisted of two spans, 590ft and 394ft long. The bridges were destroyed and fell into the water, forming an obstruction, in which the Royal Engineers, by explosives, cut an opening for navigation purposes.

For the reconstruction of the Maxau bridge, there were used ten standard spans, five for the highway bridge and five for the railway bridge. These standard lattice-truss spans, each nearly 197ft long and 26ft high, were erected on the cantilever principle.

For temporary railway bridges two types of standard span were employed on a large scale: the R.E. type, designed by the Dortmunder Union, and the S.K.R.6 (Schaper-Krupp-Reichsbahn), designed by the Stahlbau-Rheinhausen company. The R.E. sections are of lattice construction, lozenge-shaped. They are generally erected by means of 15-ton derricks at a speed of 1 metre per hour. Bridges of the S.K.R. type are lattice trusses, "N.K." or double "K"-shaped. When high tensile steel St.52 is used as structural material, S.K.R. sections may be used for spans up to 197ft and even 235ft, if chords are suitably strengthened.

A Thirty-Year Hydrological Plan in Hungary

According to the *Hydrological Review*, Budapest, a thirty-year hydrological plan was recently prepared in Hungary by the authorities concerned. The scheme includes the following items:—

Regulation of the navigable rivers Danube, Mura, Tisza and Maros.

Regulation of small rivers.

Construction of a waterway between the River Tisza and the Danube, as well as various other canals.

Extension of wharves along the Danube; establishment of a trade port at Uipest; development of the ports of Györ, Harassziget, Ercsi, Solt; and construction of wharves at Csongrad, Szentes and Tiszafüred on the Tisza River.

Defence works against floods.

Hydraulic works in order to raise the output of electric energy up to 575,000,000kWh annually; the scheme provides for the construction of four dams on the Tisza river at Tiszalök, Tiszafüred, Szolnok and Szeged, with an overall output of 150,000,000kWh. As regards the Danube, hydro-electric works to be erected will ensure a supply of 375,000,000 kWh annually. Rivers of minor importance will supply the remainder (50,000,000kWh).

Irrigation works covering some 370,000 acres.

Drainage and improvement of the soil to increase fertility.

Drinking water supply. At present the needs of nearly 80 per cent of the population are covered by wells, although chemical analysis has proved that water in three-quarters of these wells is polluted. The plan provides for drinking water distribution in some 2000 villages.

Activity of the Port of Ghent (Belgium)

In 1947 a total of 1106 ships, aggregating 1,618,198 tons, including 343 British ships of 316,666 tons, entered the port of Ghent, as compared with 731 ships, representing 860,814 tons, in 1946, an increase of 88 per cent. The total traffic handled by the port in 1947, however, was only 83 per cent of the 1938 figure and 55 per cent of 1930, which was the peak year. In 1947 a total of 4,040,503 metric tons were handled through the port, comprising 2,819,979 tons imported and 1,220,524 tons exported, and giving a figure of 2·30 metric tons imported for each ton exported. In view of existing conditions throughout the Continent, this figure may perhaps be considered normal for an industrial harbour. The main factor delaying the restoration of normal and modern efficiency to the port of Ghent and consequent development of the surrounding district is the completion of a new lock at Terneuzen.

The carrying out of this work is included in the Belgian Industrial Ten-Year Plan, to be completed during 1948–1957. The new Terneuzen lock will be 984ft long, 115ft wide, and 39½ft deep. In addition to the construction of this new lock, there are plans for widening the Ghent-Terneuzen canal to 656ft in Belgian territory and to 475ft in Dutch territory; for straightening the canal, east of Zelzaete and Sas-of-Ghent; substitution of electrically driven ferries for existing bridges; completion of the Alderman Siffer dock; excavation of a second dock, 8800ft long; and for industrialisation of the right bank of the canal on Belgian territory.

Courses in Rubber Technology.—Courses in rubber technology have been started by the Liverpool Education Committee. The first covers a year's work of the three-years' course for the Licentiate Examination of the Institution of the Rubber Industry, and is for students over sixteen, who have reached a standard in science and mathematics equivalent to that of the School Certificate. In addition, there are two elementary courses, covering instruction in the raw materials, processes, and methods of testing used in the rubber industry.

Industrial and Labour Notes

Iron and Steel Production

The British steel industry established yet another production record during November, the weekly average output of ingots and castings being 303,000 tons, which represented an annual production rate of 15,756,000 tons. In October, production was running at an annual rate of 15,455,000 tons, and in November, 1947, the annual rate was 14,174,000 tons. Pig iron production also showed a further increase last month, the weekly average output being 185,300 tons, representing an annual rate of 9,636,000 tons, compared with a rate of 9,525,000 tons in the preceding month.

In announcing these figures, the British Iron and Steel Federation comments that to have exceeded an average weekly output of 300,000 tons is an important landmark in the steel industry's expansion. The higher outputs in recent months have undoubtedly been helped by a further increase in pig iron production and a high rate of scrap delivery. The Federation adds that the good results for November are particularly satisfactory in view of the seasonal decline which must be expected over the Christmas period.

