

A Seven-Day Journal

Marconi Experiments.

IN a statement to an Italian Press representative on board his yacht "Elettra" at Genoa, Senator Marconi is reported to have said that on Friday, March 21st, he was able to speak by wireless telephony with Sydney with the same clearness as if he had been telephoning from one house to another in Genoa. The conversation was carried on between Senator Marconi and Mr. E. T. Fisk, managing director of Amalgamated Wireless (Australasia), Ltd., who, in a telegram from Sydney, says that the experiment caused great interest there. The result is particularly notable and is a world's record for duplex radio telephone conversation between ship and land. On Wednesday last, Senator Marconi also made an experiment in connection with the electric lighting of the Sydney Exhibition. After again establishing telephonic communication with Sydney he pressed a key, which resulted in the transmission of electro-magnetic waves, thereby closing the lighting circuit for the whole system of illumination of the Sydney Exhibition. The wireless transmitter on the yacht "Elettra" is a very compact and highly efficient piece of apparatus, which has been specially designed to provide a wireless telephone service between ships at sea and the land telephone network. Among its special features is a valve drive circuit which ensures constant frequency. The signals were transmitted from the "Elettra" to the Dorchester and Grimsby Beam Stations and through Rockbank, Victoria, to Sydney.

The British Electrical and Allied Manufacturers' Association.

At the annual meeting of the British Electrical and Allied Manufacturers' Association, held on Thursday, March 20th, Lieut.-Colonel R. K. Morcom presided, both the chairman and the director being absent owing to illness. Before moving the adoption of the report the chairman referred to the great loss the Association had sustained during the year by the death of Dr. Ferranti and the regrettable retirement from the Council of one of its oldest members, Mr. Nalder. Referring to the report, the chairman said that severe compression had to be exercised by the Council to keep it within reasonable limits, the bare routine work of the several departments of the Association being more than sufficient even in summary to fill sixteen quarto pages. Perhaps the most striking feature of the report was the indication it contained of the excellent position the Association occupied in the opinion of the best judges and more particularly its good friends of the Press. The valuable statistical department, a brief summary of the proceedings of which was given in the report, had brought the Association more into the public eye, and it could feel some pride in its happy relations with the Government Departments and with the other associations. Mr. Railing, of the General Electric Company, seconded, and after discussion the report was unanimously adopted. The chairman announced that the following firms had been elected members of the Council:—British Electric Transformer Company, Ltd., Metropolitan-Vickers Electrical Company, Ltd., Micanite and Insulators Company, Ltd., Nalder Bros. and Thompson, Ltd., and Allen, West and Co., Ltd. The election of auditors and a vote of thanks to the chairman for presiding concluded the proceedings.

The British Electrical Development Association.

IN a speech delivered at the annual luncheon of the British Electrical Development Association, held at the Savoy Hotel on Friday, March 21st, Mr. Herbert Morrison, the Minister of Transport, said it was widely recognised that electricity was a valuable asset to industry and transport, and the progress of the industry had been substantial. The output of authorised undertakers in Great Britain had grown from 3,600,000,000 units in 1922 to 7,600,000,000 units in 1928, but substantial as that progress was, it was much below that of the United States, where the total output in 1928 was 97,000,000,000 units. It was claimed that 68 per cent. of the population of the United States was living in electrified homes; that 500,000 farms were electrified; and that three-quarters of all power in industry was electric. In Britain, on the other hand, only 18 per cent. of the houses were wired, not one in fifty houses was completely electrified, and the present output only covered some 15 per cent. of the possible home field. If the British consumption was to reach a level corresponding with that in the United States the annual output should be 30,000,000,000 instead of the probable 8,500,000,000 in 1929. Conditions in Britain and America might not be fully comparable, but there were two things needed in the British electrical industry—first, a universal and scientific push by all the supply undertakings; and secondly, a whole-hearted publicity campaign conducted on a national scale. The Elec-

trical Development Association was a valuable institution, not only representative of supply undertakings, but of engineers, plant manufacturers, power companies, cable makers, lamp manufacturers and contractors. Within its resources its work had been admirable, and the industry had derived much benefit from its activities. A prosperous industry such as that of electricity supply ought not, however, to stint its expenditure on advertising, which at present was small in relation to the real need. The available income made it impossible for the Association to render services on a scale proportionate to the importance of the industry. He was glad to learn that an increasing number of undertakings were becoming associated with the organisation, but he would urge the 50 per cent. that remained outside to join and so help to increase the use of electricity for all purposes.

Motor Car Manufacture at Luton.

HITHERTO the Hendon factory of General Motors, Ltd., has been employed on the building of Chevrolet motor cars and commercial vehicles, but the announcement is now made that, starting with this month, Chevrolet commercial vehicles will be built from British materials at the Vauxhall factory, Luton, at which works the output of Vauxhall cars is being steadily increased. In order to manufacture the parts which were previously imported, new buildings have been provided and additional shops equipped. About 2000 workers are now employed at Luton, and the number will be increased as the output is raised. The amount of capital now invested in buildings and plant at Luton exceeds a million pounds, and about half that sum will be paid in wages in the first year of production. During this time no less than 5600 tons of drop stampings, forgings and springs will be required, which, together with leather, cloth, glass and timber, will amount to over two million pounds worth of material in the first year. At the beginning the British labour and material on a Chevrolet chassis will represent about 70 per cent. of its actual cost, and the proportion will be increased to 75 per cent. if any type of body is fitted.

An International Container Competition.

WE have received from the British National Committee of the International Chamber of Commerce particulars of a prize competition, to be held in Paris, in which awards are to be given for the most efficient designs of containers suitable for the transport of goods by sea, rail and road. The conditions under which firms, technical schools and public institutions dealing with transport may compete are outlined and the rules governing the competition are set out. Each competitor must submit two models, one open and one closed, with three containers of different sizes for each of the two types. The jury will take into account such features as lightness of weight, cost of manufacture, upkeep charges, handling facilities, methods of fixing to railway wagons or motor lorries, and the best method of closing. Competitors must first submit their plans to the International Chamber of Commerce before September 10th, 1930, with particulars in French, which may be accompanied by a description in the competitors' native tongue. A selection from the plans submitted will be made by the jury, and the best designs will be retained for the second part of the competition, in which the successful competitors will be asked to construct their models for tests by the jury. The prize-winning designs are to be exhibited. Full particulars with regard to the competition may be obtained on application to the International Committee for the Container Competition, the International Chamber of Commerce, 38, Cours Albert, 1er., Paris.

The Late Mr. Clemens Herschel.

IT is with great regret that we learn from America of the death of Mr. Clemens Herschel, a pioneer worker in hydraulics, to whom we owe the practical application of the Venturi principle as applied to the measurement of flowing fluids. Clemens Herschel was born in 1842 and graduated at Harvard University in 1860, after which he spent a further period of study in France and Germany. He then returned to the United States and began to practise as a civil engineer. His early work was largely connected with the design and construction of wrought iron bridges, but his association with J. B. Francis, the eminent hydraulic engineer, and his testing work, caused Mr. Herschel later to devote his energies to this particular branch of engineering science. In 1879 he was appointed hydraulic engineer to the Holyoke Water Power Company of Massachusetts, a position which he held for ten years. In 1881 he constructed the Holyoke testing flume, which formed part of a public hydraulic testing laboratory for large-scale work. An account of his invention of the Venturi meter and the experimental tests which were made will be found in the "Transactions" of the American Society of Civil Engineers for 1888. Leaving Holyoke, Mr. Herschel took up a position in New York, and until 1900 he was the superintendent and chief engineer of the East Jersey Water Company. As a consulting engineer he also took part in the design and construc-

tion of the Niagara Falls hydro-electric plant and of other large plants in America and abroad. He contributed freely to the engineering literature of his day, and was a past-president of the Boston Society of Civil Engineers, a member of the American Society of Civil Engineers, and of our own Institution of Civil Engineers. It is directly due to the work of Mr. Clemens Herschel that the pioneer principles enunciated by Giovanni Battista Venturi, nearly a century before, were made available for practical engineering use, and when successful were coupled in a rare and self-effacing way with the name of the earlier worker.

The Inspection of Factories.

IN a Journal note of March 14th attention was directed to the recommendations made by the Departmental Committee on the Factory Inspectorate, which has led the Home Secretary to increase the general inspection staff, and particularly the engineering branches. The report of the Committee has now been issued as a White Paper, and it is of interest to note some of the standards of inspection which have been recommended by the Committee. It is proposed that the more important works and factories should be visited each year and the less important works at least every two years; also that within an average of four years every works should be thoroughly inspected. In the case of establishments which are conducted under regulations affecting manufacture quarterly visits are suggested, and under this head we note film and celluloid works, accumulator and lead works, the manufacture of pottery, refractory materials, shipbuilding and the grinding of cutlery and edge tools. The suggestion is also put forward that frequent visits should be paid to large docks for the purpose of checking the observance of the regulations governing the loading and unloading of ships; also that large buildings in course of construction which come under the Building Acts should be visited as soon as the work has been begun and revisited as may be found necessary as the work develops. Warehouses, the report suggests, should be visited once in every five years and at more frequent intervals when power plant needs to be inspected if special regulations apply. The engineering branch of the inspectorate is described as a vital element in the whole work, and the strengthening of the electrical branch is recommended.

The Retirement of Sir Harry Haward.

IT is announced by the Minister of Transport that Sir Harry Haward, one of the five Electricity Commissioners originally appointed in 1920 under the Electricity (Supply) Act of 1919, will retire at the end of this month on the completion of his extended term of office. Sir Harry, who is sixty-seven years of age, received his knighthood in 1917. Before his appointment as an Electricity Commissioner he was for twenty-six years the Comptroller of the London County Council. In that capacity he was actively engaged for many years in the investigation of various aspects of the finances of the public utility undertakings of London, particularly those relating to electricity supply. He also served on Government Committees dealing with financial and administrative matters. Although he will cease to hold office as an Electricity Commissioner, arrangements have been made whereby Sir Harry will act in a consultative capacity in order that both the Government and the Commissioners may continue to have the benefit of his experience and his assistance in dealing with the financial aspects of electricity supply and the electrical industry.

The Charing Cross Bridge.

IN the course of his evidence before the Select Committee of the House of Commons, which is now considering the London County Council's Charing Cross Bridge, Sir Percy Simmons, the chairman of the London County Council Improvements Committee, gave some interesting particulars with regard to the cost of the new scheme. Sir Percy stated that although the Southern Railway Company regarded the first proposal to transfer Charing Cross Station to the south side of the river as an impossible one, and did not want to adopt the Lion Brewery site, it was now satisfied that everything would be done under the new scheme to meet the convenience of the passengers. The Underground Railway and bus facilities from the new station would be better than those provided at the present terminus. Referring to the proposed widening of St. Martin's-lane, Sir Percy said that he thought that this would have to be done, but it would be better to postpone a decision until the effect of the new bridge could be judged. With regard to the £12,500,000 cost of the scheme, Sir Percy said that the London County Council was paying £2,126,000 to the Southern Railway Company which did not include the cost of the new site. The new site for the station was two and a-half times as large as the old site which the Council would obtain. He considered that the Southern Railway Company had made a fair bargain and the London County Council an exceedingly satisfactory one.

The Rolling of Metals.

By J. SELWYN CASWELL, M.Sc., A.M.I. Mech. E.

No. V.*

THE EFFECT OF SPREAD.

So far the discussion has been mainly concerned with the flow of metal in the longitudinal direction. Flow also occurs in the direction of the width of the stock, but its amount is small. The occurrence of lateral flow at any point will depend on the relation between the lateral and the longitudinal frictional constraint at that point. Lateral flow would involve movement against the frictional resistance across the

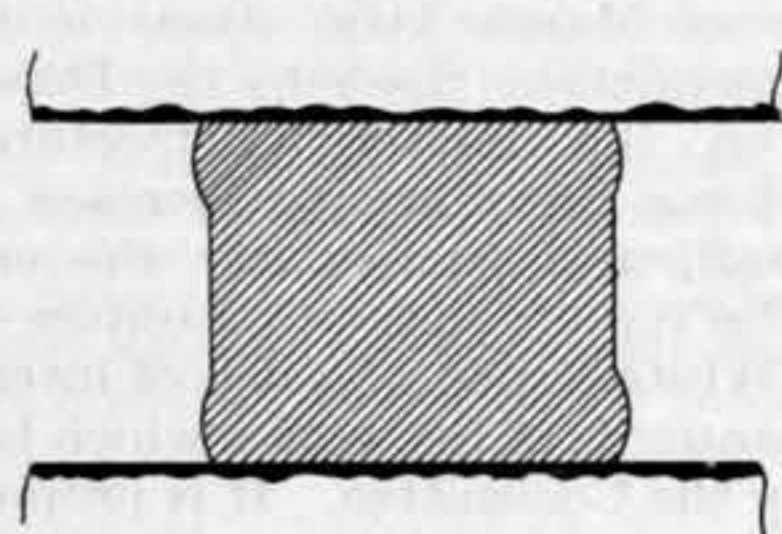


Fig 31. Spread in Thick Stock.

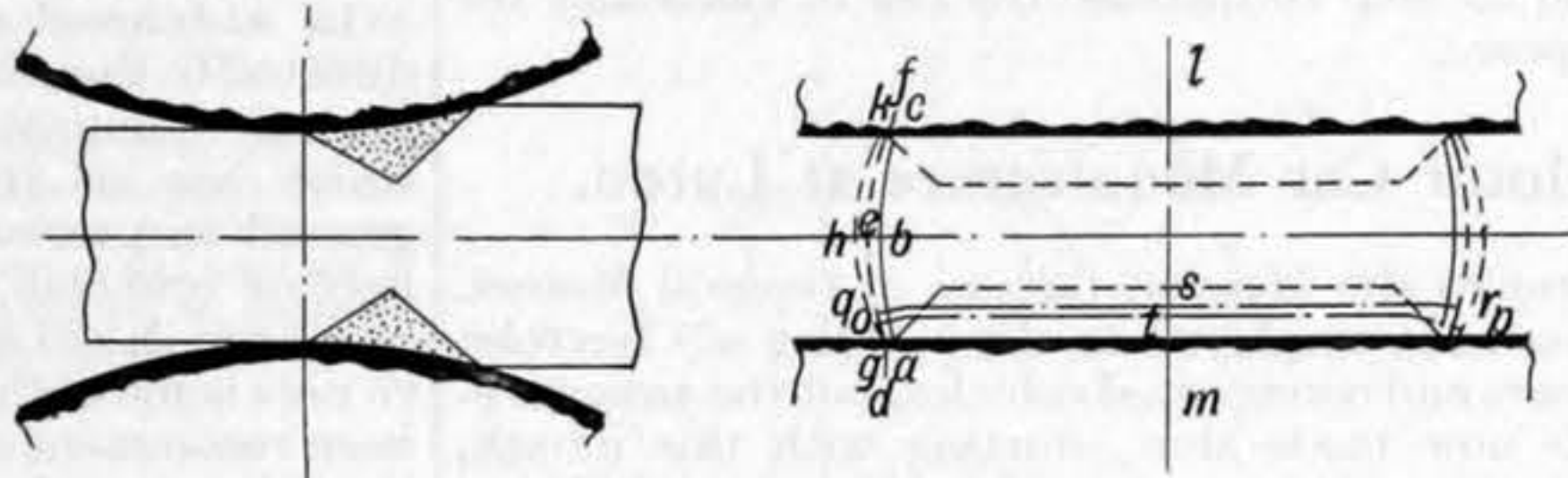


Fig 30. Lateral Flow or Spread.

whole width of the contact area, and it is at once clear that lateral flow will not occur except near the edges of the stock, where the frictional resistance is lower. The point at which lateral flow will commence will depend on the extent of the accompanying longitudinal friction. Longitudinal frictional resistance is determined by the draught, the diameter of the roll, and the physical changes in the material during the progress of the "bite," and lateral flow will be greatest when the deformation takes place under comparatively small loads.

Flow in the middle zones is less affected by roll face friction and greater lateral flow can occur in these zones. This fact is revealed by the bulging which takes place on the sides of rolled material. The amount of flow will depend on the thickness of the stock and on the variation of the physical properties across the section of the stock. The internal slip which produces slight thickening of the stock at entry will, in the same way, produce the bulging of the sides, but the thermal condition of the stock at the sides will determine the amount of bulging, this being least when the difference between the thermal condition of the sides and the centre of the stock is large. The effect of lateral flow on the shape of the stock is shown in Fig. 30.

The line abc is the approximate form produced by light draught. The line def is the approximate form produced by medium draught. The line ghk is the approximate form produced by heavy draught. These profiles are characteristic of relatively thin stock, in which the pressure penetrates into or near to the middle of the stock.

With thick stock, comparable with that rolled in cogging mills, the pressure will be effective in producing deformation of the outer zones only, and therefore the spread will be largely confined to the outer zones. The profile of the edge of the stock would then be like that shown in Fig. 31. It will be noticed that this profile corresponds to that obtained when bars of metal are "jumped up" under a forging hammer or press. In the case of the forging hammer, however, the effects are more confined to the outer or surface zones, i.e., the penetration is less.

Referring again to Fig. 30, any longitudinal plane lm , lying vertically along the middle of the stock, will remain perpendicular, or approximately so, during the progress of the "bite," but near the edges of the stock, the planes will be bent convex outwards, as a result of the different amounts of flow at the roll face and in the middle zones, and the convexity reaches its maximum value at the outside face.

Originally horizontal planes through the stock will tend to remain perpendicular to the originally vertical planes, and therefore the distortion of the horizontal planes is approximately that shown in the figure by such lines as op and qr .

The differential bending of the planes will produce an alteration in the distance between the lines near the sides, and the greatest difference will be at the edge of the stock, e.g., qo and rp , and the corresponding distance in the middle of the width is st .

The difference between the value of qo and st will be proportional to the amount by which the elongation of the material in the vicinity of st exceeds that in the vicinity of qo , and this applies to every other part of the stock.

It is evident, therefore, that there will be a considerable difference in the internal stress conditions at the edges and in the centre. The stress condition may be relieved to some extent either by the stretching of the material forming the edges or intermittent fracture of the edges, as commonly happens in the rolling of sheets and tin-plates.

The spread increases gradually until the no-slip zone in the "bite" is reached, and simultaneously with the occurrence of the spread the stock slips over the roll face, and it is probable that this slip will neutralise some of the spread which occurs during the pass.

The changing width of the stock during the progress between the rolls would then be approximately that represented in Fig. 32. The plan of the zones of retarded deformation is also shown by the lines abc , def , and ghk .

The stock below the planes abc and def will be deformed mainly in a lateral direction, and the flow which occurs will be independent of the width of the stock. The spread will therefore be relatively greater as the width of the stock decreases.

The severest stress conditions, in the edge zones, are set up in the cold rolling, and if the draught is relatively large in much worked metal, cracking of the edges may easily occur. It is not improbable that close examination of the edges of the stock would

indicate the limit of reduction before re-annealing is required.

Cold-rolled material will also be sensitive to any departure from symmetrical deformation, such as might be brought about with rolls of slightly different diameters, and different conditions of smoothness, because roll face slip is modified by it. If the stock is thin the internal stresses set up in the metal due to these causes may produce buckling.

The spread produced by large rolls is greater than that produced by small rolls, and the reason for this is shown in Fig. 33. The arc of contact is

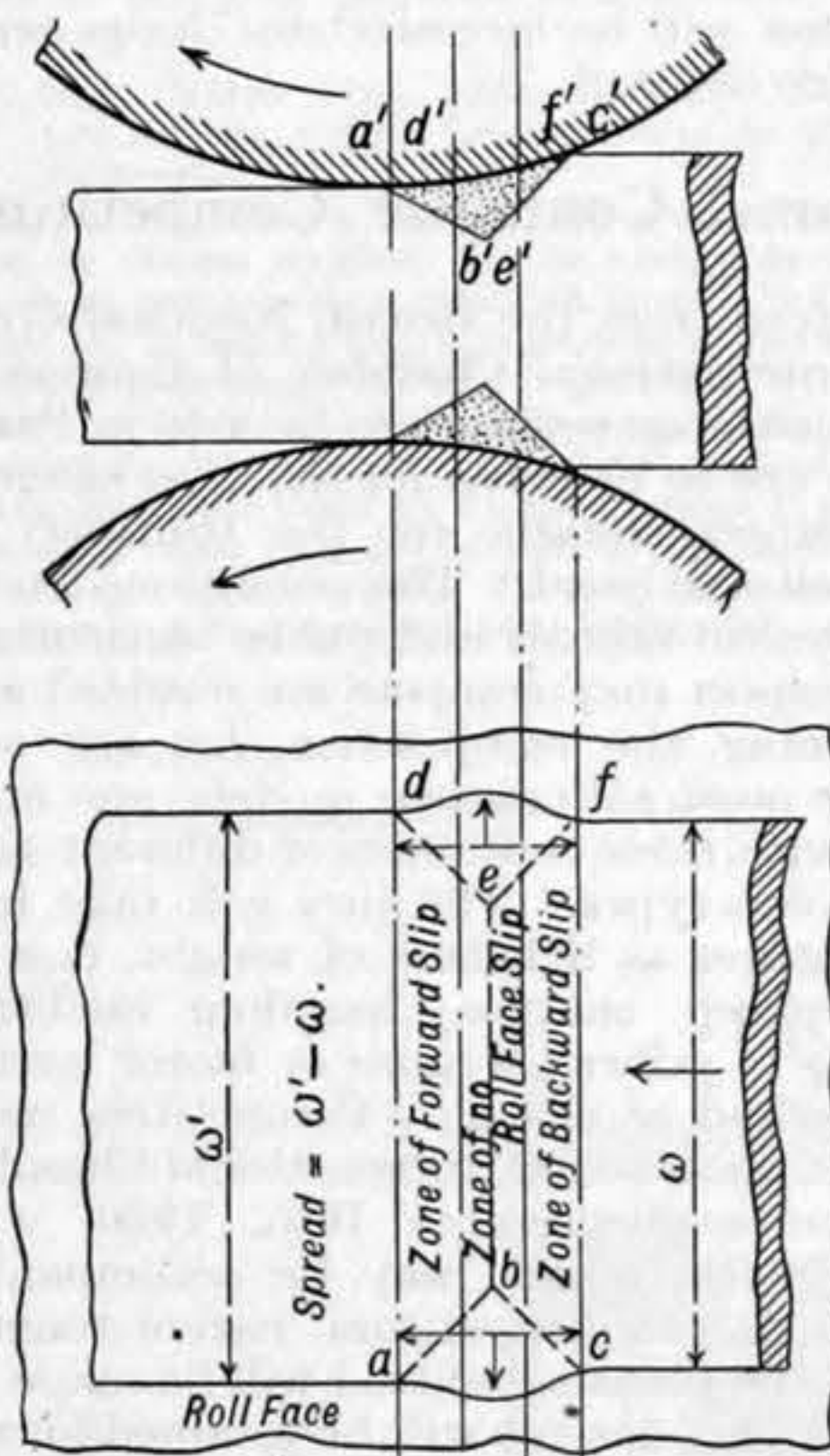


Fig 32. Changing Width of Stock.

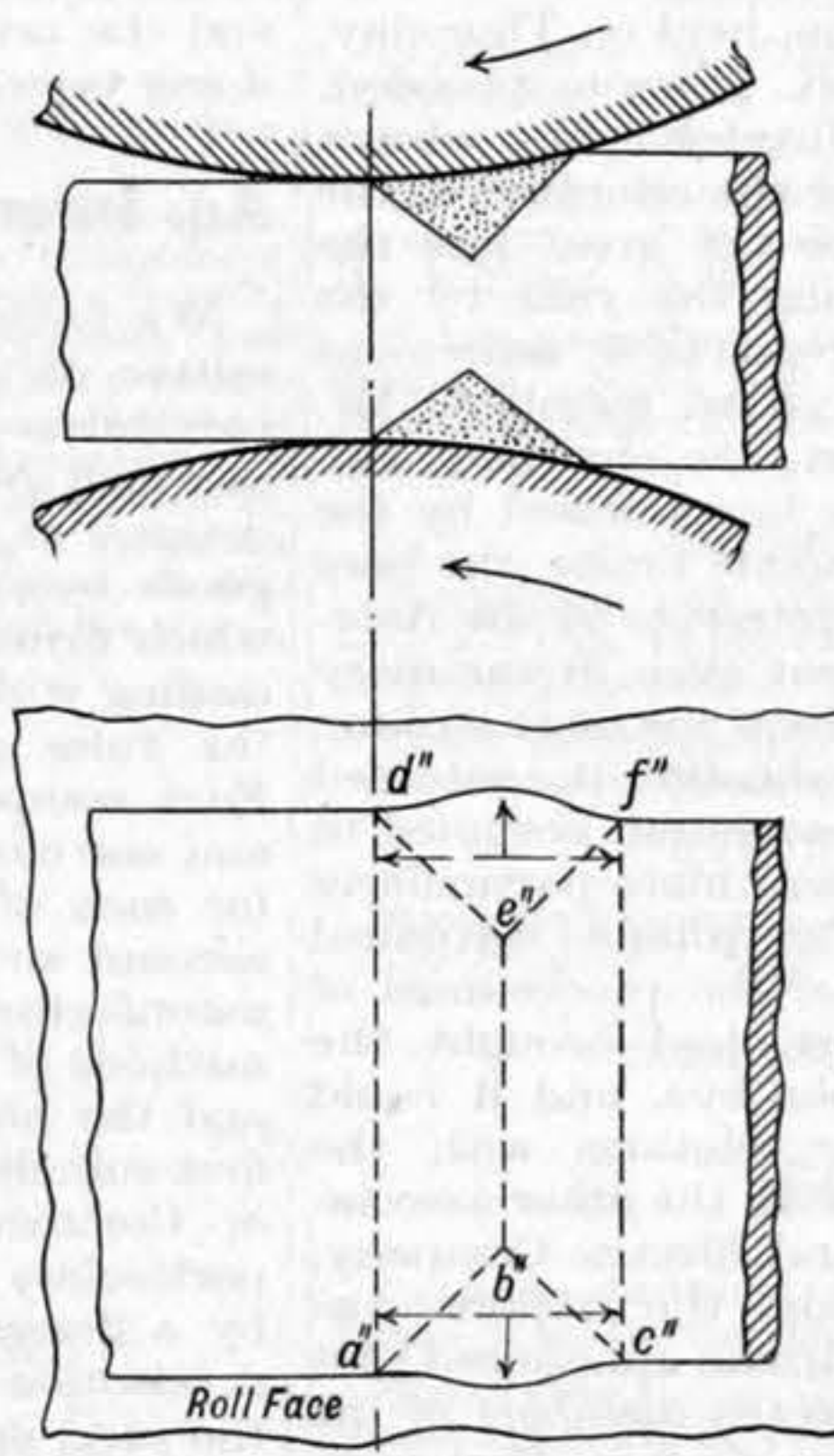


Fig 33. Effect of Roll Dia. on Spread.

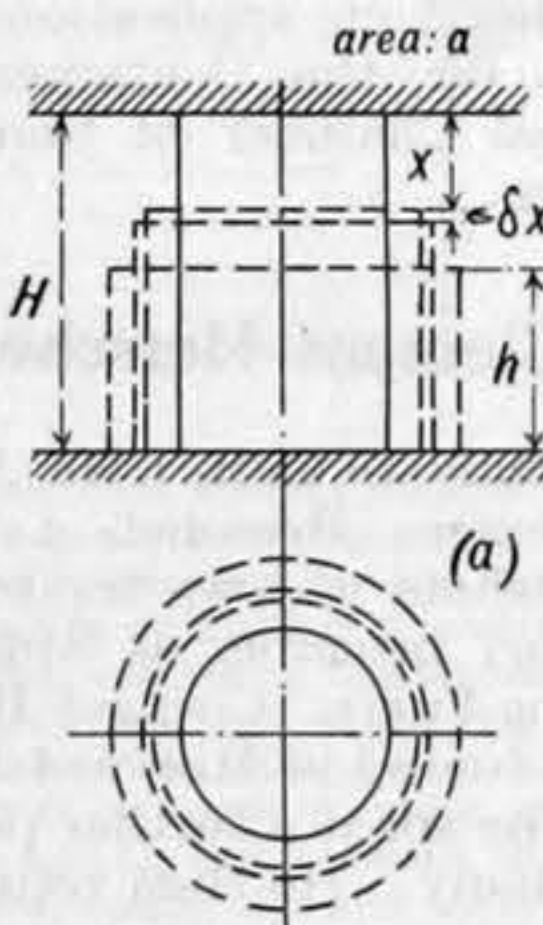


Fig 35. Compression Under Hypothetical Conditions.

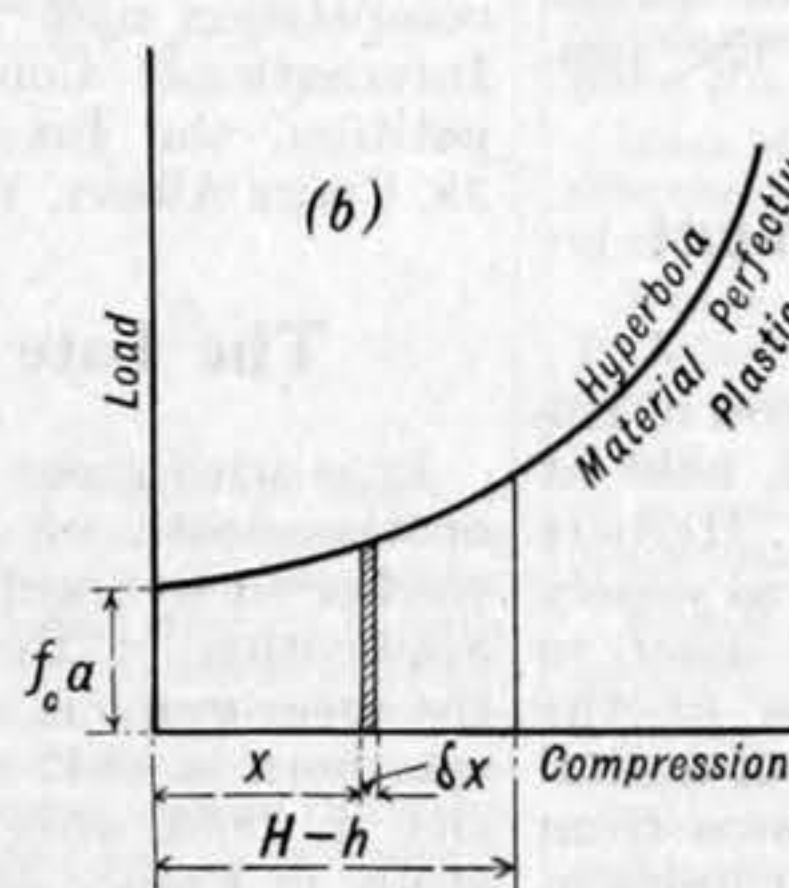


Fig 36. Compression of Slab the Width Remaining Constant.

increased, the friction zones are greater, and therefore the volumes of the lateral flow will be greater, as represented by the volume below the plane $d''e''f''$. The small roll is more effective, therefore, in producing elongation of the stock.

There are numerous empirical formulæ for calculating the spread in rolling, the simplest being that due to Geuze¹⁹, viz.:—

$$\text{Spread} = 0.35 (T - t),$$

where T = the thickness of the stock before the pass, and t = the thickness of the stock after the pass.

¹⁹ Geuze, "Traite Theoretique et Pratique du Laminage du Fer et de l'Acier."

But this formula does not embrace the variation produced by different roll diameters. Formulæ including this factor have been developed by Scheld, Falk and Tafel²⁰, but they are cumbersome to use, the first two being so due to the necessity of determining the angular measure of the angle of contact, and the second, due to the necessity of calculating a factor which Tafel calls "the compacting force."

A simple formula, based on extensive observations in rolling mills, has been developed by Sedlaczek²⁰ under the direction of Professor Tafel at the Technische Hochschule of Breslau, viz.:—

$$\text{Spread} = \frac{T-t}{6} \sqrt{\frac{D}{2T}} \quad (14)$$

where T and t have the values just explained and D = diameter of the roll.

The formula is simple to use and it embraces the variations which are produced by rolls of different diameter.

As regards the effect of the speed of rolling on the spread, it is probable that the spread will be lower at the higher speeds, because there is slightly increased resistance to the flow of the metal at the higher speeds.

The conclusions regarding the effect of spread are summarised below.

Conclusions Regarding the Effect of Spread.

- (1) Spread occurs only at the edges of the stock.
- (2) The spread is least in the material situated near the roll face, and is greatest in the middle zones when the draught is large relative to the thickness of the stock.
- (3) When the draught is relatively small compared with the thickness, the spread is mainly confined to the outer zones at the edges of the stock.
- (4) The spread is independent of the width of the stock, except for narrow stock, when the lateral flow zones overlap.
- (5) It depends on the roll diameter and the

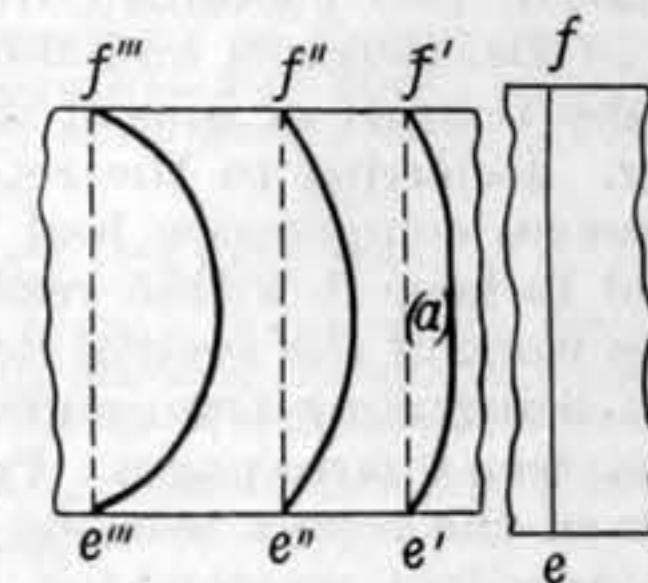


Fig 34. Effect of Non-Uniform Plasticity.

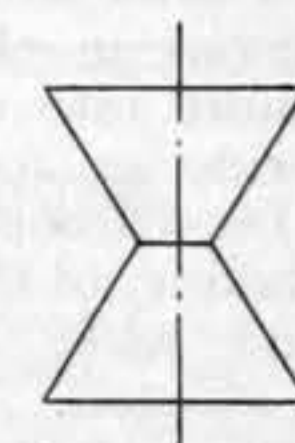


Fig 34a.

* No. IV. appeared March 21st.

²⁰ Sedlaczek, *Stahl und Eisen*, Feb. 5th, 1925.

(9) The amount of spread is given in simple terms by the Tafel-Sedlacek formula, viz.:—

$$\text{Spread} = \frac{T-t}{6} \sqrt{\frac{D}{2T}}$$

THE EFFECT OF THERMAL CONDITIONS.

The general effect of heat, uniformly distributed throughout the stock, was discussed earlier. The plastic properties are altered and the general deformation will be that already discussed. It has been explained that there is a thermal condition at which work-hardening will not occur, and that the material behaves like a highly plastic material.

Under actual rolling conditions the stock cannot be maintained in a uniform thermal condition after it has left the heating furnaces. Heat is lost by radiation and in air currents which circulate around the stock.

Deformation at any point of the stock will then depend on the thermal condition at that point, and also on the extent of the penetration of the pressure. The thermal condition at a point will depend on the distance of the point from the surface, and also on the extent of the development of heat by the deformation which occurs at the point.

There will be different plastic properties throughout the stock, and deformation will occur most easily in highly plastic parts. The difference between the centre and the surface zones may be such that considerable extrusion would occur. The general effects of the non-uniform thermal conditions are as follows:—

When thick stock is rolled there will be a greater difference between the mobility of the outer and the middle zones, because the retardation of the outer zones by roll face friction is now augmented by the reduced plastic condition of the outer zones. The volume of the stock remains practically unaltered, and any displacement at one point must produce displacement of an equivalent amount at other parts of the stock. Flow will tend to a longitudinal direction, and this will be greatest in the middle zones. A condition will be reached at which the vertical constraint exerted by the outer zones will be less than the resistance to longitudinal movement, and thickening of the stock will occur. It is probable that there will be considerable thickening in the case of thick stock which is rolled with a heavy draught, because the outer layer of less plastic material will be relatively thin. With thin stock the smaller amount of thickening will be due to the relatively thick outer zones of less plastic material.

Under heavy draughts the penetration of the pressure is deep, and if the centre of the stock is highly plastic parts of the centre may be displaced to positions nearer to the sides. It is the effect of pressure penetration which produces the expulsion of slag in the rolling and forging of wrought iron, and the scattered distribution of the impurities which segregate at the centre of steel ingots. In cast metal there are usually very minute cavities, and subsequent working of the metal will cause considerable distortion and distribution of the highly plastic or even liquid parts of the stock.

The relative displacement of the outer and the inner zones of the stock will be greater and a vertical line *ef*, Fig. 34, on the stock before entry will be deformed to a greater extent. The form of the line for varying degrees of difference in the plasticity of the outer and the inner zones is shown in Fig. 34. The first one, viz., (a), is that which would be obtained with stock in a uniform plastic condition.

The effect of heat on the deformation of the stock is summarised in the following:—

Conclusions Regarding the Effect of the Thermal Condition of the Stock.

(1) The general effect of heat is to increase the plasticity of metals and to allow deformation to take place under lower loads, but the non-uniform thermal conditions which are set up in heated stock give rise to a non-uniform plastic condition.

(2) The non-uniform condition allows greater distortion of the stock to occur.

(3) Deformation which may be described as extrusion—i.e., in relation to the rolling process—occurs to a greater extent in heated stock.

(4) The reversed flow at entry is greater and, therefore, there is greater thickening of the stock at entry; this implies that the relative displacement between the outer and the inner zones is greater with heated stock.

(5) In section rolling the most severe internal stresses are set up in the thin parts and angular parts of the section, as a result of the more rapid cooling of these parts.

THE EFFECT OF SPEED.

The resistance to flow is slightly greater at high speeds. Deformation does not occur instantaneously, and the amount of penetration by the applied pressure will depend on the time during which the pressure is applied.

The deeper penetration and effectiveness of the forging press as compared with the hammer is mainly due to the difference of the time during which the pressure is applied.

In the case of rolling, rapid deformation will affect the middle zones to a less extent than slow deformation, and the effect of speed is produced principally

in the early stages of the "bite," because it is then that the highest speeds occur during the "bite."

At high rolling speeds there is less time for reversed flow to occur at entry, and therefore there would be a relatively faster movement of the stock to the pass, i.e., the ratio:

Roller length of the stock

Corresponding distance moved through by a point on the roll face in the same time

has a higher value with high rolling speeds, with the same draught and roll diameter.

The greater resistance to deformation will call for a greater torque to operate the mill, but this disadvantage would be offset by the improvement in the roll face efficiency as expressed by the foregoing ratio, and also a better average plastic condition of the stock, due to the shorter time during which heat is lost from the stock.

The effect of speed is summarised below.

Conclusions Regarding the Effect of Speed.

(1) The time during which flow can occur is reduced and consequently the pressure is less effective in producing deformation in the middle zones of the stock, the effect being least in the case of thick stock.

(2) It is probable that the slip on the roll face is less.

(3) The resistance to deformation is slightly increased.

(4) The stock is rolled in a faster time, and in hot rolling the loss of heat before the pass is less, and consequently the average plastic condition is better than in slower rolling.

(5) The spread is diminished, and therefore the difference between the internal stresses at the edges and the middle of the stock is less.

The discussion regarding deformation is concluded at this point, and the next section deals with the energy which is required to deform stock in the rolling mill.

THE ENERGY REQUIRED FOR DEFORMATION UNDER IDEAL CONDITIONS.

Probably the earliest theoretical investigations into the energy requirements for the deformation of metal in the rolling mill are those made in 1874 by Fink, and the expression which he obtained, as recorded in the *Iron Trade Review*, October 15th, 1925, is as follows:—

$$A = \frac{K Q_1 L_1 \log_e n}{12} \text{ foot-pounds.}$$

where A = work done in foot-pounds,

K = stress, in pounds per square inch, required to produce permanent set in the material,

Q_1 = the original cross section of the stock in square inches,

L_1 = the original length of the stock in inches,

n = ratio as below:

Final length of the stock
Initial length of the stock

The assumptions on which the expression is based are not stated, but it is probable that these would be as follows:—

(a) Perfectly plastic material, i.e., one which deforms continuously under a constant stress value.

(b) Complete absence of friction between the deforming tools and the surface of the stock.

Under these conditions an identical expression may be obtained for simple compression, and with slight modification it expresses the ideal amount of energy for deformation in the rolling mill.

The deformation of a cylindrical specimen under the conditions assumed would take place as shown in Fig. 35 (a), and the load-compression curve would be a hyperbola, as shown on the accompanying Fig. 35 (b).

The area of the cross section for any compression of amount x is $\frac{aH}{H-x}$, where a = original area of the cross section and H = original height of the specimen.

The energy required for a small reduction of height x is approximately

$$P \delta x = f a_x \delta x = \frac{f a H}{H-x} \delta x$$

where f = plastic stress in pounds per square inch, and the total work done or energy required in the production of compression from the height H to some final height h is

$$\begin{aligned} f a H \int_{x=0}^{x=H-h} \frac{dx}{H-x} \\ &= f a H [\log_e (H-x)]_0^{H-h} \\ &= f a H (\log_e H - \log_e h) \\ &= f a H \log_e \frac{H}{h} \dots \dots \dots (15) \end{aligned}$$

The product aH is a measure of the volume of the material undergoing deformation, and therefore, under the hypothetical conditions assumed, the expression applies whatever the shape of the cross section.

It follows, then, that the energy required to reduce

the thickness of a rectangular slab in the manner shown in Fig. 36 is

$$f b L t \log_e \frac{T}{t}$$

where b = the width of the stock,

L = the final length of the stock,

T = the thickness before reduction,

and t = the thickness after reduction.

If the width b remains unaltered and l is the initial length of the slab,

$\frac{T}{t} = \frac{L}{l} = n$, i.e., one of the terms in the Fink formula, and $t b$ = the cross-sectional area, i.e., the value Q_1 in the Fink formula.

The formula then becomes identical with that developed by Fink.

The logarithmic term may be eliminated if several terms of the equivalent series are substituted and the expression then becomes

$$f b L t 2 \left[\frac{T-t}{T+t} + \frac{1}{3} \left(\frac{T-t}{T+t} \right)^3 + \frac{1}{5} \left(\frac{T-t}{T+t} \right)^5 \right]$$

When the draught is not large relative to the thickness the second and the remaining terms inside the brackets may be neglected, and the work done in the hypothetical case is then given by the simple formula below.

$$2 f b L t \frac{T-t}{T+t} \text{ inch-tons,}$$

when f = stress in tons per square inch, and the other terms are measured in inches.

$$= \frac{2 \times 2240}{12 \times 550} f b L t \frac{T-t}{T+t} \text{ horse-power secs.}$$

$$= 0.68 f b L t \frac{T-t}{T+t} \text{ horse-power secs.} \quad (16)$$

In rolling operations the ratio $\frac{T}{t}$ for a single pass may vary from ten for soft metals to values near to unity in the cold rolling of hard metals. It is probable, therefore, that the hypothetical expression for the work done in the rolling of soft metals should include the second and possibly the third terms shown in the brackets above.

The last expression represents the minimum amount of work required under the conditions assumed, and, as suggested by Professor Bacon,⁷ it could be used as a standard against which actual energy requirements in rolling could be compared. For the latter purpose, however, it is desirable that the variation of the plastic properties of the metal should be embraced by the expression. Such a modification is comparable with the substitution of the Rankine-Clausius cycle in steam practice in the place of the more hypothetical Carnot cycle as the standard against which steam engine performance is compared.

This appears necessary because the plastic properties, particularly at the lower rolling temperatures, are seldom ideal. At the higher rolling temperatures it is possible that there is a close approach to perfect plasticity, but at the lower temperatures the plastic stress may alter considerably during a single pass.

The minimum or ideal amount of energy required for deforming any given metal may be defined, therefore, as that required to produce change of form independently of the frictional constraint exerted by the deforming tools.

In the ordinary compression tests the stress-compression curves are affected by the frictional conditions existing between the ends of the specimen and the platens of the deforming tools, and they are not the true stress-compression curves for the material.

Riedel²¹ states that true curves may be obtained by using specimens having the form shown in Fig. 34a. They may be obtained also by using the conical platens described earlier.

When metal is tested under these conditions the resistance to deformation is entirely due to the inherent characteristics of the metal, and the variation of this value would be the same whatever method of deformation is employed, provided that the rate and the duration of the application of the load remained the same.

The tensile and compression tests would, within certain limits, provide information regarding the variation of the deforming stress, and in such tests the measure of the deformation is the uniform change in the dimensions of the specimens.

Neither of these tests is satisfactory, because the uniformity in the change of the dimensions cannot be maintained to the ultimate deforming capacity of the material. But within the limits of testing possible a relationship between the displaced volume and the applied stress could be determined.

The deforming stress could then be expressed in terms of the deformation produced. If the deforming stress f_0 is expressed as a function of the displaced volume, viz., $F(v)$, where v is the volume displaced, the formula for the energy required under ideal conditions on real materials would be

$$0.68 f_0 b L t \frac{T-t}{T+t} \text{ H.P. secs.,} \quad (17)$$

where f_0 is the mean value obtained in $F(v)$ between the

⁷ "The Forces Set Up in Sheet and Tin-plate Mills," J. S. Caswell, "Proc.," South Wales Inst. of Engineers, Vol. XLII., No. 2, 1926.

²¹ Riedel, "Behaviour of Metals in Compression at High Temperatures," Zeits. Ver. Deutscher Ing., Vol. 57, page 845.

limits represented by the displaced volume. The value obtained would correspond approximately with the mean value of the yield stress of the material in its initial condition and final condition.

The energy requirements obtained by this formula would then be a better standard of comparison than that in which the changing value of the stress is ignored.

The laws of plastic flow are not yet established, but it is probable that progress in this direction will be accelerated by the classical work begun by Dr. H. C. Carpenter and Miss Elam, and continued by other eminent investigators, in the production and study of the behaviour of single metal crystals and crystal aggregates.

(To be continued.)

Arc Welding at a Large Boiler Works.