Colour and Lighting in Factories

A short course of study of colour and lighting in factories and machines was organised recently by the Council of Industrial Design and the British Colour Council. At the various sessions, which were held in the hall of the Royal Institute of British Architects in London, papers were presented by many experts concerned with different aspects of industrial environment, emphasis being given to the need for efficient and congenial surroundings in factories, and to the conclusion that their provision should be directed by a team consisting of designers, scientists and technologists.

At the outset of the conference, Mr. M. Hartland Thomas, chief industrial officer to the Council of Industrial Design, explained that his Council's work in connection with the design of products, including machine tools, had led inevitably to an interest in the design of factories and factory interiors. The design of the factory environment was bound up with the design of the goods being produced, since design policy ran through the whole factory and its products. Many manufacturers, Mr. Thomas said, had approached both the Council of Industrial Design and the British Colour Council for assistance in the matter, and it had been found that there was little co-ordination between the many specialists concerned.

The intention of the study course was to break down the watertight compartments in which specialised work and research have hitherto tended to be done, and to relate the various lines of approach. It is hoped that as well as providing the means of effecting such a liaison, the conference may have laid the foundations of a concerted advance towards the rapid development and general acceptance of a highly specialised and necessary contemporary technique.

The National Coal Board's Quarterly Statement

The National Coal Board issued at the beginning of this week its statement of costs, proceeds and profits for the third quarter of 1948. It shows that there was an estimated deficit of £372,943, which is explained by the fact that the profit for the quarter of £3,477,057 was not sufficient to cover the sum of £3,850,000 payable as interest and interim income to the Minister of Fuel and Power.

The statement records that the saleable tonnage of coal obtained from the National Coal Board's mines during the quarter amounted to 45,834,404 tons, of which amount 42,176,589 tons were disposed of commercially. Total production costs amounted to £105,847,172, or 46s. 2·2d. per ton saleable. Wages, which included holiday pay and allowances in kind, took up £69,415,364, or 30s. 3·5d. per ton saleable, and roof supports, general stores and repairs accounted for £15,440,855. The proceeds from the Board's sales during the quarter totalled £109,264,229. The average weekly earnings of underground workers during the quarter were £7 18s. 5d. in cash, the value of allowances in kind being estimated at 6s. 4d., making a total of £8 4s. 9d. The average weekly earnings of all colliery workers were £7 10s. 7d., to which 6s 2d. has been added as the value of allowances in kind, making a total of £7 16s. 9d.

In presenting these figures, the National Coal Board says that the reduction in the estimated profits of ancillaries from £500,000 in the second quarter of this year to £150,000 in the third quarter is accounted for mainly by the effect of holidays, by payments of arrears of retrospective wage increases to coke oven workers, and by heavy costs of repairs to workmen's houses.

Productivity in the Engineering Industry

At the end of last week, the general council of the Trades Union Congress announced its decision to invite representatives of the engineering section of the Confederation of Shipbuilding and Engineering Unions and the general secretaries of the unions concerned to a conference at the earliest convenient date.

The intention, it is stated, is to discuss, in a more intimate way than was possible at the recent national conference, steps which might be taken by the engineering unions to inform their members more fully of existing economic circumstances and plans; to consider what steps are practicable to evolve some training for shop stewards, and to accelerate the formation of joint production committees, as well as to suggest means for improving the quality of service which some of those committees are at present rendering. It is also proposed that the conference should discuss industrial "bottlenecks" and shortages, and restrictive trade union and managerial practices.

This conference, the T.U.C. says, is the first of a series which it is proposed should take place between representatives of its general council and the unions concerned in the manufacturing industries. In addition, the general council has recently circularised all the organisations associated with the T.U.C., suggesting that they should affiliate to the British Institute of Management in order to participate in the work of the Institute, and to receive its services.

Control of Engagement

Following consultation with the National Joint Advisory Council, the Minister of Labour has decided to extend the operation of the Control of Engagement Order, 1947, from January 1, 1949—when it would have expired—to January 1, 1950. This extension is effected by the Control of Engagement (Amendment) Order, 1948, which was made on December 1st, and which comes into operation on December 15th.

The Control of Engagement Orders require engagements for employment to be made, with certain exceptions, through local offices of the Ministry of Labour or through approved employment agencies.

The Supervisor's Point of View

At a recent meeting in London of the National Institute of Industrial Psychology, three short papers were presented dealing with the "Supervisor's Point of View." All of them emphasised the importance of every individual knowing the why and wherefore of his particular job in relation to the organisation as a whole, for which he was working.

One of the papers, contributed by Mr. Nye, of S. Smith and Sons (England), Ltd., stressed the view that whenever a new policy was formulated, wise and enlightened managements would call together the heads of departments, or in a small organisation, the foremen, and would tell them what they were going to do, why they wanted it done, and how they wanted it done. Following that, the foreman who was properly trained and recognised his responsibility, both to his management and to the men under him, would pass the information on to the section-leaders or charge-hands when detailing the work out. Thus, Mr. Nye claimed, every man on the bench or machine could have intimate knowledge of what he was doing and why he was doing it. The foreman, Mr. Nye said, through proper direction from his manager, became a leader—a man whose abilities enabled him to organise and direct—instead of being simply a "man with a big stick."

Changes in Wage Rates

Changes in rates of wages in the United Kingdom, which were reported to the Ministry of Labour as taking effect during the month of October, resulted in an aggregate increase of approximately £496,000 a week in the wages of 2,150,000 workpeople, and in a decrease of about £15,000 a week in the wages of 110,000 workpeople.

The principal increase reported in October was that which was made in the engineering industries as a result of the agreement reached at the end of September. By this agreement, the national bonus paid to men was increased by 5s. a week, with proportionate increases for apprentices, youths and boys, and for women engaged on work normally done by men. Other women engaged in the engineering industries received an increase in bonus of 4s. a week, with proportionate increases for girls. In addition, the basic weekly rates of skilled craftsmen, which in any district were below 66s., and of unskilled men, which in any district were below 51s., were raised to those amounts. In the shipbuilding and ship-repairing industry there was an increase in bonus of 5s. a week for men, with consequential increases for other workers. The decreases during October occurred in those industries where there are arrangements by which wages fluctuate in accordance with movements in the index of retail prices. Details of all the changes are given in the *Ministry of Labour Gazette*, which states that in the ten months, January to October, 1948, the changes which have been made in wage rates have resulted in an aggregate weekly increase of £1,724,000 for 7,084,000 workpeople. At the end of October, the index figure of rates of wages of all workers was 107, a figure which is based on 1947 = 100.

For the first time in several months, no changes in hours of labour were reported to the Ministry as having come into effect in October.

Trade Union Membership

Statistics relating to the membership of trade unions in the United Kingdom in 1947 have been published recently. They show that at the end of last year the total membership, including members of overseas branches, was 9,114,000, which indicates a 3·9 per cent increase compared with the end of 1946. The total number of unions known to have been in existence at the end of 1947 was 730, including twenty-four unions having their headquarters in Northern Ireland. During the year, thirteen unions, which had an aggregate membership of 2000 at the end of 1946, were dissolved, and twenty-three unions, which had an aggregate membership of 450,000, ceased to exist as separate organisations in consequence of amalgamations with other unions. During 1947 nine new unions were formed, with an aggregate membership of approximately 416,000. The group of unions classified by the Ministry of Labour as "Road, Dock, &c., Transport and General Labour," which had 2,203,080 members, was the largest, while the "Metals, Machines, Conveyances, &c.," group, with 1,636,540 members, came second.

French Engineering News

(From our French Correspondent)

An alternator stator weighing 100 tons has arrived at Comines from Belfort on a forty-eight-wheel trailer, drawn by two tractors. It is being installed in the new Comines electric plant, which will comprise four modern turbo-alternators. In the earlier Comines plant 750 grams of coal were required to produce 1kW, but in the new plant only 500 grams are expected to be used for each unit generated.

* * *

The S.N.C.F. has now equipped twelve "230K" locomotives to haul trains running on rubber tyres between Paris and Strasbourg. Among modifications made are equipment for burning fuel oil, modification in distribution to cylinders, and improvement in the greasing system, and the fitting of electric lighting. The tenders have been modified to take 10,500 litres of fuel oil. The trains weigh a total of 310 tons and run at a maximum speed of 120km per hour. The Paris-Strasbourg run (503km) takes 5 hours 50 minutes during which 4500 litres of fuel oil and 40 cubic metres of water are consumed.

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French non-ferrous metal production shows considerable fluctuation since the beginning of the year, mainly due to shortage of foreign currency with which to purchase ore. Copper, for example, has steadily declined from 1803 tons in April, 1948, to 1683 tons in May, 1423 tons in June, 1115 tons in July, and 894 tons in August. Lead dropped from 6567 tons in January to 2840 tons in July but picked up again to 5888 tons in August. Zinc has remained fairly constant, being 5404 tons in January, rising to 6605 tons in May, and falling to 5423 tons in August. Aluminium production alone has risen from 4685 tons in January to 9610 tons in July and 8613 tons in August.

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The Fives Lille Company has just launched the Roppenheim railway bridge over the Rhine. The operation involved the installation of a 90m span, which, together with its accessories, weighed 1200 tons. It was completed in two days. Among other bridges recently constructed by the company are the Eauplet viaduct, over the Seine, which has a section weighing 1200 tons, and the Manoir bridge, also over the Seine.

* * *

Improvement and development of washing installations in the Nord and Pas-de-Calais mines will permit 420,000 tons of coal, which without washing would be useless, to be recovered each year. Present installations are insufficient in capacity and are badly adapted to the type of coal handled. Existing plants can treat about 5000 tons an hour, while installations in pits can deal with 2000 tons an hour. Extraction amounts to about 150,000 tons daily, of which 36,000 tons are hand-sorted and 114,000 tons pass through washing installations. Within the next ten or twelve years, total washing capacity will be raised to 9500 tons an hour.

* * *

The miners' strike has gradually worked itself out and miners who started work recently have made such efforts that output per man in the Nord and Pas de Calais basin has reached hitherto unattained levels. This increase in output by coalface miners has partly compensated for the reduced manpower. Lack of fuel is still causing concern, particularly in the textile industry, where conditions are precarious, and short time is being worked. Stocks have been exhausted in many industries and thermal generating plants in the Nord department, whose stocks average ten days' supply, have to be supplied as a priority. Another complicating factor is that Belgian coal imported is less than had been envisaged, due to currency deficiencies. Finally, the strike of inland waterway workers, which continues, will probably have a bad effect on the transportation of fuel.