DURING recent years the technique of arc welding has made remarkable strides. The success that has been attained in producing work that will withstand the tests appropriate to a wide variety of conditions has resulted in the displacement of riveting for many classes of tanks, even those that have to withstand high pressures. Careful study of the conditions that have to be met has led to the production of special generating units and control apparatus having the desired characteristics. Among the firms that have developed arc welding equipments the English Electric Company holds a prominent place, and with the permission of Thompson Bros. (Bilston), Ltd., we are enabled to publish particulars of an important

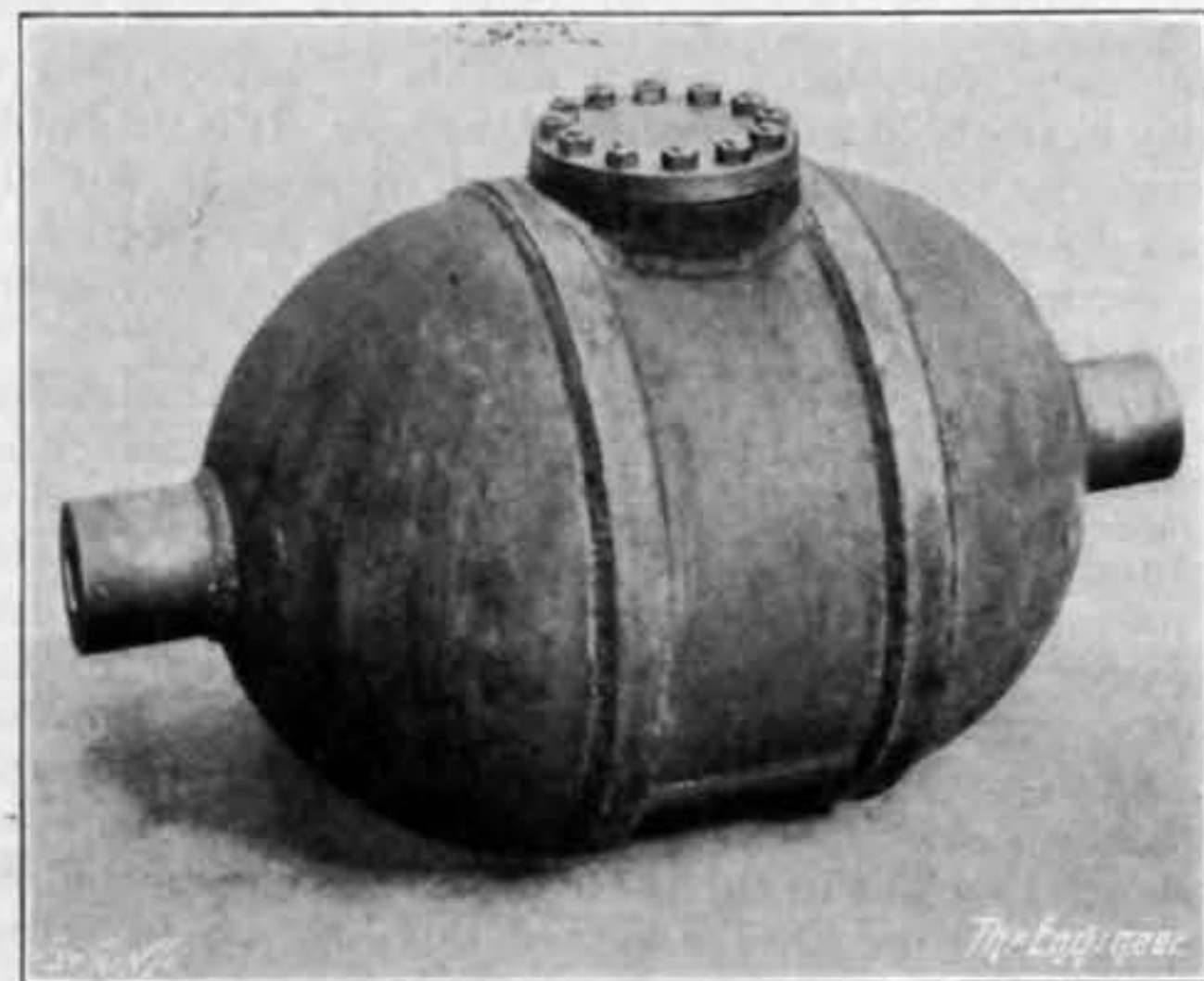


FIG. 1—WELDED CHEMICAL VESSEL

English Electric welding installation in the former firm's tank shops at the Bradley Engineering Works, Bilston. The firm specialises in the production of various kinds of welded work; it has also carried out a large amount of pioneer and research work in connection with which Mr. Ernest Corse, the company's chief engineer, and Bostock and Hargrove, Ltd., consultants, have taken an active part. The results of this development work have been of the greatest value, not only to the firm using the welding equipment, but also to the English Electric Company's engineers who designed the plant. From the collection of pictures that have been supplied to us illustrating the various classes of work carried out we have selected those shown in Figs. 1 and 4, the former showing a chemical vessel tested to a pressure of 1500 lb. per square inch, and the latter a welded

requirements to be met are: (1) high overall efficiency measured as the ratio of the output to input in kilowatts; (2) perfect control of the arc in order to make

resistance without loss of time. On the right-hand side of the cubicle there is a handle for controlling the oil-immersed star-delta starter for the motor of the

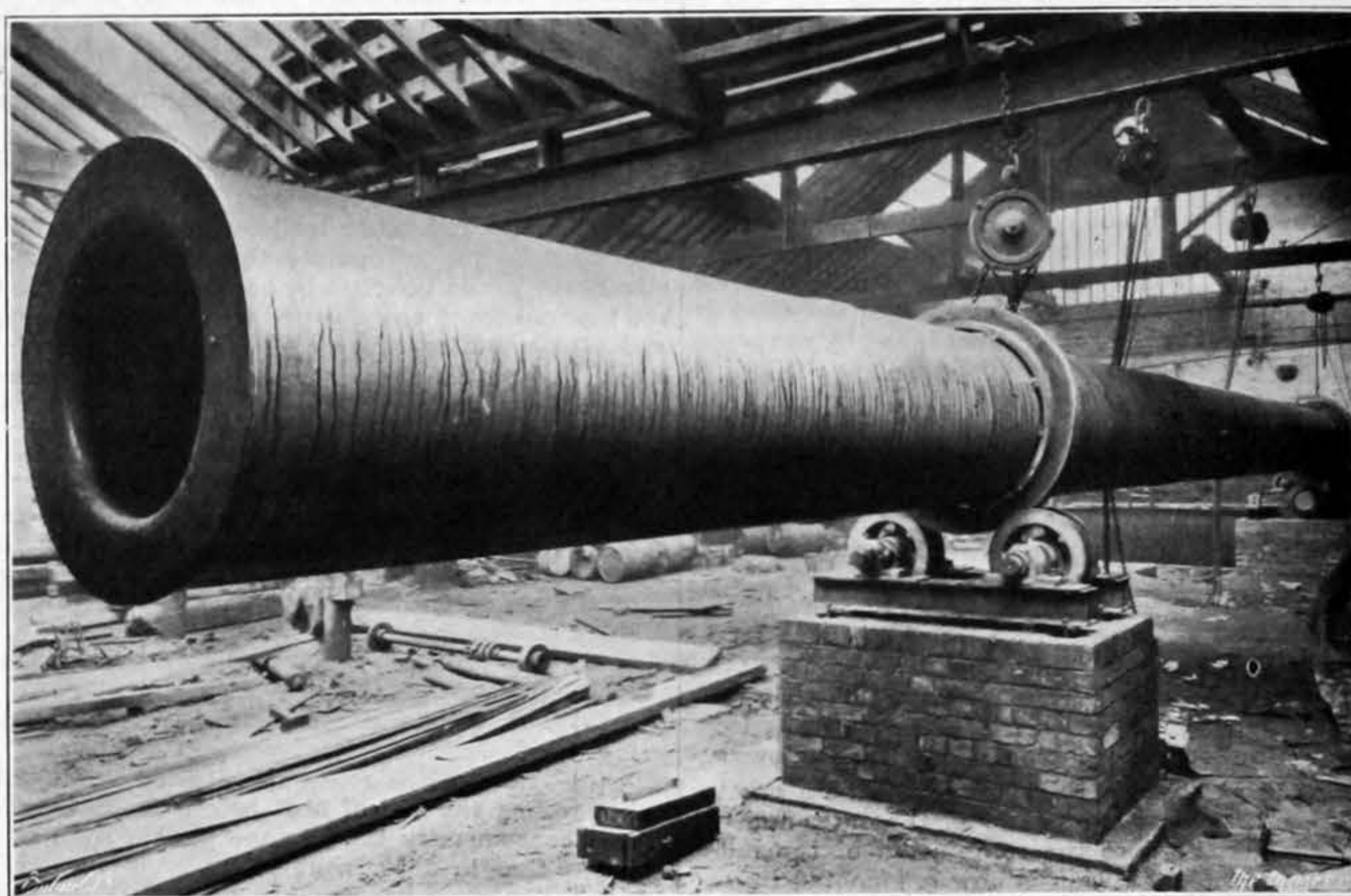


FIG. 4—WELDED ROTARY DRIER

the plant adaptable for heavy or lightly coated electrodes; (3) arc stability without sacrificing efficiency; (4) robustness of the welding generator and control gear; and (5) foolproof control gear to comply with the Home Office requirements.

The installation under consideration is composed of twelve welding sets, each consisting of a 10 horse-power squirrel-cage induction motor coupled to a steel frame welding generator capable of giving from 250 to 300 amperes at 30 volts. From Fig. 2, which gives a general view of one of the shops, it will be perceived that each welding set is self-contained and is suspended from the underside of the main girders, and this arrangement is also adopted for the exciter sets shown in Fig. 3. The floor space is therefore kept perfectly clear and the machines are protected from loose pieces of metal. The sets are designed to give their full output continuously for one hour, and are fitted with ball bearings having grease gun nipples so that they require practically no attention. Exciting current for the field magnets of all the welding sets is drawn from the two exciter sets which are controlled from a sheet steel cubicle mounted on the floor of the shop. The control gear is designed so that the excitation current for all the welder sets can be supplied by one exciter, or alternatively the two exciters can be operated in parallel. The excitation current is set by the shop foreman, who locks the cubicle so that no one else can interfere with it. As will be seen from the illustrations Figs. 2 and 3, the cables between the exciters and the welding sets and between the latter and the service points are run on racks suspended from the crane girders. Single-wire armoured cable is used, the armoring being clamped at the machines and at the control gear, so that there is a continuous earth connection throughout the shop equipment back to the sub-station.

One of the sheet steel cubicles containing the control gear for a welding set is shown in Fig. 5. The

welding set and an auxiliary trip is provided for shutting off the excitation current from the generator when the motor is stopped. In order to obtain fine

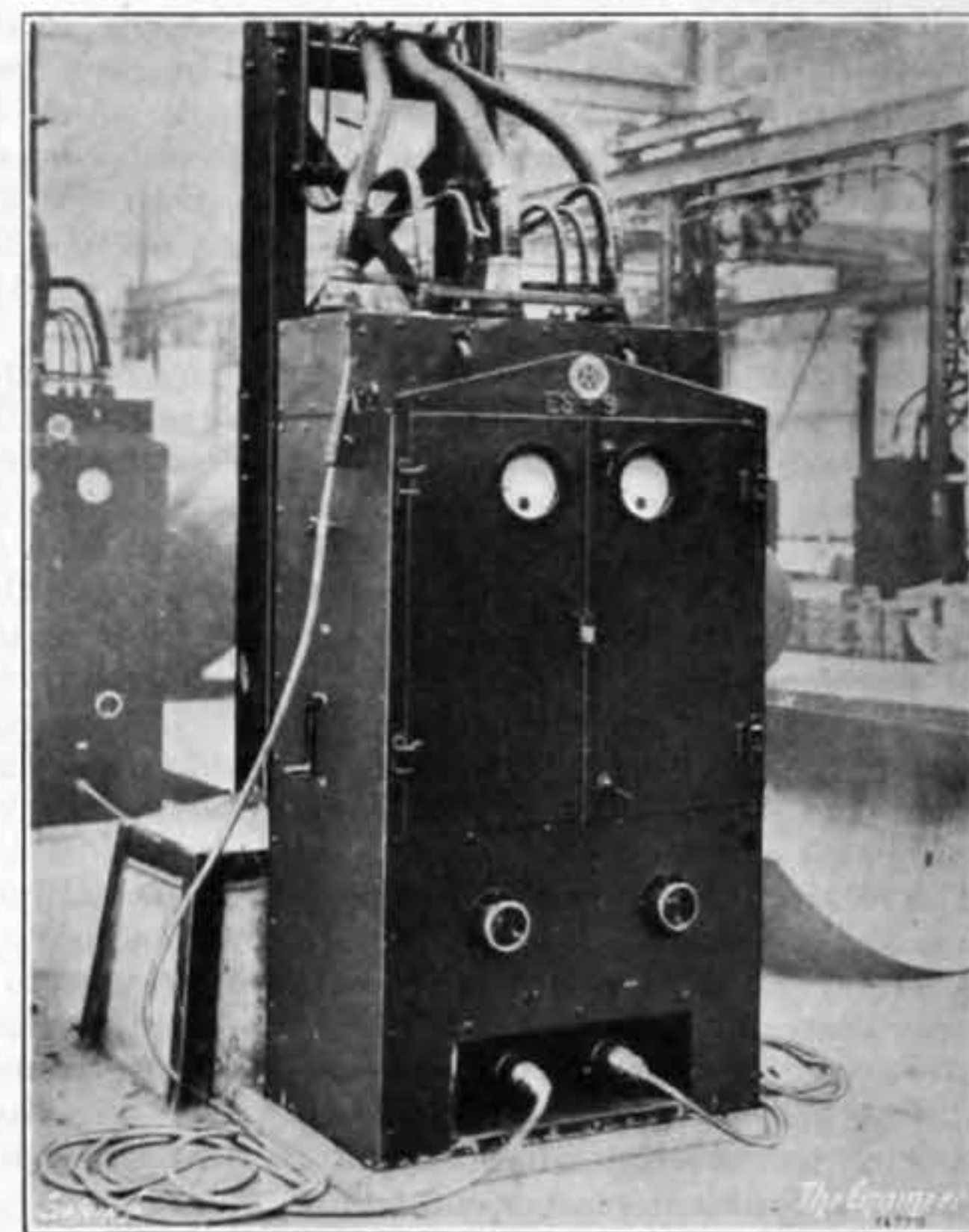


FIG. 5—CONTROL GEAR CUBICLE

adjustment of the arc current the shunt field current of the generator is regulated by means of a resistance mounted at the bottom of the cubicle on the left-hand



FIG. 2—GENERAL VIEW OF WELDING SHOP

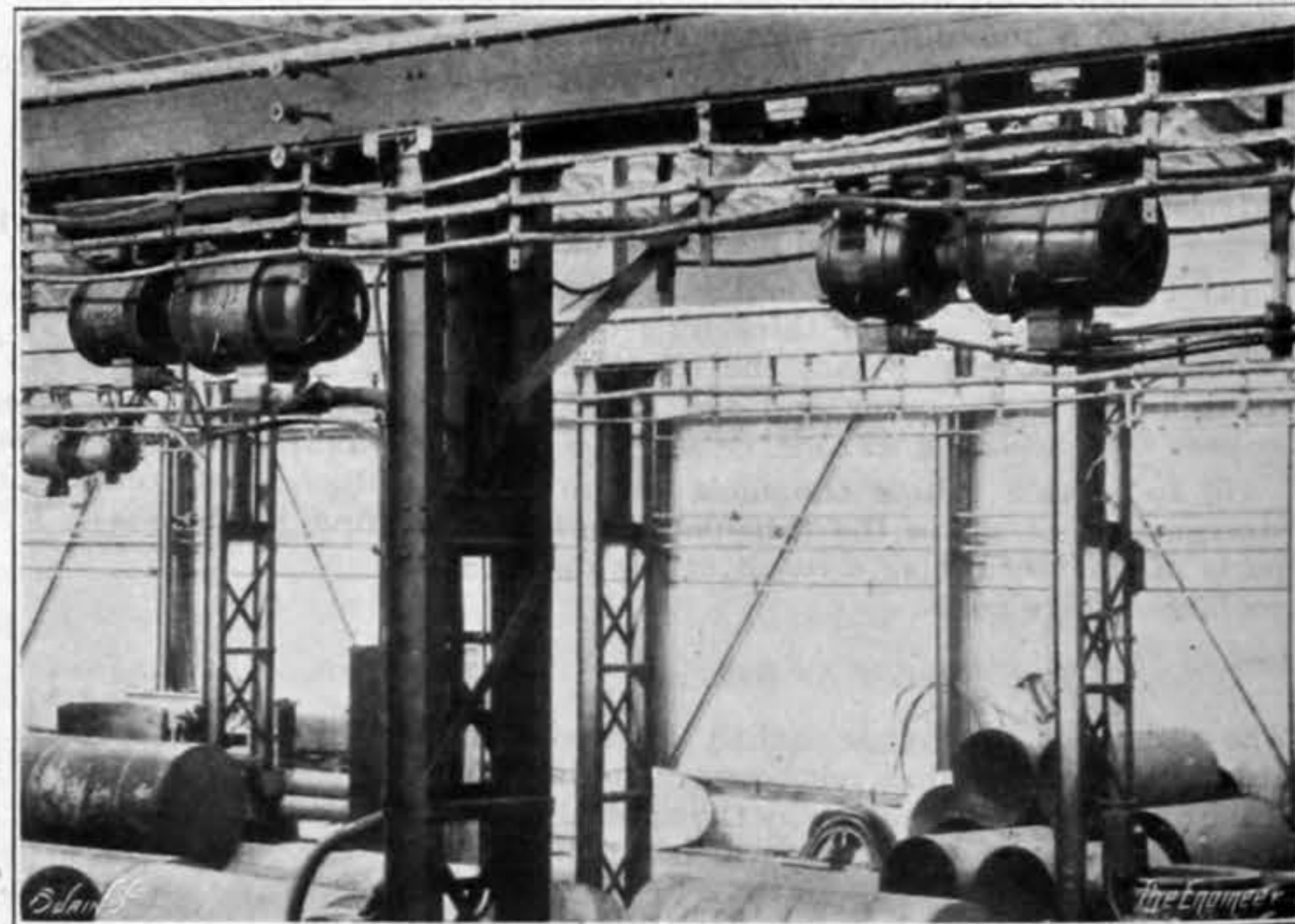


FIG. 3—SUSPENDED WELDING AND EXCITER SETS

rotary drier. The welding equipment is designed to deal with a wide range of manufactures, in which metal of all gauges up to about 2 in. is used. The

ammeter on the left is not only calibrated in amperes, but also in electrode numbers, so that the operator is able to adjust the excitation current and diverter

side and actuated by means of the hand wheel to be seen in the illustration. The current in the series turns of the generator field is also controlled by a

multiple-step diverter actuated by the hand wheel to be seen on the right of the cubicle. Perfect stability of the arc is ensured by the provision of a reactance in the arc circuit. This reactance, which is mounted inside the cubicle, is provided with a switch, by means of which half the total reactance can, if necessary, be cut out. The handle operating this

resistance in the shunt field of the exciter. In this simplified equipment, however, nothing has been sacrificed that affects the overall efficiency of the set. Recent observations in a works where a number of welding sets of different makes were in operation are said to have shown that two English Electric sets welding $\frac{1}{2}$ in. plate with No. 8 electrodes were taking

markedly soluble in solid copper. The wrought alloys of higher phosphorus content exhibit a small amount of age hardening after suitable heat treatment.

Dr. G. Masing said that he, together with the authors, had found that with a low content of phosphorus there was a great fall in density, but why that was so we did not know definitely. He had found the same in the case of bronze, and in that instance he was inclined to believe that the interaction between hydrogen, oxygen and phosphorus had a great influence. With regard to the conductivity of castings there was a great difference between deoxidising with phosphorus and with other substances, such as magnesium, calcium or beryllium. In the case of the latter substances the conductivity of castings coincided approximately with the conductivity of a round wire, but in the case of phosphorus there was a considerable difference, and he was inclined to think that it was due to the lower density of the castings when deoxidised with phosphorus.

Mr. T. R. Bolton, in a letter read by the Secretary, said that research into the effects upon copper of small quantities of other elements was considered by many concerned with the commercial side of the matter to be a most important piece of metallurgical work, because it was establishing as facts many things that hitherto had been beliefs, and a belief implied a doubt. If the present series of investigations was carried so far as to embrace the study of all common impurities in copper, alone and in combination, we should eventually be in a position to predict the behaviour of materials precisely by means of analyses and take whatever steps might be necessary by dilution or otherwise to avoid the possibility of failures.

Mr. N. F. Hubbard (Manchester), as one engaged in the manufacture, for the most part, of arsenical copper, said he was specially interested in the effect of phosphorus combined with oxygen. Phosphorus, of course, was used considerably as a deoxidiser both for non-arsenical copper and arsenical copper, and the paper gave a useful reminder that unless the oxidation was carried out very completely the result was rather worse than useless. The paper showed that the addition of .01 oxygen and .03 phosphorus gave very poor properties in the cold-worked condition, and that was another reminder that if copper was to be deoxidised the process must be carried out very thoroughly or left alone altogether. The paper indicated, moreover, that the addition of phosphorus in suitable quantities very greatly improved castings, a fact which he himself was not aware of previously.

Dr. W. Rosenhain, after expressing appreciation of the manner in which the Non-Ferrous Metals Research Association had supported the work for a long time at very considerable expense, said that although the paper constituted Part VI. of the investigation, Parts XII. and XIII. were now being dealt with, and he anticipated that the publication of the succeeding parts would not only be permitted, but facilitated. Speaking with regard to age hardening, he said that some years ago he had come across the same effect as that mentioned by the authors, but in the case of alloys of copper and iron, in which there was quite an appreciable difference of solid solubility and yet the ageing effect was very small. There was a marked increase in the Brinell number, but no corresponding increase in tensile strength, and Dr. Hanson and himself formed the idea at that time that it was because the substance deposited from solid solution in that case was an elementary substance and not a compound of iron and copper. In the case of copper, however, there was little doubt that the body which separated out was a compound, and that was a fact which theories of age-hardening would have to take into consideration. From that point of view it was interesting to notice how a research of that kind raised as a side issue a question which might ultimately become one of fundamental importance, and it was in that connection that the point raised by Dr. Masing as to the difference of conductivity between a wire and a casting assumed some importance not only in relation to copper, but a great many other alloys. The ageing phenomenon or the breaking down of the slightly super-saturated solid solution must be one of very wide occurrence. There were probably few alloys in which something of the kind did not occur to a greater or lesser extent, and there was probably no more sensitive test for occurrences of that kind than electrical conductivity.

Mr. H. C. Dews said he would like to know if the oxygen was truly in the copper or if it was just an accidental impurity and, furthermore, if the phosphorus had had sufficient time thoroughly to de-oxidise the copper could it be assumed that there was an equilibrium between the phosphorus and the oxygen. The solubility was decreased as the copper solution became saturated with copper phosphide or as the phosphorus was added to the solution, and that fact seemed to fall into line with the generally accepted principles of the laws of mass action of solutions and was worth consideration.

Mr. W. F. Brazener said that most people had the impression that it was necessary to have as much as .04 per cent. phosphorus in the copper to get complete deoxidisation, but it was possible under commercial conditions to get copper completely deoxidised with phosphorus as low as .001 per cent. It should be made clear that differences in the conditions under which the experiments were carried out would make

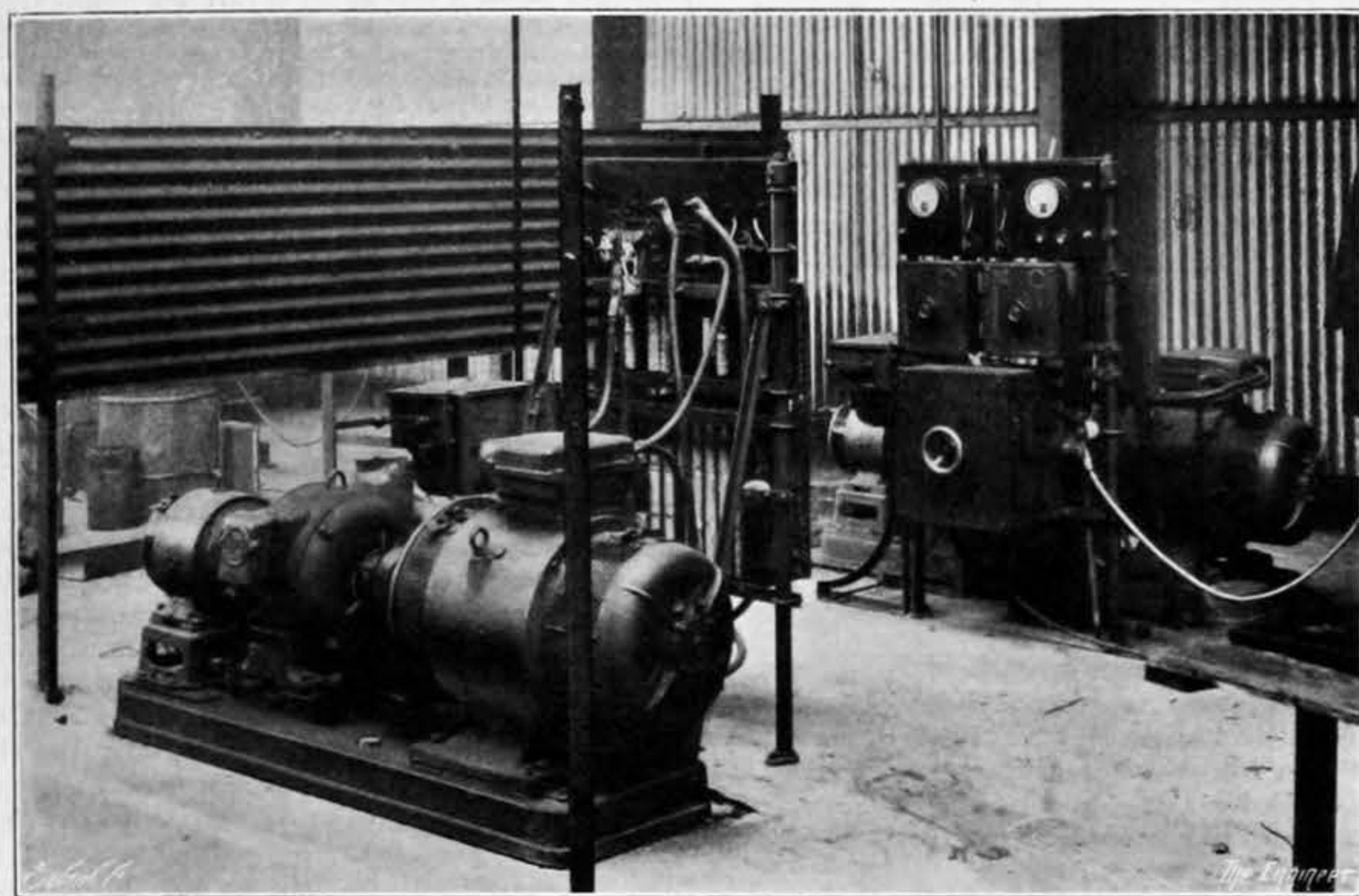


FIG. 6—SIMPLIFIED TYPE OF WELDING EQUIPMENT

switch is to be seen on the left-hand side of the cubicle. The flexible cables from the electrode holders and from the clips which are attached to the work to be welded are connected to the cubicles by means of interchangeable plugs. The importance of this interchangeability lies in the fact that certain electrodes work best when the negative side is earthed, whilst

128 ampères at 25 volts, whilst two other sets of another make doing exactly the same work were taking 200 ampères. If the cost of current be taken at 1d. per unit, the number of working hours 2500, and the load factor at 0.3, the saving resulting from the more economical plant is £7 per annum per set. On a test extending over 18½ days with this

Electrode No.	Alternating current.		Direct current.					Efficiency.
	Volts.	kW.	Generator, volts.	Generator, amps.	Diverter, amps.	Diverter, stop.	Output, kW.	
12 covered	400	3.45	35.3	70	46	11	2.47	71.7
12 covered	400	3.72	27.3	98	63	11	2.68	72
10 covered	404	3.04	36.6	55	28.5	8	2.01	66.2
8 covered	402	4.92	48	77	51	11	3.69	75
8 covered	403	5.6	41.5	103	67.5	11	4.27	76.3
6 covered	403	6.92	32.8	102	63	11	5.38	78.9
6 covered	403	7.68	46.5	129	80	10	6.0	78.2
4 covered	402	10.03	54.3	151	104	12	8.2	81.6
4 covered	400	10.85	48	178	124	12	8.55	78.8
8 bare	403	5.76	55.5	77	31	5	4.27	74.2
8 bare	400	6.4	48.5	100	41	5	4.85	75.8

NOTE.—In these tests the generators were loaded by resistance in order that stable readings could be obtained. In actual welding the voltage would be lower and the current higher in some cases.

other types are most satisfactory when the positive side is earthed. Thus the plugs are arranged so that the earth return cable is automatically connected to earth; that is to say, to the armouring on either the positive or negative side of the generator. To avoid unauthorised interference with the connections all the control cubicles are fitted with padlocks, and to render the cubicles safe for making adjustments or carrying out repairs to any of the apparatus, links are provided in the bus-bar chamber for the purpose of completely isolating the cubicle from the exciter and motor circuits. Tests taken on these sets prove, as the table above shows, that the average overall efficiency lies between 70 and 80 per cent., according to the class of work that is carried out. For ordinary coated electrodes it has been found that the current required is as follows:—

12 gauge	60 to 85 ampères
10 gauge	85 to 110 ampères
8 gauge	110 to 135 ampères
6 gauge	135 to 160 ampères
4 gauge	160 to 180 ampères

The plant described is of a type particularly designed for works requiring a large output of heavy welded articles, but there are many instances in which welded articles of only one class have to be dealt with or where the welding plant is required intermittently. In these cases the capital outlay for the plant and control gear has to be on a more modest scale, and to meet such requirements the English Electric Company has put on the market a more simple type of control gear, which, although cheaper, embodies all the essential features previously mentioned. Fig. 6 is an equipment of this kind. The generators are of the same type as those described, but the exciter is mounted on the same bed-plate as the generator and is directly coupled to it, instead of forming a separate unit. Whilst the same kinds of shunt field resistance, diverter and reactance are used, the whole gear is simplified by the employment of plain terminals instead of plugs for the flexible leads, the omission of the switch for cutting out half of the reactance and the absence of interlocks between the excitation circuit and the motor starter and of the variable

plant, consisting of thirteen sets in all, the following figures were obtained:—

Total kilowatt-hours	3976
Cost of power at .95d. per unit	£15 14s. 10d.
Total electrodes, all sizes	18,292
Electrodes used per unit	4.5
Cost of power per electrode	.21d.
Cost per 1000ft. of electrode	11s. 6d.
Electrodes per machine per day	76

The Institute of Metals.

No. III.*

THE President, Dr. R. Seligman, again presided at the two sessional meetings on Thursday, March 13th. The first paper read in the morning was by Professor D. Hanson, Mr. S. L. Archbutt and Miss Grace W. Ford, on "Investigation of the Effects of Impurities in Copper: Part VI., The Effect of Phosphorus in Copper."

THE EFFECT OF PHOSPHORUS IN COPPER.

The paper describes a systematic investigation into the properties of copper containing up to 1.48 per cent. of phosphorus, in which the amount of other impurities has been kept as small as practicable. Previous published work on the subject is summarised. A series of billets of eleven alloys containing from 0.014 to 0.95 per cent. phosphorus has been prepared and rolled. The investigation deals with method of preparation, macro and microstructure, hot and cold rolling behaviour, density, hardness, tensile tests at ordinary and elevated temperature, electrical conductivity, fatigue properties, impact strength, softening temperature of cold-worked material, determination of the solubility of phosphorus in solid copper, and age-hardening tests. The tests relate principally to rolled material.

Phosphorus removes oxygen from copper and improves its casting properties. Small amounts of oxygen can be found together with phosphorus in copper, depending on the amount of phosphorus present. Removal of oxygen by phosphorus improves the cold-working qualities of copper. Copper containing up to 0.95-1.2 per cent. phosphorus can be hot rolled, and up to 0.79-0.95 per cent. cold rolled from cast billets. Phosphorus improves all those mechanical properties of copper which have been studied, and raises the softening temperature of cold-worked material. It is seriously detrimental to electrical conductivity, which may be attributed to the fact that it is

* No. II. appeared March 21st.

a difference as to the percentage of phosphorus required for complete deoxidisation. In presenting the paper Mr. Archbutt had made certain comparisons between the mechanical properties of copper deoxidised with phosphorus and the mechanical properties of ordinary arsenical copper, but it must be remembered that it was not purely a question of mechanical properties which counted with the engineer. There were also certain machining properties which were of vital importance.

Professor T. Turner said that, not only was the question of the machining properties important, but there was also the question of corrodibility to be considered. It was known that a phosphoric copper exposed to the air rapidly deteriorated, and if copper phosphide was present as a separate constituent the possibility of greater corrosion might be assumed.

Dr. F. Johnson expressed the view that the authors should have been more guarded in their statement about hot rolling of copper alloys because it was only pure copper that could be hot rolled. Even a trace of phosphorus would make the material fatally tough. Another point was that phosphorus could be used as an aid in poling copper. By a judicious blending of poling and phosphorus it was possible to get a much greater elimination of oxygen with a smaller amount of dissolved gases. That had been practised for many years, and he himself resorted to it over twenty years ago. It was quite beneficial, but it must be done skilfully.

Professor D. Hanson, replying to some of the points raised in the discussion, said that the work described in the paper was carried out four years ago, at a time when metallurgists did not know so much about the causes of unsoundness in copper and did not realise that the phosphorus-oxygen relationship might be important, and therefore he could not assert with any degree of confidence that equilibrium between the phosphorus and oxygen had been reached in that case. It might be so, but the authors did not know that, and would not like to suggest it. What they did know, however, was that both oxygen and phosphorus could remain together in the copper for some considerable time after the de-oxidiser had been put into the copper, and that seemed to them at the time to be important. It must be realised that substances which could react with oxygen in copper might be subject to the laws of mass action, and that should be of great importance, particularly in relation to the soundness of the final casting. The point raised by Dr. Johnson, although very pertinent to the general question of copper castings, did not strictly arise in connection with that research. The authors realised that the influence of one impurity on another could be very profound indeed, and further examination of the relation between phosphorus, oxygen, and copper would no doubt give some valuable information. It might be found that some of the conclusions stated with regard to oxygen alone did not apply when there was phosphorus present.

Mr. Archbutt, replying to the point raised by Dr. Masing as to the fall in density, said that very small quantities of oxygen in copper could be quite detrimental, and unless the oxygen was completely removed, unsoundness was to be expected under certain conditions. One great difficulty in preparing these alloys was that the copper was taking up oxygen all the time. In some of the work that had been carried out, a stream of nitrogen had been directed on to the metal, and it was possible to get oxygen-free copper from the furnace, but the moment pouring began the metal was apt to take up oxygen. Mr. Dews was probably correct in assuming that there was equilibrium between the oxygen and the phosphorus. He would like to see the conditions under which Mr. Brazener prepared the copper he had referred to with no oxygen at all and very little phosphorus. With regard to the corrosion mentioned by Professor Turner, had he definite information that phosphoric copper was seriously corrodible?

Professor Turner said he had specimens of phosphoric copper kept in a damp atmosphere which had very rapidly oxidised on the surface, but the curious thing was that all specimens did not act in the same manner. Whether that was due to physical structure or different varieties of phosphorus and copper, he did not know. Some specimens he had kept for years without oxidation, but others had oxidised quickly, the content of phosphorus being 15 per cent.

Mr. Archbutt said that was a very important point, and must be borne in mind.

The next paper was one on "The Aluminium Brasses," by Mr. R. Genders.

THE ALUMINIUM BRASSES.

The work described comprises a study of the properties of the ductile aluminium-zinc-copper alloys. It is shown that, over certain ranges of composition, the presence of aluminium in brass has a beneficial influence in several directions, especially as regards resistance to corrosion and to oxidation at high temperatures. The composition of the alloys can be adjusted to give a wide range of mechanical properties.

Dr. H. W. Brownson said that the paper demonstrated the need for more work to be done on the aluminium brasses. The work done in the past upon the effect of added elements to the brasses had been of a somewhat scrappy nature, although valuable, but it was difficult for the manufacturer or user just to put his finger on what he wanted, and he found the matter rather involved. In the 60/40 brasses the work of Ellis in America was the best that had been

done in the attempts to show the effect of certain added elements such as aluminium, nickel, tin, and iron on the 60/40 high-tensile brasses, but something more systematic was necessary in regard to the ductile brasses. It would be an excellent thing, therefore, if the Non-ferrous Metals Research Association still had funds at its disposal to enable the National Physical Laboratory to work along those lines. The work done recently in Germany on that question unfortunately was rather disappointing. The alloys that had been taken were rather complex, and it was difficult to obtain from that work the results that one was looking for. The author had committed certain sins, chiefly of omission, in his paper. He dealt with the effect of cold work, but did not refer to the effect of increased annealing temperatures. Another characteristic not referred to was the rapid grain growth in aluminium brasses at somewhat elevated temperatures, such as 650 deg. or 700 deg. At such temperatures the grain growth was much more rapid than in the case of pure brass. He was specially interested in the behaviour of those materials in manufacturing operations, and he would like to know if they had found an application from the point of view of increased strength, as compared with ordinary straight brass or whether the application of these aluminium brasses was limited to their corrosion-resisting properties.

Dr. W. Rosenhain said he was specially interested in the paper, because when he first went to the National Physical Laboratory in 1906 or 1907 the atmosphere was full of aluminium bronze. At that time he was following the question of the corrosion resistance of those materials, and their use for corrosion-resisting tubes, particularly in condensers. At his suggestion some straight copper-aluminium tubes were made, but unfortunately they gave very bad results under trial, and were a great disappointment to him. At that time he also had the idea of trying aluminium brass, but was unable to persuade any manufacturer to make it. The author was more fortunately placed, and possibly the use of straight copper-aluminium alloys might now be considered in that connection. If 3 per cent. aluminium was sufficient to secure the properties in the brass mentioned in the paper, it might be that the necessary strength and possibly better corrosion resistance could be obtained without the zinc at all. Another point in connection with aluminium bronze was soldering, and he had some bitter recollections of attempting to solder the material. It was all right the first time, but anybody who tried to do it a second time he was sorry for. He would like to know if similar difficulties had arisen in connection with aluminium brasses.

Mr. N. F. Hubbard (Broughton Copper Company, Ltd.), said the paper was a shining example of the research man showing the manufacturer the way. There was a great deal of prejudice against aluminium in brasses up to perhaps twenty years ago or even later, and the trouble was that a failure with one class of material containing aluminium usually condemned it for a long time. People who had money at stake became nervous, and he believed it was due to that sort of thing that further progress with that material had not been made until the matter had been taken up in a scientific way in recent years. With better methods of casting aluminium copper, he believed it was possible to get better corrosion-resistance results.

Dr. R. S. Hutton said he did not think the author had yet received the recognition which the great value of his work entitled him to. It was perfectly true, as pointed out in the paper, that it was very difficult to get good aluminium brasses. The work done by the leading firms in Germany gave extraordinarily inconsistent and unsatisfactory results, and in none of the previous work carried out had so much valuable information been given as by the author of the present paper. The whole question of the film of aluminium oxide gave one much to think about.

The President said the paper dealt with work which manufacturers were doing nearly thirty years ago, but which they abandoned because they did not know how to get on with it. He was pleased that Dr. Rosenhain had raised the question of soldering these metals, because that emphasised the curious surface conditions of alloys containing even small quantities of aluminium. The whole question of the film of aluminium and aluminium alloys required further investigation.

Mr. Genders, replying to the discussion, said he had not dealt in the paper with the annealing of aluminium brasses after cold working; but, in general, it could be taken that if an aluminium brass had the same constituents as ordinary commercial ductile brass, the behaviour would be about the same. With 76 per cent. copper and 2 per cent. aluminium, the behaviour would be roughly the same as that of ordinary 70/30 brass. There were certainly differences in the grain growth, but they had not been investigated. Aluminium brass had already been adopted for some purposes because it was stronger than ordinary brass, and a material was now being used containing 1.5 per cent. of aluminium with 68 per cent. copper in the form of rolled sheet for articles that were acetylene welded. As to aluminium bronze referred to by Dr. Rosenhain, that was a dearer alloy than aluminium brass, and if aluminium brass was successful for condenser tubes, it was hardly likely that aluminium bronze would take its place.

There was no great difficulty in soldering aluminium brass containing 2 per cent. of aluminium provided a special type of flux was used.

The final paper on Thursday morning was on "The Diffusion of Zinc in Copper Crystals," by Miss C. F. Elam.

THE DIFFUSION OF ZINC IN COPPER CRYSTALS.

Some experiments are described which were made with the object of seeing if zinc would diffuse into copper crystals. This only took place to a limited extent at high temperatures. The method was further extended to brass crystals of different composition, and it was found that if a β brass crystal was heated in zinc vapour a layer of γ was deposited which was also a crystal. The relationship between the two crystals was found to be sometimes parallel growth and sometimes a twin. The diffusion of zinc out of a brass crystal was also studied.

Professor C. H. Desch said it appeared from the work done by several other workers that, in a closely packed lattice, diffusion did not occur in a single crystal until some disturbance had been set up by cold working or the loosening of the texture by mechanical injury, by chemical action locally, and so on. Those results had now been confirmed by the X-ray method, which had not been used before. He was surprised by the statement in the paper that no diffusion was found along the crystal boundaries in the case of a specimen consisting of more than one crystal. In experiments he had carried out with polycrystalline copper he had always found, even at low temperatures, very narrow bands of α constituent running along the crystal boundaries. One would expect that disturbance of the lattice in the neighbourhood of the boundary would allow diffusion, and if it did not occur it was difficult to see how diffusion could occur in polycrystalline material. The entering material had to get through somehow, and it was usually supposed that entrance took place in the first instance along the crystal boundaries with progressive loosening of the lattice.

Colonel N. T. Belaiew remarked that if, as the author suggested, there was no penetration along the boundaries and that it was only at certain temperatures that penetration of those atoms could be detected in the lattice the change that occurred must be a change inside the crystal grains. That might be an interesting line of experiment.

Dr. W. Rosenhain said he would call the results of the author's experiments surprising in some ways rather than disappointing. It almost looked as if the crystal boundaries in the samples which were formed in the hope that they would be single crystals were not quite the same as the crystal boundaries in the ordinary polycrystalline material. Those were cast crystals and provided an extreme case of the state of a metal which was produced by solidification from diffusion, which differed in other ways from crystals found in wrought material. For instance, there was no grain growth in a polycrystalline casting unless the metal underwent allotropic transformation, and that suggested the possibility that in the material in the cast condition there were certain inhibitions towards atomic rearrangement. If the experiments could be repeated with single crystals produced by annealing after cold work, somewhat different results might be obtained. It would be interesting to know the surface conditions of the crystals experimented with by the author when they were exposed to zinc vapour; was the surface in a condition to any degree of mechanical disturbance? If the surface had been slightly disturbed by rubbing or polishing, quite a different result might have been obtained, because there was a distinction between diffusion in a single crystal and diffusion into a single crystal. Within a single crystal there was definite diffusion. Dr. Desch's remark that it was only in the case of an open lattice that diffusion took place opened up considerable controversy. He personally suggested that it was essentially a plastic lattice in which diffusion occurred, except, perhaps, in the case of the tunnel structure such as in quartz.

Miss Elam, replying to the discussion said that the experiments had been carried out at comparatively low temperatures, below 500 deg. Cent., and possibly at higher temperatures there was diffusion along the crystal boundaries. In reply to Dr. Rosenhain, she said the surfaces had been etched, but they were not rubbed, because there would then immediately be diffusion and crystallisation, and the specimen would be useless for the purpose for which it was intended.

(To be continued.)

THE ROYAL METAL TRADES' PENSION AND BENEVOLENT SOCIETY.—The Fourth Annual Golf Competition for the President's Silver Challenge Cup will be held on Wednesday, May 21st, at Fulwell Golf Club, Fulwell, Middlesex. Subscribers and donors to the Society are eligible to compete. Those desirous of entering should send their names to the secretary, R.M.T.P. and B.S., 195, Upper Thames-street, London, E.C. 4, by Friday, May 9th. The entrance fee is 10s., which includes green fee. Luncheon and tea can be obtained at the Club House.

WHITWORTH SOCIETY.—The seventh Annual Commemorative Dinner of the Whitworth Society was held on Tuesday, March 18th, 1930, with the President, Mr. W. H. Fowler (Manchester) in the chair, and 60 Whitworths were present. The president presented a copy of "The Whitworth Book" to each of the Whitworth scholars of 1929. Sir Henry Fowler, C.B.E., chief mechanical engineer, L.M. and S. Railway, has accepted nomination as next president, and has invited the Society to visit Crewe next July. The Committee decided to make another donation to a technical college in the present year. Full details can be obtained from the hon. secretary, Whitworth Society, c/o Institution of Mechanical Engineers, Storey's-gate, S.W. 1.

The 50,000-Ton North German Lloyd Liner "Europa."

ON Tuesday, March 25th, the new North German Lloyd liner "Europa," on her maiden voyage from Bremerhaven to New York, set up a new record for the Atlantic crossing, by making the voyage between Cherbourg and the Ambrose Channel Light Vessel at the entrance to New York Harbour in 4 days 17 hours and 6 minutes, with an average speed of 27.91 knots. The time recorded was 38 minutes less than that of her sister ship the "Bremen," on her maiden voyage in July last, and 18 minutes less than the time made by the "Bremen" on her fastest run on the shorter route.

The excellent performance of the "Europa" is the more noteworthy on account of the generally adverse weather conditions in the Atlantic at this early part of the year. The log entries of the "Europa" record strong and even extremely strong head winds and heavy swells, and it is understood that some fog was encountered towards the end of the voyage. The best day's run was on the fourth day at sea, on Monday, March 24th, when 704 miles were covered at an average speed of 28.16 knots. As recorded in our last issue we were, by the courtesy of the North German Lloyd Company and its London agents, Moxon, Salt and Co., Ltd., enabled to make a short inspection of the ship off Cowes on Thursday of last week, March 20th. In what follows some general impressions and particulars are given, but as yet no official information is available with regard to the propelling machinery.

GENERAL HULL DESIGN.

The order for the "Europa" was placed with Blohm and Voss, of Hamburg, in December, 1926, the keel was laid on July 23rd of the following year, and the launch took place on August 25th, 1928. Unfortunately, the completion of the ship was somewhat delayed by a fire which occurred during the time the ship was being fitted out. In the two weeks preceding March 17th, the "Europa" ran successful trials in the North Sea. The "Europa" differs slightly from her sister ship the "Bremen," which was built at the Weser yard of the "Deschimag," at Bremen, in the matter of some hull details and internal decorations of the public rooms and cabins. The following are the principal particulars of the ship and her passenger accommodation:—

Hull Particulars.

Approximate length	936ft.
Approximate breadth	101ft. 8in.
Approximate depth to upper promenade deck	89ft. 2in.
Gross tonnage, about	50,000
Contract speed	25 to 26 knots

Passenger Accommodation.

First-class passengers	800
Second-class passengers	500
Tourist third-class passengers	300
Third-class passengers	600
Officers and crew, about	975

Propelling Machinery.

Type	Quadruple-screw, single-reduction geared turbines; oil-fired water-tube boilers; Diesel auxiliary generators, and emergency Diesel-driven dynamos
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The upper view reproduced on page 352 shows the general appearance of the ship, which, with her high superstructure, widely spaced funnels, and her two 236ft. masts, is of a distinctly impressive character. Owing to her more bulbous stem, a view of which is given herewith, she appears, if anything, to be slightly more compact than her sister the "Bremen." Another interesting departure in design concerns the two funnels, which are oval, instead of being streamlined. Their axial dimensions are 59ft. by 29ft., and the view of the ship taken from the air, which we reproduce on page 352, indicates the divided boiler uptakes, in addition to which there are separate exhaust pipes for the Diesel engines. The plating of the hull appears to follow normal practice, and we are given to understand that in the parts of the hull which are particularly subjected to stress, plates of a special steel have been employed.

There is a double bottom running fore and aft for the full length of the hull and the ship is divided into fifteen water-tight compartments by means of fourteen bulkheads. Flooding calculations are based on the assumption that the ship should be able to remain safely afloat if any two amidships compartments should be simultaneously flooded, while if three adjacent compartments at the stern or four at the bow of the vessel should be simultaneously flooded then the ship would still remain afloat. Apart from these precautions in the subdivision of the ship, the question of the lifeboats has received very special attention, and it formed the subject of a paper read by Direktor Dip. Ing. P. Biedermann before the Schiffbautechnischen Gesellschaft at its annual meetings in Berlin in the autumn of 1928. There are twenty-two large lifeboats, each of which has a length of 37ft. 8in., a beam of 13ft. 5in., and a depth of 5ft. 7in. All the large boats are propelled by internal combustion engines, which are so arranged

and encased that they will continue to operate even though the boat may be filled with water. In addition, there are four smaller motor boats, which have wireless equipment, and two small boats propelled by oars. All the boats are carried on specially designed Welin-McLachlan davits, and automatic boat-lowering gears are provided. This equipment was supplied by the Deutscher Welin Gesellschaft, of Hamburg.

Other safety equipment includes a series of fire pumps with a total designed output of nearly 46,000 cubic feet of water per hour, also large fire foam and carbon dioxide fire extinguishing plants.

The navigational equipment comprises the latest directional wireless equipment, submarine signalling gear, alarm signals, and other modern devices for safe navigation. The main navigation bridge, the navigating house and also the wireless rooms are situated on the upper sun deck and are shown in our lower illustration on page 352, which also indicates the well-rounded superstructure at the fore part of the vessel. In order to assist navigation the ship has a further bridge amidships and one aft. In the bow view of the vessel below two anchors will be noted; they each weigh close upon 1½ tons and they have a length of about 18ft. with a width of 17ft. A spare anchor is also carried. An interesting innovation on the two new North German Lloyd liners is the illuminated name of the vessel, which is lighted by some 1200 electric lamps and is arranged on the port and the starboard sides of the ship, above the large windows of the sun deck restaurant. The lettering is plainly visible in the two views we reproduce on



A BOW VIEW OF THE "EUROPA"

page 352, and the arrangement is such that even in darkness the name can be read at a considerable distance from the ship.

PASSENGER ACCOMMODATION.

The decoration of the whole of the first-class accommodation was entrusted to one architect, Professor Paul Ludwig Troost, of Munich, who enlisted the services of a number of German artists. The scheme has been carried through with a pleasing uniformity of style which is characterised by a distinctive modern note. In the tourist and third-class section of the ship similar work has been undertaken by two Hamburg architects, Herr Klaus Hoffman and Herr Fridolin Mezger. Outstanding features of the first-class public rooms are the large entrance hall and the dining saloon, which accommodates 620 passengers at small tables and includes two separate dining rooms for private parties. The public rooms extend over a length of 525ft. and the large lounge has a length of 134ft., while other rooms include an art saloon, a library and writing room, and a special ballroom. Between the boiler rooms in the lower part of the ship there is a well-designed swimming pond, with a length of 36ft. and a width of about 20ft. A feature of the first-class accommodation is the closed-in promenade deck, which is very wide and has a total walking circuit of about 1175ft. At the fore part of the ship the smoking room and the winter garden are reached from this deck. On the upper sun deck there is a special restaurant for first-class passengers who desire to dispense with the ordinary catering and order their own meals à la carte.

Both the tourist third and the third-class accommodation is noteworthy on account of the uniform excellence of the public rooms, cabins, and kitchen equipment.

PROPELLING MACHINERY AND BOILERS.

The propelling machinery comprises four sets of single-reduction geared turbines of the reaction type,

operating on four screws, which are accommodated in two separate engine-rooms with a water-tight bulkhead between them. Aft of the main engine-rooms there is a large auxiliary engine-room in which the Diesel electric generator sets and the distribution switchboards are placed. As may be noted from the distance between the two funnels, the boiler plant has been split up into two main groups, placed at some distance apart. The arrangement is one which possesses, among others, the advantage that in the case of a severe collision one of the groups of boilers would probably remain intact, and would allow the ship to proceed under her own steam. The boilers are large oil-fired units, of the water-tube type, and it is of interest to learn that in order to condense the steam from the main turbines, some 32,000 tons of water per hour is circulated through the condensers. In addition to the large auxiliary oil engine driven generator sets, there are also two generators driven by airless injection engines, which are placed on one of the upper decks, and are available for emergency use. A very complete system of ventilation of the Thermotank type is fitted throughout the ship.

The very successful performance of the "Europa" reflects great credit upon her builders and designers, Blohm and Voss, of Hamburg, and on the technical and engineering departments of the North German Lloyd, and this credit is shared to some small extent by those British firms who supplied auxiliaries and fittings. There is no doubt that the "Europa," like the "Bremen" and the re-engined "Columbus," will form an important link between Europe and America. At the Columbus Quay at Bremen the German American Petroleum Company, Ltd., has put down a very large oil bunkering installation for the fuelling of these liners, which is reported to be one of the largest of its kind in Europe. With the new equipment it has been found possible to place on board some 5000 tons of oil fuel with the necessary lubricating oil within the short space of seven hours.

At the same time as we received the news of the safe arrival of the "Europa" in New York, the confirmation of the report regarding the fusion of interests between the North German Lloyd and the Hamburg-Amerika Company was announced. It has now been agreed by these two leading German shipping companies to renounce all priority and to work together in unison. The identities of the two companies will remain as before, as will also their respective headquarters at Bremen and Hamburg, but there will be a common board of directors, and the services and ships will be operated under joint control for a common account. The combination of these two companies, each of which has within ten years built up its own fleet from a few insignificant ships to over a million gross tons, which will include such fine liners as the three North German Lloyd fast ships just referred to and the four re-engined Hamburg-Amerika liners of the "Albert Ballin" class, marks an event of outstanding importance in the history of European shipping.

B.E.S.A. SPECIFICATIONS.

VANDYKE BROWN FOR PAINTS.

A REVISED edition of B.S. Specification No. 319-1928, Vandyke Brown for Paints, has just been issued by the British Engineering Standards Association. After two years' experience in the use of this specification it was found that certain clauses needed modification in some small particulars, notably those clauses dealing with ash and volatile matter. The form of the specification follows that adopted in the previous issue, clauses regulating the composition, together with standard reception tests for the purchase of the material being included, also appendices dealing with the standard methods for carrying out the tests. Copies of this Specification may be obtained from the British Engineering Standards Association, Publications Department, 28, Victoria-street, London, S.W. 1, price 2s. 2d. post free.

BOOKS RECEIVED.

Bearing Metals and Bearings. By W. M. Corse. New York: The Chemical Catalog Company, Inc., 419, Fourth-avenue at Twenty-ninth street, U.S.A. Price 7 dollars net.

Official Year-book of the Scientific and Learned Societies of Great Britain and Ireland, 1929. London: Charles Griffin and Co., Ltd., 42, Drury-lane, W.C. 2. Price 18s. net.

Sind and the Lloyd Barrage. Second edition, as revised up to December 31st, 1929. Bombay: The Office of the Director of Information. For official use and free distribution.

The Use of Chains and other Gear for Hauling and Lifting. Mines Department Safety Pamphlet No. 6. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 6d. net.

Bauxite: Float-and-sink Fractionations and Floatation Experiments. Bulletin 312. By B. W. Gandrud and F. D. De Vaney. Washington: United States Government Printing Office, Superintendent of Documents. Price 25 cents.

Gold Coast Survey Department Records: Volume I. Report on Three Chains of Triangulation Surveyed in the Southern Part of the Colony during the Years 1924, 1925 and 1926. By Capt. J. Calder Wood, M.C. London: The Crown Agents for the Colonies, 4, Millbank, S.W. 1. Price 12s. 6d. net.

ARTICULATED STEAM RAIL COACH FOR EGYPT

THE BIRMINGHAM RAILWAY CARRIAGE AND WAGON COMPANY, LTD., SMETHWICK, ENGINEERS

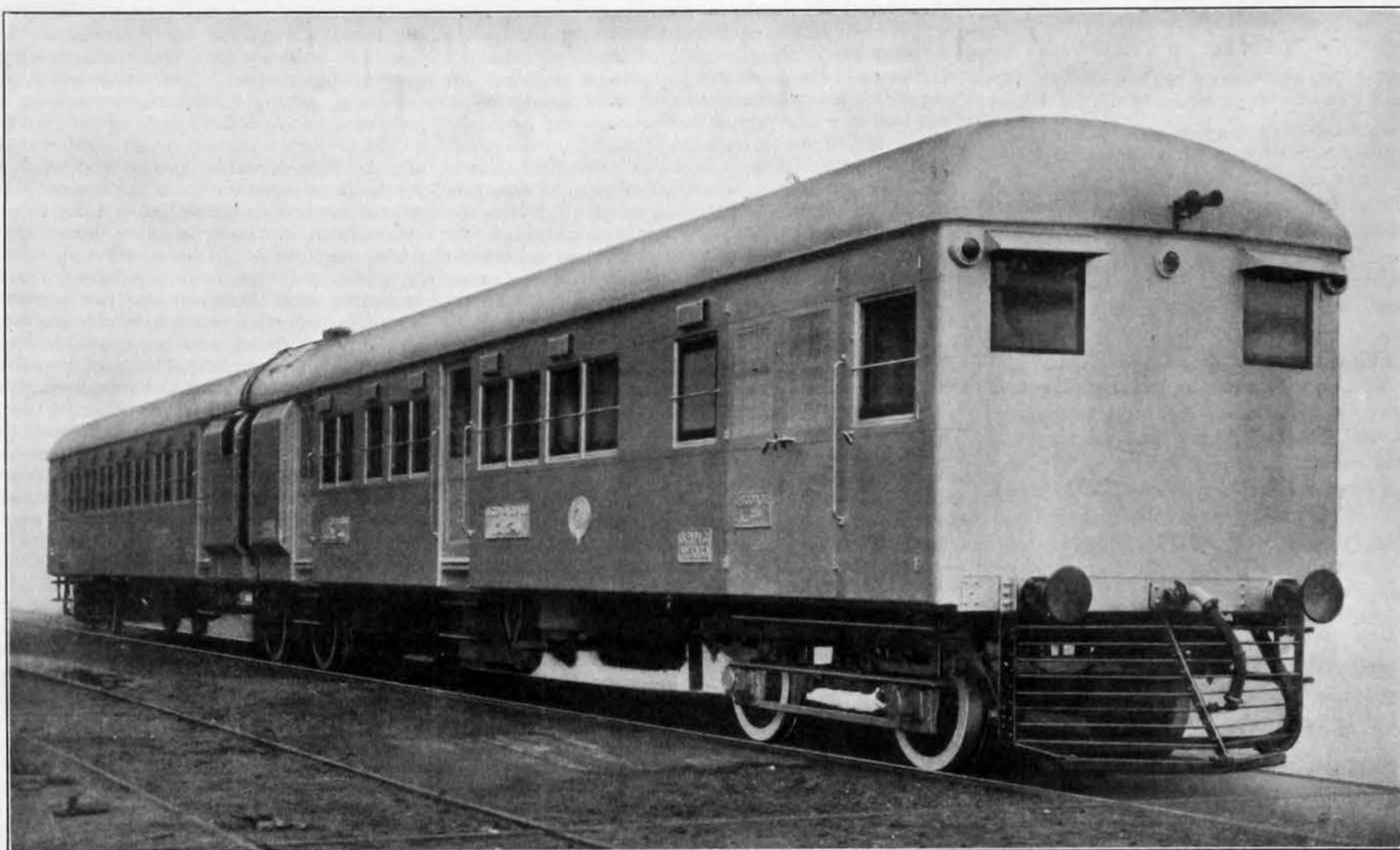


FIG. 1—GENERAL VIEW OF COACH

Articulated Steam Rail Coach for Egypt.

THE engravings which we reproduce herewith represent one of a batch of articulated steam-driven rail coaches, made by the Birmingham Railway Carriage and Wagon Company, Ltd., of Smethwick, for the Egyptian State Railways. They are divided into two types, one having accommodation for second and third-class passengers with baggage—117 passengers all told—while the other has accommodation for first, second, and third-class passengers. There are also included in the order two single coaches for the conveyance of mails, perishable goods and animals. They are to run on the standard 4ft. 8½in. gauge.

As will be seen from the general view of the coach, the

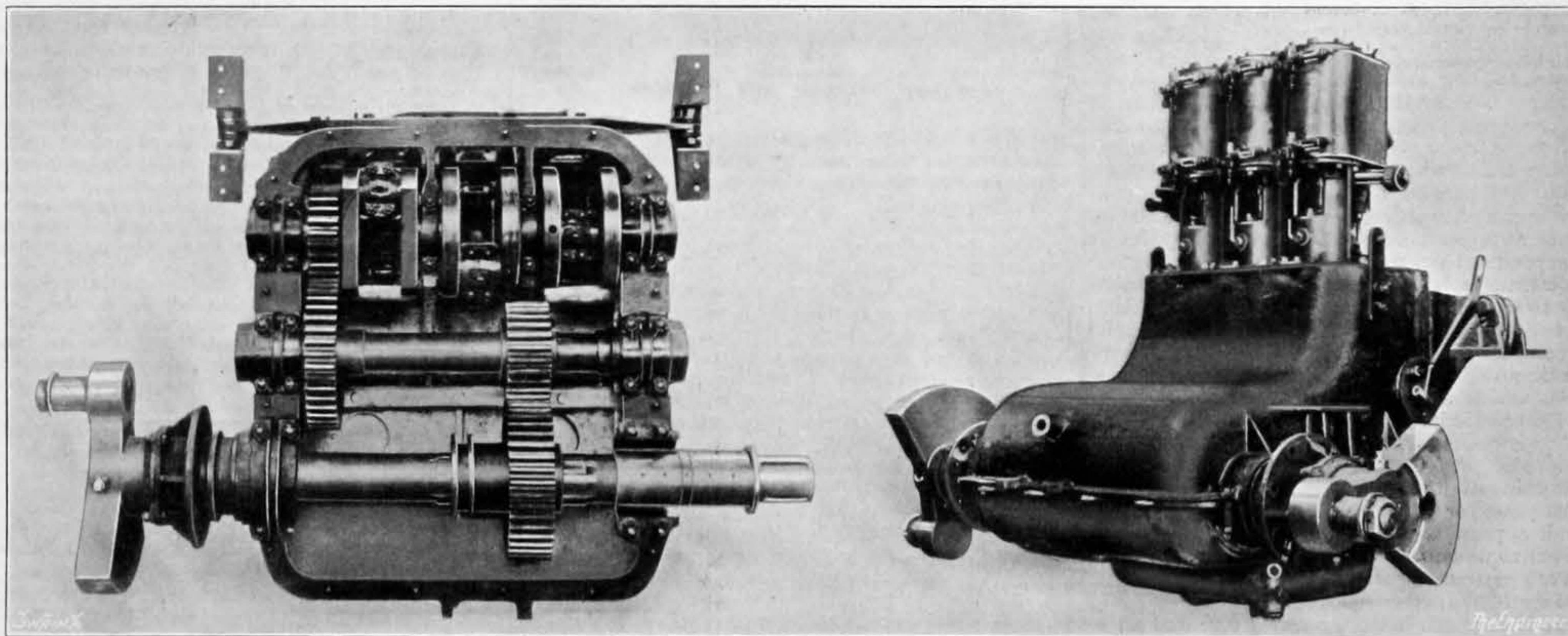
the drive is transmitted to a jack shaft by spur gearing, and the whole arrangement is totally enclosed. There is, however, a large inspection door on the crank case, and the aluminium sump can be lowered to expose the main and big-end bearings and the gearing. On the ends of the jack shaft there are balanced cranks, which transmit the drive to all four wheels of the power bogie by side shafts.

The boiler is of the "Yorkshire double loco." type, which has been developed for service on steam wagons. It has a central fire-box and two nests of horizontal fire tubes, one on either side, with a central uptake. The tubes are, consequently, easily accessible for cleaning or renewal, through the two smoke-boxes, while the fire is visible through the fire-door and can be trimmed to burn most economically. Superheaters are fitted in both smoke-boxes and act as spark arresters. The boiler has 134 square feet

"Gresley" type, and form in one casting the complete headstock of the coach.

By the removal of the bolts attaching these headstocks to the underframe, the whole power unit can be drawn away from the bodies, the removable underframe headstocks remaining on the bogie.

The axle-boxes are of cast steel, fitted with renewable bronze bearings lined with white metal and arranged for mechanical lubrication on the "Wakefield" principle. Pad lubrication is also provided. The bottoms are provided with eyes from which the laminated bearing springs are pivotally supported. Large wearing surfaces are provided to take the thrust on to renewable cast steel liners attached to the cast steel horn blocks, and the rubbing surfaces are mechanically lubricated by the same means as adopted for the axle-boxes. The wheels have cast steel



FIGS. 2 AND 3—GEARING AND ENGINE OF STEAM COACH

centre bogie carries the machinery, while the other two are merely trailers. All three are, however, fitted with brakes.

The power bogie is naturally the most interesting part of the vehicle, and we give a separate view of it, apart from the coachwork. It is equipped with an engine that will develop 150 horse-power, of which we also give an illustration. It is of the "Yorkshire" vertical three-cylinder double-acting type. The cylinders are 5in. in bore by 8in. stroke, and are fitted with Joy valve gear, with piston valves. The cylinders are lubricated by a Detroit displacement lubricator, with an auxiliary supply to keep the engine well oiled when it is coasting. The crank case is a steel casting, and is supported at either end from the framing by rubber links to prevent distortion. The crank shaft is lubricated by a reciprocating pump, which minimises the emulsification of the oil. From the crank shaft

of heating surface, and a grate area of 6.68 square feet. It works at a pressure of 275 lb. per square inch and delivers steam to the engine at a temperature of from 600 deg. to 650 deg. Fah.

The power bogie on which the machinery is assembled can be readily detached from the coachwork, and replaced by a spare unit, so that in the event of an extensive overhaul being required, the earning capacity of the coach is not lost. It is constructed of solebars of steel plate, reinforced, and the main cross bar and headstocks are reinforced steel castings. The bolster is formed of rolled steel joists, and is arranged between channel steel cross-bars attached to the top of the solebars. Provision is made at each end of the bolster to accommodate the spring cups for the body suspension, and at the centres a pivot casting is fitted which carries the centre bearing of the two articulated headstocks. The headstocks are of the

centres. They are balanced and are fitted with rolled steel tires secured by retaining rings.

Brake blocks operating on one side of each wheel are fitted, and sand-boxes are provided at each wheel with foot-pedal operating device from the central cab.

In the engine cab there are bunkers on either side for coal and water tanks. Their capacity is 1 ton of coal and 460 gallons of water. The connection between the roofs of the two halves of the coach is effected at the centre by means of a concertina, and at the sides there are collapsible gates. Round the boiler partition there are doors, so that the boiler is readily accessible.

The coach is provided with a driver's cab at either end, one of which we illustrate. In both of these cabs there are arranged the following controls:—(1) Throttle; (2) reverse; (3) vacuum brake ejector; (4) hand brake; (5) brake valve, emergency; (6) brake valve, equaliser;

ARTICULATED STEAM RAIL COACH

THE BIRMINGHAM RAILWAY CARRIAGE AND WAGON COMPANY, LTD., SMETHWICK

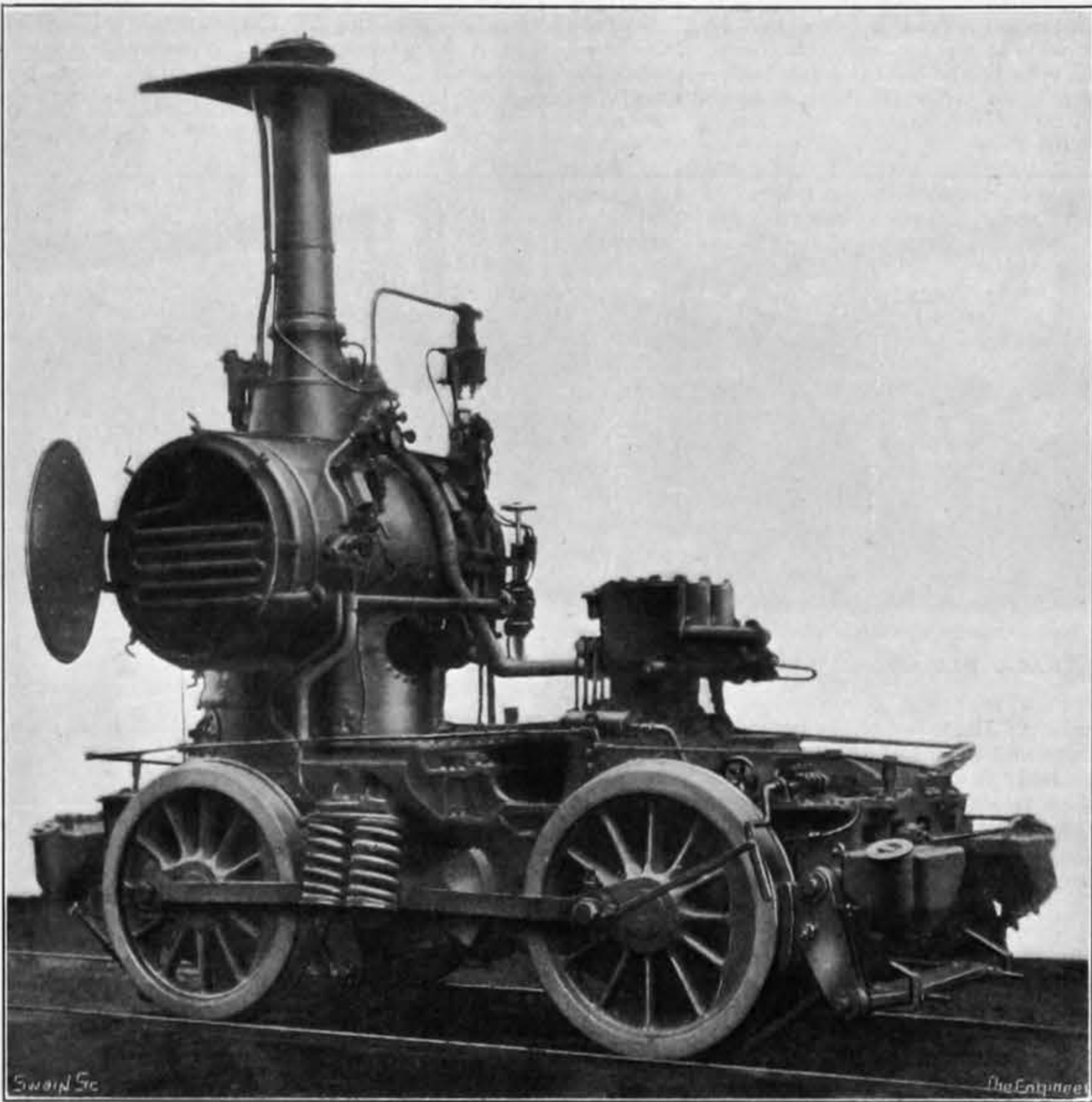


FIG. 4—BOILER AND ENGINE ON DRIVING BOGIE

(7) steam whistle control ; (8) Klaxon horn push button ; (9) duplex vacuum gauge ; (10) steam gauge. A speaking tube is installed in each cab, making connection with the central engine cab and, in addition, a signal bell is fitted, operated by a push button. The coach is controlled from either end. A group of levers controlling the throttle valve, vacuum brake, and valve quadrant, are situated on the right-hand side of the driver's compartment to the right of the driver's seat. The car is driven generally on the valve quadrant, and cut-offs ranging from 10 to 80 per cent. are obtainable. The main stop valve is operated from the engine compartment only, and, when closed, puts out of action the throttle valve under the control of the driver. The valve quadrant can also be operated from the engine compartment.

The structure of the coach is of mild steel throughout,

The leading dimensions and weights of the vehicle may be summarised as follows :—

Leading Dimensions.	
Length over cowcatchers	101ft. 7in.
Length of headstocks	98ft. 4in.
Width over side sheets—	
Main body	9ft. 4in.
Engine cab	10ft. 2½in.
Height, rail to top of roof	13ft.
Centre of bogies	41ft. 10in.
Engine bogie wheel base	7ft.
Trailing	7ft.
Diameter of driving wheels on tread	3ft. 6in.
Diameter of trailing wheels on tread	2ft. 9½in.
Gauge of railway	4ft. 8½in.
Weights.	
Complete coach with fuel and water	51 10 T.cwt.
Power unit, less water and fuel	11 16
Trailer bogie	3 11
Engine and accessories, including controls and side rods	2 0
Boiler and pipes and accessories	2 18
Weight on rail—	
At engine bogie	30 0
At each trailing bogie	10 15
Weight of passengers, all seats occupied	7 10
Weight of luggage carried	1 15
Possible overload during crush traffic	9 0
Total weight of coach fully loaded during crush traffic	69 15

Letters to the Editor.

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

THE UNEMPLOYMENT PROBLEM.

SIR,—At last the dawn appears to be breaking, and the clouds which have obscured the reason of scientists absorbed in their various pursuits, appear to be opening. The discussion of economics or the effects of scientific progress on humanity has hitherto been taboo among professional men of all kinds, including engineers. Your enlightened article on unemployment in the issue of the 14th inst. marks a new era of progress. The excellent letters which appear in your issue of the 21st inst. on the subject show that at least there are some who can associate scientific progress with human progress. The article on "The Individual in the Workshop" in this week's issue is a further contribution to the same cause, for which every thinking man must be deeply grateful to you. The present chaotic condition in which the most advanced countries of the world find themselves, is due entirely to the adoption of scientific methods of production on the one hand, and stagnation in the ideas of economics on the other. Those in charge of the latter have failed entirely to keep pace with the revolution created by the scientist and engineer. We have entered ruthlessly into every walk in life, and left a trail of human terror and misery behind. Having done this, we have not thought it any of our business to assist in solving the economic problems which we have created. What would be the effect of any member of a scientific society offering to read a paper on this branch of the subject? Even suppose it was permitted, would

not most of the members shamelessly admit that they knew nothing of the subject called the dismal science of finance? Surely the trained thinkers, if they got down to it, could assist in solving these problems. We are hindered in every way in scientific progress by the burden of unemployment. When finally the recalcitrants are beaten, and some other form of purchasing power has been thought of other than manual labour, then science will have a fair field, leading on to heights of civilisation such that the world has never dreamt of.

Cardiff, March 22nd. E. F. M.

DURBAN WATER SUPPLY.

SIR,—In your issue of January 10th there appears a reference to Durban water supply under the title "Water Supply in 1929," in which the following statement is made: "It is asserted locally that the reservoir has been formed in the wrong watershed." Any assertion of this sort is uninformed and irresponsible, if not indeed mischievous, and quite unworthy of being set forth in an engineering journal of the prestige and authority of THE ENGINEER.

The Shongweni Waterworks, despite recent unparalleled drought conditions, have been proved capable of assuring a daily supply of 13,000,000 gallons in the most adverse circumstances, whilst in years of normal rainfall 20,000,000 gallons per day will be available, and this at a cost of less than £1,000,000. Surely ample vindication, if such be needed, of the design and effectiveness of these works.

I am sure that in justice to myself and the other engineers who were associated with me in carrying out the Shongweni scheme, you will give this letter due publicity.

WALTER M. CAMPBELL,
Borough Water Engineer.

Durban, March 4th.

The World's Production of Iron and Steel.

IN a paper read before the Royal Statistical Society on March 18th by Mr. M. S. Birkett, Secretary of the National Federation of Iron and Steel Manufacturers, a review was given of the world's production of iron and steel. In 1913 the world production of pig iron reached 78,000,000 tons, which was the highest on record and practically double that of 1900; in the post-war period it was not until 1926 that the pre-war rate of output was again attained, since when each year has shown an advance on the previous year, until in 1929 the highest output in history was reached, when world production amounted to 96,000,000 tons. Great Britain's share of this total, however, fell from 13·2 per cent. of the total in 1913 to 7·9 per cent. in 1929. In the case of steel an output of 75,000,000 tons had been attained in 1913, and after the war this figure was again reached for the first time in 1923, since when production has steadily increased to a maximum of 118,000,000 tons in 1929. The United Kingdom contributed 10·2 per cent. of the world output of steel in 1913, but only 8·2 per cent. in 1929. The fact that the output of pig iron did not again reach the 1913 level until 1926 was attributable in part to the destruction of plant in France and Belgium during the war, and in part to the fact that the world was too impoverished by the war to make effective the demand which undoubtedly existed. The belligerent countries which before the war supplied capital for development were no longer in a position to do so on the same scale, and much development work had, therefore, to be postponed. Exports from iron and steel-producing countries to the rest of the world did not reach the 1913 proportions until 1927, since when they have steadily progressed.

The paper traced the course of production of pig iron and steel in the United Kingdom from 1919 to 1929, and the course of imports and exports, employment, finance, prices, &c., during the same years, and proceeded to discuss the reasons for the depression in the industry. Briefly stated, the depression is attributed to the different financial policies pursued by Great Britain and the continental countries; to the lower wages in continental countries compared with Great Britain; to the effect of the coal stoppages in 1921, and particularly in 1926; to our higher taxation and social charges; and to our higher transport and capital costs. After dealing at some length with the development of the industry since the war in Germany and more briefly in France, Belgium and the United States, the paper summarised the steps which British makers are taking in the face of such heavy handicaps to rehabilitate their industry.

It was pointed out that the most encouraging feature of the situation lies in the fact that, although steel-making capacity was increased during the war, under pressure from the Government, by 50 per cent., it is no longer substantially in excess of our export requirements plus domestic consumption. The great problem which steel makers are facing is how to secure that a greater proportion of the home consumption shall be met from home production whilst at the same time developing the export trade. They are therefore doing all in their power to reduce costs of production by means of "rationalisation"—including fuel economy and technical improvements—while they have set up the British Steel Work Association to "promote and develop the production and use of constructional steel and steel work, &c.," and the British Steel Export Association to develop export trade.

THE combustion chamber tops of a Scotch boiler in a small coasting steamer collapsed on account of shortness of water, and, in order to relieve the steam pressure, the engineer opened the blow-down cock. As the Board of Trade inspector truly says, the action of the chief engineer in opening the blow-down cock to reduce the pressure in the boiler possibly calls for adverse comment, but he stated that the wire to the safety valve easing gear was broken, and in any case the damage had already been done.

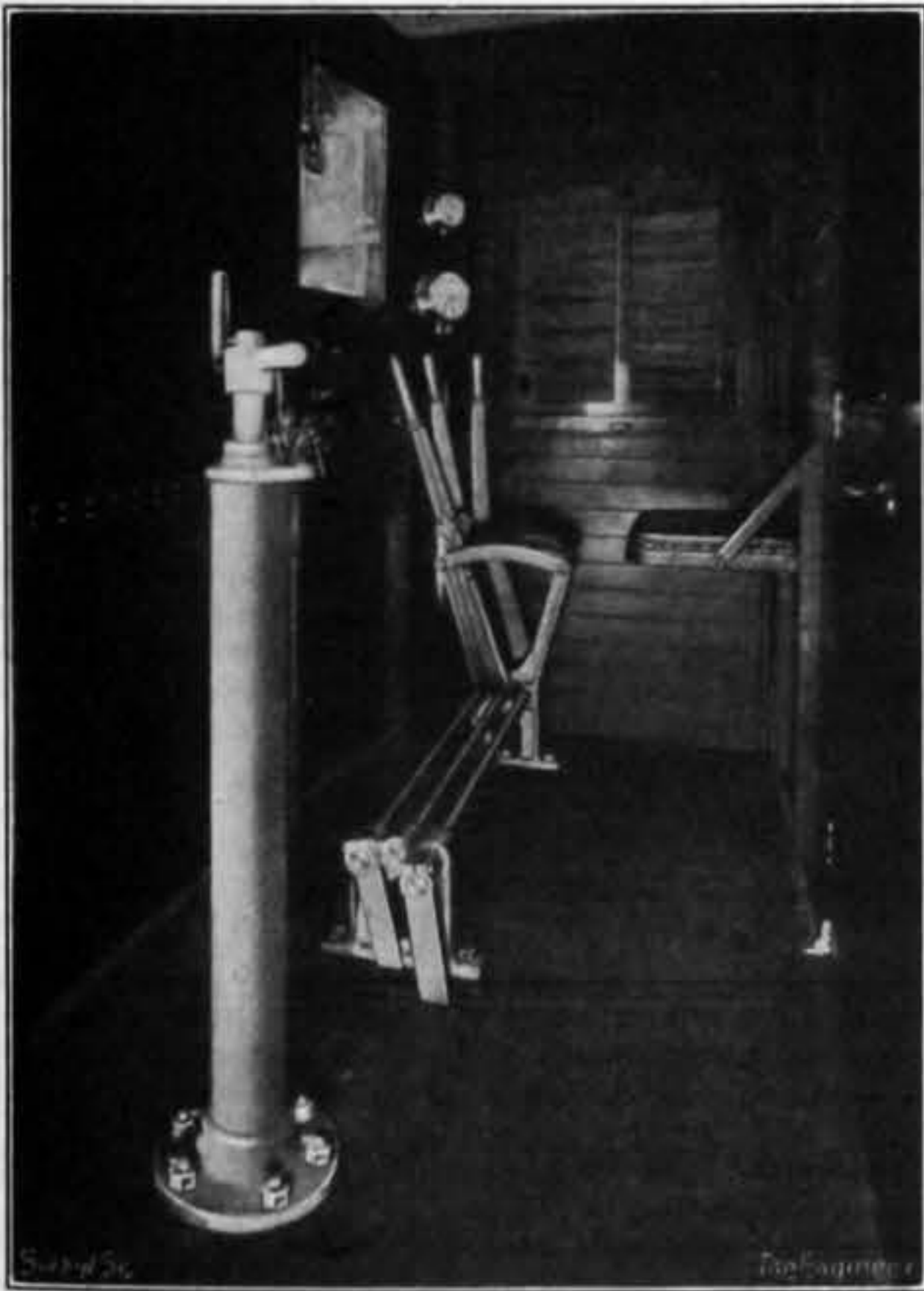


FIG. 5—DRIVER'S COMPARTMENT

the underframe being built integral with the body in the usual manner for steel cars. The underframe is built of light rolled sections and pressed members, the solebars, longitudinals and crossbars being unbroken throughout their length. The body is constructed of mild steel plates reinforced with light pressed steel pillars and carlines, and with longitudinal members in the roof and sides of light rolled steel angles, the latter being continuous wherever possible. A pair of side buffers and a drawbar are provided at each end of the unit, so that a trailer can be attached, if required. Cowcatchers are also fitted at each end. Vacuum and hand brakes are provided and arranged to be operated from each driving cab or the central engine cab. The electric lighting is of the Stone type.

A New Steam Ploughing Engine.

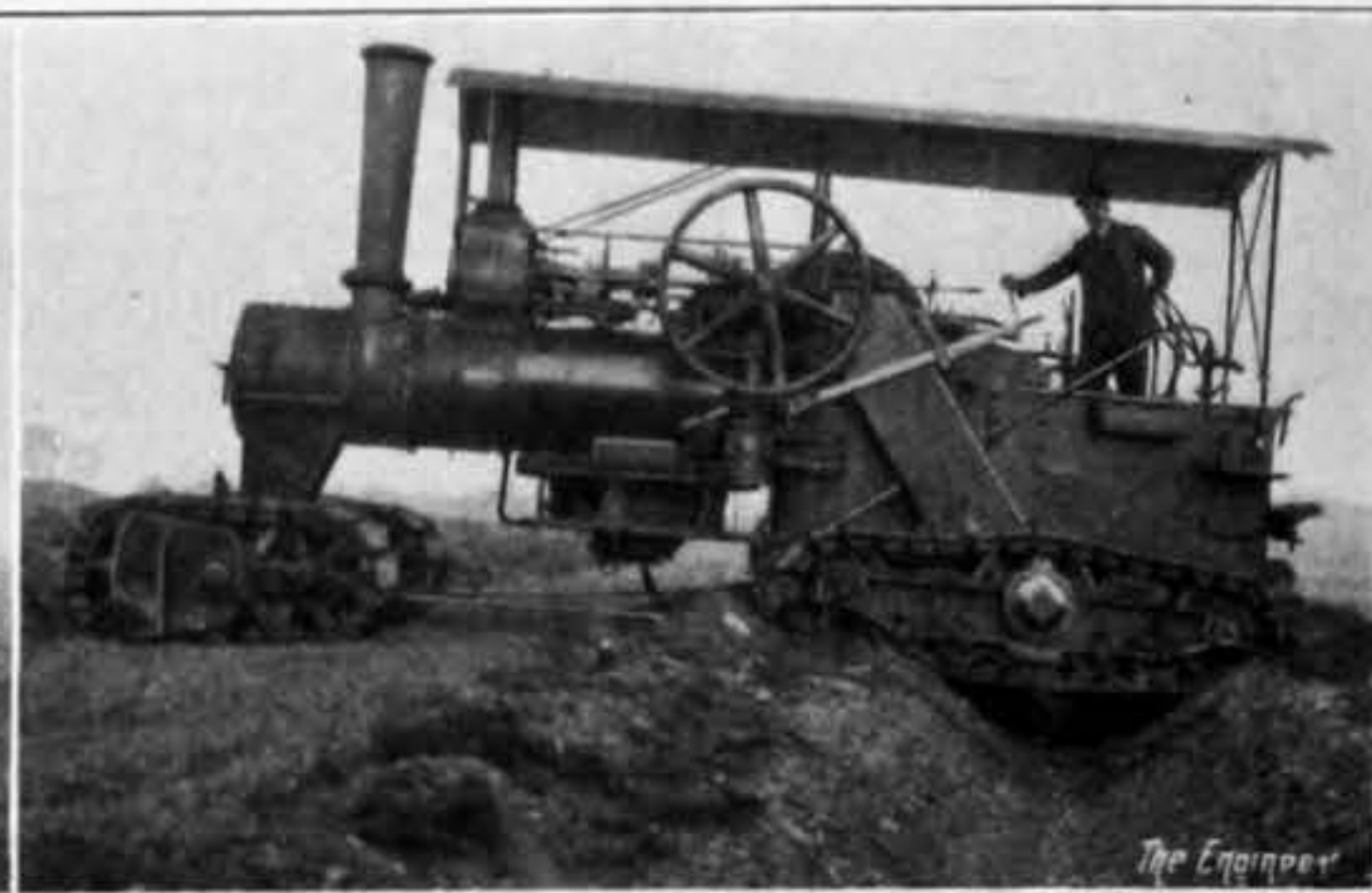
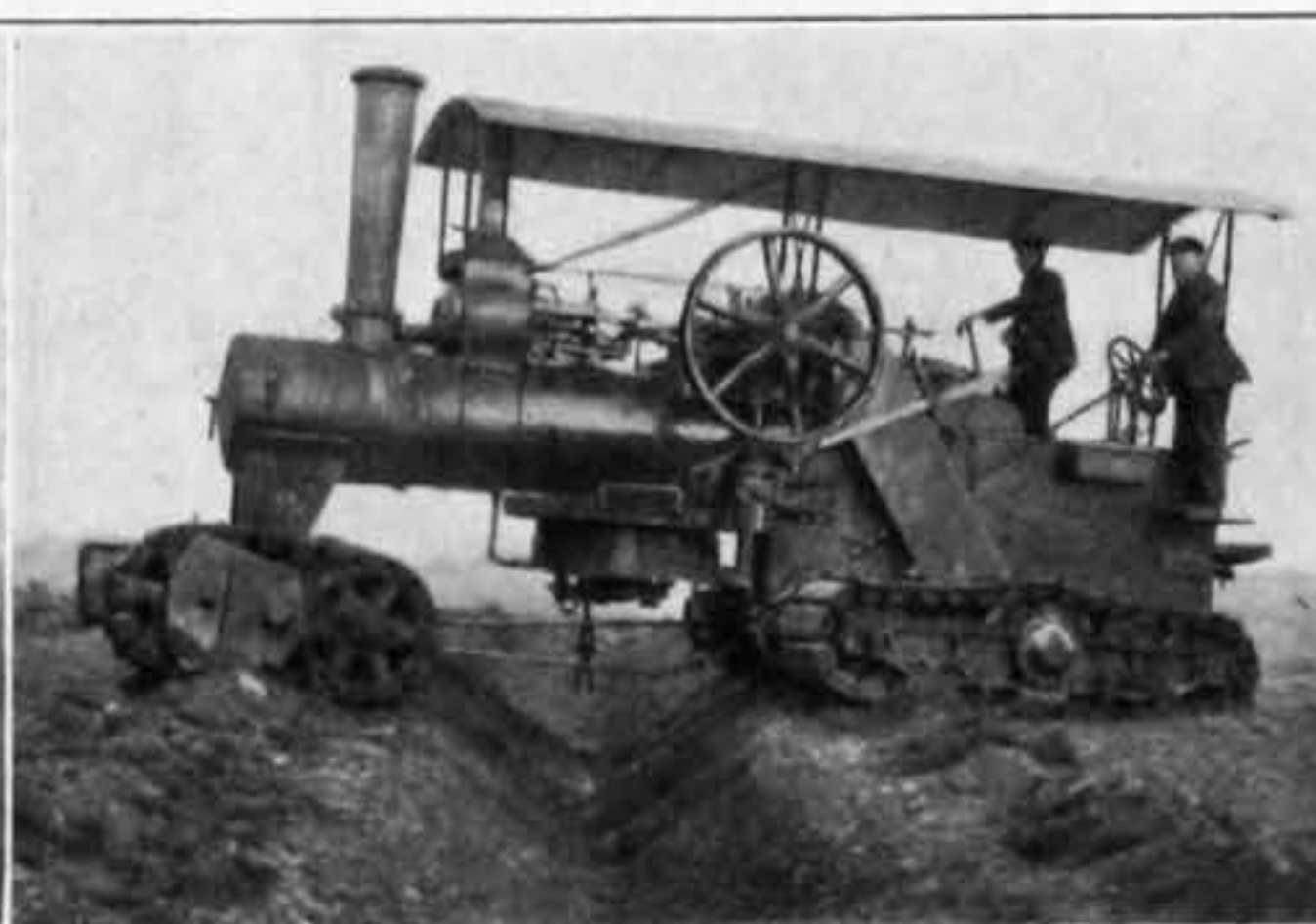
On the occasion of a recent visit to Leeds we had an opportunity of inspecting a pair of new steam ploughing engines, made by John Fowler and Co. (Leeds), Ltd., one of which is illustrated by the half-tone engravings below.

As will be seen from the illustrations, the peculiar feature

in one passage by the plough which we described in our issue of June 28th, 1929, and is cut in very loose shaley soil full of rough grass.

These engines are intended for working in conjunction with the two-furrow sugar cane trenching implement, which we also illustrate. This implement is of the turning type, and is arranged for making trenches, 1½ m. between centres, 20in. wide at the top and 12in. deep. It is fitted with a subsoil tyne at the back of each body to break the soil 4in. to 6in. deep below the bottom of the trench, to

Greater application of methods of coal cleaning has been brought about because the proportions of the types of coal required by industrial concerns are changing. Modern developments in the utilisation of coke and coal for many purposes, and the great interest being taken by the general public in the coal industry have introduced a change of view in relation to the commercial grades of coal, and it is no longer thought desirable to offer for sale uncleaned coal, especially of small sizes, because it is possible for industry to utilise it, but rather to provide the



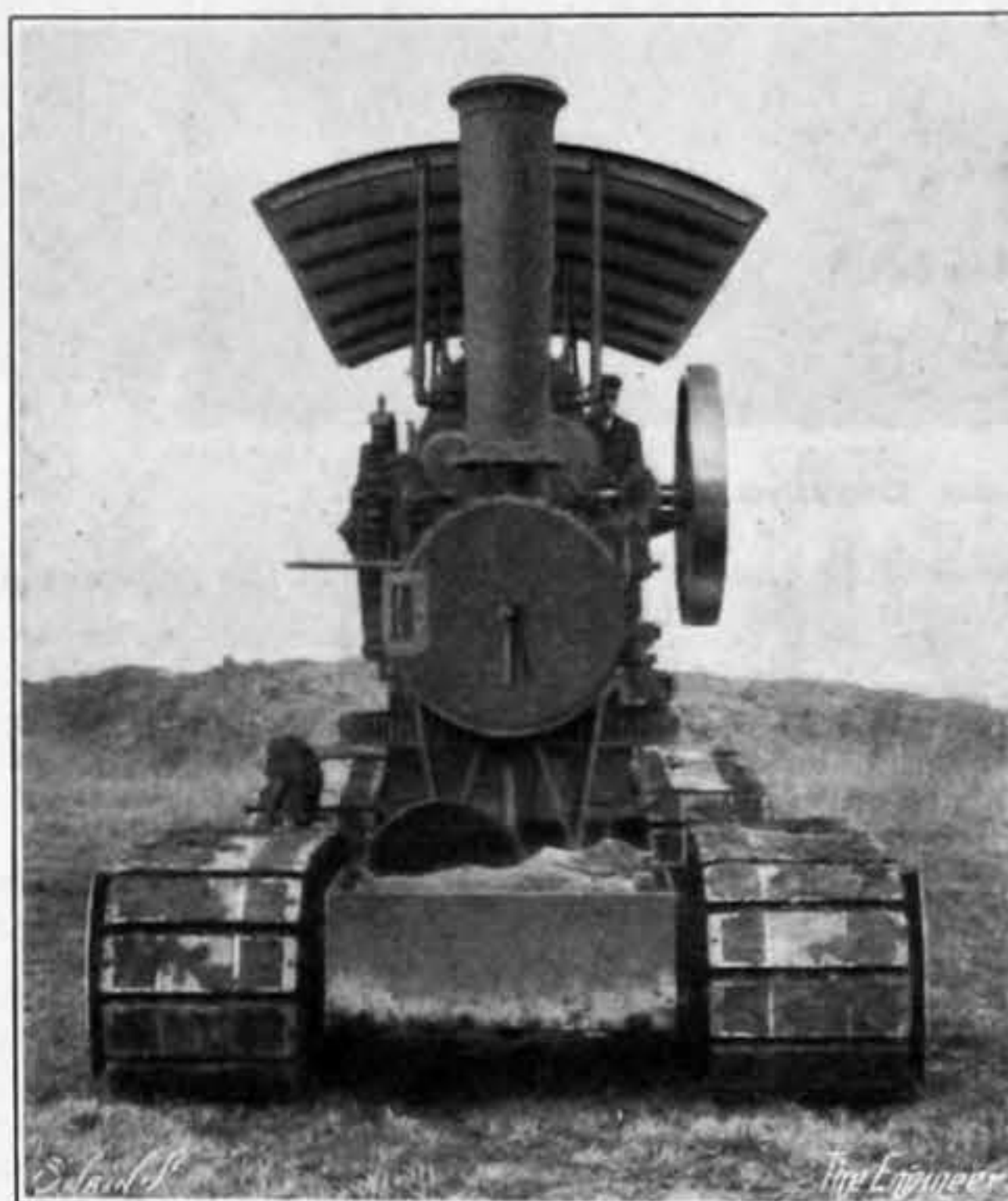
FOWLER'S ENDLESS CHAIN TRACK PLOUGHING ENGINE TRAVERSING A 6FT. DITCH

of these machines is the adoption of endless chain tracks in the place of road wheels. In this way the pressure on the ground has been reduced to slightly less than 6 lb. per square inch, and the engines can, consequently, be operated on very soft soils. They have, in fact, been designed for service on low-lying sugar plantations, rice-fields, and sewage farms, or on estates where the soil is of a very light sandy nature, in conditions under which cultivation could, in the past, only be carried out by animals.

The tackle has been specially designed and introduced as a result of the makers' experience of the conditions obtaining in the sugar cane fields of Java, where "Reynoso" trenches are made for planting sugar cane, immediately a rice crop has been harvested. The soil is then in an exceptionally wet condition throughout the short season available for this work, on account of the previous floodings of the land for the rice. The Javan soil is of an extremely sticky, clayey nature, and, having to be worked in a very wet state, has little resistance for carrying heavy agricultural machinery. Engines and implements fitted with various forms of girdle wheels, specially wide wheels, &c., have sunk considerably at times, resulting in loss of output. A tackle carried on endless tracks will propel itself and work without serious sinking, under conditions in which a tackle mounted on wheels would sink up to its axles, and therefore give a greater output and consequently reduce the running costs per unit of work. An example of this characteristic is given by the fact that the two engines under review were recently employed on a sewage farm, where the soil consisted of dumped sludge, 3ft. deep, into which a man sank over his boot tops, and yet the engines were moved about quite readily.