Notes and Memoranda

Rail and Road

BRITISH RAILWAYS, SCOTTISH REGION.—The Railway Executive announces that the maintenance and repair of carriages and wagons in the Scottish Region, which has hitherto been the responsibility of the mechanical and electrical engineer, has now been transferred to a new department. This department is known as the Carriage and Wagon Department and is under the charge of Mr. E. A. Milne, who has been appointed Carriage and Wagon Engineer, Scottish Region. Mr. Milne's headquarters are at Cowlairs Works, Glasgow, N.

NIGERIA RAILWAYS.—A written reply by the Colonial Secretary says that the re-laying of the Zania-Kano section of the Nigerian Railways with 60 lb rails has already been begun. About 90 miles of track are involved, and delivery of materials has been promised at a rate which should permit the re-laying of 4 miles of track a month. The reply also states that thirty-four heavy locomotives, fourteen of which were built in Canada, have been supplied to the Nigerian Railways since January, 1946. In addition, fifty-two locomotives of a similar type are now on order in this country.

Air and Water

THE LAST OF THE SAILING LIFEBOATS.—The last of the sailing lifeboats in the fleet of the Royal National Lifeboat Institution has now ended her career. She is the "William Cantrell Ashley," built in 1907, and for the last forty-one years has been stationed at New Quay, on the coast of Cardiganshire. Her place is to be taken by the "St. Albans," a boat of the 35ft 6in Liverpool type, weighing 8¼ tons, with two 18 h.p. engines and a speed of just over 7 knots. She is a gift to the institution from the people of St. Albans, who, in 1945, raised a special fund to celebrate the silver jubilee of the St. Albans Branch of the institution.

NAVIGATION THROUGH THE AGES.—An exhibition depicting navigation through the ages is to be opened on December 17th, at the Royal Geographical Society's Rooms, 1, Kensington Gore, London, S.W.7, by H.R.H. The Duke of Edinburgh. It is being arranged by the Institute of Navigation and the Royal Geographical Society, and will remain open until January 20th. Meetings of the Institute of Navigation during the exhibition will be held on December 17th, at 4.30 p.m., when Sir Robert Watson-Watt, F.R.S., will lecture on "Radio and Position," on Monday, December 20th, at 8.15 p.m., when a lecture on "The Navigator's Story" will be given by Professor E. G. R. Taylor and Professor W. M. Smart, and on Monday, January 10th, at 5.30 p.m., when three films on "Radio Systems" will be shown.

Miscellanea

THE LATE MR. G. BELL.—We note, with regret, the death of Mr. George Bell, managing director of the Ironsides Lubricants, Ltd., Liverpool, which occurred at his home at Wallasey, on November 29th. Mr. Bell, who was seventy years of age, was also a director of Graham Firth Steel Products, Ltd., Walsall.

THE LATE MR. A. E. SPRINGER.—We have learned, with regret, of the death of Mr. A. E. Springer, which occurred on November 28th, after a short illness. For the last twenty-four years, Mr. Springer had been superintendent of general outside contracts in the London area for Johnson and Phillips, Ltd. He joined the staff of the Johnson and Phillips contract department in 1911.

ELECTRICAL SECTION OF THE BUILDING CENTRE.—The new Electrical Section of the Building Centre at 9, Conduit Street, London, W.1, was formally opened yesterday by Mr. J. Eccles, chairman of the council of the Electrical Development Association. At this electrical exhibition, architects, builders and all concerned with housing design and domestic installations, will be able to study electrical developments and obtain expert information, as in pre-war days.

DUNSTON POWER STATION.—An unusual improvisation has been carried out by engineers of the British Electricity Authority to make good part of the electricity shortage in North-East England caused by the breakdown of a second 50,000-kW turbo-alternator in the Dunston power station. There are four 50,000-kW turbo-alternators at Dunston all of the same type and manufacture. A few weeks ago the alternator of the No. 3 set broke down and was sent away for repair. Shortly afterwards a fault occurred in the No. 2 set, and on this occasion the turbine was affected. The engineers therefore transferred the sound alternator of the No. 2 set to the sound turbine of the No. 3 set. The stator of the alternator moved weighs approximately 110 tons, and this had to be lifted from its bed and shifted along the station to the No. 3 set, where the erection problem involved aligning the two sections of two separate generating sets. In consequence of the breakdowns, the North-Eastern Electricity Board have issued a grave warning to all electricity consumers in their area to effect strict economies in order to avoid serious load shedding. The area of the Board extends from Berwick in the north to Harrogate, York and Scarborough in the south, and covers 5864 square miles.

"BRITAIN GOES AHEAD" EXHIBITION.—The last of a series of economic exhibitions at Charing Cross Underground Station was opened by Lord Latham, chairman of London Transport Executive, on November 24th. It is entitled "Britain Goes Ahead," and its aim is to demonstrate how supremacy in industrial and scientific invention can support the call for increased productivity. In a variety of ways, the exhibition illustrates what is being done to put Britain in the forefront of industrial and scientific development.

FLUORESCENT LIGHTING IN "HERMES IV."—Illumination in the main saloon of the Handley Page "Hermes IV" aircraft is provided by twenty-four Mazda 20W "warm-white" fluorescent lamps, arranged in a continuous row along the ceiling centre. The lamp-holders and auxiliary gear are mounted on the back of the reflector, which therefore constitutes a cover-plate. Extraction grills have been pierced in this cover plate to form part of the air-conditioning system. For emergency purposes tungsten filament lighting has also been incorporated in the circuit. The complete lighting installation for this aircraft was designed by the British Thomson-Houston Company, Ltd., who also supplied the equipment.

BRITISH STEEL FOUNDERS ASSOCIATION.—On Wednesday, December 1st, the British Steel Founders Association held a dinner at the May Fair Hotel, London. Mr. F. A. Martin, the Chairman of the Association, presided. In replying to the Toast of "British Industry," proposed by Mr. Martin, Sir Frederick Bain referred to the introduction of the Iron and Steel Bill as a "criminal act." He considered that if the measure went through it would be a disaster to this country and every working man in the industry. About the work of the Anglo-American Council on Productivity he remarked that the Americans were surprised to find that labour and management in this country were thinking alike on so many subjects and were so friendly. They were rapidly becoming disillusioned. They had thought us decadent but were becoming increasingly impressed with the amount that had been done in this country since the war. They were convinced that the tempo of much here was as high as in their own country, the difference lying only in the amount of power available per head. Finally, Sir Frederick remarked that if we were to maintain a high rate of exports we must recover our old skill of being the best sellers in the world. Two further toasts, "The Art and Science of Steel Founding," and "Our Guests," were proposed by the Master Cutlers and Mr. T. H. Summerson respectively, and Mr. Frank Rowe and Sir John Duncanson replied.

Contracts

VICKERS-ARMSTRONGS, Ltd., announces the receipt of an order from the British Tanker Company, Ltd., of London, for a 28,000-ton deadweight tanker to be constructed at the Barrow-in-Furness shipyard. The vessel will be powered by single-screw, double reduction-geared turbines, and will be 610ft long. It will be constructed with ten sets of triple cargo tanks.

THE NORTH BRITISH LOCOMOTIVE COMPANY, Ltd., in association with the General Electric Company, Ltd., as supplier of the electrical equipment, has received an order for eight 625 h.p. diesel-electric shunting locomotives for the Ceylon Government Railway. The locomotives have single cabs and are carried on two four-wheel bogies, with all motors on axles. Maximum tractive effort is 35,000 lb at up to 4 m.p.h. The power unit consists of a Paxman "12 R.P.H." turbo-charged diesel engine, driving main and auxiliary generators. The locomotives are designed principally for operating in the Colombo goods yard, but may also be required to work on the Kolonnawa branch line. They are to be capable of working continuously for six days without refuelling.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Association of Supervising Electrical Engineers

To-day, Dec. 10th.—CREWE BRANCH: Crewe Arms Hotel, Crewe. "Refrigeration," E. S. C. Rump. 7 p.m.

Mon., Dec. 13th.—S.E. LONDON BRANCH: Technical College, Lewisham, "Voltage Control by Means of Transformers with On-Load Ratio-Changes," H. Walmsley, 8 p.m.

Tues., Dec. 14th.—S.W. LONDON BRANCH: Compton Hall, Compton Road, Wimbledon, "Fluorescent Lighting," K. R. Gibbons, 7.30 p.m.

Wed., Dec. 15th.—BRISTOL BRANCH: Grand Hotel, Bristol, "The General Perspective of Electronics Today," J. Jackson, 7 p.m.——KENT BRANCH: Royal Star Hotel, Maidstone, "Automatic Telephony," R. D. Barber, 7.39 p.m.

Derby Society of Engineers

Mon., Dec. 20th.—School of Arts, Green Lane, Derby, "Refrigeration," H. R. Dewman, 7.15 p.m.

Diesel Engine Users Association

Thurs., Dec. 16th.—Caxton Hall, Westminster, S.W.1, "Report on Heavy-Oil Engine Working Costs, 1946–47," 2.30 p.m.

Illuminating Engineering Society

Tues., Dec. 14th.—Lighting Service Bureau, 2, Savoy Hill, W.C.2, "The Gas Arc—A New Light Source," J. N. Aldington, 6 p.m.

Institute of British Foundrymen

To-day, Dec. 10th.—LINCOLN SECTION: Tech. College, Lincoln. "New Grades of Cast Iron and Their Applications," A. B. Everest, 7.15 p.m.——MIDDLESBROUGH BRANCH: Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough. "Problems of Contraction and Distortion in Iron Castings," E. Longden. 7.30 p.m.——W. WALES SECTION: Nevills' Canteen, Llanelly. "Gates and Risers," Film. 7 p.m.