Except for the endless tracks, the engine is very similar to the standard Fowler steam ploughing engine. It is capable of producing 115 I.H.P. under continuous working conditions and will exert a maximum of 125 I.H.P. for short periods. The working pressure of the boiler is 200 lb. per square inch. The engine is of the compound type, and drives the rear tracks through a system of gearing similar to that of the usual wheeled outfit, and then by chains down to the centre sprockets of the endless track. The casing for the rear side chain can be plainly seen in the

facilitate planting. Each trenching body is fitted with a steel plate share and a central knife coulter, and working ahead of each body is a large diameter disc. The implement comprises two frames—a top frame with a front



FRONT VIEW OF PLOUGHING ENGINE

steering wheel, which is fitted with "endless" tracks instead of hind wheels, and an underframe carrying the trenching bodies, &c. A water supply is provided to lubricate the surfaces of the lifting breasts, and a cushion-

cleanest coal it is possible to obtain from each particular seam.

The paper contains observations upon some of the developments made during recent years, and re-states certain problems on the more fundamental aspects of coal cleaning, suggestions being made based upon information gained in the course of work carried out in the experimental washery at the Fuel Research Station.

Reference is made to the Lessing process, which consists in the application on a large scale of the principle of float-and-sink test widely used in the examination of coal. An important feature of Dr. Lessing's technique consists of the most efficient removal of the dust before the coal is subjected to treatment in the actual gravity separation plant.

During the past few years, Messrs. Norton's, of Tividale, have elaborated a method of automatically controlling the depth of the bed of dirt in jig washers, and the method was subjected to exhaustive experiments at the Fuel Research Station, and the plant more than fulfilled the claims of the makers.

Fine coal can be used in furnaces in the pulverised form, but authorities are beginning to doubt the efficiency of using dirty coal for pulverised fuel firing, and in populous districts special objections have been raised. Recently, there has occurred an increase in the practice of removing fines, generally by an air blast deduster, before washing coal in order to eliminate, or minimise, the slurry problem. Where dedusting is practised, the main advantage obtained is that the slack is more easily dewatered since the fines clog the interspaces and cover the surfaces of the coal with a slime of fusain and clay.

Increasing interest is being taken in what may be termed ultra clean coal, and areas in which pure coal seams occur are gaining a certain advantage.

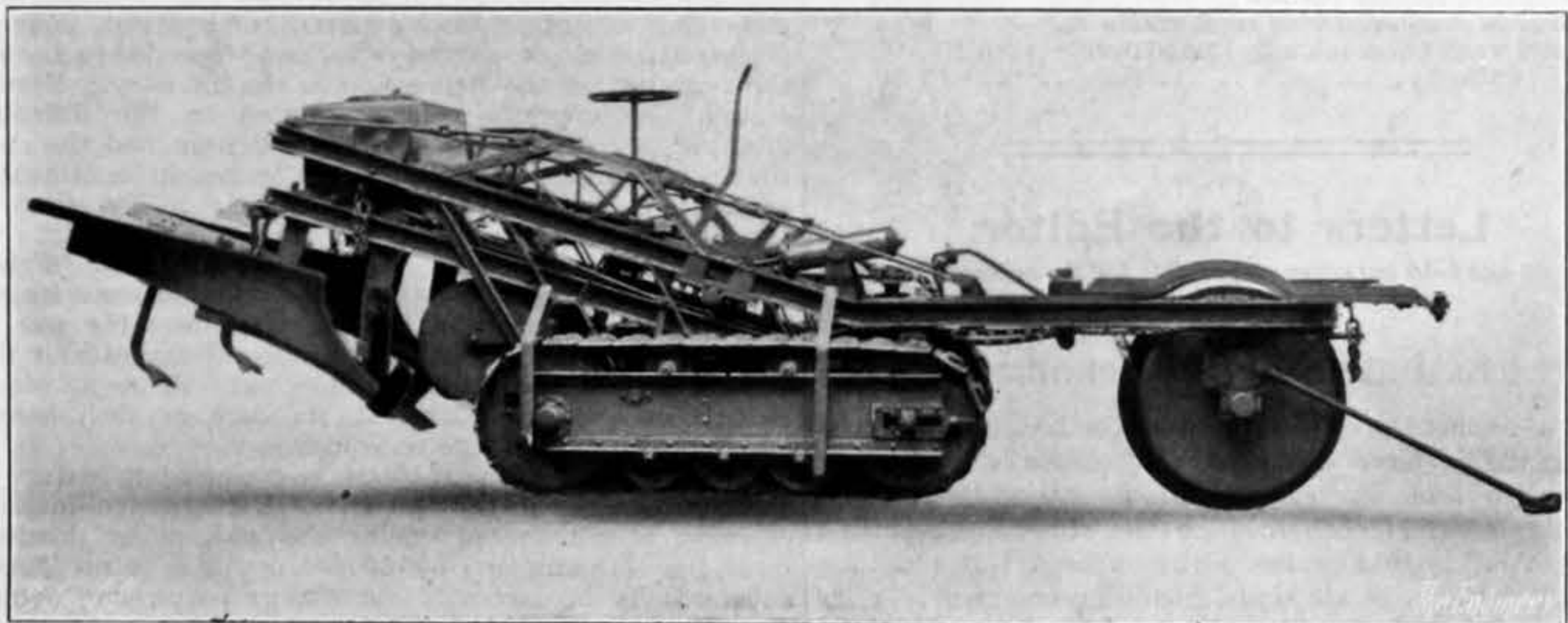
Coal containing only 1.2 to 1.5 per cent. of ash is at present being sold. If the demand for such special products increases, it should be possible, in the opinion of the authors, to obtain such coal not from special seams, but from many average seams, by the manipulation of ordinary washers, the Lessing method, or by working other washer systems, so that three products, viz., dirt, commercially clean coal and ultra clean coal are recovered from the raw coal.

The authors state that it would appear that the ankerites which contain carbonates of calcium, magnesium and iron, favour the retention of sulphur in the clinker or ash, which suggests that one method of preventing the emission of a proportion of the sulphur dioxide is either to retain the ankerites in the coal or to add chalk, magnesite, &c., to the commercial grades.

The matter is of special interest at the present time, as obviously the lower the sulphur the less contamination of the atmosphere when the coal is burned for power purposes, and, consequently, the less the objection from inhabitants of the surrounding neighbourhood.

SCOTTISH AND N.E. COAST INSTITUTIONS' VISIT TO HOLLAND.

The Institution of Engineers and Shipbuilders in Scotland and North-East Coast Institution of Engineers and Shipbuilders have decided to hold a joint summer meeting in Holland from June 21st to 28th inclusive. The programme will be approximately as follows:—Saturday, June 21st, arrive at Flushing, 6 p.m. Sunday, June 22nd, visits to Middelburg, Veere, Domburg; luncheon at Domburg, by invitation of the Schelde Yard; evening, informal dinner given by the Reception Committee. Monday, June 23rd, visit to the Schelde Yard; luncheon, by invitation of the Schelde Yard; visit to the new harbour; the ladies will visit Middelburg; 7 p.m., arrive at Scheveningen. Tuesday, June 24th, an all-day visit to the Zuyderzee Works by boat; 7 p.m., arrive at Scheveningen. Wednesday, June 25th, a meeting will be held at Scheveningen and papers will be read and discussed. During this meeting the ladies will visit the Hague. At 3.30 p.m. a visit will be made to Old Wassenaar Castle, and in the evening a reception will be held. Thursday, June 26th, Amsterdam: Party A, the Amsterdam Dock Company, Werkspoor and harbours; Party B, the Netherlands Shipbuilding Company, Rotterdam Dock Company, harbours; Party C, Volendam and Marken; Party D, the diamond factory and Rijks Museum; 6.30 p.m., arrive at Scheveningen. Friday, June 27th, Rotterdam: Party A, the Nautical Museum, the Fijenoord Yard, and the Burgerhout Yard; Party B, the Gusto Yard, Schiedam, the Rotterdam Drydock and the Nautical Museum; Party C, P. Smit's Yard, the Nautical Museum and the Wilton Yard, harbour trip; ladies, Kaag excursion; 7.45 p.m., dinner at the Kurhaus Hotel, given by the two Institutions in honour of their hosts. Saturday, June 28th. It is possible that members may wish to proceed to Antwerp and visit the exhibition which will then be in progress, instead of returning home direct. To enable them to do so, the special concession railway tickets have been made available for return from Harwich up to July 6th.



TWO-FURROW SUGAR CANE TRENCHING IMPLEMENT

illustrations. A differential gear is embodied in the countershaft.

The rear tracks have a length of 9ft. 9in. and are 2ft. wide, while the front tracks are of the same width and are 6ft. 1in. long. Steering is effected by chains and a worm wheel, very much in the same way as on a normal traction engine. It will be noticed that on the sides of the front caterpillar bogie there are steel plate appliances much resembling the lee boards of a Thames barge. These plates can be let down to bite into the ground, and help to prevent the engine being pulled sideways by its own rope if the ploughing is very heavy. The grip on the ground of the rear tracks is sufficient of itself, as they carry the majority of the weight. The winding drum is capable of accommodating 500 yards of wire rope.

Some idea of the adaptability of the engine may be gained from our set of three illustrations, which show it negotiating a ditch 6ft. wide by about 2ft. deep, with a spoil bank on either side. This ditch, by the way, was made

ing cylinder is used to steady the fall of the bodies when they are lowered into work.

Some Developments and Problems in Coal Cleaning.*

THIS subject is of special interest at the present time because very rapid advances have been made during the past seven years, and particularly during 1927 and 1928, and the authors point out that the view held in some quarters that Great Britain has lagged behind the Continent in the applications of methods of coal cleaning is incorrect.

* Abstract of a paper presented by F. S. Sinnatt and D. T. Davies at a joint meeting of the Society of Chemical Industry and the Institute of Fuel, held at the Bristol University, on Thursday, March 6th.

Railway and Road Matters.

THE Metropolitan Railway Bill, which includes powers to make a railway from Wembley to Stanmore, has been read a third time in the House of Commons. The London and North-Eastern and the Great Western Bills have also passed that stage.

FROM an answer given recently in the House of Commons on the question of the gas lighting of railway carriages it appears that the railway companies have agreed to include in their annual returns to the Ministry of Transport particulars of the progress of conversion from gas to electric lighting.

ALTHOUGH Mr. J. H. B. Jenkins, the chief chemist to the London and North-Eastern Railway, died in December, 1928, the position created by his death has only now been filled. The new chief chemist is Mr. T. H. Turner, who since 1924 has been lecturer in metallurgy at the Birmingham University. Mr. Jenkins had been chemist to the Great Eastern and when he succeeded Mr. W. G. Young as chief chemist, L. and N.E.R., he remained at Stratford, but Mr. Turner, like Mr. Young, will be stationed at Doncaster.

THE Indian Railway Board report for the year ended March 31st, 1929, came to hand by the last mail. It shows that the receipts were 105.90 crores of rupees and the expenditure 98.09 crores, as compared with 105.49 crores and 94.64 crores respectively for 1927-28. It is observed that the decrease of 3 crores in the net receipts was due chiefly to the increase in interest charges on capital outlay owing to the inclusion, for the first time, of the value of income tax concessions on certain loans. The increase in expenditure was due to the appropriations to the depreciation fund being more than a crore and a-half higher than in the previous year.

THE regretted death of Lord Balfour on March 19th prompts a reference to the "Balfour" lines in Ireland. He became Chief Secretary for Ireland in 1887 and, under his administration, there was passed the Light Railways (Ireland) Act, 1889, which granted State assistance to railways to be built for the development of fishing and other industries, and the Transfer of Railways (Ireland) Act, 1890, which sanctioned the transfer of powers to make a railway to any railway company with whose system the new railway was to be connected, subject only to the approval of the Railway and Canal Commission. From a return given in the report of the Scotter Vice-Regal Commission of 1906-10 there were thirteen railways built under the Act of 1889, of a total length of 250 miles, towards which the State contributed £1,500,000.

IN the *Railway Newsletter* for March an article appears which praises colour light signals, but fails entirely to credit the Liverpool Overhead Lines with having introduced them in 1921. The article, further, says that "The railway companies, never slow to utilise the discoveries of science for the improvement of their equipment, have quickly realised the possibility of simplifying signalling by introducing a system of colour light signals." We would observe, however, that the London, Midland and Scottish, except on the Tilbury line in 1928, had none until a year ago; the Great Western still has none on a passenger line; and, except a couple or so of isolated cases, the London and North-Eastern has none, except those between Wembley and Neasden, provided in April, 1923, in anticipation of the British Empire Exhibition. On the other hand, too much praise cannot be given to the Southern for what it has done in colour light signalling since 1926.

THE Sydney correspondent of *The Times*, cabling on March 21st, reports a very serious state of affairs in railway and other businesses in New South Wales. Mr. Cleary, who has just taken office as Chief Commissioner of Railways in place of Mr. J. Fraser, retired, is said to have told a deputation that he proposed to reduce his own salary of £5000 a year by one-half until the end of the financial year and to give £2000 of it to relieve distress among unemployed railwaymen and £500 to the railway organisation—the latter, we assume, means the railwaymen's organisation. Replying to another deputation, Mr. Cleary said that there had been a loss of £1,250,000 in passenger and goods traffic in the last eight and a-half months of the financial year, whilst last year the railways lost more than £1,000,000. During the last eight months the railways had carried 2,000,000 tons of goods less than in the corresponding period of last year and the loss in passenger revenue was £343,000. It was useless to say that to drive motor transport off the roads would end the trouble; people must face the changed traffic technique.

A MATTER of no little interest to railways overseas was mentioned in the annual report for the year ended March 31st, 1929, of the general manager of the South African Railways and Harbours. It was said that up to the end of the year 1925 it was the usual practice for the Administration, when ordering new locomotives, to prepare complete designs, drawings and specifications departmentally in South Africa. Early in 1926 that practice was changed and the preparation of designs was placed in the hands of locomotive builders, who, however, were required to comply with specifications prepared by the Administration, upon which tenders were called. The general design submitted by the successful tenderers, after approval by the chief mechanical engineer, was embodied in the contract, and the contractors were required to obtain the approval of the Administration's advisory engineer in London to their detailed designs and drawings as the work of construction progressed. The idea underlying the arrangement was to afford tenderers an opportunity of embodying in their designs all modern improvements. In actual practice, says the present report, the new system did not prove satisfactory. Various reasons for that fact are assigned, one being that by allowing makers to prepare their own designs the number of types and sub-types of locomotives tended to increase unnecessarily. Although the difference was comparatively slight, it became requisite to order additional stocks of expensive spare parts which could have been avoided had standard types been adhered to. It has now been decided that, in future, the detailed locomotive designs and specifications shall be prepared by the chief mechanical engineer. The decision, it is stated, "will go far to remove the troubles experienced during the past two years as a result of placing in service new types of locomotives embodying designs unsuitable to South Africa."

Notes and Memoranda.

DURING 1929 nearly one million barrels of oil were produced by the wells of Alberta, which represents an increase of about 100 per cent. over the production of 1928.

THERE is a faint hint of warning as to the fallibility of steam traps in the following comment in a recent report on the fracture of a cast iron steam stop valve. The passage runs as follows:—As the drain pipes are now to be connected to steam traps, the drain valves can be left fully open, and risk of water accumulation is reduced to a minimum. But even with this arrangement it is necessary that inspection of the traps should be made regularly to ensure that they are working satisfactorily.

A RUSTPROOF, stainless iron, known in Detroit as "Alleghany metal," has, says the *Iron and Coal Trades Review*, been produced in the Ford laboratories at Detroit, U.S.A., and is now being used for the bright metal fittings of the Ford car. The process is at present a secret, but it is surmised that the new metal is very cheaply made from melted down scrap iron (probably treated with cadmium), is ductile, non-brittle, and lends itself readily to pressing. In colour it resembles, when buffed, highly polished pewter.

THE Recommended Practice Committee of the American Society for Steel Treating has issued a tentative recommendation on a standard macro-etch test for iron and steel. The pamphlet covers the preparation of the sample, composition and temperature of the etching solution, time of etching and interpretation of results. Recommendations are made on treatment and examination of carbon steels, nickel, and nickel-chromium constructional steels, and nickel-chromium corrosion-resisting steels—nickel 8, chromium 18 per cent.

IN connection with the electrification of Tiruppur Town, as well as for providing power to the various factories here from the Pykara hydro-electric power scheme, a Government electrical supervisor has, according to *Indian Engineering*, been deputed to this place. It is understood that steps are being taken to supply power to all mills, factories, and other big concerns in the Coimbatore district. The formation of necessary transmission lines to get power from Pykara is being surveyed and Tiruppur is expecting the electrification at an early date.

A MULTITUBULAR vertical boiler in a workhouse in the North Country failed through the pitting of the tubes about the water level. It was examined by an engineer of the Board of Trade, who found that two of the tubes had been plugged by driving in tapered steel plugs. The plugging of the ends of the leaky tubes in the manner described was, says the Engineer Surveyor-in-Chief, a dangerous practice as the steam pressure might have been raised sufficiently to blow the plugs out. As the plugged tubes would have been full of water a serious accident to the attendant might have occurred.

IN the course of the Symons Memorial Lecture, delivered by Dr. Herbert Lapworth before the Royal Meteorological Society on March 19th, the lecturer stated that water engineers started from the basis of rainfall, the laws of fluctuation of which were regarded by the water engineer as more precise than the laws of hydrology and hydrogeology. Nevertheless, the preliminary investigations of water supply were based upon nineteenth century rainfall observations, whereas there was good evidence that in the previous century there were longer and worse droughts than those which occurred within the next hundred years. If such conditions recurred, probably no waterworks in Britain could adequately meet them.

IN continuation of the study of phenomena associated with the passivity of metals, U. R. Evans and J. Stockdale have, according to *Chemical News*, developed a new method for the removal of the surface skins of metals. The process depends on anodic undermining and has been evolved with a view to the preservation of the metal enclosed in the surface layer of oxide. In a number of cases it has been possible to transfer the film to a glass surface coated with nitro-cellulose. The method has been applied to samples of nickel and copper, and a transparent skin has been isolated from "Staybrite" steel. The oxide on heat-treated nickel appears to be sharply divided from the metal, whilst on copper and iron there is interlocking.

IN a paper by H. J. French and T. G. Digges, issued by the American Bureau of Standards, entitled "Turning with Shallow Cuts at High Speeds," a method is described for testing lathe tools under shallow cuts and fine feeds. The relations were determined between the cutting speed, feed, depth of cut, and tool life for carbon and high-speed tool steels. Comparisons were made of tools of different forms and of tool life when cutting dry and with water or lard oil. Heat treatment and chemical composition of the tools were also studied, including, in the case of high-speed tool steels, the effects of cobalt, nickel, molybdenum, arsenic, antimony, phosphorus, sulphur, copper, tin, aluminium, titanium, and tantalum. The results obtained under shallow cuts and fine feeds with these steels are compared with those obtained under heavy duty.

THE outstanding work of the British Non-Ferrous Metals Research Association for the electric cable manufacturers, to overcome the fatigue of the lead sheathing, resulted, says *Tin*, in the discovery of a means of so improving the mechanical quantities of lead as to make what is, in fact, an entirely new white metal alloy. This alloy, when used in place of lead for such applications as pipes, roofing sheets, glazing bar sheathings and the like, shows a saving in section—and, therefore, weight—of 33½ per cent. In these applications it is not only cheaper than lead, but in these weight ratios is markedly stronger. On a weight for weight basis it has 84 per cent. greater ultimate tensile strength, while the elongation is reduced by 25 to 28 per cent. The Brinell hardness is 80 per cent. greater than that of lead, and most remarkable of all the resistance to vibration, measured by the Haigh machine, shows an increase of 217 per cent., while the results of tests carried out by Dr. Thresh, of London, show that under the corrosive influence of hard and soft waters, the new alloy may be regarded for all practical purposes as just as resistant as pure lead.

Miscellanea.

AN Institute of White Metals is to be formed in the United States.

It has been decided to build a Central Rescue Station for the Kent coalfield at the village of Aylesham.

THE discovery of new base metals, including chrome, zinc, and lead ores, is reported from Lindi Province in East Africa.

A COMPANY has been formed with the object of exploiting the coal measures near Inyantue, on the Wankie Railway, Rhodesia.

AN expedition sent out by the Chemical Mining Trust has discovered in the Nerchinsk region of Siberia—not far from Tchita—valuable deposits of lithium, beryllium, wolfram, molybdenite, &c. The expedition also confirmed the existence of rich deposits of cinnabar with an enormous quicksilver content.

THE Council of the Royal Agricultural Society of England is offering a medal for original agricultural research. It will be awarded for a monograph or essay giving evidence of original research on the part of the candidate on any agricultural subject, on any of the cognate agricultural sciences or on agricultural economics.

THE Calcutta Water Works Extension Scheme, which started in March last, will be completed in about 10 months' time, resulting in the supply of water being increased to 60 gallons filtered and 40 gallons unfiltered water per head per day. The total estimated cost, states *Indian Engineering*, will be Rs. 266 lakhs, out of which Rs. 219 lakhs have already been paid. At present there has been an increased supply of water of about 18 million gallons.

THREE cotton textile plants are to be erected in Siberia as follows:—Novosibirsk, 120,000 spindles; Barnaul, 60,000 spindles, and Kuznetsk, 60,000 spindles. A cotton textile plant of 60,000 spindles is being planned for erection at Odessa, the first one in the Ukraine. A new textile plant with a yearly capacity of 1,400,000 metres is being erected in Tiflis at a cost of about £700,000. One thousand workmen will be employed in the plant. It will use electric power.

THE Secretary for Mines announces the publication of Mines Department Safety Pamphlet No. 6, which has been prepared under the direction of the Chief Inspector, with the object of presenting as concisely as possible detailed information—at present only available by reference to numerous text-books and other publications—as to the best existing practice in design, conditions of use and treatment of mine lifting and hauling gear other than ropes. The pamphlet may be obtained from H.M. Stationery Office, price 6d.

THE completion of a fund of over 200,000 dollars to finance the initial stage of a programme of co-operative research work on alloys of iron is announced by the American Engineering Foundation. With the aid of industries, engineering societies, the National Government and other organisations, alloy research work has been started under the direction of the Iron Alloys Committee of the Foundation. The Committee's first task, covering five years, will be a critical review of the world's literature on iron and its combination with other substances.

THE International Telephone and Telegraph Corporation has purchased a controlling interest in the stock of the Constantinople Telephone Company, an Anglo-French concern. The official announcement issued by the International Telephone and Telegraph Corporation to the above effect states that the transaction has already been approved by the Turkish Government. It is also announced that a new rotary automatic equipment will be installed in Turkey. The Corporation already operates in Spain, Cuba, Mexico, Porto Rico, Peru, Chile, Argentina, Uruguay and Brazil.

It is reported by the National Federation of Iron and Steel Manufacturers that the number of furnaces in blast at the end of February was 162, a net increase of 3 since the beginning of the month. The production of pig iron in February amounted to 597,000 tons, compared with 650,000 tons in January and 519,600 tons in February, 1929. The production includes 189,100 tons of hematite, 233,500 tons of basic, 129,700 tons of foundry, and 19,900 tons of forge pig iron. The February output of steel ingots and castings amounted to 776,400 tons, compared with 771,100 tons in January and 774,900 tons in February, 1929.

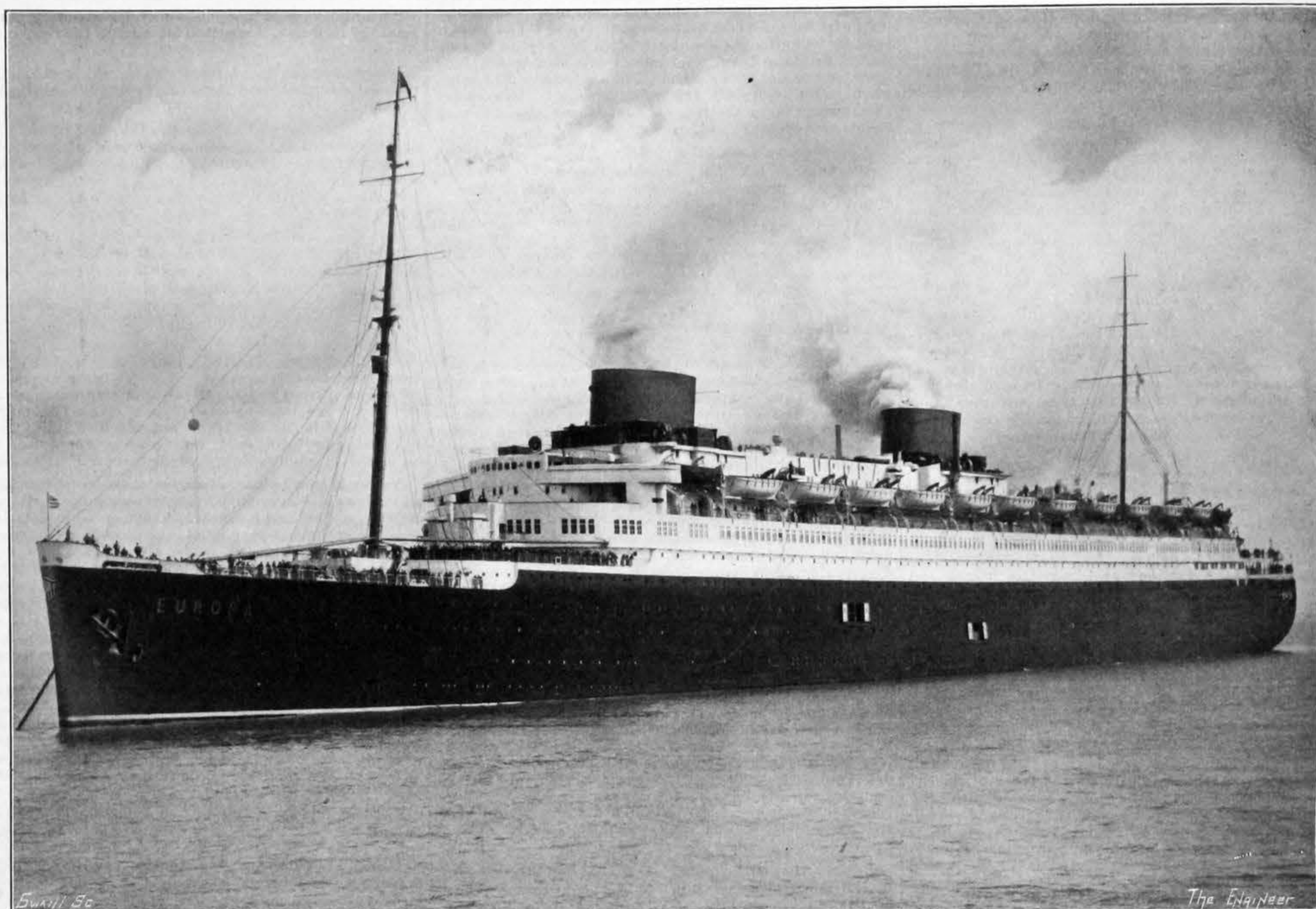
At the London and North-Eastern Railway's locomotive depot at Coatbridge electrically operated mechanical coal-lifting plant has been put into commission. The coal from the overhead storage hoppers is delivered to the engines by means of an electrically operated endless steel belt, and the amount of coal delivered to each engine is automatically registered on a tape, together with the engine's number. Coal is delivered by this means from the overhead hoppers at the rate of 1.5 tons per minute. The plant was constructed to the specification of the chief mechanical engineer of the London and North-Eastern Railway by Henry Lees and Co., Ltd., of Glasgow.

ACCORDING to the *British-Russian Gazette and Trade Outlook*, the new Krivoi Rog electric power station has been officially opened. The station has been built by the Southern Ore Trust at a cost of about 16,500,000 roubles (£1,650,000) near Vetcherni Kut on the Yekaterinski Railway. It is planned for a total output of 44,000 kW. Two sets, each producing 10,000 kW, have already been installed and later on a 24,000 kW turbine will be added. With the opening of the new station it will be possible to centralise the electric supply of the whole of the Krivoi Rog ore basin, one of the most important in the Soviet Union, a number of small out-of-date stations that used to supply power to the mines being done away with. When fully at work the station will devote part of its power to the lighting of the Krivoi Rog region and the supply of electricity to the great Krivoi Rog iron and steel works that are to be built. Pulverised fuel will be used. The machinery was supplied by the German A.E.G. To ensure a good supply of water to the station a dam has been built on the River Saksagan and a reservoir with a capacity of 6,000,000 cubic metres.

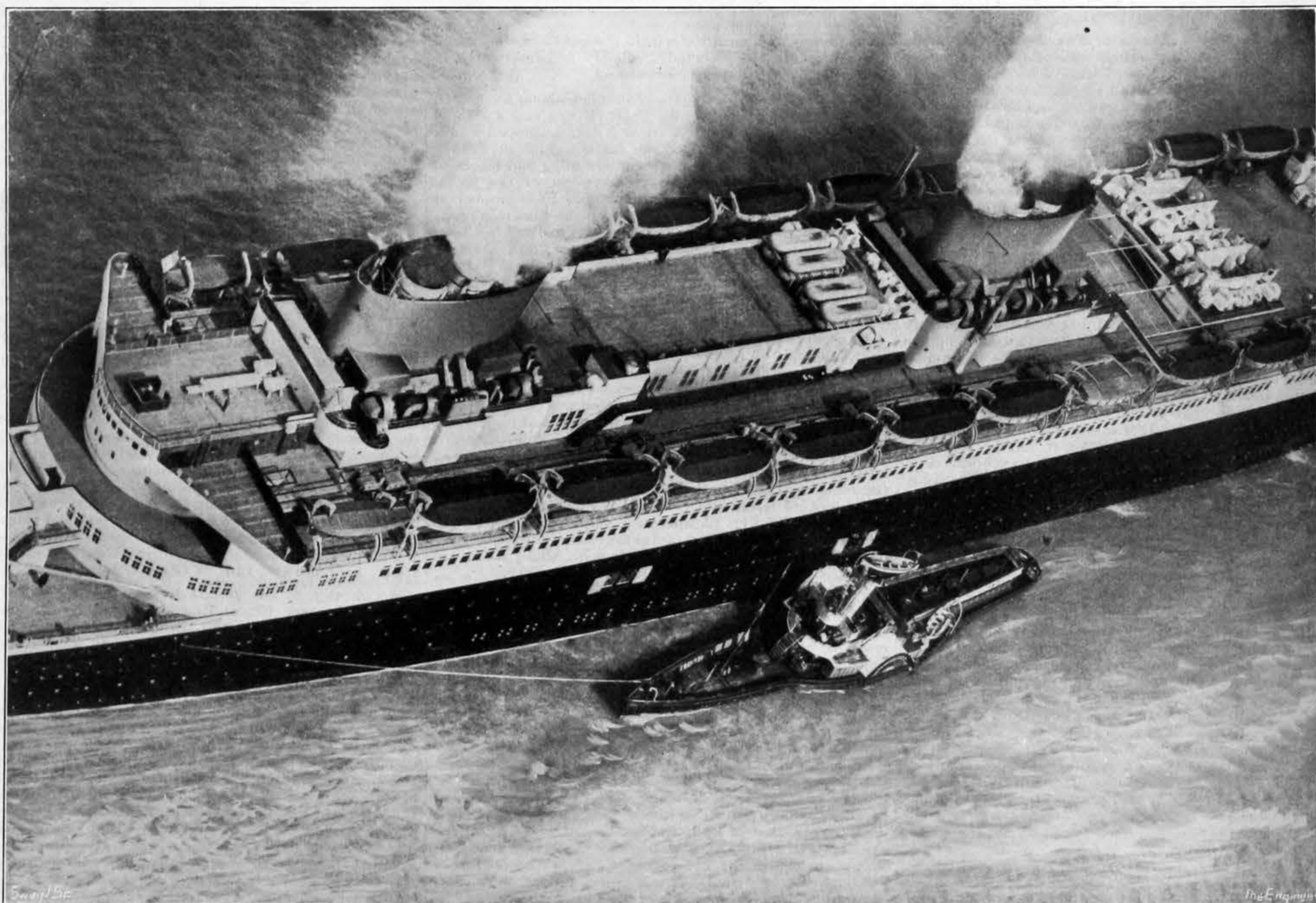
50,000-TON NORTH GERMAN LLOYD LINER "EUROPA"

BLOHM AND VOSS, HAMBURG, SHIPBUILDERS AND ENGINEERS

(For description see page 347).



VIEW OF THE "EUROPA" IN COWES ROADS



APPEARANCE OF SUPERSTRUCTURE FROM THE AIR

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Contents.

THE ENGINEER, March 28th, 1930.		PAGE
A SEVEN-DAY JOURNAL		341
THE ROLLING OF METALS. No. V. (Illus.)		342
ARC WELDING AT A LARGE BOILER WORKS. (Illus.)		344
THE INSTITUTE OF METALS. No. III. (Illus.)		345
THE 50,000-TON NORTH GERMAN LLOYD LINER "EUROPA."		347
ARTICULATED STEAM RAIL COACH FOR EGYPT. (Illus.)		348
LETTERS TO THE EDITOR—		
The Unemployment Problem—Durban Water Supply		349
THE WORLD'S PRODUCTION OF IRON AND STEEL		349
A NEW STEAM PLOUGHING ENGINE. (Illus.)		350
SOME DEVELOPMENTS AND PROBLEMS OF COAL CLEANING		350
RAILWAY AND ROAD MATTERS		351
NOTES AND MEMORANDA		351
MISCELLANEA		351
LEADING ARTICLES		
Smoke in the Steel Trade		353
Continental Trade Problems		354
INSTITUTION OF MECHANICAL ENGINEERS		354
OBITUARY—Sir William Symington M'Cormick		355
SIXTY YEARS AGO		355
DESIGN AND RESULTS OF A 600 LB. PER SQUARE INCH BOILER		
INSTALLATION. (Illus.)		356
HIGH-POWER MERCURY ARC RECTIFIERS		357
THE ST. HUBERT AIRSHIP MOORING TOWER. (Illus.)		358
A 7200 HORSE-POWER SINGLE-PHASE LOCOMOTIVE. (Illus.)		359
INSTITUTION OF NAVAL ARCHITECTS		359
LARGE COAL STRIPPING EXCAVATOR		359
CANADIAN ENGINEERING NEWS		359
HYDRAULICALLY DRIVEN SHAPE MACHINE. (Illus.)		360
A 60,000-KVA THREE-PHASE TRANSFORMER. (Illus.)		360
SOUTH AFRICAN ENGINEERING NOTES		360
PERSONAL AND BUSINESS ANNOUNCEMENTS		361
CATALOGUES		361
PROVINCIAL LETTERS		
The Midlands and Staffordshire—Lancashire		361
Sheffield—North of England		362
Scotland—Wales and Adjoining Counties		363
CONTRACTS		363
LAUNCHES AND TRIAL TRIPS		363
CURRENT PRICES FOR METALS AND FUELS		364
FRENCH ENGINEERING NOTES		365
BRITISH PATENT SPECIFICATIONS. (Illus.)		365
FORTHCOMING ENGAGEMENTS		366

SIXTEEN-PAGE SUPPLEMENT—"THE METALLURGIST."

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The Metallurgist.

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MARCH 28, 1930.

Smoke in the Steel Trade.

DURING the last few years the public conscience has been increasingly alive to the evils of a smoky atmosphere. The doctors have preached its baleful influence in obscuring sunlight and the architects have complained that its sulphurous contents corrode the ornamentation of their works in stone, but perhaps more potent than all in the demand for purer and cleaner air is the resentment of the multitudes of ordinary citizens at a lifelong struggle against dirt and grime which they now believe to be unnecessary. As soon as a nuisance is felt the natural course is to look round and see who can be blamed for it. The Barton lawsuit and the Battersea controversy have tended to concentrate public attention on the behaviour of power station chimneys, though, as every one conversant with the facts is aware, these as a class are among the least of the offenders. The real culprits responsible for most of the smoky haze overhanging many large cities are the ordinary citizens themselves, who, by burning soft coal in innumerable domestic grates and ranges, contribute each his tiny share to the formidable total. It is, however, useless to indict a multitude. Offenders though the individuals may be, when they strain, it is rather at the camels of industry than at the gnats of their own hearths. These latter they are prepared to swallow and will, no doubt, continue to do so until, industry having removed its own reproach, the truth is forced upon the owner of the domestic poker that if he and his fellows want clean skies above them, it is their own ways that must be mended.

Of all the smoke-producing industries, that of steel making easily holds the first place. Concentrate such an industry in a limited area and the hundreds of furnaces of the large and small manu-

facturers can pollute the air until nothing but long custom or sheer necessity could reconcile the inhabitants to their grimy existence. Every steel-making centre in the world is notorious for its dirt and smoke, and Sheffield, the cradle of the industry, has probably nothing to learn from its rivals in this connection. That it may have something useful to teach them in the not too distant future is, however, possible, for the problem of the suppression of smoke production in the manufacture of steel is now being definitely studied by a local organisation under the name of the Sheffield Manufacturers' Smoke Abatement Research Committee. A year ago this Committee issued a memorandum dealing with the smoke question from the legal and general points of view and recommended that arrangements should be made for an independent investigation of the conditions which existed in Sheffield. The manufacturers adopted this recommendation and took advantage of an offer by the National Federation of Iron and Steel Manufacturers to place at their disposal the services of two of their fuel officers—Messrs. F. J. Bailey and E. C. Evans—for the investigation in question. The report of these two gentlemen has now been published, and though it is disappointing in that it contains no recommendations, and, moreover, its discussion of facts is too general to be of much assistance to anyone in the industry, it does at least serve to show that manufacturers really desire to mitigate the smoke nuisance and that many of them have made definite attempts to do so. One of the difficulties of the general problem arises from the great variety of uses to which furnaces are put and to the corresponding diversity of the conditions which have to be maintained in the heating zone. Certain characteristics, however, are required for all steel heating furnaces. With an ordinary coal-fired furnace the loss of metal by scaling may be anything from 2½ to 5 per cent., representing a direct wastage of material which may be very costly in the case of valuable alloy steels. But far more serious than this loss may be the injury to the metal caused by the surface decarburisation which accompanies scaling. Scaling, then, must be minimised, and since the ordinary products of complete combustion, namely, carbon dioxide and water vapour, both have an oxidising action on steel, while a certain amount of free oxygen in addition can hardly be avoided, experience teaches that the furnace flame ought to contain incandescent particles of carbon. In other words, it must be exactly the sort of flame which, when chilled and extinguished, turns into a dense cloud of black smoke. By careful furnace control, continuous firing, and a regulated supply of secondary air, it may be possible to arrange that practically the whole of the smoke-forming carbon shall be burnt out before the gases escape into the atmosphere; but anyone who has ever operated a furnace knows how much more easily smokelessness can be obtained in theory than in practice. Developments which the authors of the report mention as likely to mitigate the production of smoke by steel furnaces using solid fuel include mechanical stoking, the use of which is rapidly expanding; the employment of partially distilled, or "smokeless," coal; and the use of coal in a pulverised form, which is now being successfully applied to forging furnaces. That the convenience of pulverised coal, in the matter of control, may tend to make its use in steel works more general we may readily believe, though whether it is not more likely to accentuate than to solve the problem of getting a clean chimney discharge by introducing its own peculiar difficulties seems at least open to argument. The use of producer gas as an alternative to coal is said to involve difficulties in achieving the delicacy of control necessary for special steels, unless great care is taken to maintain constant the pressure and quality of the supply, and also to be uneconomical for the intermittent production, or "jobbing" work typical of Sheffield industry. A further drawback is said to be the necessary emission of quantities of soot for a considerable period, when the mains have to be "burned out" at the end of a week's run, no alternative and clean method of removing the accumulations of soot having so far been developed. Coke oven gas, which can be supplied at constant quality and pressure, would seem to be the fuel most favoured by the authors on the grounds of smokelessness and adaptability to heating operations requiring the greatest delicacy of control. Its use has, however, been so far restricted on the score of price. Oil firing and electrical heating are both disposed of in a paragraph of six lines.

If we start from the premises that unburned carbonaceous matter is a necessary constituent of

the flame of a furnace in which the heating of steel has to be carried out, there must always be smoke at the chimney outlet unless the carbon is removed in some way before the gases reach that point. One way of removing it is to burn it, and if the gases after leaving the furnace are hot enough, this can be done by merely supplying them with air—a horrible proceeding from the point of view of efficiency, and one that may not be uniformly successful. To carry out the burning under a waste heat boiler is manifestly more economical, but the difficulties of securing smokelessness are considerably increased. In order that these, or any other method of "after treatment" of the gases may be successful, the authors of the report make two postulates: first, that "the installation and running costs must be exceedingly low, and, secondly, that the device must be simple and interfere as little as possible with the draught of the furnace." These conditions are both, of course, highly desirable, but what the public is beginning to demand, and rightly so, we think, is that the gross pollution of the atmosphere of cities shall be stopped soon and for ever. Once that point of view is appreciated, we have no fear that engineers will find it impossible to cope with the smoke and sulphur nuisance from metallurgical furnaces as efficiently as they are doing in the case of power stations, and, once it is done, everybody will wonder that it was not done before.

Continental Trade Problems.

ONE cause of the almost universal trade depression is the development of industries abroad. Countries that were formerly customers for British goods are now producing what they need for themselves. Why this should be so is explained by economical reasons which are now well understood. In some countries industries were extended during a time of monetary depreciation that placed them beyond danger of foreign competition, and under this temporary stimulus a considerable export business was done which enabled our former customers to establish definitely important manufacturing industries. They mean to maintain them at all costs. While the production is in excess of home needs the consumption is reduced by a lower purchasing power, owing to heavier taxes and financial burdens, which, in their turn, increase manufacturing costs. Makers in some continental countries, therefore, feel that they are turning in a vicious circle. They know that something must be done to adjust the situation, but they are not yet certain what direction their efforts should take. The idea of a limitation of output is generally accepted, provided that all makers have their share of the trade, but no one will agree to the suppression of industries even if they are unable to stand alone against foreign competition. Yet it is quite clear that the weaker trades which cannot exist unless they are carefully nursed by protection against more vigorous industries abroad must be sacrificed if there is to be any sound international arrangement for a trade recovery. For the moment there is no question of making such a sacrifice, and import duties in most countries are being strengthened, not so much as a means of immediately protecting industries as of bargaining for advantages later on when some real advance has been made in the negotiations for bringing about an international agreement. On the Continent, import duties are regarded as weapons both of defence and attack, and they are freely used for retaliation as well as for protection. Whether that method is sound or not is another matter. All that counts at the moment is the supposed efficacy of tariffs as a means of dealing with an obscure and complicated situation, when certain national industries must be saved from foreign competition, and when duties are put up against certain goods in order to negotiate for the reduction of foreign tariffs on others. All this makes a bad situation worse, if it could be worse than it is now, for the entanglement of tariffs does not facilitate the carrying out of the scheme for improving international exchanges.

Two widely divergent industries on the Continent like engineering and agriculture are clamouring for the same thing, although for different reasons. Their objects cannot be attained in the same way. In a recent address, Monsieur Dalbouze, President of the Syndicat des Industries Mécaniques de France, stated that the menace to continental engineering industries came from the United States. The proposed remedy of a gradual reduction of import duties and their final suppression and the creation of a United States of Europe was, he said, worse than the disease. There is no free trade argument underlying the expressions

of foreign industrial leaders. Monsieur Dalbouze can only see relief in the suppression of the causes which have brought about the industrial depression. Taxation and fiscal burdens of all kinds must be pulled down from their exaggerated heights, and production costs must be brought to a level at which it is possible to sell and export goods. The remedy is sound, and is the only one that can be relied upon to produce permanent beneficent results, but with the crushing financial burdens that lie upon all European countries the prospect of anything being done in that direction appears to be remote. Until then, foreign engineering industries insist upon adequate protection. In the case of agriculture the requirements are high differential tariffs and international agreements which will permit of products being exported. As agriculture is the dominant industry in most continental countries this policy is being pursued with the greatest vigour and must necessarily affect the manufacturing industries. The situation is further complicated, so far as the British industry is concerned, by the fact that in most countries the engineering trades do not depend so much upon sales abroad as they do in Great Britain; even the steel making industry in France has, until recently, been able to dispose of the great bulk of its output at home. There are exceptions in Belgium and Germany. In the latter country industries have grown with the help of an elaborate system of financial aid, but even there manufacturers are less dependent upon a foreign trade in this connection. That really increases the severity of German competition abroad. The general tendency, therefore, is to aim at a monopoly of home markets and to secure, if possible, arrangements that will facilitate exports in particular countries in return for the importation of goods and produce that do not enter seriously into competition with native products. This must be borne in mind because it constitutes the basis of a particularly complicated problem and explains the negative results that have so far been obtained at Geneva, where committees have been at work for years past endeavouring to unravel an entanglement of economic interests that appear at the moment to be inextricable. The attempt to find some simple formula on the basis of free trade in Europe has so far failed, and it will need long and patient negotiations to produce anything that will prove to be even fairly acceptable.

That something will be done to mitigate at least the evils of the situation appears certain in view of the widespread need of some sort of remedy. In Central Europe the problem is being discussed more methodically and more rationally than it is elsewhere. There exists a non-political association known as the Mitteleuropäische Wirtschaftstagung, or Economic Delegation of Central Europe, which has national committees in the different states embracing the whole of the Continent from Germany and Switzerland, on the one hand, to Roumania on the other. The association meets periodically to discuss the conditions under which it may be possible to bring all the nations together into a sort of commercial union for the freer interchange of products. The idea is to extend the old German zollverein system throughout Central Europe. At the last meeting of the association it was concluded that a suppression of tariffs between purely agricultural countries was impossible and that free exchanges could only be effected between agricultural and industrial States. At Geneva the same objections were formulated by agricultural nations, which must have a means of maintaining prices on a profit-making basis, whether the harvests are good or bad. It was mainly this phase of the question that threatened to defeat the Geneva Conference, because discussion was conducted on the lines of a gradual reduction of tariffs with a view to their ultimate suppression, and a deadlock was only avoided by the French compromise, which is clearly based upon the maintenance of tariffs that may be more or less mitigated in the future according to the conditions under which international agreements can be carried out. Hence, the situation becomes a little clearer and British manufacturers can see what is in store for them when real progress is made in the way of European economic adjustment. The whole matter will turn upon what each country can offer in order to secure advantages from others, and there will be again a manipulation of tariffs as a means of getting the most for as little as can be granted. The fact that the French proposal, which has been accepted for discussion, provides for the cancelling of international treaties in the event of existing duties being increased during a period of one year, when each State is required to prepare data of its economic requirements, is

characteristic of the trend that the discussion will almost certainly take in the future. Difficulties in the way of a common agreement between European countries for removing some of the barriers to trade do not discourage those at Geneva and elsewhere who are seeking a solution, and the necessity of devising a workable plan is so urgent that something which will help trade in the future must come out of the discussion.

Institution of Mechanical Engineers.

At the meeting of the Institution of Mechanical Engineers held in London last Friday, March 21st, Mr. William Nithsdale presented a paper entitled "The Design and Results of a 600 lb. per Square Inch Boiler Installation." We begin a reprint in full of this paper elsewhere in to-day's issue. The boilers dealt with were two supplied by Messrs. Yarrow for the Castner-Kellner Alkali Company's works at Runcorn.

Before the paper was presented and discussed Mr. Pendred, the President, addressed a few words to the members concerning the Institution's Benevolent Fund. The position of the fund, Mr. Pendred said, was not very satisfactory. The number of grants being made was increasing, but there was not a proportionate increase in the income. The grants, in fact, now exceeded the available income. To meet the commitments of the next few months £500 had just been drawn from the capital account. The fund had been of inestimable benefit to many distressed people. At present only 13.2 per cent. of the Institution's members subscribed to it. He appealed to every member to support it. The minimum subscription for membership of the fund was half a guinea a year, but sums of less amount would be very welcome as gifts. Mr. Daniel Adamson, supporting Mr. Pendred's appeal, assured the members that the management expenses of the fund were very small, and that of every shilling subscribed to it 11½d. were expended directly in grants.