Sat., Dec. 11th.—BRISTOL BRANCH: Grand Hotel, Broad Street, Bristol. "Light Alloy Founding," E. Raybould. 3 p.m.——E. MIDLANDS BRANCH: School of Arts and Crafts, Green Lane, Derby. "Some Solved and Unsolved Problems in the Metallurgy of Black Heart Malleable," Dr. Schwartz. 6 p.m.——LANCASHIRE BRANCH: Engineers' Club, Albert Square, Manchester. "Some Aspects of the Joint Advisory Committee Report on Conditions in Ironfoundries," J. W. Gardom. 3 p.m.——NEWCASTLE BRANCH: Neville Hall, Westgate Road, Newcastle-upon-Tyne. "Core-Making," J. Gilbert. 6 p.m.——SCOTTISH BRANCH: Royal Tech. College, Glasgow. "Manganese Bronze Propellers," F. J. Tector. 3 p.m.

Mon., Dec. 13th.—SHEFFIELD BRANCH: Royal Victoria Hotel, Sheffield. "Nodular Cast Irons—Their Production and Properties," H. Morrogh and J. W. Grant. 7.30 p.m.

Wed., Dec. 15th.—BIRMINGHAM BRANCH, STUDENTS' SECTION: British Restaurant, Grosvenor Street, Birmingham, Debate, 6.30 p.m.

Fri., Dec. 17th.—LONDON BRANCH: Café Royal, W.1, Annual Dinner and Dance, 7 p.m.

Sat., Dec. 18th.—W. RIDING OF YORKS BRANCH: Tech. College, Bradford, "Some Aspects of the Joint Advisory Committee Report on Conditions in Ironfoundries," J. W. Gardom, 6.30 p.m.——BURNLEY SECTION: Mechanics Institute, Manchester Road, Burnley, "Some Thoughts on the Laboratory," D. Fleming, 6.15 p.m.

Institute of Marine Engineers

Tues., Dec. 14th.—85, Minories, E.C.3. "Latest Developments in Reversible Propellers," L. C. Burrill. 5.30 p.m.

Thurs., Dec. 16th.—Municipal Tech. College, Hull, "Diesel-Engined Trawlers," A. C. Hardy, 7.30 p.m.

Institute of Metals

Mon., Dec. 13th.—Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow. "The Uses of Non-Ferrous Metals for Aircraft," G. Meikle. 6.30 p.m.

Thurs., Dec. 16th.—SHEFFIELD LOCAL SECTION: Grand Hotel, Sheffield, "The Electrometallurgy of Silver," L. B. Hunt, 6.30 p.m.

Institute of Navigation

Fri., Dec. 17th.—Royal Geographical Society, 1, Kensington Gore, S.W.7, "Radio and Position," Sir Robert Watson-Watt, 5 p.m.

Mon., Dec. 20th.—Royal Geographical Society, 1, Kensington Gore, S.W.7, "The Navigator's Story," E. G. R. Taylor and W. M. Smart, 8.15 p.m.

Institute of Road Transport Engineers

Thurs., Dec. 16th.—Royal Society of Arts, John Adam Street, W.C.2, "The Development of the Gas Turbine for Road Transport," J. Hodge, 6.30 p.m.

Institute of Transport

To-day, Dec. 10th.—NORTHERN SECTION: Royal Turks Head Hotel, Newcastle-upon-Tyne. "Transport Education," J. Lamb. 7 p.m.——BRISTOL GRADUATE AND STUDENT SOCIETY: Office of the Regional Transport Commissioner, Bristol. "Staff Relationships," G. S. Rider. 6.15 p.m.

Tues., Dec. 14th.—SCOTTISH SECTION: Corporation Transport Offices, Glasgow. "London Transport," J. G. Shaw Scott. 6 p.m.——YORKSHIRE SECTION: Great Northern Station Hotel, Leeds. "L.M.R. Modernised Traffic Control Organisation," A. Forester Fielding. 6.30 p.m.

Wed., Dec. 15th.—WESTERN SECTION: The University, Bristol, "A Code for Management," W. B. D. Brown, 7 p.m.

Thurs., Dec. 16th.—BIRMINGHAM GRADUATE AND STUDENT SOCIETY: Imperial Hotel, Temple Street, Birmingham, "The Trade Union in Relation to Transport," F. E. Bell, 7 p.m.——S.W. SECTION: Oldway Mansion, Paignton, Short Papers by J. A. Stevenson, G. Frankis, and G. L. Brock, 7 p.m.

Fri., Dec. 17th.—NOTTINGHAM GRADUATE AND STUDENT SOCIETY: City Transport Officer, Nottingham, Open Night and Film Display, 7 p.m.

Institute of Welding

Wed., Dec. 15th.—N. LONDON BRANCH: Tech. College, East Ham, Open Discussion on Welding Methods, 7.30 p.m.

Institution of Chemical Engineers

Tues., Dec. 14th.—Geological Society, Burlington House, Piccadilly, W.1. "Deposits on the External Heating Surfaces of Water Tube Boilers," H. E. Crossley. 5.30 p.m.