Opening the discussion on Mr. Nithsdale's paper, Mr. P. Kirk referred to a paper presented in 1926 at Hull by Mr. Spyer on high-pressure steam generation. All the designs referred to by Mr. Spyer were preferable to that shown by Mr. Nithsdale. The Yarrow design was a "teaser." Nineteen rows of tubes had to be employed to obtain the requisite difference of temperature, and they had to be accommodated on one-quarter of the circumference of the steam drum. That result could not be achieved except by the use of very small tubes. The designer, in fact, had been forced to use tubes 1½ in. in outside diameter. For good practice the tube lengths should be about 90 inside diameters or, say, 10½ ft. long. They were apparently about 14 ft. in length and hence would seem to be some 33 per cent. too long. Tubes of small diameter were objectionable because they were apt to become choked with scale. It was for that reason presumably that distilled water was used in the Yarrow boiler at Runcorn. There was no limitation imposed on the size of the tubes in the boilers described by Mr. Spyer. Further, they were easy to inspect and remove. That remark could not be applied to the tubes of Mr. Nithsdale's boiler. He could not understand the curves given in Fig. 1 of the paper. At the 7500 B.Th.U. rating the gas temperature drop over the first four rows of tubes was shown to be 400 deg. Fah., but at the lower rating of 4500 B.Th.U. the drop was given as 500 deg. Fah. That result was just the reverse of what it should be. Mr. Nithsdale had stated that in 1927 special heat-resisting tubes were not obtainable, and that with the quality of steel then available it was considered advisable to limit the maximum temperature of the steam to 780 deg. Fah. He would, however, point out that at the Langerbrugge station, where a pressure 33 per cent. greater than that of the Runcorn boiler and a considerably higher temperature were employed, ordinary steel tubes were used and had given no trouble. There was nothing in the argument developed by the author in favour of tubes of small diameter. Almost all other water-tube boilers on the market could be made with any size of tube. Mr. Nithsdale's boiler was tied down to the use of small tubes. It was to be noted that the smaller the tubes the greater was the number of joints to be made and maintained on the drums.

Mr. A. Pollit contended that if, as the author had said, this country had not been in the forefront in adopting high pressures, it had certainly led the way in the adoption of high steam temperatures. Mr. Nithsdale's boiler was a very honest work-a-day generator, but it had nothing special about it. It did not make use of water walls, although, as was well known, such walls were profitable, if only from the point of view of saving in the cost of refractory linings. He would like to know whether any trouble had been experienced with the air distribution on the stokers and from segregation of the ashes. He was surprised that the safety valves had been set to lift at such low pressures. A good working rule for the blow-off pressure for the safety valve on the saturated steam drum was:—

Blow-off pressure = working pressure + 7% + 3 lb.,

and for the superheater safety valve :—

Blow-off pressure = working pressure + 5%.

Commenting on the use of nickel steel jointing rings with fourteen serrations per inch of width, he remarked that he had found the so-called gramophone rings with forty serrations per inch better in every way. The operating results recorded by the author were just what were to be expected from a good boiler in any modern boiler-house.

Mr. F. Samuelson appealed to boilermakers to supply boilers suitable for higher steam temperatures than those to which users to-day were restricted. High temperatures and moderate pressures were preferable to lower temperatures and higher pressures. For example, a pressure of 600 lb. in conjunction with a temperature of 800 deg. Fah. would not give as good results as a pressure of 400 lb. in conjunction with a temperature of 1000 deg. Fah. At Rugby his firm was completing a 10,000-kW plant using steam at 400 lb. and 1000 deg. Fah. It had been found impossible to get a British boiler to supply the steam, and the firm had to send to the United States for the requisite plant.

Mr. C. Erith said that the results recorded for a typical week's run of the boiler showing an overall efficiency of 83.8 per cent. were remarkably satisfactory. The advantages claimed for the use of thin walled tubes need not be taken very seriously. There were numerous boilers running with every success with thick-walled tubes 3 in. to 4 in. in diameter. The small tubes in the Runcorn boiler made the use of distilled water highly desirable. What were the considerations which led the designer to use the single flow in preference to the double flow principle?

Mr. G. E. Hider referred to the use of steam in rolling mills. The relation of the rated capacity of a rolling mill boiler to its peak load was of fundamental importance. To meet a peak load of, say, 140,000 lb. of steam an hour a Lancashire boiler of 70,000 lb. rated capacity would serve. If, however, the boiler were of the water-tube type it would have to be of a much larger rated capacity. He thought that rolling mill engineers would for many years to come prefer the Lancashire boiler to any form of water-tube boiler.

Major S. J. Thompson said that the boiler described by Mr. Nithsdale was not novel. The paper drew attention to the fact that the Yarrow boiler, which had proved very successful for low pressures, could be designed to work satisfactorily at higher pressures. Mr. Samuelson, in his quest for higher temperatures, should talk, not to the boilermakers, but to the steel manufacturers. He certainly had not asked his firm before going abroad for his 1000 deg. boiler.

Mr. W. H. Martin compared the solid forged drums used in the Runcorn boilers with similar drums lap welded by the Thyssen water gas process. Quoting particulars of a large number of lap-welded drums now in service, he said that their wall thicknesses ranged from 1½ in. to 2½ in., as compared with 3½ in. in the Yarrow boiler. All the lap-welded drums had been tested hydraulically to 3 or 4½ times the working pressure. He believed that by the use of lap-welded drums instead of forged drums from 30 to 60 per cent. could be saved in weight and 50 per cent. or more in the cost of the finished drums. On the Continent welded drums were replacing riveted drums for pressures in excess of 200 lb. to 250 lb. Forged drums became competitive only when the pressure was over 750 lb.

Mr. S. F. Dorey, discussing the results given by the thick and the thin wall formulae for the strength of tubes, said that the thick wall formula showed that as the internal pressure increased the stress in the metal rose very markedly. He thought that in the Yarrow boiler described in the paper the thickness of the tube walls could have been slightly reduced. According to the author, if a tube was stressed to 3000 lb. per square inch a temperature approaching 900 deg. Fah. might cause failure. He thought it was possible to go beyond that figure with safety. In the Benson boiler a factor of safety of two on the creep strength was employed. How long, he asked, could the Runcorn boiler be run without being cleaned, and what was the condition of the fire tubes at the end of a run?

Mr. Sterry B. Freeman said that pulverised fuel was more suitable for water-tube boilers than for Lancashire boilers and, therefore, if pulverised fuel was to be extensively applied at sea, it would be essential to develop the water-tube boiler for marine purposes. There had been a very great advance as regarded material and workmanship in marine water-tube boilers during the past ten years, and marine engineers no longer feared high temperatures and pressures. Water-tube boilers and mechanical grates had been extensively tried at sea, but what was still required was a plant low in initial cost and capable of being simply repaired and run by plain engineers.

Mr. F. H. Newman commented upon the fact that the economisers used in conjunction with the Runcorn boilers were not of the contraflow type. He calculated that with contraflow economisers 3240 square feet of surface would have served the purpose of the 5500 square feet actually provided. He noted, too, that economiser tubes of special non-corrodible steel had been employed. In an economiser the velocity of flow greatly affected the corrosion of the tubes. If a forced draught contraflow economiser had been used

corrosion difficulties would, he maintained, have been largely overcome.

Dr. Daniel Adamson remarked that pyrometer readings of the temperatures existing between the rows of tubes were untrustworthy and were more likely to indicate the tube wall temperature than the gas temperature. He noticed that the author estimated the energy required to drive the station auxiliaries at about 1 per cent. of the total heat released in the furnace. That figure was, he thought, very low, as 3 to 4½ per cent. was the usual allowance. In a high-pressure boiler plant the feed pump alone was responsible for a considerable consumption of power.

Mr. W. H. Patchell, dealing with the difficulty mentioned by the author, of designing a high-pressure boiler to extract from the furnace gases as much heat as that extracted by a low-pressure boiler, said that the argument was a familiar one. The back of the boiler suffered as regarded heat transmission from the reduced difference between the temperature of the gases and the saturation temperature of the steam. As a consequence, for high-pressure plants economisers were coming into favour again as a means of lowering the temperature of the exit gases. At one time steaming in a condenser was regarded as objectionable. To-day, however, the steaming condenser was being sold as the latest development of practice—a fact which seemed to suggest that people believed they could obtain an economiser more cheaply than a boiler. He thought it was quite true that higher boiler pressures and temperatures were dependent upon the steel maker. The tube maker also had his part to play in the advance.

Mr. Taylor Fleming asked the nature of the contingency provided for by the liberal rating of the forced draught and induced draught fans. The fans used had apparently a very flat characteristic curve, the very reverse of what was wanted in a boiler plant. The efficiency of the forced draught fans was given as being 50 per cent., but with good modern designs efficiencies of 60–75 per cent. were quite obtainable. The efficiency of the induced draught fans was said to be 22–24 per cent., but there was no reason why it should not be 65 per cent.

Mr. B. Samuels said that a decrease in the flue gas temperature of about 25 deg. Fah. for each 1 per cent. by which the CO₂ content was increased above 12 per cent., was not in accordance with his experience. There was no difficulty in building a large boiler. The difficulty lay in burning a sufficiency of coal beneath it, otherwise than by resorting to pulverised fuel.

Mr. H. E. Yarrow said that there had formerly been a rooted objection to the use of water-tube boilers at sea largely because of the fear of salt getting into the tubes. To-day, however, improved methods of condenser construction had practically eliminated all chance of sea water leaking into the circulating system. He had hoped that some steel manufacturers would have taken part in the discussion. Heat-resisting steels resisted heat, but they were brittle and could not withstand being expanded into a tube plate. It appeared probable that in the near future still higher temperatures and pressures would be employed on land and at sea.

Mr. Nithsdale, replying briefly to the discussion, said that he would not take Mr. Kirk too seriously. There was no reason why tubes should be limited in length to 90 internal diameters. They could be, and had been, made up to 100 diameters in length. There was little likelihood of any difficulty arising in connection with the removal of a defective tube from the middle of the larger nest. At that point the temperature of the gases was about 1000 deg. Fah., and unless a defective tube had originally been used, there was no fear of a failure occurring. If any tube was going to fail it would be one of the fire tubes, and those tubes were quite accessible. Replying to Mr. Erith, he said that there was no advantage in employing the single flow in place of the double flow principle, except that the single-row type happened to suit the building available for the boilers. He could undertake to surprise Mr. Hider in the matter of high peak loads by showing him what could be done with a water-tube boiler in a destroyer. After a run the inside of the Runcorn boilers was found to be beautifully clean. Economisers, he continued, were handicapped by high inlet feed temperatures and, therefore, in order to obtain a low leaving temperature for the flue gases, resort had to be made to the air heater. He himself did not place much reliance on pyrometer readings of the gas temperature between the tubes. Fan design was, he thought, an occult science, but it was, undoubtedly, false economy to restrict the size of the auxiliary equipment of a boiler plant.

Obituary.

SIR WILLIAM SYMINGTON M'CORMICK.

WE regret to have to put on record the death of Sir William Symington M'Cormick, G.B.E., LL.D., F.R.S., who died suddenly of heart failure in Barcelona, on March 22nd. Born in 1859 at Dumfries and educated at Glasgow, Göttingen, and Marburg universities, his was a life filled to overflowing with varied

interests. In his early career, after being a partner in a firm of Glasgow publishers, his inclinations led him to the scholastic side of life, and we find him as Assistant to the Professor of English in Glasgow University and Professor of English at Dundee University. Later on he accepted the onerous position as Secretary to the Carnegie Trust, which, under his capable administration, did much to advance university education in Scotland, and there are many who will look back upon Sir William in this respect with more than mere remembrance.

By our readers, however, it is as Administrative Chairman of the Advisory Council for Scientific and Industrial Research that Sir William M'Cormick will be best remembered. On accepting the position of Administrative Chairman of the Council in 1915, he at once turned all his energy and tact, with both of which qualities he was endowed to no small extent, to compelling the interest of the industrial and scientific world towards its plans. That in its early days he and those working with him might have become dispirited, can well be imagined. After its first year of working, we find ourselves saying—*THE ENGINEER*, December 8th, 1916—"Ever since the Advisory Council was set up, we have deplored the indifference that was shown by the general public and even by those very people who should have most ardently supported it. To overcome that indifference is one of the duties of the new Department, and it will best achieve it by a ready sympathy with all who desire to see investigation conducted, by breadth of outlook, and by displaying in itself that spirit of adventure without which research cannot be carried to its greatest heights."

Sir William and his Council were not to be discouraged, and in the fourteenth annual report, December, 1929, we read: "All the research organisations of the Department have the same tale to tell of increased requests for special investigations and for advice on industrial problems, and of the cordial co-operation and help they have received from outside." The long years of patient work and tact had told their tale. Apathy has disappeared, and co-operation has taken its place.

A portrait, painted by Sir William Orpen, R.A., hangs in the Tate Gallery. Thus will his likeness be preserved; but to those, his friends, Sir William's charm of character will ever remain, and his absence prove a blank not easily filled.

SIXTY YEARS AGO.

LONDON'S earliest tube railway was about to be opened for public service sixty years ago. It ran beneath the river in the neighbourhood of the Tower. It still exists, but its use was long ago abandoned. The scheme was conceived and carried out by Mr. Barlow, and is historically interesting not only because it was our first tube railway, but because it provided the first opportunity for applying the Great-head shield in practice. It was a tube railway in the proper sense, in that it was formed by boring through the London clay and lining the bore with cast iron tubular segments. The tunnel afforded a means of avoiding a detour by way of London Bridge or of escaping from the discomforts of a water passage from the Tower Stairs. When, as we felt sure it would soon do, the Subway Company had established a reputation for cheap, quick and comfortable service, it would, we estimated, attract nine-tenths of the existing traffic and create additional new traffic. At each end of the tunnel there was a station, which we described, no doubt sufficiently well, as being "an iron box with a pavilion roof." From the street level a lift "with stuffed seats and lit with lamps" took six or seven passengers at a time to the bottom of the shaft in a space of twenty to twenty-five seconds. The passengers awaited their vehicle in a white-washed apartment "having seats along each side and well lit by four lamps." While waiting they would no doubt amuse themselves by reading the company's by-laws, one of which was to the effect that a surplus charge of 40s. would be levied on anyone riding on the steps or roof of the vehicle. The warning was perhaps superfluous, at least as regarded riding on the roof, for between it and the top of the subway there was scarcely room for a moderately thick pancake. The vehicle of transit was an iron omnibus, "more cleanly and less uncomfortable than an ordinary street omnibus." It ran on rails which were laid on an incline from each end of the tunnel down to the mid point. At first it was intended that the energy acquired on the first half of the journey should carry the omnibus up the slope of the second half, the small amount of additional power required being provided by the conductor by manual or more exactly by foot power. In the end this scheme was abandoned and the power required was supplied by a 4 horse-power haulage engine at each end. Some delay occurred in the opening of the tunnel for public service, the chief cause being a lack at first of a satisfactory system of communication between the conductor of the omnibus and the attendant at the hauling engine. We fully anticipated that Mr. Barlow, having shown how "to make the egg stand on end," would speedily be copied by others. Another twenty years had, however, to elapse before the first of our present tube railways was opened for public traffic, the City and South London Stockwell line, in December, 1890.

For the purpose of conveying bulky and heavy loads by road a Liverpool company has constructed a fourteen-wheeled lorry, which is steered from both ends. It weighs 28 tons, and its first job will be to transport a rudder frame weighing 67 tons from the Darlington Forge to Glasgow. It is capable of carrying a load of over 100 tons.

Design and Results of a 600 lb. per Square Inch Boiler Installation.*

By WILLIAM NITHSDALE, B.Sc., Associate Member.

HIGHER pressures for steam generation have not perhaps been so rapidly adopted in Britain as in other countries, but on land there is now an increasing tendency towards them. Marine practice is gradually following land practice in this respect, and a number of the latest liners and cargo vessels are fitted with water-tube boilers operating at much higher pressures than were usual a few years ago. It is a basic principle that the higher the initial steam pressure the higher is the possible theoretical overall efficiency of a steam power plant. More work can be obtained in the prime mover from steam as its pressure is increased, and for the same final superheat temperature less heat is required to produce 1 lb. of high-pressure steam than is the case with low-pressure steam. Every steam user, in determining the most economical pressure for adoption, has to consider his case on its merits, taking into account all local conditions, such as fuel costs, capital charges, load factor, &c.; but, generally speaking, a high pressure merits consideration where the load factor or the cost of fuel or both are high. At sea higher pressures are enabling the steam turbine, which has the great advantage of being a rotary engine, to maintain its supremacy.¹

An endeavour will be made to discuss some points in the design of a high-pressure boiler plant, with special application to a land installation which has been in commercial operation for some time in Britain. Particulars will be limited to the steam-raising parts only of the installation. The main boiler safety valves are set to lift at 600 lb. per square inch, which is consequently the pressure governing the design of the scantlings, while the actual working pressure is 575 lb. per square inch gauge. The plant comprises two complete steam generating units designed and constructed by Messrs. Yarrow and installed at the works of the Castner-Kellner Alkali Company, Runcorn, a subsidiary company of Imperial Chemical Industries. They were ordered in January, 1927, and the first was put on load in May, 1928, the second following two months later. The whole design was evolved under the supervision of the engineers of Imperial Chemical Industries and Dr. P. T. Petrie, Chief Engineer of the Manchester Steam Users' Association, whose staff had the survey under their care.

It will be desirable to begin at the proposal stage, when careful study of the particular power requirements, which gave rise to a high load factor, decided the company to adopt the following performance for each unit:—

Normal evaporation	61,500 lb. per hour
Overload evaporation	77,000 lb. per hour
Steam temperature	780 deg. Fah. maximum
Working pressure (gauge) ..	575 lb. per square inch
Feed temperature	225 deg. Fah.
Fuel	Coal
Calorific value of fuel	10,000 B.Th.U. per lb.

Stoker firing was most readily adaptable to the conditions obtaining at the works, but adequate height was allowed for an extension of the combustion chambers downwards should a change to pulverised fuel firing prove desirable later. Better coal, having a minimum calorific value of 11,500 B.Th.U. per pound with 25 per cent. of volatiles, and a maximum of 15 per cent. moisture and 15 per cent. ash, was likely to be available under ordinary conditions, but the performance was to be based on the poorer quality stated above.

The overall design called for exhaustive study in arriving at the most commercially economical combination of surfaces to give a low leaving temperature for the flue gases. Compared with 200 lb. per square inch working pressure, where the saturation temperature is about 388 deg. Fah., the higher pressure of 575 lb. corresponds to a fluid temperature of 486 deg. Fah., which is nearly 100 deg. Fah. higher and adverse to heat transfer as the mean temperature difference between the gases and water is reduced. In low-pressure work 550 deg. Fah. is a common temperature of exit of the gases at ordinary ratings—for 200 lb. per square inch this is 162 deg. Fah. above the saturation temperature—but it becomes an impossible figure at higher pressures, and above 1000 lb. per square inch the saturation temperature itself exceeds 550 deg. Fah. For a given rating a boiler surface at 200 lb. per square inch pressure can be expected to reduce the temperature of the gases more than the same surface at 575 lb. per square inch; in other words, the high-pressure boiler has to be of larger surface to give the same exit temperature. This is a point to be noted in designing for the highest efficiencies when it is considered that about 30 deg. Fah. or 35 deg. Fah. gas temperature represents roughly 1 per cent. efficiency in a coal-burning boiler with reasonably good combustion, but as compensation it should be remembered that the high-pressure generator produces superior quality steam.

Performance curves of a 200 lb. per square inch pressure Yarrow boiler are shown in Fig. 1, deduced from various records taken by means of pyrometers placed between the different rows of tubes, and show the fall in temperature as the gases traverse the tubes. The abscissæ represent the number of tubes the gases have passed after leaving the furnace and the ordinates the corresponding temperatures in degrees Fahrenheit. It is probable that nearly half the total heat transfer takes place in the first two rows of tubes bordering the combustion chamber of such a boiler, by direct radiation from the furnace. From the preceding paragraph it follows that these curves could not apply as they stand for 575 lb. per square inch pressure, but they may be sufficiently accurate for higher pressures up to 600 lb. per square inch if the ordinates are increased by the amount the saturation temperature increases. In the boiler from which these records were taken the ratio of radiant to convection surface differed somewhat from the high-pressure surfaces under review; also it will be apparent that the superheater was smaller.²

* The Institution of Mechanical Engineers.

¹ See Mr. J. Johnson's paper on "The Propulsion of Ships by Modern Steam Machinery," "Trans." I.N.A., 1929, Vol. LXXI., page 39.

² Mr. Harold E. Yarrow gives valuable figures showing the drop in temperature of flue gases passing tubes in his paper on "Results of Experiments with a Water-tube Boiler, with Special Reference to Superheating," "Trans." I.N.A., 1912, Vol. LIV., page 159.

The CO₂ percentage realised in flue gases, indicating the amount of excess air being used, gives a measure of furnace efficiency and has an important bearing on the performance of a boiler, particularly of this type, where a large proportion of the heating surface is susceptible to radiant heat. Transfer of heat by radiation is proportional to the fourth power of absolute temperature and therefore increases very rapidly as furnace temperature rises. (By convection, the rate of heat transfer is only directly proportional to absolute temperature.) If a design is based on giving certain results with 12 per cent. of CO₂ realisation of 13 per cent. means less excess air, less weight of gas and

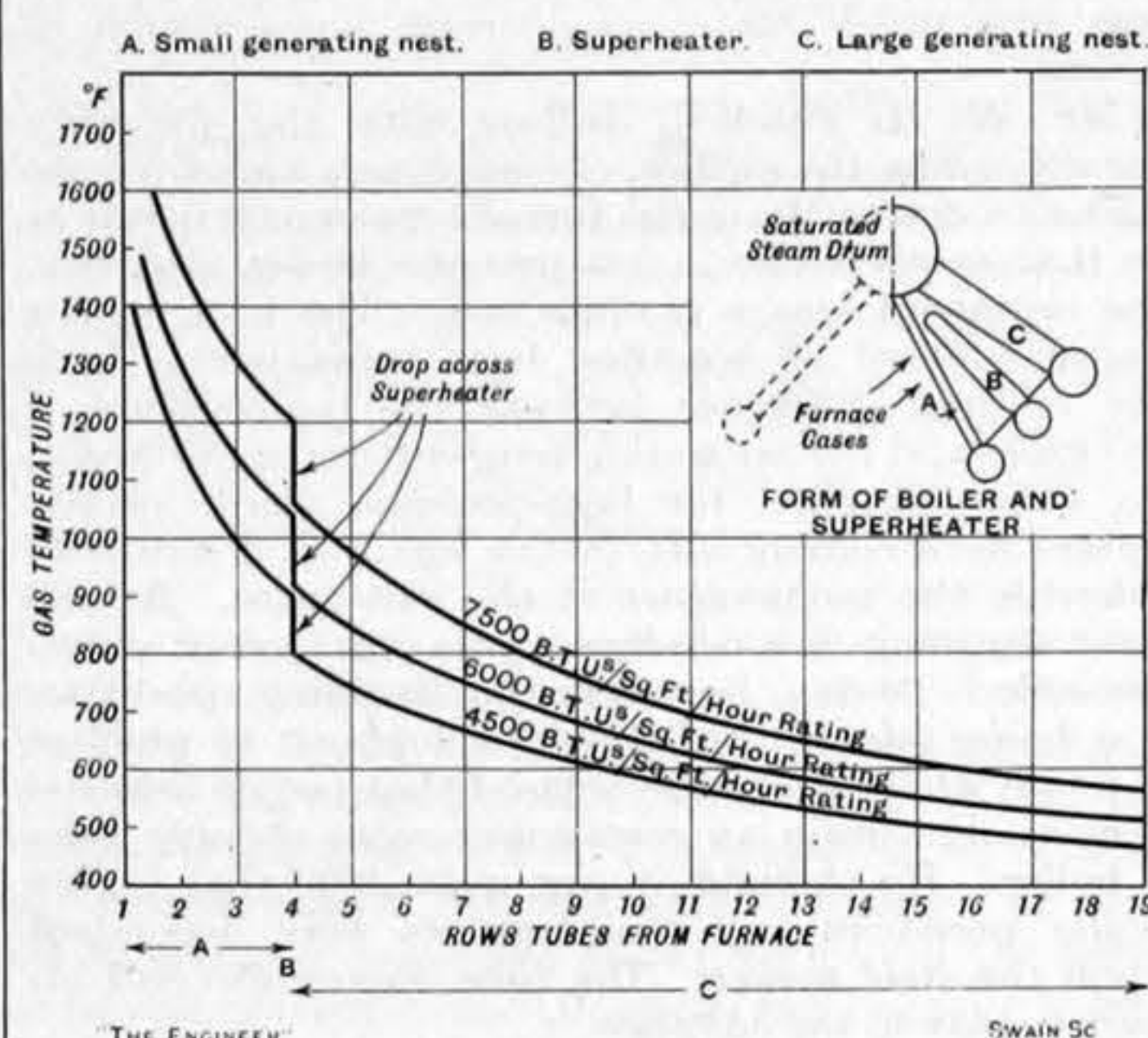


FIG. 1

Approximate Gas Temperature Drop through a 200 lb. per Square Inch Pressure Boiler and Superheater.

a higher initial furnace temperature. The heat absorption by radiation is more effective in view of the higher temperature and the ultimate result is a lower gas temperature at the boiler exit. This decrease in gas temperature may be in the region of 25 deg. Fah. or more for each 1 per cent. the CO₂ is increased above 12 per cent. up to, say, 14 per cent., and conversely if the CO₂ is allowed to fall to 10 per cent. instead of a projected 12 per cent. the gases may be expected to leave at a temperature 50 deg. Fah. higher. The foregoing observations are based on an "ideal CO₂" of 18.5 per cent. By "ideal CO₂" is meant the percentage of CO₂ resulting from perfect combustion of a fuel. Usually the ideal figure varies between 18 and 19 per cent.

Output = 75,000 lb. steam per hour. Pressure = 600 lb. per square inch. Steam temperature = 750 deg. Fah.

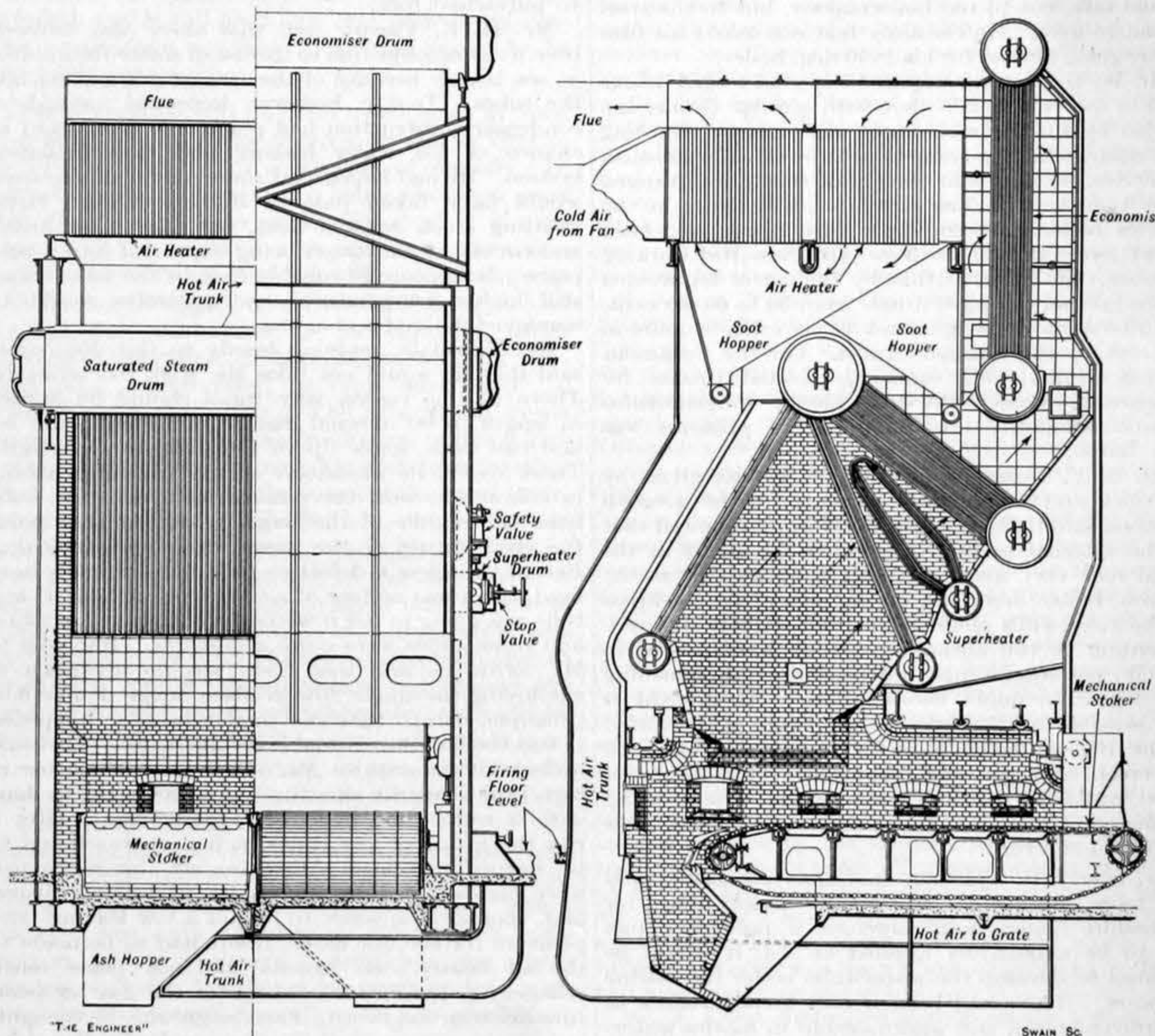


FIG. 2

High-pressure Boiler Installation.

FIG. 3

Transverse Section of Boiler.

with ordinary British coals, depending on their actual composition. Oil fuel gives an "ideal CO₂" figure of about 15.5 per cent.

Having in view the pioneer nature of this installation, it was imperative that a margin should be allowed in designing; thus it was decided that the exit temperature of the flue gases should be 600 deg. Fah. on a CO₂ content of 12 per cent., but to give a margin the figure was taken as 650 deg. Fah. and the area of the other heat-extracting surfaces calculated accordingly.

The design of the superheater was more straightforward, being comparable with low-pressure work. Less heat requires to be imparted to steam for a given final tem-

perature, as its pressure is increased, although in this case also the mean temperature difference becomes less. It is of interest to note that in the integral superheater of a coal-burning boiler, traversed by all the gases and passing all the steam, the rise in temperature of the steam is approximately equal to the temperature drop of the gases across the tubes, when the CO₂ content of the gases is 12 per cent. Special heat-resisting tubes were not obtainable in 1927 and with the quality of steel then available it was considered advisable to limit the maximum (overload) temperature of the steam to 780 deg. Fah.

Economisers are subject to convection heat only and in consequence give the best results when the temperature difference between gases and water is high. Feed heating by bled steam, &c., limits the advantage of an economiser owing to the higher temperature of the inlet water. Air heaters also are subject to convection heat only, but can be designed on the contraflow principle to give low gas temperatures at exit because the temperature of the entering air is but little more than atmospheric. At the same time a large drop in the temperature of the gases through an air heater produces high air temperatures which are deleterious to the cast iron fire-bars of a mechanical stoker. Combinations of economiser and air heater are frequently used when a low chimney temperature is required. For the economiser and the air heater and for a combination of both there is a performance which it is uneconomical to exceed, as the improved result obtained, expressed in saving of fuel over a number of years, does not cover the cost of the additional surface involved. In the plant under review a final temperature of 275 deg. Fah. for the gases was aimed at with economiser and air heater in series. The surfaces were proportioned to give the desired result on a sound economic basis, different ratios of surfaces of economiser to air heater being tried, and that which gave the required performance at lowest cost being adopted. Approximate figures useful in such estimations are:—

Economiser:

$$\frac{\text{Rise in feed temperature}}{\text{Drop in flue gases}} = 0.4 \text{ to } 0.5$$

Air Heater:

$$\frac{\text{Rise in air temperature}}{\text{Drop in flue gases}} = 1.0 \text{ to } 1.2$$

As the plant had to be housed in an existing building, an important limitation was imposed on the construction of the various parts. It was also requisite that the gas flow should be arranged to suit a special layout of flues. These conditions were met successfully, showing the elasticity possible in boiler design.

The general arrangement of a unit is shown in Figs. 2 and 3, the latter showing the arrangement more clearly. A unit comprises boiler with integral superheater, superposed economiser, superposed air heater, and mechanical

stoker. Forced and induced draught fans are fitted so that the furnace operates under conditions of balanced draught.

The boiler is of the single-flow type, in which all the gases pass the saturated steam drum at the front, the superheater being situated between two nests of generating tubes in such a position that the fluctuation in steam temperature at varying loads is a minimum. The generating tubes at the back of the boiler act as a water screen for the absorption of radiant heat only. All the boiler tubes are well inclined, those which are in the nests adjoining the fire and in which the greatest heat transfer takes place are nearly vertical and well drowned. In the superheater also

the tubes are steeply inclined and self-draining, whilst the large integral drum acts as a steam receiver. The gases flow straight across the boiler and then upwards round the vertical steel tubes of the economiser as indicated by the arrows. Deflectors, which can be rotated to dislodge flue dust, are provided in the economiser. The air heater is provided with vertical tubes and is in two sections, the gas passage being downwards through the tubes in the first section and upwards in the second section. The gases are finally discharged to a common horizontal main flue which passes along the top of the wall, at the back of the boiler-house. Cold air from the forced draught fan enters the air heater at the rear of the plant, passing round the outside of the tubes, as indicated in Fig. 4, and through the hot air trunks to the grate. One twin stoker is installed and the furnace arches are of the double suspension type.

Vigorous circulation of the water is maintained in each bank of boiler tubes due to the temperature difference of the gases entering and leaving. Circulation is free and independent in each bank. A large proportion of the heating surface is exposed to the direct radiation of the furnace. An advantage in a large tube surface surrounding a furnace is that the heat becomes absorbed so rapidly by the boiler that the brickwork side walls of the furnace do not reach deleterious temperatures. A high percentage of CO₂ and low suction draughts which are necessary for high efficiency can also be carried safely.

Among other points of special interest in the design it may be mentioned that all parts subjected to internal pressure are cylindrical in section, that being the best form. The combustion chamber is large to enable combustion to be complete as far as possible before the gases reach the tubes. For inspection and cleaning it is only necessary to remove the manhole doors to gain access to the drums. The saturated steam drum from which most inspection and cleaning can be carried out is of large diameter. The tubes are all straight.

The principal particulars of a unit are as follows:—

Generating heating surface	10,500 sq. ft.
Superheater heating surface	3,250 sq. ft.
Air heater heating surface	12,050 sq. ft.
Economiser heating surface	5,500 sq. ft.
Grate area	324 sq. ft.
Combustion chamber volume	4 330 cu. ft.

The boiler, superheater and economiser are supported on steel columns and girders, cast iron or steel tools bolted to girders being placed under the saturated steam, economiser and superheater drums. The nests of boiler tubes are free to expand longitudinally from the saturated steam drum which supports them.

The whole unit is, of course, completely steel cased, thereby ensuring air-tightness throughout. The casing is lined with asbestos and brickwork at the hottest parts and lagged efficiently near the air heater. The hot air trunks are also lagged.

Flue dust is removed from the hoppers below the air heater by screw conveyors driven by chains, and is discharged through pipes to an ash trough in the basement.

The boiler drums were machined from hollow forgings manufactured by Messrs. John Brown and Co. The ends only of the drums are riveted. The forgings are of Siemens-Martin acid open-heat mild steel, having an ultimate tensile strength of 26-30 tons per square inch. The elongation on a standard test piece having a gauge length of 2in. and 0.564in. diameter was specified to be not less than 31 per cent. for 26 tons per square inch and not less than 27 per cent. for 30 tons per square inch, with corresponding elongations for intermediate limits. It might here be mentioned that in the manufacture of a drum an ingot is first cut to length and a hole of suitable diameter trepanned through it. The forging process expands and draws the ingot, the steel being worked both circumferentially and longitudinally over a mandrel. After suitable heat treatment the forging is finally tested and machined to the required size. Details of the completed drums are:—

Part.	Internal diam., inches.	Weight, tons.	Circular joint efficiency, per cent.		Min. factor of safety.
			Plate.	Rivet.	
Saturated steam drum	50	20.41	70.2	66.64	4.32
Large water drum	38	10.76	71.7	66.5	4.43
Lower front water drum ..	23	3.76	65.7	52	5.6
Back water drum	23	4.37	65.7	52	4.6

The thickness of the saturated steam drum shell is 3½in. The weights given are "finished weights" after the ends were riveted and the tube holes bored. The drums were all hydraulically tested to about 860 lb. per square inch before the tube holes were bored.

The boiler tubes are 1½in. external diameter, the two fire rows on each side of the furnace being No. 7 L.S.G. (0.176in.) thick, and the other rows No. 8 L.S.G. (0.160in.) thick. Their ductility, limit dimensions and hydraulic tests (1000 lb. per square inch) were in conformity with the standard conditions for the design and construction of water-tube marine boilers issued by the Board of Trade in 1923. The stress in the fire row tubes when the boiler is carrying a pressure of 600 lb. per square inch is about 2400 lb. per square inch and in the other rows about 2700 lb. per square inch. These stresses are low and give high factors of safety, the minimum tensile strength of the steel being not under 20 tons per square inch. It is important in high-pressure boiler work that the tubes should be as thin as possible, due regard being paid to the stress to be carried. If a tube is only stressed to 3000 lb. per square inch, a temperature approaching 900 deg. Fah. may cause failure. In a thick tube, due to the heat gradient across its walls, the mean temperature will be higher. Increased saturation temperatures naturally lead to reduced margins of safety for a given stress in boiler tubes, but a thin tube wall opposes little resistance to heat transfer and remains approximately at the temperature of the water. Where high rates of heat transfer are found, especially in fire-row tubes exposed to the sum of radiant and convection heat, it is still more important that the tube walls should be thin. These considerations point to the use of tubes of

small diameter. Tubes of large diameter necessitate increased thickness if the stress is kept low, or high stress if the tubes are kept thin, both of which are equally objectionable and operate to reduce the margin of safety.

The action of scale in causing a tube to burst is not always fully realised. Scale forming on the inside of a tube prevents the heat passing through the metal to the water, which causes local heating of the tube and consequent failure. Considering two clean tubes equally stressed—one of large diameter and thick, the other of small diameter and thin—a piece of scale just thick enough to cause failure of the thick tube would not necessarily overheat the thin tube. This is another point in favour of tubes of small diameter.

The tubes fitted throughout the plant are of cold solid-drawn manufacture, and although more expensive than those of hot-drawn manufacture, policy dictated the use of the best possible material for the part of the installation subjected to the heaviest duty. With regard to tensile strength and elongation, there is little difference between hot and cold-drawn tubes apart from that due to the kind of steel employed, but it will be appreciated that, owing to cold drawing, such tubes are of closer grain, smoother finish and more accurate than is possible in a tube finished by the hot process, and there is also little risk of a faulty tube escaping notice. The smooth finish greatly reduces the tendency for scale and flue dust to deposit. The tubes are expanded in the boiler drums in the usual way, and the ends bell-mouthed more to give a good entrance for the water to the tube than from considerations of strength.

Steam is led from the saturated steam drum through a steam pipe 6in. bore and enters the superheater drum at one end. By means of trough divisions in the drum the steam is made to flow several times round the U-tubes before leaving the superheater at the other end. The construction and materials used in manufacturing the

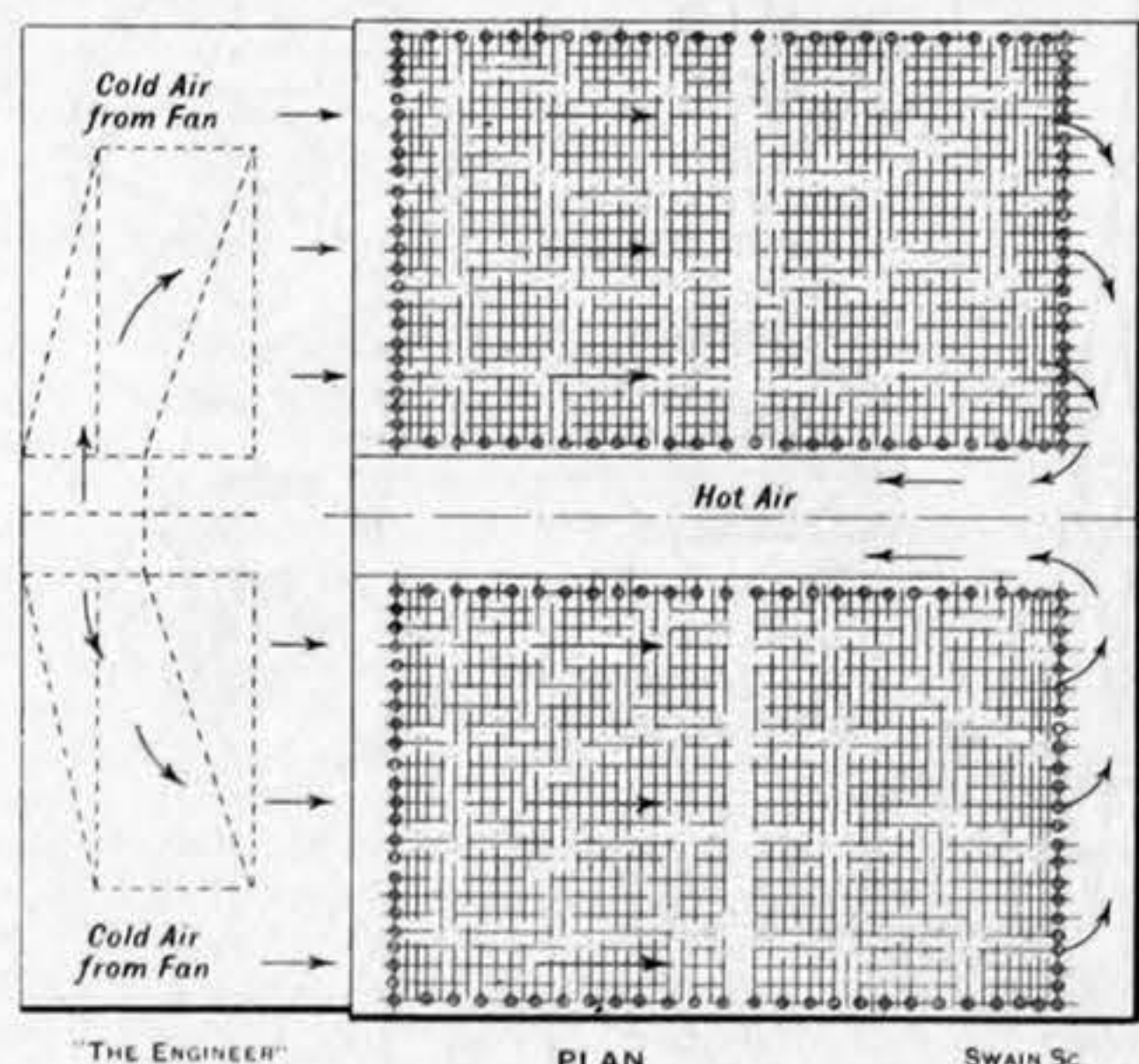
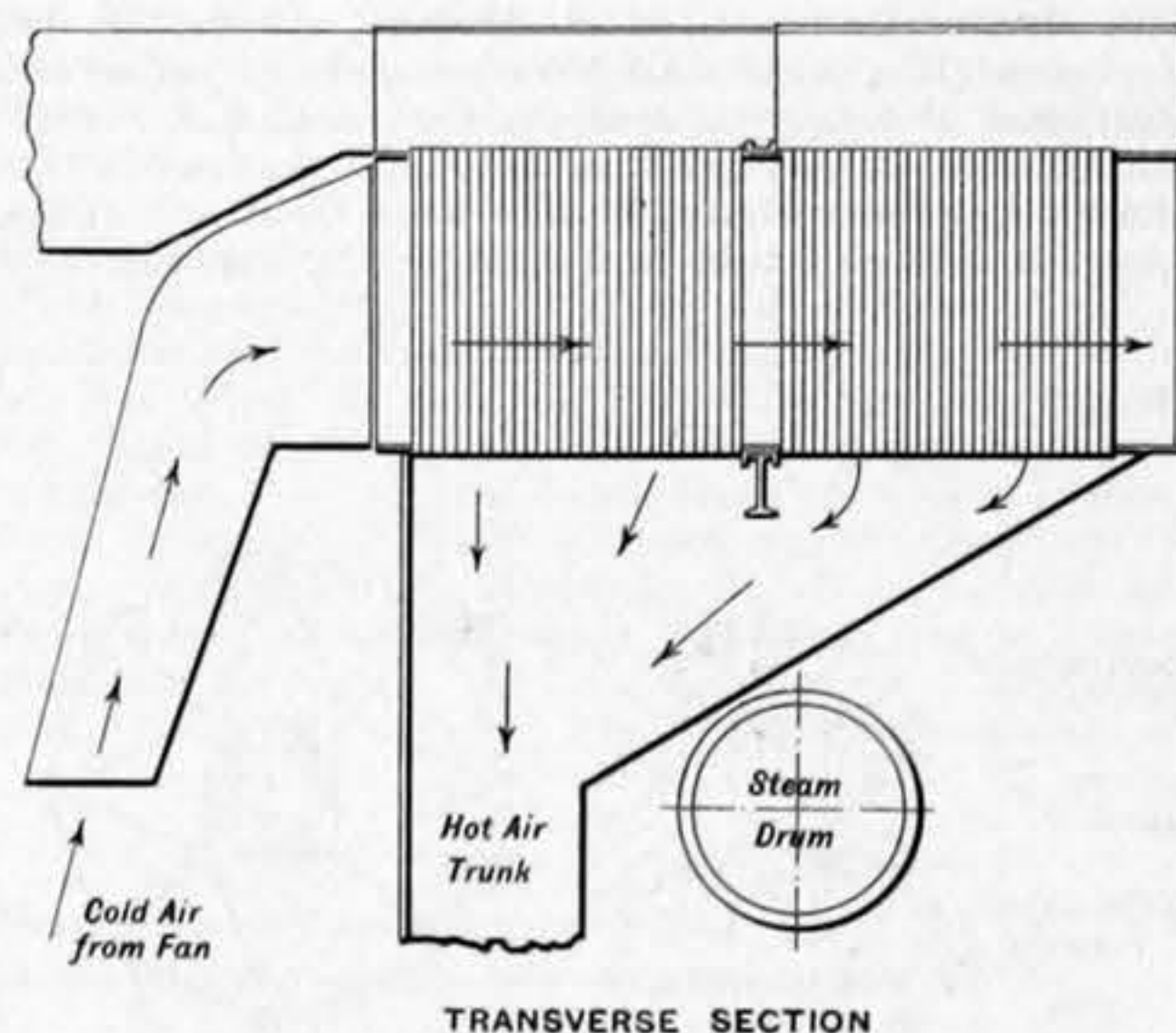


FIG. 4

superheater are similar to those of the boiler. The superheater tubes are 1½in. external diameter and No. 11 L.S.G. (0.116in.) thick. For 600 lb. per square inch pressure the stress is approximately 2300 lb. per square inch, which gives a safety factor (cold conditions) of about 19.5, the minimum tensile strength being taken at the low figure of 20 tons per square inch. It will be seen that the superheater is readily accessible and self-draining. Four rows of boiler tubes, fairly widely pitched, screen the superheater tubes from the furnace, from which the latter tubes receive a small proportion of radiant heat direct through the lanes of boiler tubes.

It is essential that a low stress for superheater tubes should be preserved. Recent research has shown that, whilst adequate strength is retained in ordinary mild steel up to about 750 deg. Fah., in the region of 850 deg. Fah. there is a serious lowering of strength, which rapidly falls away with still higher temperatures. At 850 deg. Fah. the ultimate strength is roughly one-half the value at atmospheric temperature, and the elastic limit falls to only one-third of its value when the metal is cold. The limiting creep stress is higher than the yield point at temperatures below 850 deg. Fah., but above this figure creep must be considered. In designing superheater scantlings the controlling conditions are:—"Elastic limit" up to 850 deg. Fah.; and "limiting creep stress" above 850 deg. Fah. In the plant under review the superheater tubes in the last pass, having steam at 780 deg. Fah. inside and still hotter gases outside, are very likely to approach a temperature of about 850 deg. Fah. when the elastic limit of the material may be little over 4 tons per square inch. Thus the true factor of safety based on the elastic limit is reduced to about 4, instead of 19.5 previously mentioned.

High pressures undoubtedly call for the use of steel in economiser construction, and the mention of steel econo-

misers raises the question of feed water. On the score of high pressure alone the purity of the feed demands the greatest care. Familiar chemical reactions at normal temperatures and pressures become disconcertingly problematical at high pressures and high rates of heat transfer. These points were fully realised by the Alkali Company, who wisely removed anxiety by using only distilled water for feed make-up.³ As a further precaution special economiser tubes were obtained of non-corrodible steel. They were made to British Standard Specification No. 53, and each was tested hydraulically to 1000 lb. per square inch. The life of these tubes is claimed to be three to five times that of ordinary steel and comparative tests made by placing similar tube samples side by side for twenty-eight days in a 5 per cent. solution of sulphuric acid showed a loss in weight in grammes per square centimetre of exposed surface of 0.049 in the case of non-corrodible steel and 0.243 for ordinary steel. The tubes are 2in. external diameter and No. 6 L.S.G. (0.192in.) thick. The construction of the economiser is similar to that of the boiler. The drums are each 38in. diameter, about 12 tons in weight, and have a minimum factor of safety of 4.8. Feed water enters the economiser at one end of the top drum and leaves at the other end of the same drum, there being no internal divisions.

The manhole doors are jointed with ordinary high-quality asbestos composition. These are the only bolted joints in the whole of the parts subjected to pressure. It is important that the number of bolted joints should be reduced to a minimum under conditions of high pressure.

There are no features of special interest about the air heater, which is built up of tubes of 2½in. external diameter, No. 14 L.S.G. (0.08in.) thick expanded at each end into tube plates. The gases flow through the tubes and the air round the outside of the tubes.

The stoker is the Underfeed Company's latest class "L" "louvre" type, 17ft. 6in. wide by 18ft. 6in. long, arranged as a twin grate, with separate air compartments enabling the distribution to the different sections of the grate to be varied at will. Each grate has a separate electric motor and driving mechanism.

Davidson's "Sirocco" type fans are installed, motor driven, the forced draught being of the double inlet and the induced draught of single inlet form. They are liberally rated in order to give a large margin for any contingency.

(To be continued.)

High-power Mercury Arc Rectifiers.

In a paper on "High-power Mercury Arc Rectifiers," read by Mr. J. C. Reed at a recent meeting of the Rugby Engineering Society, it is shown that mainly as the result of increased knowledge of the mechanism of the arc, progress in the design of power rectifiers has been made in two directions. Arc-backs have at least become sufficiently rare for satisfactory commercial service regularly to be obtained, and there has been a striking development in the rating that can be secured from a given size of rectifier. The limits both of current and voltage obtainable in a single unit are now well above anything that is likely to be required at present. As the losses, cost and size of a rectifier, distinct from its transformer are all functions of current rather than of kilowatts, and are affected by voltage to only a minor degree, the field of appreciation of the rectifier is at high voltages. The author contends that for ordinary power and lighting service at 500 volts, and below, the rectifier is only commercially justifiable in very rare cases, and not at all at the lower voltages.* For traction at 600 volts the rectifier has higher cost, larger floor space, and from 1½ to 2 per cent. lower efficiency than rotating machinery, and is therefore generally only justifiable in special cases, where rotaries are unsuitable on account of noise, ventilation difficulties, intended frequency change or very low load factor. At 1500 volts the rectifier compared with two 750-volt rotaries in series is about equal, or slightly lower in cost, requires less floor space, and has from 1½ to 2 per cent. better efficiency. It is considered, however, that owing to its inherent disadvantages of low-power factor and impossibility of regeneration, the two classes of apparatus will probably exist side by side at this voltage. But at 3000 volts and above the rectifier will probably displace rotating machinery almost entirely, for it shows advantages in cost, efficiency and floor space sufficient to offset the loss of the ability to use regenerative braking. It is considered, in fact, that at 3000 volts the rectifier may settle the rivalry between the direct-current and alternating-current systems for railway electrification in favour of the former.

As interesting examples of recent rectifier installations, the author quotes the following:—The Berlin suburban railways, which have been electrified at 800 volts, principally with rectifiers; the Czechoslovakian State Railways, which are using a 1500-volt, 4270-kilowatt rectifier; the Consolidated Mining and Smelting Company, which is installing a 650-volt, 6500-kilowatt rectifier; and the Delaware, Lackawanna and Western Railroad, which is to be worked by means of eighteen 3000-volt rectifiers with a total capacity of 37,000 kilowatts.

The paper deals with the principle of operation, the plant involved in a rectifier equipment, the theory of the mercury arc, the vacuum gauge and relay, the vacuum pumping system, ignition and excitation, water cooling, the calculation of the electrical characteristics, transformers and their connections, surge protection, the smoothing circuit, bake-out equipment and performance, and cost. Here, however, we shall only consider a few interesting points. In connection with water cooling it is shown that close temperature control is essential, and except when

³ Mr. John Anderson's valuable account of his 1300 lb. per square inch pressure plant at Milwaukee is of great interest in this connection. In his high-pressure boiler, troubles developed due to water conditions, which, it is understood, were quite satisfactory in 300 lb. per square inch pressure boilers alongside. His account also emphasises the importance of tight condensers and indicates that to prevent corrosion the oxygen content must be a minimum.

* This is contrary to the experience of Brown, Boveri and Co., who have supplied more rectifiers for 500 volts and lower pressures than for pressures above 500 volts.—ED. THE E.

tap water is abnormally costly or is liable to produce corrosion, it should always be used. A 1500-kilowatt, 600-volt rectifier will put about 18 kilowatts of loss into its cooling water per 1000 ampères, and will require about 150 gallons of water per hour per 1000 ampères. Assuming 40 per cent. load factor, 6000 hours operation per year, and water at 1s. per 1000 gallons, the annual cost of water will be about £44.

If a closed circuit cooler were employed, the fan and circulating pump would require about 10 H.P., which, with power at one-third of a penny per kilowatt-hour, would cost £60 per annum, apart from the annual charges on the capital cost—about £300—of the cooler and its accessories. At 600 volts and 40 per cent. load factor, the cost of water is of about the same magnitude as the cost of brush replacements on rotary converters, but at higher voltages it becomes much less. It is highly desirable that all water jackets on the rectifier should be made easily removable for inspection and renewal of the protective enamel, and for cleaning out sediment. Owing to the rectifier and its jackets being highly positive to earth electrolytic corrosion is rendered negligible by introducing the water through insulating rubber hose, and by insulating the water outlet by a drip arrangement. Such electrolysis as does take place is concentrated adjacent to the ends of the insulating section and special carbon bushes are inserted to take the corrosion at these points. Preferably, the water used should have a resistivity of at least 2000 ohms per cubic inch and a hardness not exceeding 200 parts in a million. Where water is scarce or costly, or where it is excessively conductive or corrosive, closed-circuit cooling systems are used. Where the elimination of electrolytic corrosion is aimed at, either the complete water system may be insulated or the cooler may be at earth potential and distilled water should be used. While the latter arrangement is the most simple, it involves very careful cleaning of the water system in order to avoid contaminating the distilled water, but it is used with success in several places. Evaporative coolers result in a continually increasing amount of sediment in the water, and the coolers are therefore always of the fan-cooled radiator type, with a circulating pump. In some of the early installations thermosyphon circulation was employed, but its use is not likely to be repeated.

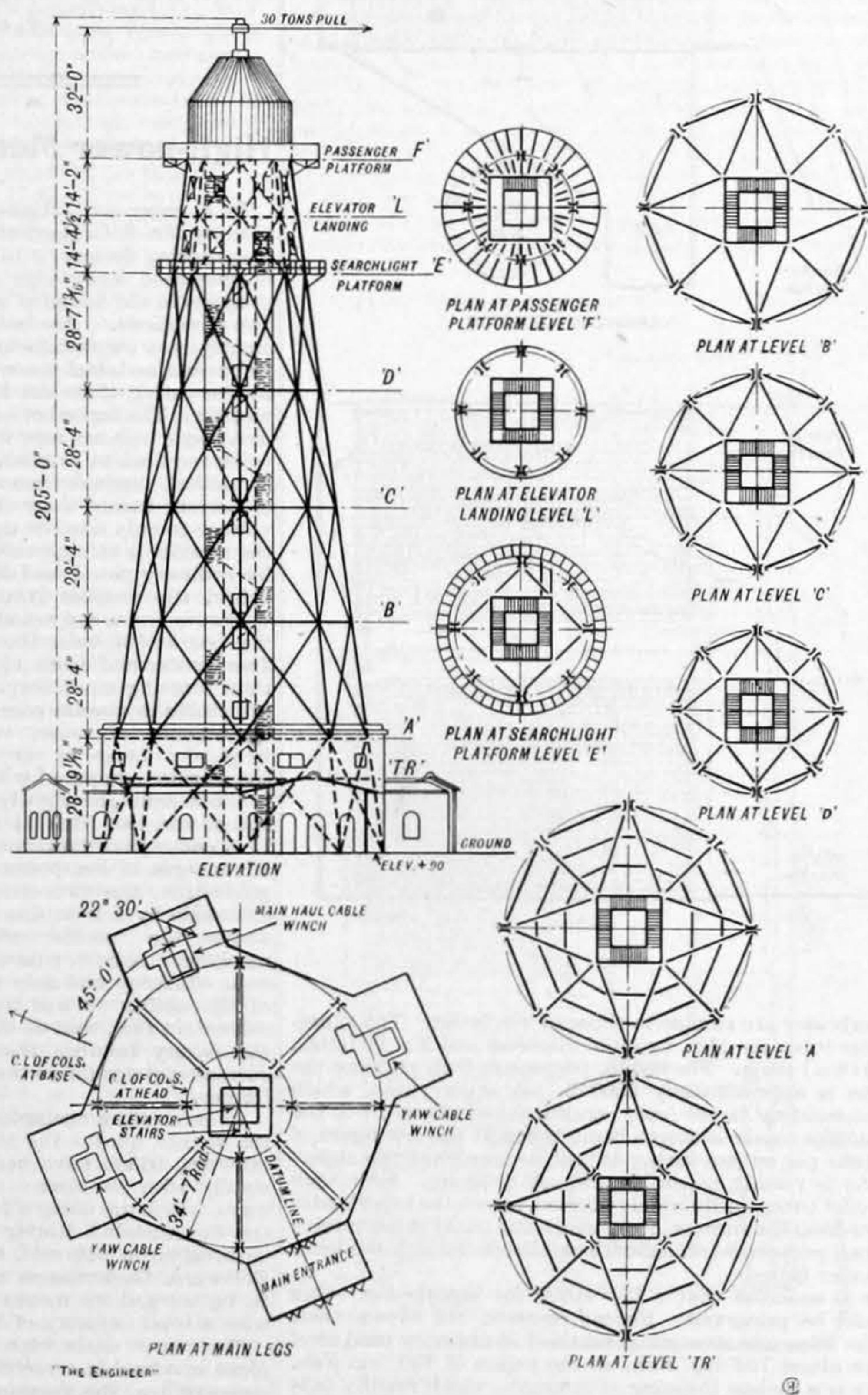
The author maintains that the rectifier involves greater total complication than rotating machinery, but its characteristics are sufficiently advantageous, mainly at high direct-current voltages, to justify its use within its own proper field of application. The rating of any given size of rectifier is fixed rather by the current to be carried than by the kilowatts, and thus the size and cost decrease rapidly at high direct-current voltages. As the heat storage capacity of the anodes of a rectifier is much smaller than that of the stator and rotor of a machine, the heavy loads normally called for in railway service—as far as the rectifier portion of the equipment is concerned—are obtained by designing the rectifier for an increased continuous rating. On the other hand, momentary overloads and short circuits are more easily carried by rectifiers than by rotary converters. As regards efficiency, most of the loss is in the arc drop, which varies only slightly with current, and is independent of voltage. Consequently, the efficiency is nearly constant over a wide range of load, and improves considerably with increasing direct-current voltage. In railway service the load is usually very fluctuating and the load factor is therefore low, and this gives the light load efficiency of the rectifier some importance. The author shows that in the case of 600-volt units, the rectifier will give a better all-day efficiency than rotary converters on any load factor lower than about 40 per cent. Load factors of 20 to 25 per cent. are not uncommon, especially on the Continent, and in such cases rectifiers are showing improved all-day efficiencies. But in most of these cases the connecting plant is too large for the load, and when proper advantage is taken of the over-load capacity of rotaries, load factors below 30 to 35 per cent. are rare.

In dealing with power factor, the author points out that it is not always realised that a power factor that is other than unity can mean anything else but a lag or lead of the current. But in the case of six-phase rectifiers the wattless current consists only partly of lagging current, the remainder being harmonic currents due to the non-sinusoidal wave form of the current drawn from the alternating-current supply. With twelve-phase operation the harmonic current is practically eliminated, but there is usually a slight increase of lagging current. Owing to the pressure of the harmonic currents, the power factor cannot be determined from the ratio of two wattmeter readings, but only from the ratio of watts to volts ×

ampères. The provision of power factor meters is useless, as apart from the fact that the power factor is not under control, the readings of such meters are meaningless when applied to rectifiers. Although no reliable information is as yet available as to maintenance cost, as the production of reliable rectifiers only dates back a year or two, it appears that on the average the cost will be about the same as that of good rotary converters. The cost of brush renewals in the case of converters is about the same as that of the cooling water necessary with rectifiers. The change-over point at which the initial cost of rectifiers becomes less than that of rotaries generally occurs a little below 1500 volts, although there are naturally large variations in different cases. Automatic control tends to favour rectifiers, although, in the opinion of the author, only slightly. The cost of the sub-station building also has to be considered. At 600 volts the rectifier occupies more floor space than the rotary converter, but at pressures above 1500 it shows a considerable saving, whilst in some cases a special construction or location of the building to prevent noise is saved. In spite of its heavier transformer, the total weight of a 600-volt rectifier is slightly less than that of a 600-volt rotary, and much less at higher pressures. The foundations can consequently be lighter and more simple. The reduced cost of sub-station buildings and the rather more simple automatic control gear tend to render closer spacing of sub-stations feasible, thus affording further economy in the direction of a reduction of the voltage drop in the trolley wire.

The St. Hubert Airship Mooring Tower.

THE Montreal airport, at St. Hubert, selected in 1927 by representatives of the Air Ministry and the Department of National Defence, is a triangular plot, 615 acres in area, 90ft. above sea level, situated on the south shore of the St. Lawrence River, 7 miles from Montreal, in open country, free from smoke and other flying hazards. Pro-



ELEVATION AND SECTIONS OF ST. HUBERT TOWER

vision has been made for railway siding, water, electric power, telephone, hydrogen gas and petrol supply service to airships and aeroplanes. The Department of National Defence has established radio, wireless and meteorological services.

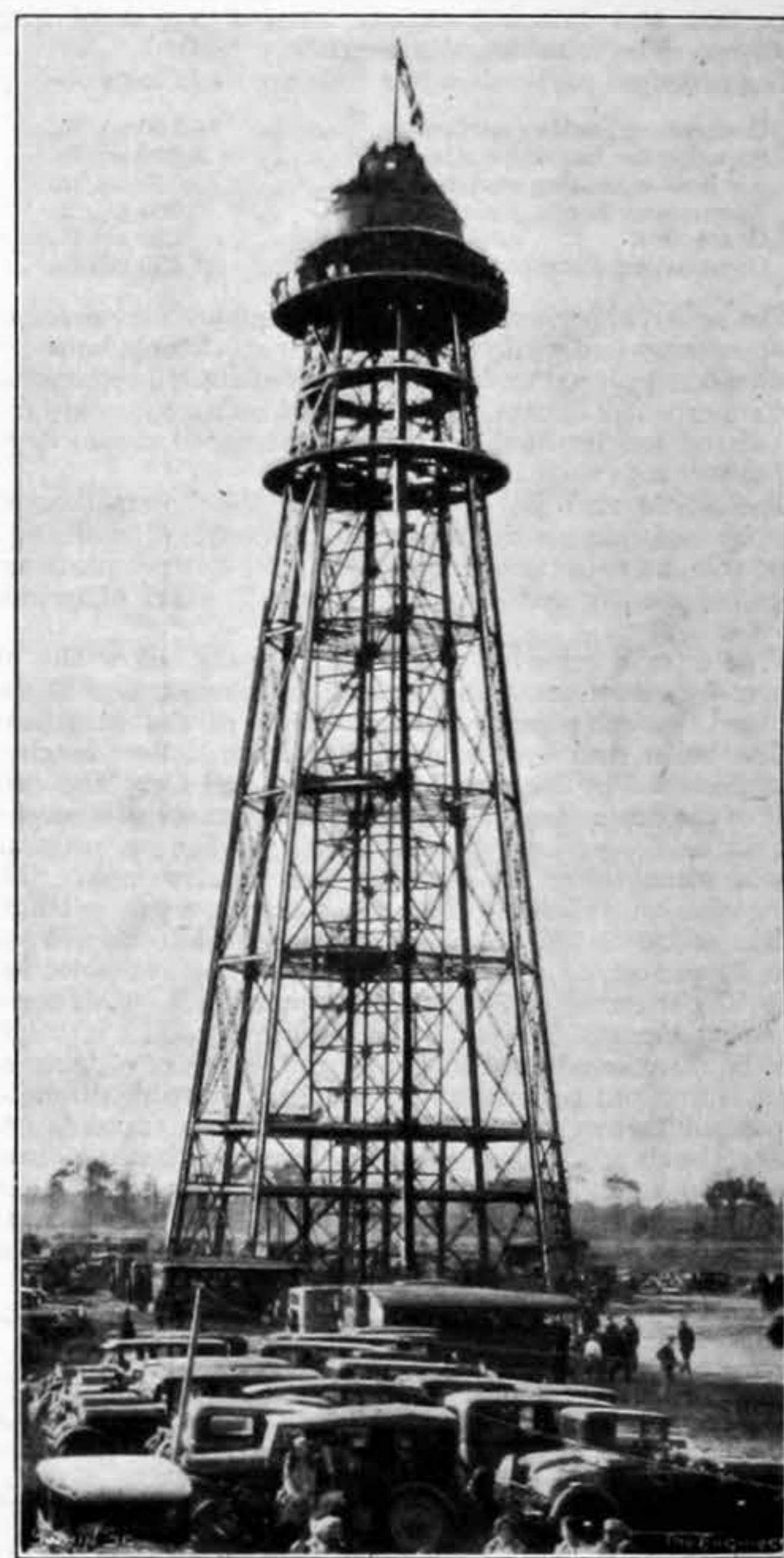
Following a visit of representatives of the Airship Development Directorate and the Directorate of Works and Buildings, the Canadian Government was supplied with complete plans of the Cardington tower, and the Air Ministry, in co-operation with Babcock and Wilcox, Ltd., further improved the design of the mooring head, which was later made in England and shipped to Canada for erection.* In adapting the plans for the steel structure,

* A detailed account of the mooring head for the St. Hubert tower will be found in our issue of December 28th, 1928.

slightly heavier sections had to be used than those used at Cardington and certain changes were made to meet conditions in the Dominion.

The Canadian mooring tower, illustrated herewith, is a self-contained structure, anchored to concrete footings. At the base there is a two-storey building, cruciform in shape, to house the mooring winches, heating plant, &c., and to provide lobby entrance, retiring rooms and offices. It is an octagonal structure 171ft. high, surmounted by a steel plate turret 25ft. in diameter, from the top of which projects a telescopic mooring arm to which the nose of the airship is attached. The total height of the tower to the top of the mooring arm is 205ft. It is made of steel and is composed of eight posts on a base 69ft. 2in. in diameter, drawn in to a diameter of 25ft. 8 1/8 in. at the passenger platform level, 171ft. high. The posts are braced diagonally between levels of horizontal bracing, which occur at intervals of 28ft. 4in. In addition to this regular system of horizontal bracing, there is a heavy network of I-beams 19ft. above ground to support the reinforced concrete floor, and another 29ft. above ground for the reinforced concrete roof of the building at the base of the tower. Horizontal struts support the searchlight platform, and heavy girders covered with checkered plate floors form the elevator landing and passenger platform. In the centre of the tower there is a lift and stair shaft 16ft. square.

The searchlight platform, 142ft. 6in. above ground, is equipped with searchlights which are used to spot the anchorages on the ground and, generally, to facilitate airship moorings at night. A movable platform landing stage is provided on the passenger platform, connecting over the guard rail with the airship's gangway. Passengers



TOWER AND MOORING HEAD

descend a stairway inside the turret to a landing 14ft. 2in. below, and thence by the lift to the ground floor, 156ft. 10in. below.

The arm, which can be extended 7 1/2 ft., weighs 15 tons, and is mounted on gimbal bearings and counterweighted, through a system of cables and pulleys, to swing 30 deg. from the vertical and in any position of the compass. It is operated by compressed air. When the ship's cone is cupped, the arm is contracted, brought back to its vertical position and locked so as to permit the ship to swing with the wind.

There are twenty-four concrete blocks, spaced at 15 deg. intervals, on the circumference of a circle of 750ft. radius. These are for anchoring the 25-ton snatch blocks through which the yaw cables pass from the nose of the ship through fairleads.

Canadian Vickers, Ltd., of Montreal, were awarded the contract to make and erect the steel tower and to erect the mooring head.

For the operation of the swinging arm, there is, at ground level, a vertical two-stage air compressor direct-coupled to a motor. This compressor charges an air receiver to a pressure of 400 lb. per square inch. This pressure is reduced to 150 lb. per square inch for delivery to a receiver on the passenger platform, which supplies the locking cylinder, top and bottom, and the mechanism for bringing in the arm against the resistance of the ship. The air is again reduced to 25 lb. per square inch pressure in the recoil receiver, which is slung underneath the passenger platform. This air is used for pushing out the arm and holding it out until the cone on the nose of the ship enters the cup on the swinging arm.

All the machinery in the tower is electrically operated. There is a motor generator set for charging the airship batteries, and a complete installation of motors and switchboard for all power and lighting services. The tower is

flood-lighted below the passenger platform and the mooring head above has obstruction and operating lights. The electrical installation was carried out under the regulations of the Quebec Inspection Bureau.

To develop an adequate water supply for the airport, an arrangement was made with the Canadian National Railway to use St. Lawrence River water from the twin railway tanks at Southwark, 2½ miles from St. Hubert, where there is a hydrant pressure of 25 lb.

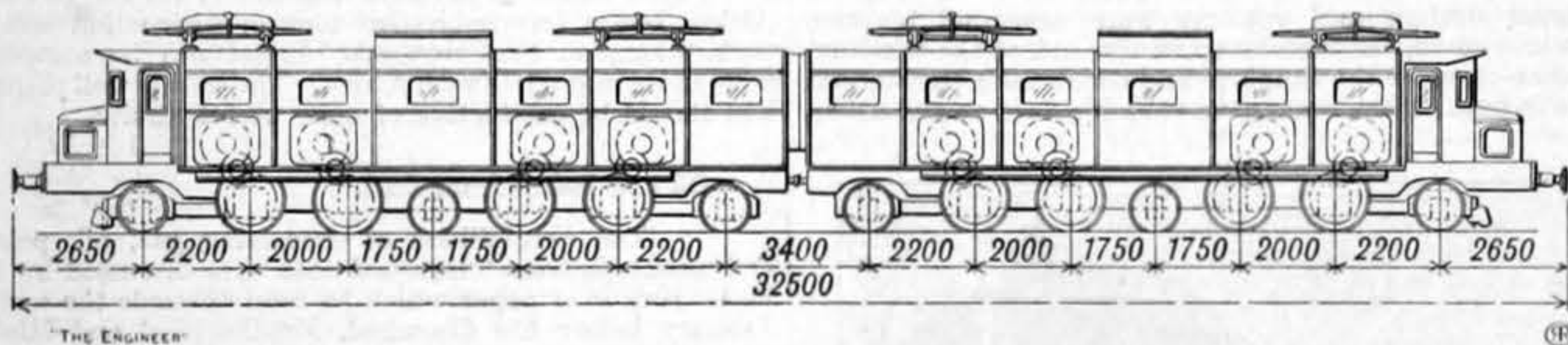
For the delivery of petrol or Diesel oil to the fuel tanks of the airship, the Aqua Flotation system was selected. The installation consists of a 10,000-gallon pressure storage tank, placed underground and connected to the domestic water service. The water enters the tank under pressure and displaces the spirit, which is forced up the tower through a 2-in. pipe.

A Silicol hydrogen plant of 40,000 cubic feet per hour capacity in two units, each of 20,000 cubic feet capacity, is installed in a special building alongside a 50,000 cubic feet gasholder, 2500ft. away from the mooring tower. At the top of the tower the hydrogen pressure is reduced through a regulator valve to 30 mm. water gauge, and is then measured through gas meters before it reaches the airship supply pipes in the mooring head.

At the base of the tower, on the ground floor of the machinery house, there are three variable speed electro-hydraulic winches, two for the yaw cables and one for the main haul cable. These winches are of the spur gear type, each operated by an electric motor through a Waterbury hydraulic transmission, and capable of handling a load of 33,600 lb. at 50ft. per minute and a light line at 150ft. per minute. The drums are designed to hold 5000ft. of ¾-in. diameter special mooring cable coiled in five layers. This is to provide for the larger airships of the future. For mooring the 5,000,000 cubic feet airships, 2000ft. of cable has been provided for the main haul winch, and 3000ft. each for the yaw winches. There is an automatic spooling device on each drum, and the main haul cable is guided by a sheave, 46in. in diameter and set 25ft. away from the main winch.

A 7200 Horse-power Single-phase Locomotive.

FOR the Swiss Federal Railways the Oerlikon Company is building what is believed to be the largest locomotive so far constructed in Europe. It is described by the makers as a 1 Bo 1 Bo 1 + 1 Bo 1 Bo 1 type of engine, the symbol 1 meaning one carrying axle, and the symbol



SWISS FEDERAL RAILWAYS—72,000 H.P. SINGLE-PHASE LOCOMOTIVE

Bo two driving axles with individual drive. An outline drawing of the locomotive is given above, and the following are the main particulars:—

Pressure at overhead line, average	15,000 volts		
Frequency	16½ cycles		
Gauge of track	1435 mm.		
Radius of curves—			
Smallest on open track	690ft.		
At points	373ft.		
	One-hour rating.	One-hour rating.	Continuous rating.
Total output of driving motors, measured at shaft—			
H.P.	7,200	6,560	6,560
kW	5,300	4,800	4,800
Corresponding speed, miles per hour, approx.	38.5	31	41.3
Corresponding tractive effort at wheel rim, lb.*	69,200	78,050	58,650
Maximum tractive effort when starting at wheel rim, lb.		141,100	
Maximum speed, m.p.h.		62	
Total gear ratio, approx.		1:3.5	
Diameter of driving wheels, mm.		1,350	
Diameter of carrying wheels, mm.		950	
Wheel base of half locomotive, m.		11.9	
Wheel base of the double locomotive, m.		27.2	
Length over buffers		32.5 m.	
Weight of the electrical equipment, including regenerative plant and compressor		121.3 tons	
Train staff and stores, such as oil, sand, &c., approx.		1.2 tons	
Weight in working order, approx.		230 tons	
Adhesive weight, approx.		153 tons	
Distribution of axle load in the case of each half locomotive	12.3 + 2 × 19.2 + 13.7 + 2 × 19.2	12.3 tons	
Type		1 Bo 1 Bo 1	

* Without taking into account the gear losses.

* Without taking into account the gear losses.

The locomotive is composed of two parts, close coupled, and with a driver's cab arranged at either end. A step transformer, together with built-on gear for the H.T. control, is mounted over either of the two middle carrying axles. The two outer and the two inner carrying axles are grouped with the adjoining driving axles, so as to form separate bogies. In order to ensure good running qualities on curves, the driving axles each have a side play of 2 mm. by 20 mm., and the two middle carrying axles a side play of 2 mm. by 30 mm.

The parts of the two units of the locomotive are mechanically interchangeable, but certain parts of the electrical equipment are not duplicated, such, for instance, as the main circuit breaker, the compressor set, and the

generator for the supply of the lighting and control circuits, and its regulating gear. The electrical equipment is so designed that these parts can be fitted and connected either on one or the other half of the locomotive, as desired.

The torque of the driving motors is transmitted to the axles by means of the so-called "universal" individual axle drive, manufactured by the Winterthur Locomotive Company, which is supplying the mechanical parts, including the double reduction gear.

In all, there are sixteen motors, which are separately cooled and placed over the driving axles, as shown. As the locomotive is intended for the St. Gotthard line, which has very steep gradients, it is equipped with the Oerlikon Company's system of regenerative braking.

The locomotive has four current collectors, three of which are operated from the driver's cab, the fourth serving as a stand-by.

INSTITUTION OF NAVAL ARCHITECTS.

THE annual meetings of the Institution of Naval Architects will be held in the Lecture Hall of the Royal Society of Arts, John-street, Adelphi, W.C. 2, on Wednesday, Thursday, and Friday, April 9th to 11th. The annual dinner of the Institution will be held on Wednesday, April 9th, at 7.30 p.m., in the Grand Hall of the Connaught Rooms. The following programme of proceedings has been arranged:—On Wednesday, April 9th, there will be a meeting in the morning at 11 o'clock, at which, after the transaction of the usual business, the President, Admiral of the Fleet the Right Hon. Lord Wester Wemyss, will deliver his address. The following papers will then be read and discussed:—"Safety of Life at Sea (1929 Conference)," by Sir Westcott S. Abell, K.B.E., M. Eng., and Mr. A. J. Daniel; and "Some Materials used for Naval Engineering Purposes," by Eng. Captain J. Hope Harrison, R.N. On Thursday morning the meetings will be resumed at 10.30, when the following papers will be taken:—"Recent Results Obtained in Service with the High-pressure Steam Installation of the Holland-America Liner 'Statendam,'" by Dr. W. M. Meijer; and "Performance of Two Vessels with Electric Transmission Gear," by Mr. W. J. Belsey. At the afternoon session, which will begin at 2.30 p.m., the following papers are to be considered:—"On the Final State of a Gas Discharged from a Reservoir into a Space under Constant Pressure," by Colonel F. Modugno, R.I.N.; "Notes on the Behaviour of Two Passenger Vessels during a Voyage to and from Australia," by Dr. B. C. Laws; "The Stability of a Vessel with a List," by Mr. F. H. Alexander, M.Sc.;

Canadian Engineering News.

(From our own Correspondent.)

Noise Elimination.

To the general discussion on noise elimination, J. B. Hendrickson, vice-president of the Dominion Welding Engineering Company, Ltd., contributed some interesting views in a paper read before the Electric Club of Montreal. Choosing the special topic of electric welding by means of which skyscrapers are being silently erected and the noisy riveting hammer discarded, Mr. Hendrickson declared this work had become an engineering and metallurgical problem instead of an ordinary mechanic's job. Five essentials of good welding were named:—Proper equipment (a good welding machine); good welding wires; good operators; proper methods; proper supervision. The equipment he found no longer difficult to secure; good welding wire is also readily available now, although formerly it varied widely in grade and quality; good operators were to be had if the tests imposed upon those seeking work were made sufficiently strict; methods were to be determined by engineers in each special case, as there was some special features to each problem that required technical training for their treatment; supervision was indispensable, as workmen were always apt to fall short of requirements if left to themselves.

Saint John Harbour.

Additional berthing accommodation, a new grain elevator and conveyor system, and other less important construction and improvements, involving an expenditure of several millions of dollars, are being undertaken by the Saint John Harbour Commission. The full scheme contemplates the construction of two piers, each 1250ft. in length by 300ft. in width, and one quay wall 1250ft. in length. The piers and quay wall will be equipped with modern fireproof warehouses and grain conveyor galleries on each pier. It is proposed to fill in the area behind the quay wall, and connect same with Navy Island—in the middle of the harbour—so that sufficient space may be provided for industrial and other purposes. The initial unit of the grain elevator is designed to handle 1,500,000 bushels. Ultimately, it is proposed to give the elevator a capacity of 3,000,000 bushels. The new elevator system will be connected up with the existing elevators, so that a vessel at any berth in the harbour may receive grain from either elevator.

Quebec Oilfield.

The belief that a new field rich in oil and natural gas will be brought into production at the back doors of Montreal and Quebec led to a staking rush throughout the lower St. Lawrence Valley that was unprecedented for the industrious and rapid manner in which the rush itself went forward. Practically 300,000 acres were staked and recorded on land that until the present had been regarded simply as farming property by its owners. The St. Lawrence itself is the focal point of this oil-staking campaign, and properties staked on the north shore are adjacent to the main trunk highway connecting the cities of Montreal, Three Rivers, and Quebec to the Canadian Pacific Railway lines. A second zone of activity, situated on the south bank of the river within similar geographical confines, is equally well situated for transportation. Modern drilling equipment is being moved to the ground in nearly a dozen regions adjacent to the Montreal-Quebec highway. The geology of the plain at the base of the Laurentians, the very gentle northerly dip of the limestone formation, leads experts to believe that rich pools of crude oil will be found in this region at shallow depths.

New Deputy Minister of Railways.

Mr. R. A. C. Henry, Canadian Deputy Minister of Railways and Canals, has resigned to accept the position of vice-president and general manager of the Beauharnois Power Company. He is succeeded as Deputy Minister of Railways, by Mr. Victor I. Smart, who has been connected with the Canadian National Railways for several years. Mr. Smart was born in Brockville and graduated in engineering at Queen's University, Kingston, in 1897. After following his profession in the United States for some years, in 1907 he became Professor of Railway Engineering at McGill University, which position he occupied until 1914. He practised for some years as consulting engineer in Montreal. In 1923 he entered the service of the Canadian National Railway as special engineer, which position he held until 1926, when he was transferred to the Western region of the National system as General Superintendent of Transportation.

Canadian National Railways in 1929.

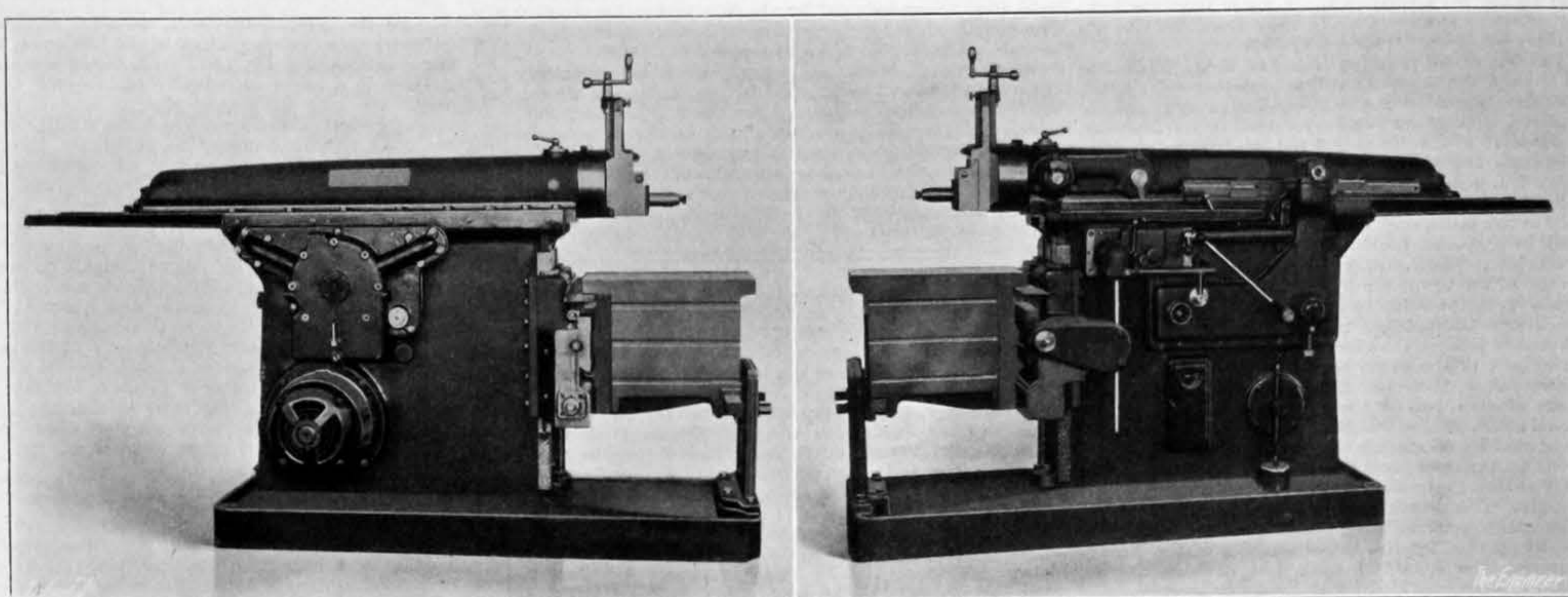
A statement by the Hon. I. A. Crerar, Canadian Minister of Railways, of the operating revenue and expenses of the Canadian National Railways for 1929, shows the effect of reduced tonnage largely produced by the lighter grain movement. The operating revenue was 259,678,972 dollars as compared with 276,631,921 dollars, a reduction of 16,752,949 dollars. Operating expenses were 214,816,892 dollars, as compared with 218,248,343 dollars in 1928. The net revenue from railway operations was 45,062,080 dollars, as compared with 58,577,000 dollars. The ratio of operating expenses to revenue was 82.66 per cent., as against 78.80 per cent. The freight revenue of the system was 193,653,911 dollars, against 200,439,962 dollars, and revenue from the passenger service 32,012,885 dollars compared with 34,189,023 dollars. For express carriage the railways received 13,381,326 dollars, a slight increase on the previous year. The receipts from the telegraphs were 6,122,152 dollars, an increase of 693,241 dollars. The railways spent 46,868,217 dollars on maintenance of ways and structures, and 48,480,840 dollars on the maintenance of equipment. The system paid in taxes during the year 5,241,586 dollars. On the lines east of Levis and Diamond Junction, for which separate accounts are kept, the operating revenue was 30,618,007 dollars, an increase of 2,658,760 dollars, and operating expenses 33,815,382 dollars. Both freight and passenger business showed an increase during the year on the Eastern lines.

LARGE COAL STRIPPING EXCAVATOR.

For working a strip pit coal deposit in Illinois an electric excavator having a bucket of 15 cubic yard capacity is used. The coal seam is 6ft. to 8ft. thick, overlaid by rock and earth. Dragline excavators with 10-yard buckets clear the top soil and the rock is then shattered by liquid oxygen charges, in readiness for the power shovel. This huge machine has a massive rectangular underframe composed of plate girders and mounted at each corner on a crawler tractor instead of wheels. The deck, 60ft. by 30ft. in plan, is 20ft. above the ground. Upon this deck is a revolving frame which carries the machinery, the A frames for the luffing tackle and the long steel truss boom or jib. With this jib and the long bucket handle the bucket has a reach of 85ft. While its level full capacity is 15 cubic yards, its heaped-up load is about 20 cubic yards, and with a slightly shorter handle and reach a 20-yard bucket can be used, with full loads of some 25 cubic yards. All operations are effected by electric motors under the control of one man. A cable on a reel at the back of the machine brings current from a 4000-volt alternating-current line which drives a motor-generator set consisting of a motor, three generators and an exciter. The 1700 H.P. motor drives one 860-kW generator supplying 800-volt direct current for the hoist motors; the other two generators supply 1000-volt current for the swinging and thrusting motors. Two 500 H.P. motors operate the hoists, two of 150 H.P. operate the crowding and thrusting. The weight of the machine is about 1600 tons in working order. Control is of the variable-voltage type, varying the generator voltage by varying the generator field, thus permitting rapid manoeuvring and reversing without excessive torque. The coal is loaded into railway cars and taken to a plant where it is crushed, cleaned and graded for shipment.

HYDRAULICALLY-DRIVEN SHAPING MACHINE

LANGE AND GEILEN, HALLE, GERMANY, ENGINEERS



Hydraulically-driven Shaping Machine.

IN our review of the machine tool exhibits at the recent Leipzig Fair, we referred to the adoption of the hydraulic drive by several makers of planing and shaping machines. We are now able to illustrate herewith the new hydraulically driven shaper shown by Messrs. Lange and Geilen, of Halle (Saale), Germany, on their stand in the main Machine Tool Hall. In the construction of earlier types the makers had employed a hydraulic transmission between the motor and the crank shaft, the rest of the mechanism following more or less standard lines, but in the present machine the principle is carried out very much more completely. The reciprocating head of the machine is now actuated directly by oil pressure, and oil pressure is also used for the traverse of the table, and serves as a means of speed regulation. The machine is driven primarily by the flanged electric motor, shown bolted to the side of the casing. This motor drives a rotary oil pump, supplying oil at a pressure of 800 lb. per square inch to a cylinder underneath the head, the latter being attached to a ram working in the cylinder. A pressure of 2.2 tons can be exerted at the cutting tool, and the cutting speed can be regulated uniformly while the machine is running, from nothing up to 164 ft. per minute. The speed of the return stroke is constant at 197 ft. per minute. The maximum length of stroke of the machine illustrated is 21.6 in., though both larger and smaller machines are built on the same lines. A special feature of the design is the elimination of valves for reversing the motion of the shaper head. The reversal is brought about by an automatic change over in the direction of the oil flow from the pump. The table feed is actuated by a special small hydraulic drive, and can be operated while the head is stationary. The feed is timed to take place during the brief period when the tool is not cutting. The machine is provided with automatic lubrication, and its speed and power enable a very high rate of output to be obtained. The finish of the work is also exceptionally good on account of the smooth steady cutting motion and the absence of vibration produced by gearing.

A 60,000-kVA Three-phase Transformer.

THE accompanying illustration shows a 60,000-kVA three-phase 132,000/2200-volt transformer built by Ferranti Ltd. for the South-East England electricity scheme, which has just been delivered at Willesden. It is star connected on the 132,000-volt side and delta connected on the 22,000-volt side and is designed to operate as a naturally cooled unit up to an output of 30,000 kVA. For the higher outputs provision is made for forced circulation of the oil through the radiators and windings and at the same time a blast of air is directed on to the radiators. The cooling plant consists of radiators mounted on steel work apart from the transformer, the position of the cooler being arranged to suit the most convenient layout of the site. Voltage control equipment of the tap-changing type is provided for varying the effective transformation ratio on each side of the normal ratio through a total range of 10 per cent. above normal to 10 per cent. below normal. Under ordinary conditions the parallel windings on the 132,000-volt side each carry half the line current, and when it is desired to change the voltage the circuit through one of the windings is opened by means of a quick-break oil switch and the tapping on this winding is changed. The series switch is then re-closed, after which the same operations are carried out on the parallel winding. Thus the voltage is changed in the proper sequence by the operation of the series and tapping switches without interrupting the load. The equipment is arranged for remote electrical operation and for local operation by hand. As will be seen from the illustration, the mechanical drive, which runs in an oil bath, is at one end of the main tank and is contained in a weatherproof casing. The tap-changing equipment is the outcome of several years' development, and orders in hand or executed for transformers fitted with it represent a total capacity of 2,250,000 kVA.

The experience of the firm in the construction of large cores is also embodied in the unit. There are considerable difficulties in the construction of such cores, for the effects of faulty construction, such as magnetic short circuits and burning of the core are serious and may not become apparent for years after the transformer has been put into commission. The large insulating cylinders forming the main insulation were made at the Stalybridge factory, where there is a paper Bakelite varnishing machine for paper 9 ft. wide, a Bakelite cylinder machine for cylinders with dimensions up to 9 ft. long by 6 ft. in diameter, and extracting, baking and finishing plant. The design of the end turn reinforcement is based on an exhaustive series of experiments on transformers carried out by means of a surge generator. In these tests surges of definite amplitude and steepness were sent into transformer windings of different designs and voltages were measured between coils and earth, between turns at the end of the winding, between turns at the tappings and across coils throughout the winding. These tests gave valuable data on the distri-

directly or indirectly to the gold mining industry, and it was estimated by the Low Grade Mines Commission of 1920 that that industry, directly or indirectly, supports about 250,000 whites and about 1,000,000 coloured persons.

To Study British Methods.

Early this year a number of skilled and experienced men belonging to the mechanical branch of the Railways and Harbours Department will leave Pretoria under the leadership of Mr. A. G. Watson, Chief Mechanical Engineer, to conduct a tour of the workshops of Great Britain and various countries of the Continent, in order to study the methods and machinery employed there. The object is not to purchase machinery for use in South Africa, but a comprehensive tour of instruction will be undertaken, so that methods abroad can be compared with those in use in South Africa. The tour is well planned and should be productive of some useful results.

Oil and Petrol from Coal.