Institution of Civil Engineers

Tues., Dec. 14th.—Great George Street, Westminster, S.W.1. "The Design of Reinforced Concrete Piles, with Special Reference to the Reinforcement," B. F. Saurin. 5.30 p.m.——NEWCASTLE-UPON-TYNE AND DISTRICT ASSOCIATION STUDENTS' SECTION: N. of England Institute of Mining and Mechanical Engineers, Westgate Road, Newcastle-upon-Tyne, "Design of Concrete Mixes," A. G. Preston, 6.15 p.m.

Fri., Dec. 17th.—YORKSHIRE ASSOCIATION: Great Northern Station Hotel, Leeds, "The Construction of a Pre-stressed Reinforced Concrete Bridge," A. J. A. Roseveare, 7 p.m.

Tues,. Dec. 21st.—Great George Street, Westminster, S.W.1, Inaugural Unwin Lecture, Oscar Faber, 5.30 p.m.

Institution of Electrical Engineers

To-day, Dec. 10th.—N.E. STUDENTS' SECTION: King's College, Newcastle-upon-Tyne. Technical Film Show. 7 p.m.

Mon., Dec. 13th.—N.E. CENTRE: Neville Hall, Westgate Road, Newcastle-upon-Tyne. "The Lightning Protection of High-Voltage Transmission and Distribution Systems," H. M. Lacey. 6.15 p.m.——LONDON STUDENTS' SECTION: Savoy Place, Victoria Embankment, W.C.2. "The Fundamental Principles of the Sale of Electricity to Consumers," F. Grant. 7 p.m.

Tues., Dec. 14th.—RADIO SECTION: Savoy Place, Victoria Embankment, W.C.2. Discussion on "V.H.F. Mobile Radio-Telephone Services," opened by D. H. Hughes. 5.30 p.m.——N. MIDLAND CENTRE: Yorkshire Electricity Board, 1, Whitehall Road, Leeds, 1. "Electrical Aspects of Overhead Travelling Cranes," G. V. Sadler. 6.30 p.m.

Wed., Dec. 15th.—SCOTTISH CENTRE: Heriot-Watt College, Edinburgh, "Application of Electricity to Horticulture," C. A. Cameron-Brown and E. W. Golding, 7 p.m.

Mon., Dec. 20th.—N.E. CENTRE RADIO AND MEASUREMENTS GROUP: King's College, Newcastle-upon-Tyne, "Three-Dimensional Cathode Tube Display," E. Parker and P. R. Wallace, 6.15 p.m.

Tues., Dec. 21st.—SCOTTISH CENTRE: Royal Tech. College, George Street, Glasgow, "The Design of Contactors with Regard to Their Industrial Application," Bernard Feltbauer, 7 p.m.

Institution of Engineering Inspection

Tues., Dec. 21st.—LEEDS BRANCH: Hotel Metropole, King's Street, Leeds, "Noise and Vibration in Machinery," W. G. Tuplin, 7.30 p.m.

Institution of Engineers and Shipbuilders in Scotland

Tues., Dec. 14th.—39, Elmbank Crescent, Glasgow. "Water Turbine Machinery," A. A. Fulton. 6.30 p.m.

Institution of Locomotive Engineers

Wed., Dec. 15th.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1, "Forty Years of Automatic Train Control," A. W. J. Dymond, 5.30 p.m.

Institution of Mechanical Engineers

To-day, Dec. 10th.—Storey's Gate, St. James's Park, S.W.1. "Fluid Flow Through Granular Beds," Discussion based on papers by H. E. Rose and A. M. A. Rizk. 6 p.m.

Tues., Dec. 14th.—AUTOMOBILE DIVISION: Storey's Gate, St. James's Park, S.W.1. "Lubrication of Engines," A. T. Wilford. 6 p.m.

Thurs., Dec. 16th.—AUTOMOBILE DIVISION, GRADUATES SECTION: Storey's Gate, St. James's Park, S.W.1, Technical Film Exhibition, 6.30 p.m.

Fri., Dec. 17th.—Storey's Gate, St. James's Park, S.W.1, "Cinematography in Engineering," H. A. V. Bulleid, 6 p.m.

Sat., Dec. 18th.—N.E. BRANCH, GRADUATES' SECTION: Newcastle and Gateshead Gas Company, Grainger Street, Newcastle-upon-Tyne, Film, "Atomic Physics," 2.30 p..m

Institution of Mining and Metallurgy

Thurs., Dec. 16th.—Geological Society, Burlington House, W.1, Special General Meeting, 5 p.m., "Notes on the Treatment of Pyrites Cinders at the Plant of the Pyrites Co., Inc., Wilmington, Delaware," R. C. Trumbull, W. Hardiek, and E. G. Lawford, 5.15 p.m.

Institution of Production Engineers

To-day, Dec. 10th.—E. COUNTIES SECTION: Britannia Works, Colchester. "Material Handling," H. M. King. 7.30 p.m.——COVENTRY SECTION: Geisha Cafe, Hertford Street, Coventry. "New Development in Centreless Grinding," A. Scrivener. 7 p.m.

Mon., Dec. 13th.—HALIFAX SECTION: White Swan Hotel, Halifax. "Production and Inspection of Gears," J. Milwain. 7 p.m.

Tues., Dec. 14th.—BIRMINGHAM GRADUATE SECTION: James Watt Memorial Institute, Great Charles Street, Birmingham. "Air-Operated Fixtures," N. P. Watts. 7 p.m.