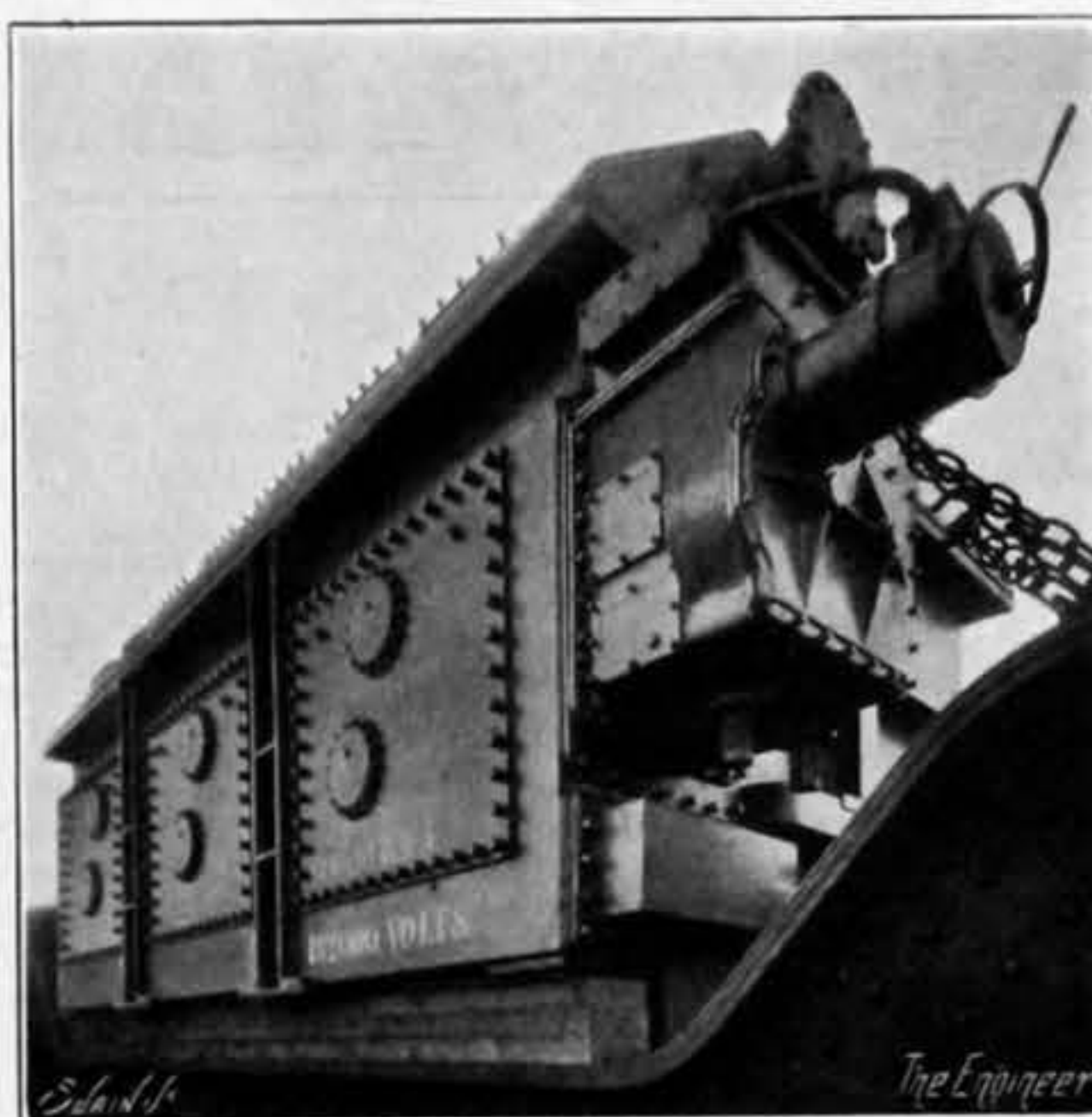
The possibilities of extracting gas, oil, petrol, and ammonia from Transvaal coal were discussed by Dr. P. E. Hall in a paper which he read towards the end of January before the Chemical, Metallurgical and Mining Society of South Africa, at a meeting held in the Scientific and Technical Club, Johannesburg. Dr. Hall explained the comprehensive tests he had undertaken in England with samples of coal from the Witbank and Ermelo district. General experience had proved that coals from the Witbank and Ermelo fields were eminently suitable for steam raising in modern boiler plants. An examination of the possibility of establishing a coal gas industry in the Transvaal revealed some interesting technical points. It had been shown that an adequate supply of coking coal was not yet certain. None of the Ermelo coals examined exhibited coking properties. In view of the prospective large increase in the demand for coal suitable for gas and coke manufacture, it seemed advisable to prosecute with great vigour the search for greater resources of this valuable fuel. The possibility of further discoveries of coking coal had been indicated. The possible technical advantages pertaining to the manufacture of coal gas from the coals were the enhanced value of benzol and lubricating oils in South Africa, as compared with Great Britain, a fact which might make the by-product side of great importance, and the high percentage of nitrogen present. That in itself was not of such great importance, but, coupled with the high freight rates on imported products, it might make the recovery and sale of ammonia a profitable undertaking. On the other hand, the high percentage of ash in the coal would have a deleterious effect on the process.

Projected Power Stations in Rhodesia.

Some half a dozen large steam power stations will be laid down during the next year or two in the Northern Rhodesian copper fields. Hydro electric development may follow later, but the industry cannot wait for that.

Pioneer of New Fleet.

The American-African Line has been formed in the United States of America for the purpose of running a line of motor vessels between New York and South Africa. The project is justified by the fact that the United States of America is now, next to Great Britain, the largest exporter of commodities to South Africa—a few years ago the United States of America exports to South Africa were about £2,000,000 per annum; to-day, they are about £14,000,000 per annum, or 18 per cent. of the total imports of the Union, while the United States of America takes less from South Africa every year, under £2,000,000 per annum for last year. The first vessel of the line to run to South Africa is the "City of New York." This pioneer vessel of the new fleet is the first privately owned American passenger and cargo liner to be built in an American shipyard since 1918 for exclusive use in long-voyage foreign trade, and was built by the Sun Shipbuilding Company, of Chester, Pennsylvania. She is a twin-screw oil engine-driven combination passenger and cargo ship—



60,000 - kVA FERRANTI TRANSFORMER

bution of surge voltages throughout the winding and particularly in the neighbourhood of tappings and floating sections of windings. The high-tension condenser bushings were manufactured at Hollinwood. Finally it should be mentioned that it was specified that the transformer immersed in its oil should be suitable for railway transport under normal weekday traffic conditions.

South African Engineering Notes.

State's Return from Mining.

VARIOUS estimates have been made from time to time of the return made by the gold mining industry of the Witwatersrand to the State in the shape of direct and indirect revenue. The latest and most authoritative statement on the subject is embodied in the evidence submitted to the Miners' Phthisis Commission by the Gold Producers' Committee of the Chamber of Mines. It is pointed out that up to March 31st, 1929, the State received the sum of £14,382,161 as direct revenue from the leased gold mines. This revenue at the present time accrues to the State at the rate of nearly £2,200,000 per annum, in addition to an amount of £1,100,000 per annum payable by the scheduled mines under the Income Tax Act. In addition to these large sums of money the State also receives direct revenue from pass fees, claim licences, &c., and indirectly benefits enormously through the gold mining industry. In 1918 a Government investigation computed that something like 40 per cent. of the Union revenue—excluding railway dues—was attributable

She is 470ft. in length and 61ft. in breadth, and her loaded draught is 26ft., at which depth the cargo capacity will be 10,000 tons with a capacity below decks of over 464,000 cubic feet. The main propelling power consists of two sets of Sun-Doxford opposed piston double-acting, solid injection oil engines, developing over 5000 horse-power and giving a sustained speed of at least 13 knots on an economical fuel consumption. It is expected that the vessel will do the voyage between New York and Cape Town in 23 days.

New Rhodesian Coalfield.

A company has been formed to exploit a new coalfield between Bulawayo and the Wankie Colliery in Southern Rhodesia. The new discovery is claimed to be of great importance. The claims which have been pegged are bisected by the main railway line and extend 2 to 3 miles on each side of it. From some personal knowledge of the district the writer considers the area must be a detached portion of the Wankie field. If so, it was investigated years ago by the Wankie Colliery Company and turned down in favour of the present colliery sites. At one time part of the area at Inyantue was pegged by a syndicate which subsequently abandoned it. It would appear that this is a part of the area now being exploited, but in spite of the rather discouraging history attached to it the new company is hopeful and means to give the proposition a thorough test. Even, however, if it fulfils much that is hoped of it in point of its coal content, it can scarcely hope to compete with Wankie. The mileage to the copper field in the North is somewhat greater, but a more formidable obstacle is the great amount of money which would have to be spent on it in coal-cleaning machinery such as that in existence at the Wankie collieries. The evidence available, as far as one is acquainted with it, points to the coal in the Inyantue area being of lower calorific value than that at Wankie. According to the maps part of the new area was once held in the original Wankie special grant, but was abandoned by the Wankie Company about 10 years ago in favour of other areas in the main coal basin.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE HENRY WELLS OIL COMPANY, Ltd., has removed to larger premises at 736-739, Salisbury House, Finsbury-circus, London, E.C. 2. Telephone: Metropolitan 4283. The address for the company's works is still Henry Wells Oil Company, Ltd., Salford, Manchester.

THE London office of the United Steel Companies, Ltd., and associated firms has been removed to 16, Great George-street, Westminster, S.W. 1. The telephone numbers and telegraphic address remain unaltered.

At a board meeting of Dorman, Long and Co., Ltd., held on March 17th, Mr. Charles Mitchell was appointed joint managing director of the company. He will, however, continue in charge of the Bridge and Constructional Departments at 55, Broadway, Westminster, S.W. 1, the company's London office.

MAJOR E. G. BEAUMONT, O.B.E., A.M. Inst. C.E., M.I. Mech. E., M.I.A.E., M. Inst. T., son of the late Mr. W. Worby Beaumont, M. Inst. C.E., &c., with whose practice as a consulting engineer he was associated prior to 1914, has now resumed this work at the same address, 20, Essex-street, Strand, W.C. 2, and will be occupied primarily in the automobile engineering and road motor transport field.

MR. WALTER DONOVAN, jun., B.Sc., A. Am. I.E.E., after four years in the United States of America, has resigned his position on the engineering staff of Cutler-Hammer, Inc., of Milwaukee, Wisconsin, U.S.A., with whom he has been engaged for some three years, and has joined Donovan and Co., Stechford, Birmingham, where he will take charge of the automatic and alternating-current control section of the business.

CATALOGUES.

TANGYES LTD., Birmingham.—“A Few Examples of Tangye Pumping Plants.”

T. C. JONES and Co., Ltd., 93-95, Wood-lane, W. 12.—Price list of road contractors' tools and equipment.

THOS. HART, Ltd., Blackburn.—A book entitled “Rope Driving or the Transmission of Power by Ropes.”

JAMES KEITH and BLACKMAN COMPANY, Ltd., 27, Farringdon-avenue, E.C. 4.—Booklet K129, “K-B” Drying Plants.

SUPERHEATER COMPANY, Ltd., Bush House, Aldwych, W.C. 2.—Booklets W.1, “The Manufacture of ‘M.L.S.’ Superheaters at Trafford, Park, Manchester;” and L.7B, “‘M.L.S.’ Multiple Valve Regulator Header.”

F. A. PERRY, 63, Queen Victoria-street, E.C. 4.—As British representative of the Berliner Maschinenbau-Aktion-Gesellschaft, Mr. Perry is distributing the firm's catalogue of “Schwartzkopf Locomotives for Overseas.”

FIRESTONE TYRE and RUBBER COMPANY (1922), Ltd., Great West-road, Brentford, Middlesex.—An illustrated souvenir booklet of the opening of the new tire factory. The booklet describes the complete process of making motor car tires.

FRY'S (LONDON), Ltd., 24-26, Water-lane, London, E.C. 4.—A loose-leaf general catalogue containing illustrated price lists of the firm's stock of small tools, which include saws, reamers, drills, taps, saw benches, bench drilling machines, wrenches, &c.

ENGLISH STEEL CORPORATION, Ltd., Vickers Works, Sheffield.—Catalogue S.S. 2/4 on Cammell's “Supertough C. 20” railway and general purpose steel.—A booklet dealing in detail with the construction and uses of the “Camel” patent tool for lathes, planers, boring and turning mills, &c.—New publications, “Standard Pneumatic Chisels and Blanks”; “Rivet Snaps for Pneumatic Hammers”; “Case Hardening Boxes.”

SMITH BROS. and Co. (HYSON), Ltd., Nottingham.—The following catalogue sections:—(1) Pressure Gauges and Thermometers; (2) “Hyson” Gun-metal Valves; (3) Gun-metal Asbestos-packed Gland and Plug Cocks; (4) Water Gauges, Indicator and Test Cocks, Steam Swivels, &c.; (5) Lubricators, Tallow Cups, Oil Boxes, &c.; (6) Whistles, Syrens, &c.; (7) Safety and Reducing Valves, Steam Traps, Expansion Joints, &c.; (8) Fire Fittings and Appliances; (9) Heating and Water Fittings; (10) Cast Iron and Steel Valves and Cocks, Valve Chests, Boiler Test Pumps, &c.; (11) Oil Valves and Fittings; (12) Injectors, Ejectors, Water Lifters and Heaters.

300 B.H.P. OIL ENGINE DRIVEN LOCOMOTIVE FOR CHILE: CORRECTION.—In our article of March 7th, describing this locomotive, we stated that it was of the 2-4-2 type. This should have read 2-6-2 type. The designed duty is 30 tons at 12.4 m.p.h. on a 3 per cent. gradient at 4000ft. above sea level and not 300 tons as stated. The gauge of the locomotive is 2ft. 6in.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Depressed Conditions.

THE basic industries in the Midlands and Staffordshire are uniformly quiet, and the general trade tone is subdued. Neither iron and steel masters, engineers nor manufacturers are able to report increased activity, and there seems little prospect of any immediate improvement in the situation. It is, however, hoped that the second quarter of the year will witness a revival of business, and industrialists are taking a broad view. Consumptive demand for iron and steel in this area is poor, and orders at date are for “penny numbers.” Selling prices continue relatively firm, alike in controlled and uncontrolled departments of the market. The weekly meeting of the Midland iron trade in Birmingham to-day—Thursday—failed to provide any encouraging business.

Will Midland Iron Prices Fall?

The question exercising the minds of those interested in the production and consumption of pig iron is what effect the reduction of 5s. per ton in selling prices of Cleveland pig will have upon the trade in the Midlands. The scarcity of business and the price cutting by merchants has forced makers to depart from a scale of charges to which they have held since last June, and local consumers are speculating as to how long Midland blast-furnacemen will be able to hold out against the disintegration of the market. The repercussions of the reduction in Cleveland iron will presumably be first manifested in the districts further north, where the furnacemen of Cleveland and the Midlands come into direct competition. Cleveland pig iron is more nearly analogous in its phosphorus and manganese contents to Northamptonshire makes than to those of Derbyshire and other producing districts in the Midlands. Northamptonshire producers have of late been keen competitors with Cleveland makers, not only in the North of England, but in Scotland, and a substantial amount of iron smelted in Midland furnaces went to Cleveland and Scotland last year. Now there is a difference of 7s. 6d. a ton in favour of Cleveland iron, as Northamptonshire No. 3 is still quoted at £3 15s. delivered in the Black Country. This effort to secure the Cleveland and Scottish market for the North-East furnaces gives Midland smelters something to think about, and the market is watching what action they will take. It is pointed out that the Central Pig Iron Producers' Association gives its members a free hand outside the home radius, so that Northamptonshire furnacemen may be tempted to reduce their prices to compete with Cleveland. Although eyes are at date directed to the North, it is fully expected that the fall in Cleveland iron will ultimately affect the whole area of supply. A month ago the Central Pig Iron Producers' Association announced, in reaffirming the scale of selling prices fixed last September, that the basis would not be reconsidered till the end of April. It is now suggested that the decision may not be irrevocable. Although it does not follow that there will be a break in Midland iron, the Central Pig Iron Producers' Association is not likely to ignore the situation. Midland pig iron consumers who have been pressing for a price reduction for some months now consider their case is strengthened by the fall in Cleveland material. At the time of writing, Northamptonshire and Derbyshire smelters report a slight increase in the call for foundry material, and they are rigidly adhering to the scale of charges fixed by the Association. Northamptonshire No. 3 foundry is £3 15s. and Derbyshire £3 18s. 6d., and furnacemen will not hear of any other selling figure.

Steel.

The steel works in this area continue production chiefly owing to the contracts which were secured some months ago, and which are still uncompleted. There is very little new business about, and mills are unable fully to replace the orders which they are completing. Steelmasters express some little concern as to the future, but, generally speaking, in this area, they are not in immediate need of business. The re-declaration of the scale of selling prices for heavy steel which was fixed by the Steelmasters' Association in December last was generally expected, though it was known that quite a number of the members favoured a revision in an upward direction. The basis for angles remains at £8 7s. 6d., for joists £8 10s., and for ship, bridge and tank plates £8 17s. 6d. These prices are subject to substantial rebate to those users who confine their purchases to British material, and in this district the majority of consumers who use structural material are in the rebate scheme. Boiler plates continue to be quoted £9 12s. 6d. upwards, and Staffordshire hoops £10. Strenuous endeavours are still being made by continental steel masters to strengthen prices by an extension of the cartel system, and some increase of basis rates has been effected. In Birmingham this week foreign steel tube strip was quoted at £6 17s. 6d. upwards, an advance of 1s. 6d. per ton. Continental makers acting in unison have made £5 15s. f.o.b. their minimum. The disparity between home and foreign prices is too great for the advance to have any influence on the allocation of orders. Continental steel bars are offered at £6 9s. delivered, against Staffordshire re-rollers' figure of £8, while continental billets at £5 12s. 6d. compete against native billets at £6 2s. 6d.

Staffordshire Iron Trade.

There is a considerable dearth of business in the Staffordshire finished iron trade. In the South Staffordshire area the only mills operating with any regularity are those making marked bars, high-class material for which there is nearly always a steady demand. Other makes of iron are depressed, and a number of firms are working short time, and in some cases are having a struggle to keep going at all. At some works only three days a week are being done, despite the fact that the number of employees has been reduced. Selling prices are maintained, how-

ever, marked bars costing £12 10s., Crown bars £10 to £10 7s. 6d., and nut and bolt and fencing bars £9 upwards. Iron strip is being consumed by the district tube works in fairly satisfactory tonnages and values are upheld at £11 2s. 6d. While heavy tonnages of continental material have come into this district for many years past, the number of new contracts now being made cannot be large, for merchants report that they are meeting with very little inquiry. The consuming industries are not in a prosperous state, and the tendency in the nut and bolt industry is towards less active conditions.

Sheets.

The improvement in the galvanised sheet industry is being maintained, and business all round is reported to be better. Orders on account of home trade are fairly satisfactory, but export business still leaves much to be desired. Orders are not so scarce as they were, but they are nothing near the normal. Values are upheld at the new agreed level, 24 gauge corrugated being firmly quoted £11 17s. 6d. per ton f.o.b. Liverpool. Black sheets are only in moderate request, the automobile engineering industry not producing at date up to its normal level for the time of the year.

Scrap.

The steel scrap market is weak, owing to the reduced consumption in steel works locally and in South Wales. About £2 15s. delivered into Black Country works is as much as may be obtained, or £3 6s. delivered South Wales.

Longford Electricity Station.

In view of the opposition of the Electricity Commissioners, the proposal put forward by the Coventry Corporation Electricity Committee for an extension of the Longford generating station at a cost of £162,000, which has recently been approved by the City Council, has been withdrawn. The reason given by the Commissioners is that a supply of electricity will be available from the grid by the autumn of 1931, and that until then the bulk supply of the Leicestershire and Warwickshire Power Company will be available.

Indian Bridge Contract.

Braithwaite and Co. (India), Ltd., the Indian subsidiary company of Braithwaite and Co., Ltd., of West Bromwich and Westminster, have been awarded by the Indian Stores Department, Delhi, the contract for the manufacture and erection on the site of 10,000 tons of steel work for the bridge over the Irrawaddy, some 9 miles from Mandalay.

Unemployment.

If the large number of development schemes which are under consideration by the local authorities, mainly in the Black Country, are carried through, considerable work will be found at no great distance of time for men in the area who are at present unemployed. Moreover, there is a large amount of bridge building work to be carried out, and this would enable many of the works to increase their output and possibly take on additional hands. Work becomes scarcer week by week in the Midlands, and the latest unemployment returns record a further increase of 12,545 in the number of idle hands. In the Birmingham area the figures advanced during the past week from 31,938 to 33,652. At Bilston they were up over 500, at Coventry over 100, at Nottingham by some 300, at Leicester by roughly 200, at Stoke-on-Trent by 897, and at Wolverhampton by 191. All the Black Country manufacturing towns show increases on the week. The Midland total at date stands at 216,859, a truly alarming figure at this period of the year.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Institution of Gas Engineers.

It is sixty years ago this month since the Manchester District Institution of Gas Engineers came into existence, and the occasion was marked this week by a diamond jubilee meeting and luncheon at the Midland Hotel, Manchester, on Tuesday last. The term “Manchester District” in this case covers a much wider area than the title indicates, for Lancashire, Yorkshire and Cheshire come within its range. Mr. W. J. Smith, of Bolton, in the course of his presidential address, said that while they regretted the unfair nature of some of the competition with which the gas industry was faced, they could take comfort from the fact that the use of gas had increased year by year and that it is still increasing. Calculated in B.Th.U.s, the output of gas undertakings to-day was far in advance of the output of electricity undertakings, in spite of the many statutory privileges enjoyed by the latter, privileges which include a high maximum price per unit and a high minimum charge per quarter, with no supervision as to quality. The gas industry, on the other hand, was subject to low maximum prices and no minimum charge, with a keen supervision by the gas referees. The consumer of electricity might, however, be subject to considerable variations in voltage which acted detrimentally upon his apparatus, especially lamps, causing expensive renewals.

Low-temperature Carbonisation.

Discussing the question of low-temperature carbonisation, which, he said, had not so far been a financial success, Mr. Smith continued: “Competition from this source has not been felt to any great extent, but it is up to the gas industry to see that the development of smokeless fuel takes place within the industry itself. From experiments I have made, I am satisfied that coke suitable for the domestic grate can be produced even with high-

temperature carbonisation. In the past there has been a ready market for coke irrespective of the domestic market, but with the growing demand for a cleaner town atmosphere a market is growing for a suitable domestic fuel. It is of the greatest possible interest to the gas undertakings to secure this market, inasmuch as the production of a smokeless fuel entails the production of a certain amount of gas. If the production of such material is in the hands of interests outside the gas industry, such interests will become a competitor for both gas and coke."

A Gas Meter Contract.

The fact that the Gas Committee of the Manchester Corporation has, for the third year in succession, placed an important contract for gas meters with a Liverpool firm has aroused some discussion here, more particularly among the Manchester trade union representatives of the men employed in the meter industry. Representations are being made by local officials of the National Union of Braziers and Sheet Metal Workers to the Manchester City Council, and it is expected that the matter will come in for detailed discussion at the next meeting of the Council. The Liverpool firm's tender was for £46,000, the most favourable price quoted from Manchester being a little over £1000 higher.

Overseas Railway Electrification.

The chairman's speech at the annual meeting at Liverpool of British Insulated Cables, Ltd., on Friday of last week, March 21st, conformed with past experience in giving much interesting information. Mr. D. Sinclair said that his company had practically completed during the past year the track electrification of the Great Indian Peninsular Railway, and this work, together with the Bombay suburban electrification carried out for the same company a few years ago, constituted the most important railway equipment work yet carried out in the British Empire. The company had also practically completed the Scottish overhead "grid" system and many of the lines were in use, but owing to the difficulty of securing permission for wayleaves the work was interfered with and had extended beyond the time required for economic construction. New work in hand included a large extension of the super-tension cable work for the London Power Company, an underground trunk line for the Post Office from Manchester to Chester, and an overhead connecting link between the national "grid" system and the new Clarence Dock power station at Liverpool.

Conditions After the "Grid."

Dealing with future prospects, Mr. Sinclair expressed the opinion that the volume of business would be maintained, but that there would be no great rush of new business following on the completion of the national "grid" system, as had been contemplated in some quarters. The cheapening of the cost of electricity supply could, he said, only come about when a very considerable extension of the use of the current had taken place. On the question of the growing use of overhead wires instead of underground cables, Mr. Sinclair stated that because they were costly to maintain, unsightly, relatively dangerous to the public, and unreliable in operation, it was only a question of time before history, as exemplified by the adoption of underground cables by the Post Office, would again repeat itself.

Locomotives for the Argentine.

The Vulcan Foundry Company, Ltd., of Newton-le-Willows, has just secured a contract for the supply of twenty locomotives to the Buenos Aires Great Southern Railway Company at a total cost of about £120,000.

Preference Dividend Passed.

An announcement of the directors of John Hetherington and Sons, Ltd., textile machinists, Manchester, states that they are unable to recommend the payment of the preference dividend for the second half of the financial year which is due at the end of March. During the past four years Hetherington and Sons have been prominent as manufacturers of artificial silk machinery.

Non-ferrous Metals.

All sections of the market for non-ferrous metals have experienced varying degrees of recovery during the past week which, if sustained, may infuse more confidence into the market than has been seen for some time. Neither in refined nor standard brands of copper has business been at all active, but in spite of this a steadier tone has developed with current quotations from 20s. to 40s. per ton higher on balance, according to position. The lower rates ruling in the tin section have aroused rather more buying interest, and whilst up to the present there has been no appreciable change in the statistical position of the metal prices have responded, the past week's advance of from £7 to £8 per ton bringing values to a higher level than has been seen for about a month. A bigger volume of buying has been in evidence in the case of lead, much of it being from consumers, and quotations have moved up compared with a week ago to the extent of about 10s. per ton. With regard to spelter, there has been a somewhat better tone here also. The demand has shown some improvement, and although the advance is one of only about 5s. per ton it comes after a steady and almost unbroken decline over the last five or six weeks.

Iron and Steel.

Lancashire pig iron users are patiently awaiting possible price developments in their favour, and are rigidly abstaining from purchasing more than very early needs. The buying wave usually experienced at this time of the year is singularly lacking, but sellers of Midland irons on this market hold the view that so low have consumers' stocks been allowed to fall that, whatever may happen in respect of prices in the near future, an early improvement in the volume of business must soon be witnessed. Current quotations for delivery in the Manchester area are 77s. per ton for Staffordshire and Derby-

shire No. 3, about 80s. for Middlesbrough, 95s. for Scottish, and 92s. for hematite. Bar iron is in exceptionally poor demand, with prices unchanged at £10 15s. for Lancashire Crown material and £9 15s. for seconds. In the steel market rather more interest has been shown during the past week in frame and boiler plates for locomotive builders, but apart from this there has been no favourable feature to record. Constructional steel is a slow section of the market, and for most varieties of bars inquiry at the moment is restricted. Boiler plates are now obtainable at about £9 17s. 6d. per ton, tank plates at £8 17s. 6d., small re-rolled bars at from £8 to £8 2s. 6d., according to quantity, joists at £8 10s., sections at £8 7s. 6d., and large bars at £9 7s. 6d.

Hematite.

There is very little change in the hematite pig iron market, which continues to be on the quiet side. Makers for the time being are not badly off for orders, for they are fairly well booked up for the next month or two. Further, the stocks in the district are moderately low on the whole, some works having practically none. The re-starting of the Barrow steel works will have a relieving tendency on the iron requirements locally. It seems pretty well established that very few works are at present producing iron at a profit—certainly not more than two. At some works production has been at a slight loss. An endeavour to lift prices has failed in view of competition from other producing centres. The principal factor in the high cost of production is the dear fuel, which does not allow of any margin to speak of. Those works producing steel are little better situated, for the steel departments have been showing small profits. The iron ore trade is about the same locally, but the outside demand is inclined to sag. The steel market is dull. Barrow restarts this week-end, having secured further contracts during the week, but it is not known how long the rail departments will be kept running.

SHEFFIELD.

(From our own Correspondent.)

No Buying Movement Yet.

ALTHOUGH stocks of steel in the hands of many consumers must have reached a low ebb, no general buying movement has developed yet, and the Sheffield trade situation continues dull. There are many orders, but most of them are small, and bookings on forward account are very few. The steel and tool makers, in their anxiety to provide work for their plants, are competing severely for such business as is offering, with the result that prices are being shaded, and the trade is yielding very little remuneration. Some firms, in fact, declare that they are working for nothing. The output of open-hearth steel is maintained without curtailment, as makers have uncompleted orders on their books, but, as no weight of new business is coming to hand, the outlook for the future is viewed with anxiety. In the case of tool steel, foreign competition is at present very formidable, in both home and overseas markets, and it is stated that considerable quantities of this foreign material are being used in Sheffield. The position in North Lincolnshire continues to be better than that of Sheffield. The works of the former area are still busy, and they continue to book work which formerly went abroad.

Vickers' Year.

The annual report of Vickers Ltd. for the year ended December 31st, 1929, shows that the balance of profit was much the same as for the previous year. The figure was £941,971, as compared with £939,908, showing an increase of £2063. The dividend of 8 per cent., less tax, on the ordinary shares, is the same; £250,000 is again placed to reserve; and the carry forward is £228,754, against £217,704. As I mentioned last week, the Sheffield works of Vickers—now, of course, part of the English Steel Corporation—are at present among the busiest in the city. They are especially well employed on marine work, such as shafting and similar forgings. For many years continental material has been used by British shipbuilders because the price showed a substantial saving compared with that of home-produced supplies, but Vickers are now able to provide these forgings at prices approximating to those of foreign competitors. In order to bring about this result, costs of production have been reduced and the margin of profit cut down. As the trade expands, this work should become more remunerative.

Chimney Stacks of "Stainless" Steel.

There are several interesting points to be mentioned this week with regard to the progress of stainless and kindred steels, the production of which continues to be a very active line in the city. The use of stainless steel for works chimney stacks is one of the latest applications of the material to industrial purposes. Four such stacks, made of Firth's Staybrite steel, are now being erected at the engineering works of Markham and Co., Ltd., of Chesterfield. Sir Robert Hadfield, at the annual meeting of Hadfields, Ltd., last week, spoke of the growing appreciation of the newer types of corrosion-resisting steels in the chemical, dyeing, and other industries. He added that Hadfields, in their own works, had used for such steels, and they had, for example, applied their "Era/C R 2" grade of steel to particularly searching service in a pickling tank heater. This heater was constructed from castings and tubes—all made from the material in question—and it had to withstand the combined action of the scaling effect of the hot products in combustion, of the hot pickling acid, and an added condition of severe stress. Its life had already exceeded twenty-one months without any appreciable deterioration of the metal.

Moorland Road Improvements.

In a small blizzard last week end, the Lord Mayor of Sheffield formally opened two valuable road improve-

ments which have been carried out by the Corporation on the Derbyshire moors, a thousand feet above sea level, but a few miles from the centre of the city. The "Devil's Elbow," a notorious hair-pin bend, on the road to Fox House, has been a nuisance and a danger for many years, but it has now been robbed of its terrors. Something like 30,000 loads of material have been tipped into the ravine round which the elbow went, and the road has been so altered that the curves now have a minimum radius of about 400ft. Further on, the road from Sheffield to Froggatt Edge has been shortened by bringing into use an old, derelict road which strikes off at Stoney Ridge. It is now possible to reach Froggatt Edge without going round by Fox House, which means first a descent and then a rise. The old road, which has a length of 1630 yards, had a water-logged foundation, and consequently drainage works have involved very considerable expense. Neither here nor at the Devil's Elbow have permanent surfaces been put on the road, but the temporary surface is expected to be quite satisfactory for motorists at present. The two improvements have cost £22,000, towards which the Ministry of Transport is making a grant of 60 per cent. The work has been carried out by the City Engineer's department, under the supervision of Mr. W. J. Hadfield, the City Engineer, to the value of whose work for the city generally a tribute was paid by Mr. A. J. Lyddon, Chief Engineer of the Ministry of Transport for the Northern Counties.

The Finished Trades.

There is nothing fresh to say about the cutlery and plate trades. Several firms have valuable work on hand, in connection with large special contracts, but general trade is quiet, and output is low for the time of the year. At the same time, the production of stainless table cutlery, forks and spoons is on a large scale, and there is considerable activity in the departments dealing with scissors, best pen and pocket cutlery. The output of safety razor blades is also substantial, but has not yet returned to the normal. The colonial demand for cutlery is disappointing. In connection with drilling operations at gold and copper mines, there is a growing demand for drill steel of the hollow type with smooth core, and Hadfields are engaged on important orders for the South African, South American and other mining centres. The saw trade has been quiet for some time, but is now showing signs of revival. The trade in files, on the other hand, shows a further falling off.

Smokeless Coal.

It is announced that a new process of treating coal, so that while it is rendered practically smokeless, it will still produce a good volume of flame when burned, has been invented by Professor R. V. Wheeler, and Messrs. F. Lloyd, and A. P. Pehrson, of Sheffield.

Doncaster Colliery Activities.

Good reports of activity and progress come from two collieries in the Doncaster area. At Thorne Colliery, which is now working the High Hazel seam at a depth of 860 yards, about 16,000 tons per week are being raised with 3000 employees, and this output could be increased if more coal getters were obtainable. The agent has stated that the pit could do with 200 more coal getters at once, and could afterwards continue to set more on week by week. The pit is sunk as far as the Barnsley bed, at a depth of 923 yards, where the coal is 6ft. 8in. thick, and it is expected that this will be opened out before the end of the year, when still more men will be required. Hatfield Main Colliery is also developing at a rapid rate, and is in a position to set on 600 more men at once. This colliery is to share considerably in an order for 150,000 tons of British coal placed last week-end by the Belgian National Administration of Railways. The additional men are not wanted in connection with this order, however, but for the ordinary development of the pit. At Norwood Green, near Halifax, a new pit is being sunk to work the Black and Better Bed seams of the old Low Moor Company. It is expected that the seams will be struck at depths of 80 and 120 yards respectively, that the colliery will employ 200 men and produce 2000 tons a week, and will have a working life of about thirty years. At Huddersfield a new company is being formed whose object is to lay down plant at the pithead of a Lepton colliery for the manufacture of coke and treatment of by-products; and it is understood that an offer has been made to sell the coke oven gas to the Huddersfield Corporation.

NORTH OF ENGLAND.

(From our own Correspondent.)

French Deal in Durham Pits.

CONSIDERABLE surprise has been occasioned in Northern coal trade circles by the announcement that a French steel and coke syndicate has acquired a controlling interest in the Pelaw Main group of collieries in the Birtley area. This group includes five pits which are amongst the most prolific producers of a high-class Durham coking coal. Of their annual output of 1½ million tons nearly half has been regularly taken by the French concern which has now acquired the controlling interest. About 4000 men are employed in the group and they have received the news with satisfaction, as there is virtually a guarantee of the regular output being absorbed under the new arrangements. The Pelaw Main collieries have an excellent system of private railways direct to the staiths on the South side of the river, and several of the pits have been modernised and considerably improved in recent years. During the serious depression of 1924-5, they, in common with many other Durham collieries, had a very lean time and were eventually taken over by the bank. In 1926 a new company was formed, and the collieries were purchased for slightly under £100,000. The new company was floated with an authorised capital of £250,000. It is understood that the management, both at headquarters and at the collieries, will remain unchanged.

Cleveland Iron Trade.

A substantial business has been done by Cleveland ironmasters since prices were reduced last week, and although the economic position is unsatisfactory, any margin of profit being wholly eliminated, the impulse to trading activity, which lower prices has provided, warrants the hope that no curtailment of output will become necessary. Relatively, Cleveland pig iron is now the cheapest in the country, and on this basis a substantial recovery in the Scottish market is looked for. In addition, it is believed that there is now a possibility of foreign sales, though continental prices f.o.b. Antwerp are still below Cleveland's f.o.b. figures. Merchants are understood to possess very little Cleveland pig iron, and facilities for disposing of their moderate holdings are limited. No. 1 Cleveland foundry iron is 70s., No. 3 G.M.B. 67s. 6d., No. 4 foundry 66s. 6d., and No. 4 forge 66s.

Hematite Pig Iron.

East Coast hematite producers are burdened with heavy and increasing stocks. Business is still almost confined to small parcels for home consumption. Export trade is quite trifling owing to the comparative cheapness of foreign hematite. Market values of East Coast mixed numbers are not easily ascertained, as there is keen competition for orders, and sellers readily fall in with offers that come forward. The basis of quotations is in the neighbourhood of 76s. for ordinary qualities, but merchants do not hesitate to take a little less, and some makers are inclined to give favourable consideration to buyers' efforts to negotiate for substantial quantities on rather lower terms.

Ironmaking Materials.

With foreign ore consumers heavily bought and well stocked, buying is at a standstill. Nominally best Rubio remains at 21s. 6d. c.i.f. Tees. Sellers of Durham blast-furnace coke experience difficulty in making contracts. Good medium qualities are offered freely at 20s. delivered to North-East Coast works, and consumers claim that they can satisfy their requirements at a lower figure.

Manufactured Iron and Steel Trade.

The position of the manufactured iron and steel trade shows little change on the week. Quotations are upheld, though buying is on only a moderate scale. The number of ships building and to be built will keep producers of shipbuilding requisites busy for some months, and manufacturers of necessities for railways have quite a lot of work on hand. Producers of bridge-building and other constructional materials are turning out heavy tonnages.

The Coal Trade.

The two northern coal counties have done fairly well in the allocation of the Belgian State Railways' coal order. Of about 150,000 tons placed in the United Kingdom and required over the next six months, 93,000 tons has come to Durham and Northumberland, the former county securing the larger proportion. Screened, un-screened and small steams were stipulated in the inquiry. The market position presents no outstanding feature. Some classes of fuel are well stemmed and others are wanting trade. Individual circumstances vary greatly, but, in the main, conditions are no worse. More railway contracts are expected in a few days, notably those of the Danish and Westeras undertakings. Freights are still very low and shippers are able to cope with any amount of prompt business. Here and there are signs that pits are finding it difficult to carry on for want of trade, and the prospects are that fewer men may be needed in the industry before long. Old workings that got a fresh start in 1928 and last year are beginning to drop back into an unwanted position. Trade is maintained in Northumberland steam coals. The large qualities are only in moderate offer for prompt positions at 14s. 6d. to 14s. 9d. second-hand and 15s. direct. Small steams are firm at 11s. 6d. Tyne prime steams, 14s. 3d. for large and 12s. for smalls and are more readily obtainable. Durham steam coal is unchanged at 17s. to 18s. for large qualities and 14s. for smalls, and these figures are steadily quoted. Durham coking coal is marked at 14s. 3d. to 14s. 6d. Turns are well taken up, and although there is not much new business passing, the inquiry is of fair dimensions. Gas coal is quiet, the demand being on the low side. Best gas fuel remains at 16s. to 16s. 6d., with 16s. 9d. indicated for primes and 13s. 9d. to 14s. for seconds. Prices for bunkers continue to show a weak tendency, though not notably altered at 15s. to 15s. 3d. for bests, 15s. 9d. to 16s. for superiors, and 13s. 9d. to 14s. for ordinaries. There are no signs of the demand for coke reviving. Supplies are pressing on the market and values are weak. Patent oven stocks are abundant and weakly held at 18s. Beehive and special foundry coke is easily obtainable at prices ranging from 25s. to 30s. Gas coke is scarce, but offered at 21s.

SCOTLAND.

(From our own Correspondent.)

Steel.

On the whole, the position in the steel trade shows very little change. It is said that makers are a little more hopeful that business will expand somewhat in the near future, but signs of improvement are not prominent. As a rule, specifications are still short of requirements, the position having been aggravated a little by industrial troubles at the shipyards. Plants have not been kept going with regularity, and at least at one large establishment within recent weeks a start has not always been made on Monday mornings. Some producers are comparatively well supplied with orders, while others are distinctly short of work. On the average, orders for plates and sections have been disappointing, but a fair demand for structural material has been met.

Steel Sheets.

There has been a moderate turnover in light black sheets, and a continued slight improvement in the inquiry for galvanised descriptions.

Tubes.

So far, it cannot be said that the export market has improved. The demand for lap-welded descriptions has improved of late, but at those works mainly interested in the export trade, short time has been the rule of late. Generally speaking, an expansion in overseas business would be most acceptable.

Iron.

Producers of bar iron and re-rolled steel are still unable to keep their plants working full time, owing, in a large measure, to the shortage of export orders. A seasonal improvement is expected about the middle of April, however, in view of the opening up of navigation in Canada. It is also expected that Eastern markets will come into line. Bar iron prices are unchanged, and re-rolled steel bars are quoted £7 12s. 6d. per ton, home or export.

Scrap.

The market for scrap has not improved, and heavy steel is still quoted round about 65s. per ton, with heavy basic about 62s. 6d. and cast iron machinery 69s. per ton. Supplies are ample, consumers purchasing most sparingly.

Coal.

The continued scarcity of shipping business is being viewed with no little concern by the collieries, more especially those in the Lothians and in Fifeshire, depending as they do mainly on export business. Importers abroad are no more inclined to purchase on a considerable scale than they have been for weeks past, and are, in fact, endeavouring to obtain release in some instances from contracts. Collieries, therefore, are not only feeling a shortage of new business, but find difficulty in securing orders from exporters against contracts placed some time ago. Almost all classes of fuel are adversely affected, notable exceptions being navigation descriptions in most districts and best Lanarkshire splints. The last named are well booked, well into next month. Aggregate shipments amounted to 230,629 tons, against 241,176 tons in the preceding week and 258,829 tons in the same week last year. The home demand is uneven, household demands being well maintained, but the consumption at public works is declining.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade.

THE best that can be said of the steam coal trade conditions prevailing in this district is that they are not appreciably worse than they were a week ago. At the same time, it cannot be disguised that they are very unsatisfactory, though a review of the European sphere shows that in other coalfields a crisis is being experienced; in fact, it looks very much as if the state of trade in other areas abroad is worse than it is in this country. Perhaps the severity of the strain upon all districts will hasten the day of complete international agreement. Confirmation has been received of the Polish-German agreement, and there is naturally a certain amount of speculation as to what, if any, effect this will have upon this country. It is reported that there is to be a conference shortly between representatives of the Polish coalowners and representatives of English coalowners, chiefly of the Central Collieries Commercial Association. Unfortunately, the immediate outlook in the coal export trade is far from cheerful. Comparatively little fresh foreign demand is being received, which is not surprising, in view of the reports that stocks abroad are extremely heavy and cannot be disposed of. Apart from the report that the Paris-Orleans Railways of France are asking for prices for supplies for 1931, there is nothing of special interest in the market. The current demand is negligible, and the weekly shipments are less satisfactory. At the end of last week there were thirty-eight idle tipping appliances at the various docks in South Wales, and arrivals of steamers over the week-end did not improve the situation very materially, as on Monday there were fourteen tipping appliances idle and only seven steamers waiting to berth. That was really a bad start for the week, but it is too much to expect better conditions when the chartering of tonnage of late has also declined. Last week the amount of tonnage reported to have been taken up for South Wales loading was well under the 300,000 tons mark, which is an inadequate level. While coal trade conditions leave so much to be desired, the position of shipowners is not better. Outward rates have not displayed any recovery, and returns now show that well over 500 foreign and British vessels of over 3,000,000 tons carrying capacity are now on the laid-up list.

Swansea's New Lock.

Since writing last week on the question of a new lock entrance at Swansea, Great Western Railway officials, together with Sir Alexander Gibb, the eminent consulting engineer, have paid a visit to Swansea, and the belief is held that early steps will be taken for the construction of a new entrance lock, as an alternative site is understood to be practicable. No official information is as yet forthcoming, but it is understood that the new site for the entry into King's Dock will be quite serviceable, if not an ideal one. The matter has yet to be considered by the Great Western Railway Company directors, and also by the Government, in view of the financial aid the latter has agreed to give, but it is not expected that any insuperable difficulties will be met with.

Steel Smelting Development.

Considerable interest is displayed in a new type of furnace, the first to be used in this country; and which

was lit on Saturday last at the well-known Pontardawe Works of W. Gilbertson and Co., Ltd., in the presence of the directors and a large number of officials. This furnace, which is known as the Moll 40-ton, and is of the tilting type, may revolutionise steel smelting in the Swansea area. Its output is much larger than that secured in the past, and is stated to amount to between 800 and 900 tons per week.

A New Cargo Service.

It is announced that the Blue Star Line, Ltd., has arranged to run a regular monthly service from Newport to the Far East—the Straits, China, and Japan—taking alternative sailings with Alfred Holt and Co.'s Blue Funnel Line, which has for many years served Newport. The new service is to start with the "Doric Star" closing for cargo about May 2nd.

Current Business.

The tone of the steam coal market is quiet all round, though Monmouthshire large coals are relatively better placed than other large coals, as the result of the tonnage put at their disposal to load the requirements of the Italian State Railways. All large coals, however, are at minimum prices, and smalls are also more freely obtainable and down to minimum figures, the reason being that the demand is diminished as so much tonnage is laid up and less bunker coals are being consumed. Sized coals are very irregular and weaker. Coke is steady and patent fuel is not quite so well off for orders. Pitwood is easier, and is about 26s. to 26s. 3d.

CONTRACTS.

THE WESTINGHOUSE BRAKE AND SAXBY SIGNAL COMPANY, Ltd., has received an order from the London, Midland and Scottish Railway Company for the supply and installation of a complete power signalling plant at St. Enoch's Station, Glasgow.

RUSTON AND HORNSBY, Ltd., Lincoln, have received an order from the Manchester Corporation to supply three 6-cylinder vertical oil engines, each of 360 B.H.P., for generating electricity in connection with the Corporation's waterworks undertaking at Haweswater.

THE EGYPTIAN GOVERNMENT MINISTRY OF PUBLIC WORKS has accepted the tender of Dorman Long and Co., Ltd., for the erection of a steel-framed power station at Atfi, in Lower Egypt, about 70 miles from Alexandria along the Mahmudieh Canal. The building will contain approximately 770 tons of steel and the accepted price is £E69,700.

THE UNDERFEED STOKER COMPANY, Ltd., has recently received orders for ash sluicing plants from the London Power Company for Battersea Power Station; from Ipswich Corporation; from the Shropshire, Worcestershire and Staffordshire Electric Power Company, Ltd., for the Severn Power Station, Stourport, Worcestershire, and from Ed. Lloyd and Co., Ltd., for the Kemsley Paper Mills, Sittingbourne.

THE GENERAL ELECTRIC COMPANY, Ltd., of Magnet House, Kingsway, London, W.C. 2, has received an order from the Union Construction Company, Ltd., for electrical equipment for some new high-speed tramcars now being constructed for the Uxbridge-road services of the London United Tramways. The order comprises 94 high-speed motors of 70 H.P. on a 1-hour rating, 500 volts, 96-cam type controllers and 48 sets of line switches with overload release.

THE ELECTRIC FURNACE COMPANY, Ltd., of 17, Victoria-street, London, S.W., has received an order from an Ajax-Northrup high-frequency furnace of 25 cwt. capacity from a French steel works. This furnace will have an output of over 1 ton per hour. The company has also recently received orders for a 3½-ton Héroult furnace for Spain, and for 64 tube heaters and 24 frame heaters for a French firm. Recent orders for Ajax-Wyatt furnaces include three furnaces of 24 cwt. capacity and a battery of six furnaces in another works.

THE PARSONS OIL ENGINE COMPANY, Ltd., Southampton, has booked several orders lately, including one for two 75-kW emergency sets for the P. and O. Company's two new liners being built by Vickers-Armstrongs. It has also received an Admiralty order for four marine sets for 30ft. motor boats, and two paraffin sets for the India Office. Two engines are being supplied to W. H. Allen, Sons and Co. for an oil company, and a Parsons engine was recently incorporated in the wireless telephone plant on s.s. "Majestic" to the order of Standard Telephones, Ltd.

As agents for the English Electric Company, Ltd., London, the contract has been placed with Siemens (Aust.) Pty., Ltd., by the Hydro-electric Department, Tasmania, for the water-driven turbo units and automatic switchgear for the Shannon River power station. The new station will contain two 7250 H.P. reaction turbines directly coupled to three-phase alternators, each set being provided with a direct-coupled exciter, as well as an auxiliary generator for operating the switchgear control circuits and automatic devices. The switchgear for controlling these two units will be entirely automatic in operation, with the exception of the actual starting-up and synchronising, and the station will run unattended. The water turbines and alternators, including main valves, governor gear, &c., will be of English Electric design and will be manufactured partly at the English Electric works in England and partly by the Clyde Engineering Company, Ltd., Sydney. The switchgear will be designed and manufactured by the English Electric Company at the Stafford Works, England.

LAUNCHES AND TRIAL TRIPS.

BELLO, motor ship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of Berg, Torgersen A/S.; dimensions, 420ft. by 58½ft. by 31½ft.; to carry 9000 tons. Engines, single-acting two-stroke Wallsend-Sulzer; constructed by the Wallsend Slipway and Engineering Company, Ltd.; launch, March 17th.

THOROLD, motor ship; built by Earle's Shipbuilding and Engineering Company, Ltd., to the order of the Quebec and Ontario Transportation Company, Ltd.; dimensions, 250ft. by 43ft. 9in. by 23ft. Engine, single-acting, two-cycle, four-cylinder Diesel, about 1000 B.H.P.; constructed by Sulzer Bros.; trial trip, March 19th.

BARON NAPIER, cargo steamship; built by David and William Henderson and Co., Ltd., to the order of H. Hogarth and Sons; dimensions, 350ft. by 50ft. by 25ft. 9in.; gross tonnage 3650. Engines, triple-expansion, 21½in., 37in. and 62in. diameter by 42in. stroke, pressure 210 lb. per square inch; constructed by the builders; trial trip, March 21st.

Current Prices for Metals and Fuels.