Wed., Dec. 15th.—LIVERPOOL SECTION: Radiant House, Bold Street, Liverpool, "Manufacture and Application of Sintered Carbides," H. Eckersley, 7.15 p.m.——BIRMINGHAM SECTION: James Watt Memorial Institute, Great Charles Street, Birmingham, "Costing as an Aid to Management," H. H. Norcross, 7 p.m.

Thurs., Dec. 16th.—GLASGOW SECTION: Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow, C.2, "Furniture Production," R. E. Harrison, 7.30 p.m.

Fri., Dec. 17th.—N.E. GRADUATE SECTION: Neville Hall, Westgate Road, Newcastle-upon-Tyne, Film Evening, 6.30 p.m.

Mon., Dec. 20th.—HALIFAX GRADUATE SECTION: Tech. College, Halifax, "The Manufacture of Plant Used in the Production of Town's Gas," W. Raistrick, 7 p.m.

Junior Institution of Engineers

To-day, Dec. 10th.—Royal Society of Arts, John Adam Street, Adelphi, W.C.2. Presidential Address, Sir Noel Ashbridge, "New Developments in Broadcasting," 6.30 p.m.

Mon., Dec. 13th.—SHEFFIELD AND DISTRICT SECTION: Metallurgical Club, West Street, Sheffield. "Machinery for Motor Driven High-Speed War Vessels," E. Scott. 7 p.m.

Fri., Dec. 17th.—39, Victoria Street, S.W.1, "Fuel Efficiency as Applied to Heating and Domestic Boilers," B. H. Shoard, "The Efficient Operations of Industrial Boiler Plants," John Gayfer, 6.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders

To-day, Dec. 10th.—Literary and Philosophical Society's Lecture Theatre, Newcastle-upon-Tyne. "British Marine Gas Turbines," T. W. F. Brown. 6.15 p.m.

Royal Aeronautical Society

Thurs., Dec. 16th.—Institution of Civil Engineers, Great George Street, S.W.1, "Present Thoughts on the Use of Powered Flying Controls in Aircraft," D. J. Lyons, 6 p.m.

Royal Society of Arts

Wed., Dec. 15th.—John Adam Street, Adelphi, W.C.2, "Industrial Design and the Engineering Industries," M. Hartland Thomas, 2.30 p.m.

Sheet and Strip Metal Users' Technical Association

To-day, Dec. 10th.—Waldorf Hotel, Aldwych, W.C.2. Annual General Meeting and Winter Conference.

Society of Engineers

Fri., Dec. 17th.—17, Victoria Street, S.W.1, Film, "Pressure Die-Casting," 6.30 p.m.

Stephenson Locomotive Society

Sat., Dec. 11th.—N.E. AREA: Methodist Church Hall, Ridley Place, Newcastle-upon-Tyne. "A Railcar Miscellany," N. G. Robson. 2.30 p.m.——N.W. AREA: Geographical Society's Rooms, Manchester. "Steam Rail Motors," G. Clifford. 6.15 p.m.

Personal and Business

MR. B. J. TAMS, M.I.Mech.E., has been appointed general manager of J. Brockhouse and Co., Ltd.

MR. GEORGE ARCHER and Mr. L. K. Brindley have been appointed directors of the Mond Nickel Company, Ltd.

MR. M. R. HADDOCK has been appointed an assistant secretary of the Docks and Inland Waterways Executive.

MR. G. E. MOYSEN has been appointed advertising manager of Elliott Brothers (London), Ltd., and Swift and Swallow, Ltd.

DR. B. J. LLOYD-EVANS has been appointed to the Kennedy Chair of Mechanical Engineering, tenable at University College, London.

S. WOLF AND CO., Ltd., announces that it has acquired additional factory space at Acton, London, W.2, for the further development of its range of portable electric tools.

THE ROYAL SOCIETY announces the appointment of Professor D. Brunt as Physical Secretary in succession to Sir Alfred Egerton, who has completed ten years in that office.

BOULTON PAUL AIRCRAFT, Ltd., has opened a London office at Kinnaird House, 1, Pall Mall East, S.W.1 (telephone, Whitehall 9261). Air Vice-Marshal L. M. Iles is the company's London representative.

B. AND S. MASSEY, Ltd., states that its London agent, Mr. G. M. Turnbull, has changed his address to 131, Victoria Street, S.W.1 (telephone, Victoria 7971; telegraphic address, "Dredgeable, Sowest, London").

SCOPHONY, Ltd., has acquired the assets and undertakings of John Logie Baird, Ltd., television manufacturers, and its associated company, W. Andrew Bryce and Co., Ltd. Mr. J. Buchanan, managing director of the two companies, has joined the board of Scophony, Ltd.

TUBE INVESTMENTS, Ltd., announces the formation of a new company, TI Aluminium, Ltd., to co-ordinate the administrative, technical, research and marketing resources of the group's aluminium division. The division includes Reynolds Light Alloys, Ltd., Reynolds Rolling Mills, Ltd., and the South Wales Aluminium Company, Ltd. The head offices of the new company will be at Redfern Road, Tyseley, Birmingham.