IRON ORE.			
N.W. COAST—			
(1) Native	19/6 to 21/-		
(1) Spanish	21/6 to 23/-		
N.E. COAST—			
Native	18/- to 21/-		
Foreign (c.i.f.)	21/6		
PIG IRON.			
	Home.	Export.	
	£ s. d.	£ s. d.	
(2) SCOTLAND—			
Hematite	4 1 0	—	
No. 1 Foundry	4 0 6	—	
No. 3 Foundry	3 18 0	—	
N.E. COAST—			
Hematite Mixed Nos. ..	3 16 0	3 16 0	
No. 1	3 16 6	3 16 6	
Cleveland—			
No. 1	3 10 0	3 10 0	
Silicious Iron	3 10 0	3 10 0	
No. 3 G.M.B.	3 7 6	3 7 6	
No. 4 Foundry	3 6 6	3 6 6	
No. 4 Forge	3 6 0	3 6 0	
Mottled	3 5 6	3 5 6	
White	3 5 6	3 5 6	
MIDLANDS—			
(3) Staffs.— (Delivered to Station.)			
All-mine (Cold Blast) ..	—	—	
North Staffs. Forge ..	3 15 6	—	
„ „ Foundry	3 19 6	—	
(3) Northampton			
Foundry No. 3	3 15 0	—	
Forge	3 11 0	—	
(1) Derbyshire—			
No. 3 Foundry	3 18 6	—	
Forge	3 14 6	—	
(3) Lincolnshire—			
No. 3 Foundry	3 13 6	—	
No. 4 Forge	3 9 6	—	
Basic	—	—	
(4) N.W. COAST—			
N. Lanes. and Cum.—			
Hematite Mixed Nos. ..	4 9 6 (a) ..	—	
	4 11 6 (b) ..	—	
	4 15 0 (c) ..	—	

MANUFACTURED IRON.			
	Home.	Export.	
	£ s. d.	£ s. d.	
SCOTLAND—			
Crown Bars	10 5 0	9 15 0	
Best	—	—	
N.E. COAST—			
Iron Rivets	11 10 0	—	
Common Bars	10 15 0	—	
Best Bars	11 5 0	—	
Double Best Bars	11 15 0	—	
Treble Best Bars	12 5 0	—	
LANCS.—			
Crown Bars	10 15 0	—	
Second Quality Bars ..	9 15 0	—	
Hoops	13 0 0	—	
S. YORKS.—			
Crown Bars	11 0 0	—	
Best Bars	11 10 0	—	
Hoops	12 0 0	—	
MIDLANDS—			
Crown Bars	10 0 0 to 10 7 6	—	
Marked Bars (Staffs.) ..	12 10 0	—	
Nut and Bolt Bars	9 2 6 to 9 7 6	—	
Gas Tube Strip	11 2 6	—	

STEEL. (d)			
	(6) Home.	(7) Export.	
	£ s. d.	£ s. d.	
(5) SCOTLAND—			
Boiler Plates (Marine) ..	10 10 0	10 10 0	
„ „ (Land)	10 0 0	10 0 0	
Ship Plates, 3/4 in. and up	8 15 0	7 15 0	
Sections	8 7 6	7 7 6	
Steel Sheets, 3/4 in. ..	9 0 0	8 15 0	
Sheets (Gal. Cor. 24 B.G.)	12 15 0	12 5 0	

STEEL (continued).			
	Home.	Export.	
	£ s. d.	£ s. d.	
N.E. COAST—			
Ship Plates	8 15 0	7 15 0	
Angles	8 7 6	7 7 6	
Boiler Plates (Marine) ..	10 10 0	—	
„ „ (Land)	10 0 0	—	
Joists	8 10 0	7 7 6	
Heavy Rails	8 10 0	—	
Fish-plates	12 0 0	—	
Channels	10 5 0	£9 to £9 5s.	
Hard Billets	8 2 6	—	
Soft Billets	6 17 6	—	
N.W. COAST—			
BARROW—			
Heavy Rails	8 10 0	—	
Light Rails	8 15 0 to 9 0 0	—	
Billets	6 15 0 to 9 10 0	—	
MANCHESTER—			
Bars (Round)	9 7 6	—	
„ (Small Round)	8 0 0 to 8 2 6	—	
Hoops (Baling)	10 0 0	9 15 0	
„ (Soft Steel)	9 0 0	8 15 0	
Plates	8 17 6 to 9 2 6	—	
„ (Lanes. Boiler)	9 17 6	—	
SHEFFIELD—			
Siemens Acid Billets ..	9 10 0 (basis)	—	
Hard Basic	9 2 6 and 9 12 6	—	
Intermediate Basic ..	7 12 6 and 8 2 6	—	
Soft Basic	6 10 0	—	
Hoops	9 15 0 to 10 0 0	—	
Soft Wire Rods	8 0 0	—	
MIDLANDS—			
Small Rolled Bars	8 0 0 to 8 15 0	—	
Billets and Sheet Bars ..	6 2 6 to 6 12 6	—	
Galv. Sheets, f.o.b. L'pool	11 17 6	—	
Sheets (30 W.G.)	16 7 6	—	
Angles	8 7 6	—	
Joists	8 10 0	—	
Tees	9 7 6	—	
Bridge and Tank Plates ..	8 17 6	—	
Boiler Plates	9 12 6	—	

NON-FERROUS METALS.			
SWANSEA—			
Tin-plates, I.C., 20 by 14	.. .. .	18/3 to 18/6	
Block Tin (cash) .. ..	.. .. .	170 0 0	
„ (three months) .. ..	.. .. .	171 15 0	
Copper (cash) .. .. .	.. .. .	70 7 6	
„ (three months) .. ..	.. .. .	67 17 6	
Spanish Lead (cash) ..	.. .. .	19 0 0	
„ „ (three months) ..	.. .. .	19 0 0	
Spelter (cash) .. .. .	.. .. .	18 10 0	
„ (three months) .. ..	.. .. .	19 1 3	
MANCHESTER—			
Copper, Best Selected Ingots	.. .. .	77 5 0	
„ Electrolytic .. .. .	.. .. .	84 7 6	
„ Strong Sheets .. .. .	.. .. .	110 0 0	
„ Tubes (Basis Price), lb.	.. .. .	0 1 3	
„ Brass Tubes (Basis Price), lb.	.. .. .	0 1 1	
„ Condenser, lb. .. ..	.. .. .	0 1 3	
Lead, English .. .. .	.. .. .	20 12 6	
„ Foreign .. .. .	.. .. .	19 0 0	
Spelter .. .. .	.. .. .	19 5 0	
Aluminium (per ton—raw ingot)	.. .. .	£95	

FERRO ALLOYS.			
Tungsten Metal Powder ..	.. .. .	3/4½ per lb.	
Ferro Tungsten .. .. .	.. .. .	3/- per lb.	
	Per Ton.	Per Unit.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 7 6	7/-	
„ „ 6 p.c. to 8 p.c. ..	£22 10 0	7/-	
„ „ 8 p.c. to 10 p.c. ..	£22 0 0	7/-	
„ „ Specially refined ..	.. .. .	.. .. .	
„ „ Max. 2 p.c. carbon ..	£33 10 0	10/-	
„ „ „ 1 p.c. carbon ..	£38 0 0	13/6	
„ „ „ 0.70 p.c. carbon	£40 10 0	15/-	
„ „ „ carbon free ..	11d. per lb.	.. .. .	
Metallic Chromium .. ..	.. .. .	2/7 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home	.. .. .	
	£13 10 0 for export	.. .. .	
„ Silicon, 45 p.c. to 50 p.c.	£11 10 0 scale 5/- per unit	.. .. .	
„ „ 75 p.c.	£19 0 0 scale 7/- per unit	.. .. .	
„ Vanadium	12/9 per lb.	.. .. .	
„ Molybdenum	4/2 per lb.	.. .. .	
„ Titanium (carbon free) ..	9d. per lb.	.. .. .	
Nickel (per ton)	£170 to £175	.. .. .	
Ferro Cobalt	9/6 per lb.	.. .. .	

FUELS.			
SCOTLAND.			
(Prices not stable.)			
LANARKSHIRE—			
(f.o.b. Glasgow)—Steam ..	.. .. .	13/9	
„ „ Ell .. .. .	.. .. .	15/-	
„ „ Splint .. .. .	.. .. .	16/9 to 18/-	
„ „ Trebles .. .. .	.. .. .	12/6	
„ „ Doubles .. .. .	.. .. .	11/6	
„ „ Singles .. .. .	.. .. .	11/-	
AYRSHIRE—			
(f.o.b. Ports)—Steam ..	.. .. .	13/6	
„ „ Jewel .. .. .	.. .. .	17/-	
„ „ Trebles .. .. .	.. .. .	13/-	
FIFE—			
f.o.b. Methil or Burnt-			
island—Steam .. .. .	.. .. .	11/6 to 12/9	
Screened Navigation ..	.. .. .	17/-	
Trebles .. .. .	.. .. .	12/6	
Doubles .. .. .	.. .. .	11/9	
Singles .. .. .	.. .. .	11/3	
LOTHIANS—			
(f.o.b. Leith)—Best Steam	.. .. .	13/-	
Secondary Steam .. ..	.. .. .	12/9	
Trebles .. .. .	.. .. .	11/9	
Doubles .. .. .	.. .. .	11/6	
Singles .. .. .	.. .. .	11/-	
ENGLAND.			
(8) N.W. COAST—			
Steams .. .. .	.. .. .	21/6 to 23/-	
Household .. .. .	.. .. .	38/- to 51/-	
Coke .. .. .	.. .. .	23/- to 23/6	
NORTHUMBERLAND—			
Best Steams .. .. .	.. .. .	14/6 to 15/-	
Second Steams .. .. .	.. .. .	13/6 to 14/-	
Steam Smalls .. .. .	.. .. .	11/-	
Unscreened .. .. .	.. .. .	13/-	
Household .. .. .	.. .. .	25/- to 37/-	
DURHAM—			
Best Gas .. .. .	.. .. .	16/- to 16/3	
Second .. .. .	.. .. .	13/9 to 14/3	
Household .. .. .	.. .. .	25/- to 37/-	
Foundry Coke .. .. .	.. .. .	26/- to 29/-	
SHEFFIELD—			
Inland.			
Best Hand-picked Branch ..	26/6 to 28/-	—	
Derbyshire Best Bright House	21/- to 23/-	—	
Best House Coal	20/6 to 21/6	—	
Screened House Coal	18/6 to 20/-	—	
„ „ Nuts	16/6 to 18/-	—	
Yorkshire Hards	15/6 to 17/-	—	
Derbyshire Hards	15/6 to 17/-	—	
Rough Slacks	9/- to 10/-	—	
Nutty Slacks	7/6 to 8/6	—	
Smalls	3/- to 5/-	—	
Blast-furnace Coke (Inland)	17/- on rail at ovens	—	
Furnace and Foundry Coke (Export), f.o.b.	19/6 to 20/-	—	
CARDIFF—			
(9) SOUTH WALES.			
Steam Coals :			
Best Smokeless Large ..	.. .. .	20/-	
Second Smokeless Large ..	.. .. .	18/9 to 19/9	
Best Dry Large .. .. .	.. .. .	18/9 to 19/3	
Ordinary Dry Large .. ..	.. .. .	18/- to 18/6	
Best Black Vein Large ..	.. .. .	18/3 to 18/6	
Western Valley Large ..	.. .. .	18/- to 18/3	
Best Eastern Valley Large	.. .. .	18/- to 18/3	
Ordinary Eastern Valley Large	.. .. .	17/9 to 18/-	
Best Steam Smalls .. ..	.. .. .	13/6 to 14/-	
Ordinary Smalls .. .. .	.. .. .	12/9 to 13/3	
Washed Nuts .. .. .	.. .. .	17/6 to 23/6	
No. 3 Rhondda Large ..	.. .. .	20/6 to 21/-	
„ „ Smalls .. .. .	.. .. .	15/6 to 16/-	
No. 2 „ Large .. .. .	.. .. .	17/- to 17/3	
„ „ Through .. .. .	.. .. .	16/- to 16/6	
„ „ Smalls .. .. .	.. .. .	14/- to 14/3	
Foundry Coke (Export) ..	.. .. .	32/6 to 37/-	
Furnace Coke (Export) ..	.. .. .	27/- to 28/-	
Patent Fuel .. .. .	.. .. .	22/- to 22/6	
Pitwood (ex ship) .. ..	.. .. .	25/6 to 26/-	
SWANSEA—			
Anthracite Coals :			
Best Big Vein Large ..	.. .. .	35/- to 37/6	
Seconds .. .. .	.. .. .	28/- to 32/-	
Red Vein .. .. .	.. .. .	23/6 to 27/6	
Machine-made Cobbles ..	.. .. .	42/6 to 45/-	
Nuts .. .. .	.. .. .	43/- to 46/-	
Beans .. .. .	.. .. .	25/- to 27/6	
Peas .. .. .	.. .. .	19/6 to 20/-	
Breaker Duff .. .. .	.. .. .	10/- to 10/6	
Rubbly Culm .. .. .	.. .. .	11/- to 12/-	
Steam Coals :			
Large .. .. .	.. .. .	20/- to 21/-	
Seconds .. .. .	.. .. .	18/6 to 19/6	
Smalls .. .. .	.. .. .	12/6 to 13/6	
Cargo Through .. .. .	.. .. .	15/6 to 16/6	

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate: Joists (minimum), 12/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 10/- if home consumers confine purchases from associated British Steel Makers.

French Engineering Notes.

(From our Correspondent in Paris.)

Export Agreements.

THE value of agreements amongst producers to regulate prices for export is shown by the experience of blast-furnace owners in France, Belgium, and Luxemburg, who, a little while ago, dissolved their association which had fixed export prices for pig iron. Price-cutting then became rampant and the fall of values on a weak market threatened disaster, with the result that within a month pig iron producers in the three countries named met in Paris to reconstitute their syndicate. The market immediately improved with the higher scale of prices. This experience is regarded as demonstrating the necessity of complete union at a time when the conditions are unfavourable to trade. It appears that while the Steel Cartel has been prolonged for another six months, because it has been found impossible, so far, to come to an agreement over quotas, there will be as little delay as possible in putting into operation the international sales comptoirs which are to be an indispensable corollary of the Cartel. Frequent meetings are being held in order to settle complicated details, and it is officially stated that the comptoirs will begin to work at the beginning of August. Meanwhile, statistics show that, except in the case of Luxemburg, all the countries in the Cartel failed to reduce their production of raw steel in January by 10 per cent. as arranged. The French total, which should have been 762,000 tons for the month, rose to 864,000 tons. Germany produced 1,275,000 tons, or 40,700 tons more than the agreed total, and the production in Belgium was 329,500 tons, an excess over the agreed maximum of 7800 tons. These figures again show the difficulty of adhering to any prescribed limit of production, and it is believed that it will be achieved automatically under the operation of the new sales comptoirs when each country will have its quota for export.

Public Transport.

The whole of the public road transport in and around Paris is in the hands of the Société des Transports en Commun de la Région Parisienne, which runs both the omnibus and tramway services in the department of the Seine. It is now extending its operations to Seine-et-Oise, where it is working all the local railways for the departmental authorities. These lines have always been a financial burden to the department, as they are elsewhere, and in many parts of the country the local railways have been abandoned. In the case of Seine-et-Oise, this course is not possible on account of the utility of the services in a populous region near Paris, and it has therefore been found advisable to place the working of the whole system, consisting of lines connecting up outer suburban towns, in the hands of the Société des Transports en Commun. One of the reforms being carried out is to connect the local lines with the main lines and to arrange with the railway companies to run their rolling stock on them, so that the utility of the local railways will be greatly increased for the carriage of goods.

Hydraulic Works.

In Algeria and Morocco there is great activity in the carrying out of various works, mainly of an irrigation character, and several dams are now in course of construction. The most important of them are two barrages that are being constructed in Algeria to the south of Orleansville, one at Ghrib and the other on the Oued Fodda. They will each take six years to build. The Ghrib dam will have a height of close upon 240ft. and a length of 1140ft. The thickness at the base will be 490ft. The dam will hold up the waters of the Chelif and will form a lake of about 5000 acres, with a capacity of 250 million cubic metres. The height of the Oued Fodda dam will be 198ft. It will create a reservoir, 8 miles long, and there are features of special interest in its construction, notably the injection of 4500 tons of concrete into the bed of the river over a distance of 2½ miles. In Morocco an extensive irrigation programme is being carried out, and some of the dams are of great importance, one of them being intended to provide at the same time 60,000 horsepower. They are necessary on account of the torrential rainfall in winter, and the prolonged drought in summer, and the idea is to build dams that will hold up water equivalent to at least two winter floods.

Railways and Canals.

There is a good deal of friction between the railways and the inland waterway transport concerns, and each is endeavouring to prove that it is suffering from the competition of the other, the object of each party being to induce the State to protect its respective interests. Since the railway rates were made uniform in 1920 and the special rates offered for bulky goods that might otherwise be carried on the canals were suppressed, it is affirmed that the inland waterway traffic has been steadily increasing. From 1927 to 1928 it rose from 41,851,910 tons to 48,120,590 tons. On the Seine the increase was more than 30 per cent. In view of this competition the railway companies have revived their system of diminishing rates according to the quantities consigned by individual users during the year. This system is strongly objected to by the canal transport concerns, which are endeavouring to induce the State to suppress these preferential rates. They affirm that the statistics put forward to show that the companies are suffering from the competition of the inland waterways are misleading, since they are due to special conditions arising out of the Rhine traffic. They state that the only fair comparison is to take the figures for the inland waterways, excluding those of Alsace-Lorraine, when, they allege, it will be found that there has been a heavy reduction in the water-borne traffic. The situation is a difficult one for the State, which regards it as a national policy to do nothing to prejudice the situation of the railway companies, and it is at the same time committed to the programme of inland waterway development. There is so much to be done in the way of providing greater traffic facilities on the canals with larger and fewer locks, and improved equipment, that private enterprise hesitates to embark upon the undertaking, and everyone is looking to the State for financial assistance.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

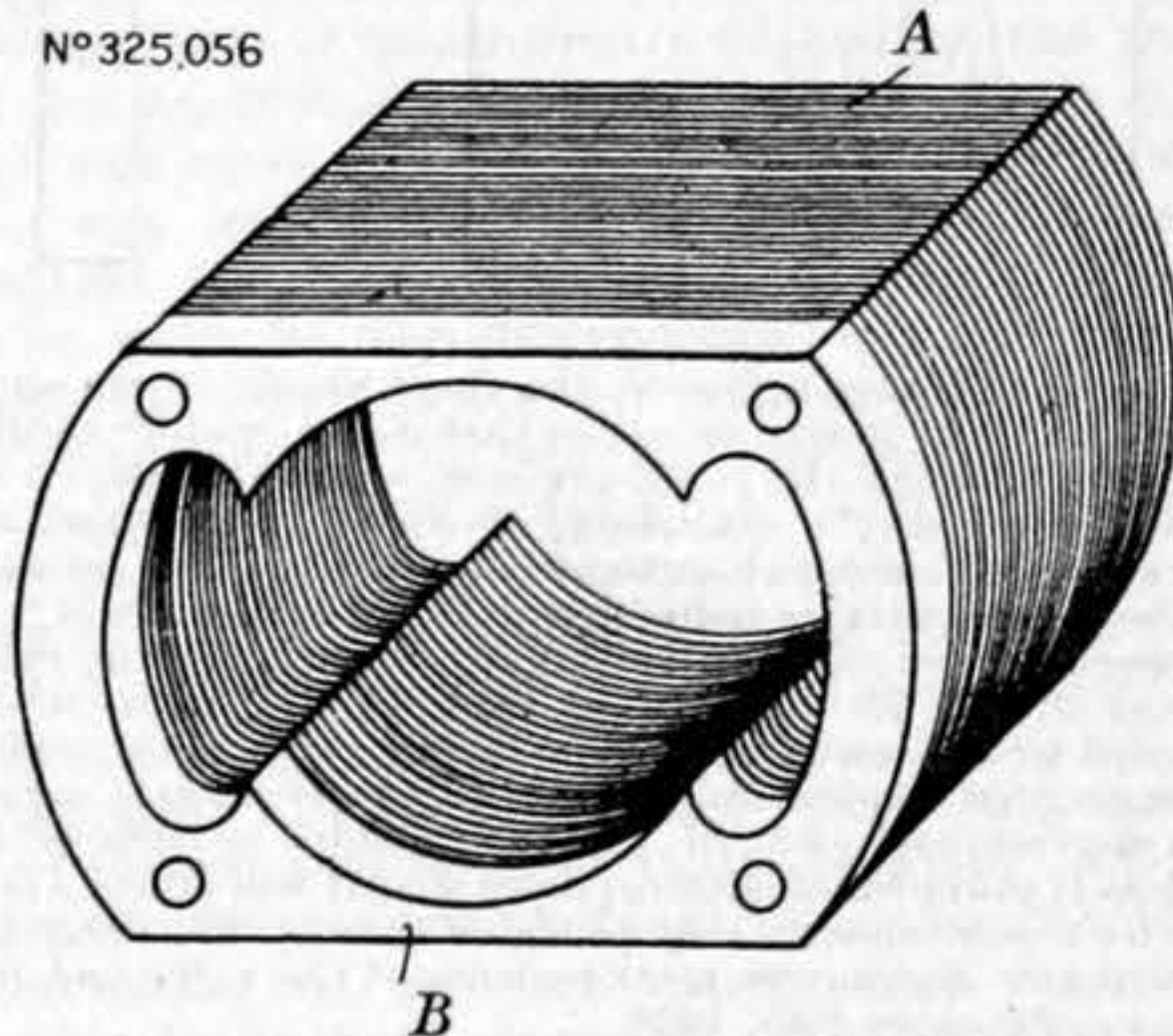
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

325,056. December 21st, 1928.—FIELD MAGNET CONSTRUCTION FOR DYNAMO-ELECTRIC MACHINES, Frederick Newton, of Alfreton-road, Derby.

To ensure self-excitation, the field magnets of dynamo-electric machines have been built in part of material of high magnetic permeability, and in part of material of high magnetic remanence, these two parts being generally parallel branches of the magnetic circuit through the armature, and preferably forming together apart from the armature a nearly closed magnetic circuit. According to this invention, the soft steel core laminations A have substantially flat exterior surfaces nearly tangential to the pole arcs at their centre, while the interpolar yoke parts are bounded by circular arcs concentric with the arma-

N°325,056

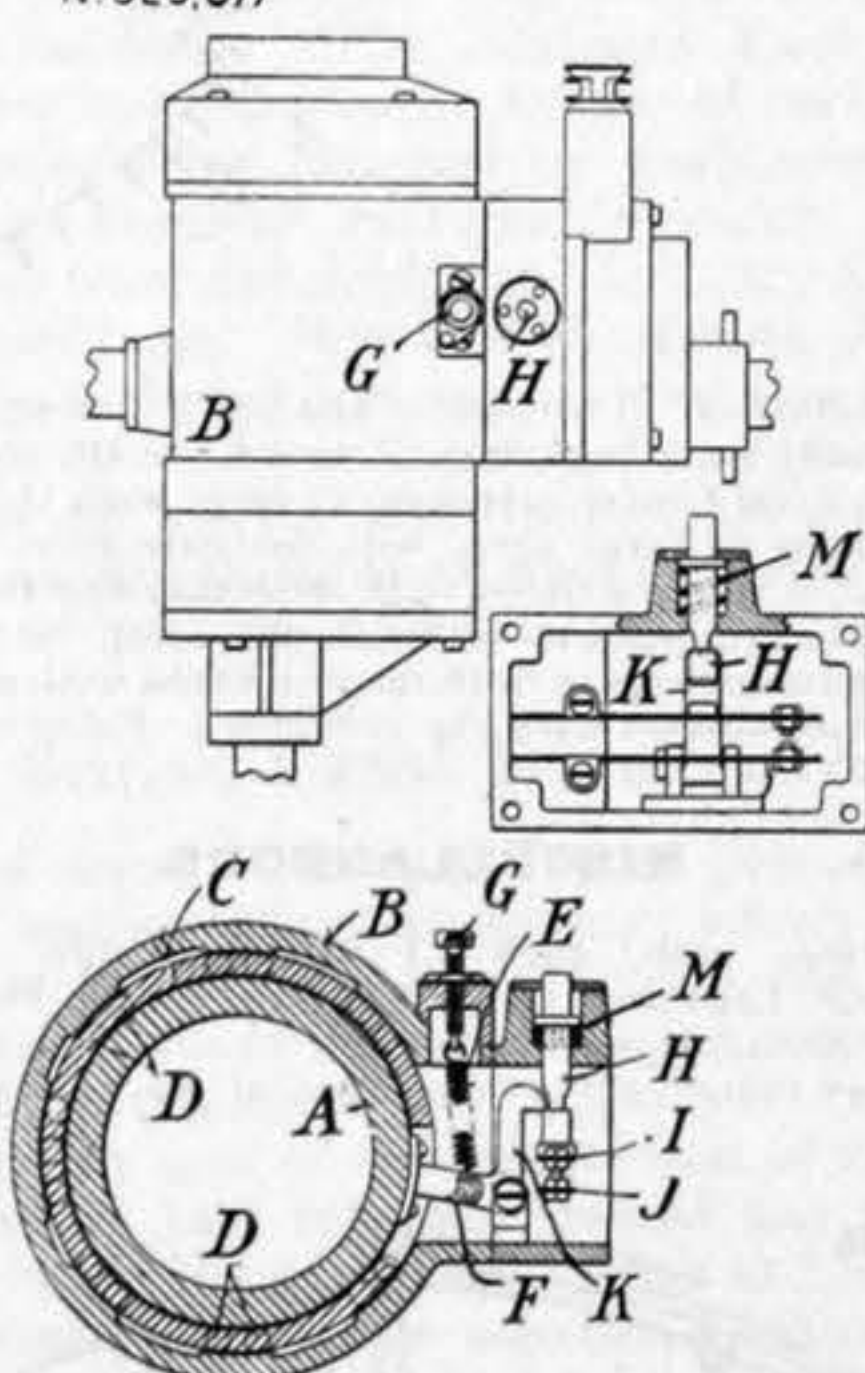


ture. The permanent magnet B may be cast in similar form to the laminations, but is conveniently a single piece structure of the thickness of several laminations hardened and machined to size. It may be placed at one end of the pile of laminations A or among them. If desired, two or more such plates may be used. As an indication of the proportions suitable the following example may be taken. A small generator having an armature 2in. in diameter, with an air gap of .0175in. radial depth, may have a field magnet built of soft steel laminations over a length of 1.175in., and of cobalt steel over a length of 0.2in. The permanent magnet is submitted to a very high magneto-motive force after assembly with the magnetic circuit completed by a temporary armature. When the armature is removed, the soft steel part of the field serves as a keeper.—February 13th, 1930.

325,077. January 16th, 1929.—PROTECTIVE MEANS FOR ELECTRIC MOTORS, Frank Wootton Highfield and the Highfield Electrical Company, Ltd., both of "Faraday Works," Stoney Stanton-road, Coventry.

The object of the invention is to provide improved means for automatically protecting portable electric motors. In the application of the invention to a small motor for a portable drill or other tool, the stator A is rotatably mounted within a body or holder B, such as by means of rings C carrying bearings, balls, or rollers D, and the stator is held in its normal position relatively to the part B, by means of a spring E, acting on a lever F attached to the stator A. The spring may be adjustable by means of a screw G. In such position the lever F holds a plunger H in contact with the movable spring contact piece I

N°325,077



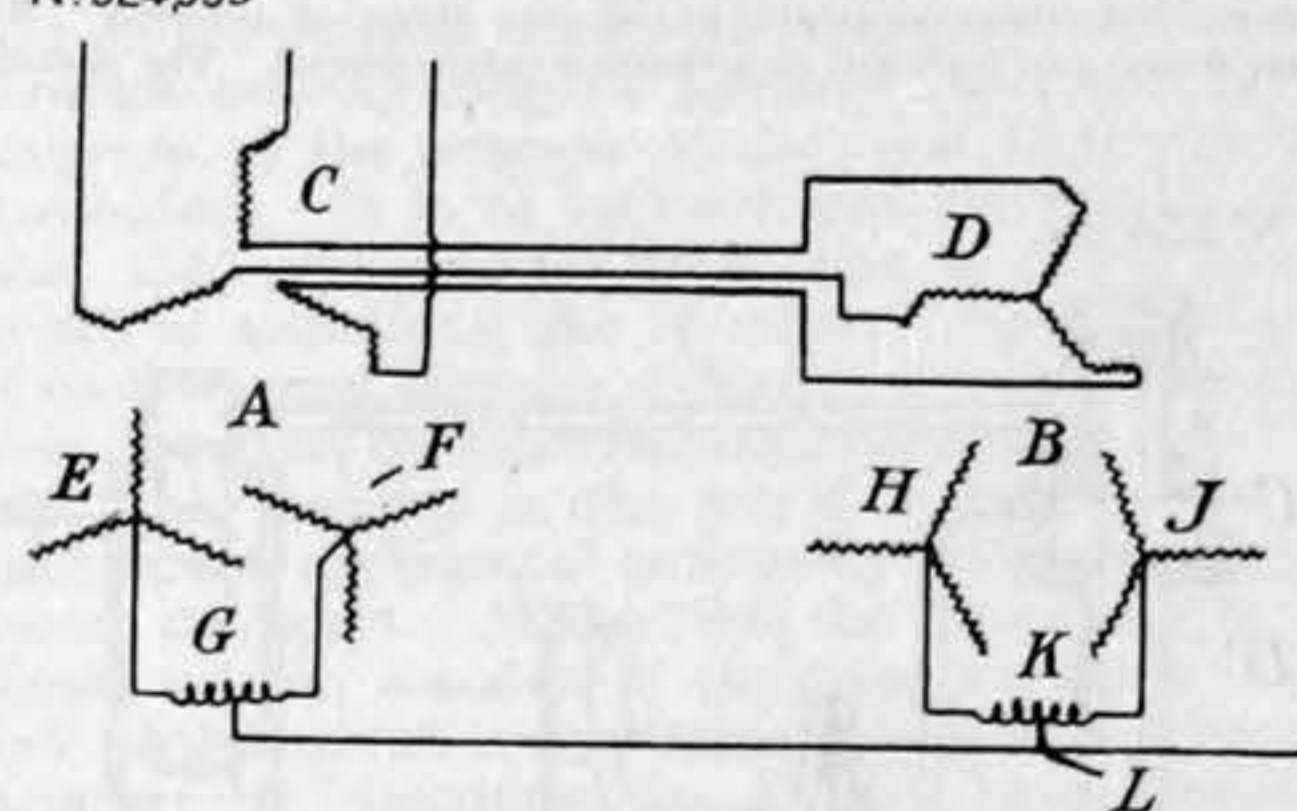
of a switch, the complementary contact being indicated by J. The connection between F and H is provided by a bell crank lever K, one end of which is connected with the lever F, whilst the other end is adapted to engage a shoulder on the plunger. So long as the torque exerted by the motor is normal, no movement occurs in the stator relatively to the holder B, but if the torque becomes excessive the stator moves against the action of its controlling spring E, and the plunger is released, thereby allowing the switch to open under its own spring action. To re-establish the circuit, it is necessary for the operator to close the switch by pressing inwards the outer end of the plunger H, and thereby causing the plunger to be re-engaged by the lever K. A spring M is preferably provided in conjunction with the plunger H.—February 13th, 1930.

TRANSFORMERS AND CONVERTERS.

324,999. November 9th, 1928.—TRANSFORMER CONNECTIONS, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2, and John Carley Read, of 14, Dunchurch-road, Rugby.

This specification describes a twelve-phase supply to mercury arc rectifiers, in which two three-phase transformer sets are employed. The primary windings are connected in series, and by phase combination produce fluxes 30 deg. apart. On each transformer set the secondary winding consists of two three-phase stars, 180 deg. apart, and the neutral points are connected together through an interphase transformer, the neutral points of which are connected together. The two transformer sets are of a type in which no appreciable triple harmonic flux is able to flow. A and B are two three-phase transformers of the core type, having three wound legs and no unwound legs. The primary windings C and D are series zigzag star-connected, so as to produce fluxes 30 deg. apart in the two transformers. The secondary windings E and F on transformer A consist of two three-phase stars 180 deg. apart, and the neutral points are connected together through an interphase transformer G of known type. Similarly the secondary windings H and J on

N°324,999



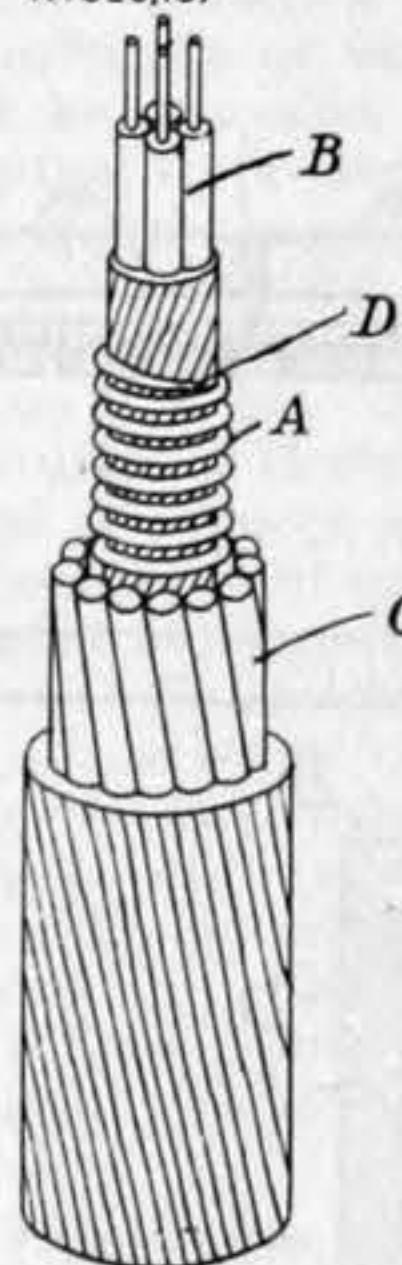
transformer B have their neutral points connected together, through interphase transformer K. The ends of the secondary phases remote from the neutral points are connected to the anodes of the rectifier. The mid-points of interphase transformers G and K are connected together at L, which forms the negative pole of the direct-current system. The spread of the anode currents in the arrangement is identical with that in the usual arrangement, high impedance to triple harmonic flux in the anode current being produced in the interphase transformers G and K instead of being produced in the core of the main transformer. The fact that there is no path for triple harmonic magnetising current to flow in the main transformers is of no importance, because the transformers A and B are of the three-phase core type without unwound legs, so that there is no low-reluctance path available for any triple harmonic flux in them. Consequently, the phase voltages produced in transformers A and B are now practically sinusoidal, and thus there is only a relatively small difference, about 20 per cent., between the direct-current voltage at no load and that at light load. Alternative systems of connections are described.—February 10th, 1930.

TELEGRAPHS AND TELEPHONES.

325,157. April 6th, 1929.—MULTI-CORE SUBMARINE CABLES WITH GUTTA-PERCHA OR LIKE INSULATION, Norddeutsche Seekabelwerke, Aktiengesellschaft, of Nordenham an der Weser, Germany, and Carl Traugott, of 8, Goethestrasse, Nordenham an der Weser, Germany.

The object of this invention is to provide pressure-protecting means which, during the laying of a multi-core cable, will keep the arising pressure away from the cores. With this object in view, a wire helix A is mounted over the core B of the cable directly under the armouring wires C. The helix A may extend over the whole length of the cable, or it may be used in the form of short lengths for the protection of points which are specially endangered. The turns of the pressure-protecting helix A may lie close to or at a certain interval from one another, and the helix may be made of steel or any other material having similar properties. In order to increase the resistance to rusting, the helix may be made of an alloy and with the same object in view it may be tarred or galvanised, as is well known in connection with armouring wires. The helix may be made of wires of circular cross section or the wires may be flat or have any other shape. Further, the helix may consist of a pressure hose similar to a metal hose. When use is made of short helices, the free ends D are secured to the adjacent turn, in order to prevent the core from being damaged.—February 13th, 1930.

N°325,157

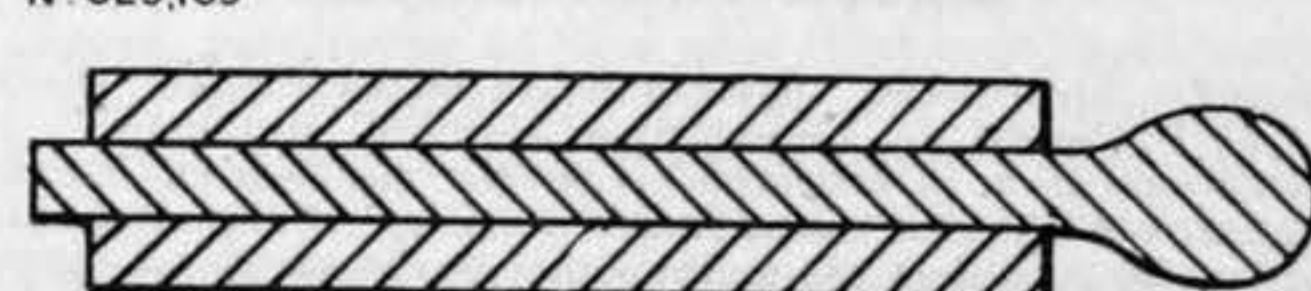


MACHINE TOOLS AND SHOP APPLIANCES.

325,169. April 29th, 1929.—THE MANUFACTURE OF HOLLOW METAL BARS, A. P. Pehrson, Attercliffe Wharf Works, Sheffield, and F. Lloyd, 25, Alma-street, Sheffield.

This invention relates to the manufacture of hollow metal bars from hollow billets by rolling, forging, or drawing the hollow billet with a metal core which is introduced therein prior to the

N°325,169



reducing operation, the core being subsequently removed when the reducing operation is completed. The inventors state that they have found that if the core is made initially of substantially the same length as the billet, the billet extends during the rolling operation and its ends roll over the core, forming comparatively long blank ends, whereby "ending waste" is occasioned. The chief object of the invention is to reduce this end-

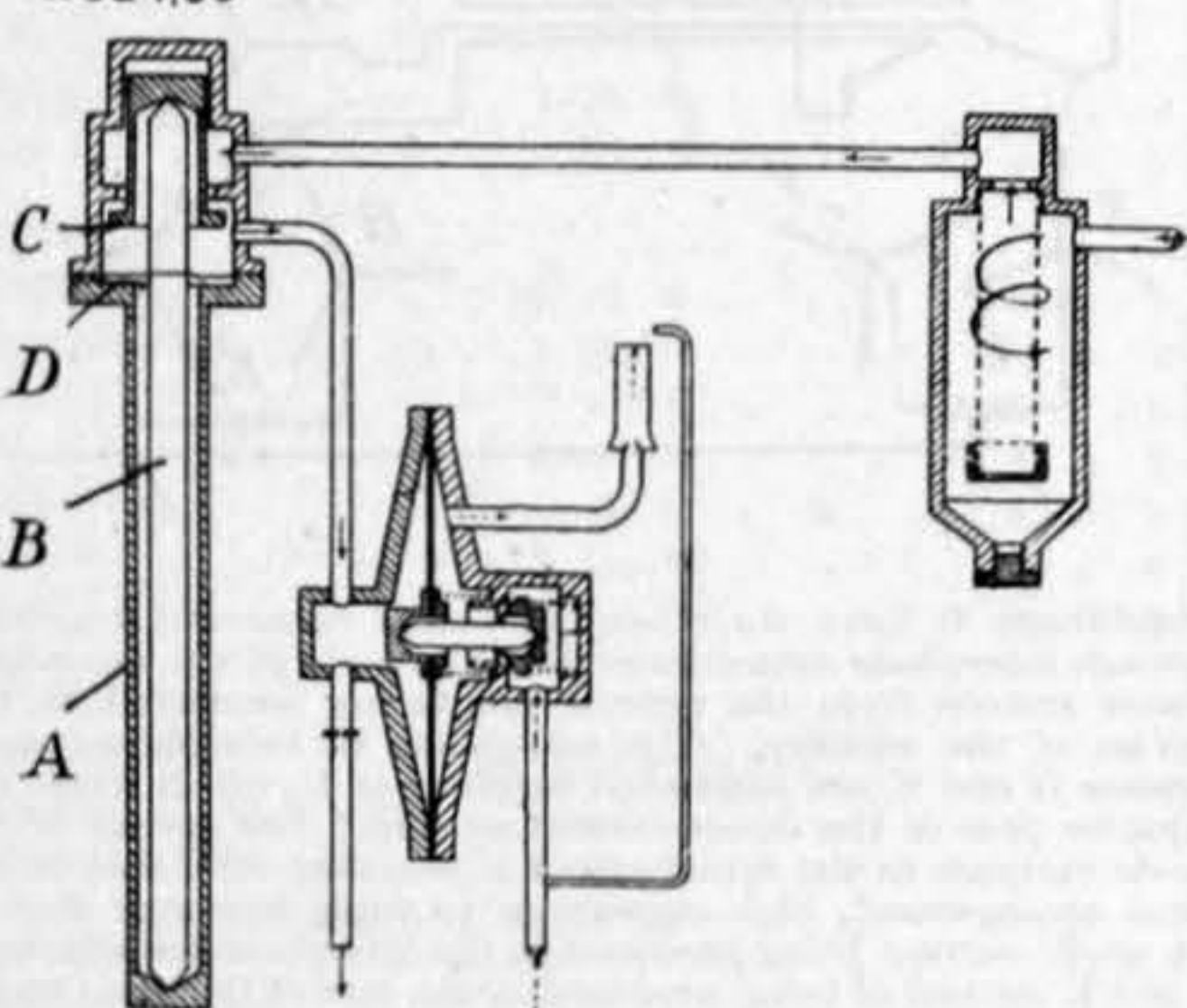
ing waste. This object is attained by extending the core beyond the end of the hollow billet and forming an enlarged end thereon of such a shape that the billet, when it elongates, is able to pass over the surface of the enlarged portion without encountering any appreciable resistance to its elongation. The enlarging of the projecting end of the core enables the extended portion to retain its heat longer than it otherwise would do, and the enlarged portion of the core can be situated near to the end of the hollow billet, so that it is enfolded within the hollow billet at an early stage in the reducing operation, before any appreciable cooling takes place. The retention of heat by the extended end of the core is desirable in so far as if cooling takes place, the chilled and consequently hardened portion of the core cannot be reduced after it has become enfolded in the hollow billet, and the extending end of the billet might take the end of the core with it and cause the formation of a constriction in the core or even a rupture of it.—February 13th, 1930.

MEASURING AND TESTING INSTRUMENTS.

324,961. October 3rd, 1928.—THERMOSTATIC CONTROLS, C. E. Foster, Elm Tree House, Letchworth-lane, Letchworth, Herts.

This specification is one of those of the involved kind, in which it is difficult to discover which matter the inventor desires to protect, but there appears to be one item of interest. The apparatus is put forward as a thermostatic control. The thermo-

Nº324,961



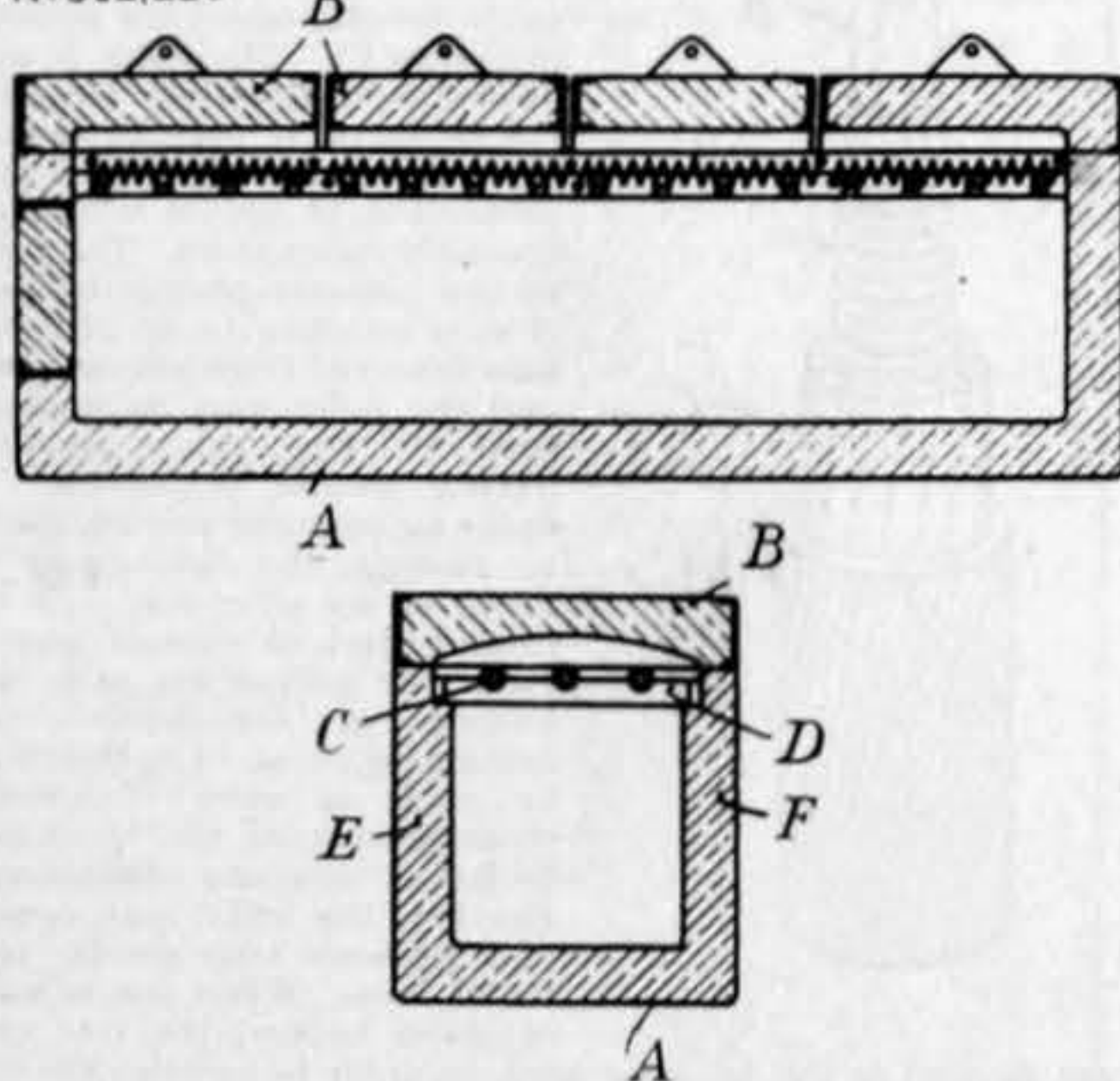
stat is shown with a highly expansive tube A and a relatively less expansive rod B that actuate the valve C in the piping system of the heating or cooling system. The rod B passes through a diaphragm D, which is slightly spherical in shape, so that it will spring into one or the other of two extreme positions, but will not remain in a neutral or intermediate position. The consequence is that the valve C is either fully opened or closed.—February 3rd, 1930.

FURNACES.

302,223. October 29th, 1928.—ELECTRICALLY HEATED FURNACES, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

This specification describes an electric heating furnace with a removable cover and heating resistances, arranged in a horizontal plane beneath the cover characterised by the heating resistances being carried on a fire-resisting framework adapted to rest on the side walls of the furnace beneath the cover and independently thereof, the resistances and the framework

Nº302,223



carrying them being subdivided into several parts and being separately interchangeable. In the drawings A are the walls and B the cover, which can be subdivided into separate sections along the length and lifted independently of the heating resistances C. Underneath the cover B is a framework D of refractory material, which rests on a recess in the side walls E and F. The framework D and the heating resistances C carried by it, are subdivided into several parts separate from one another and interchangeable.—January 29th, 1930.

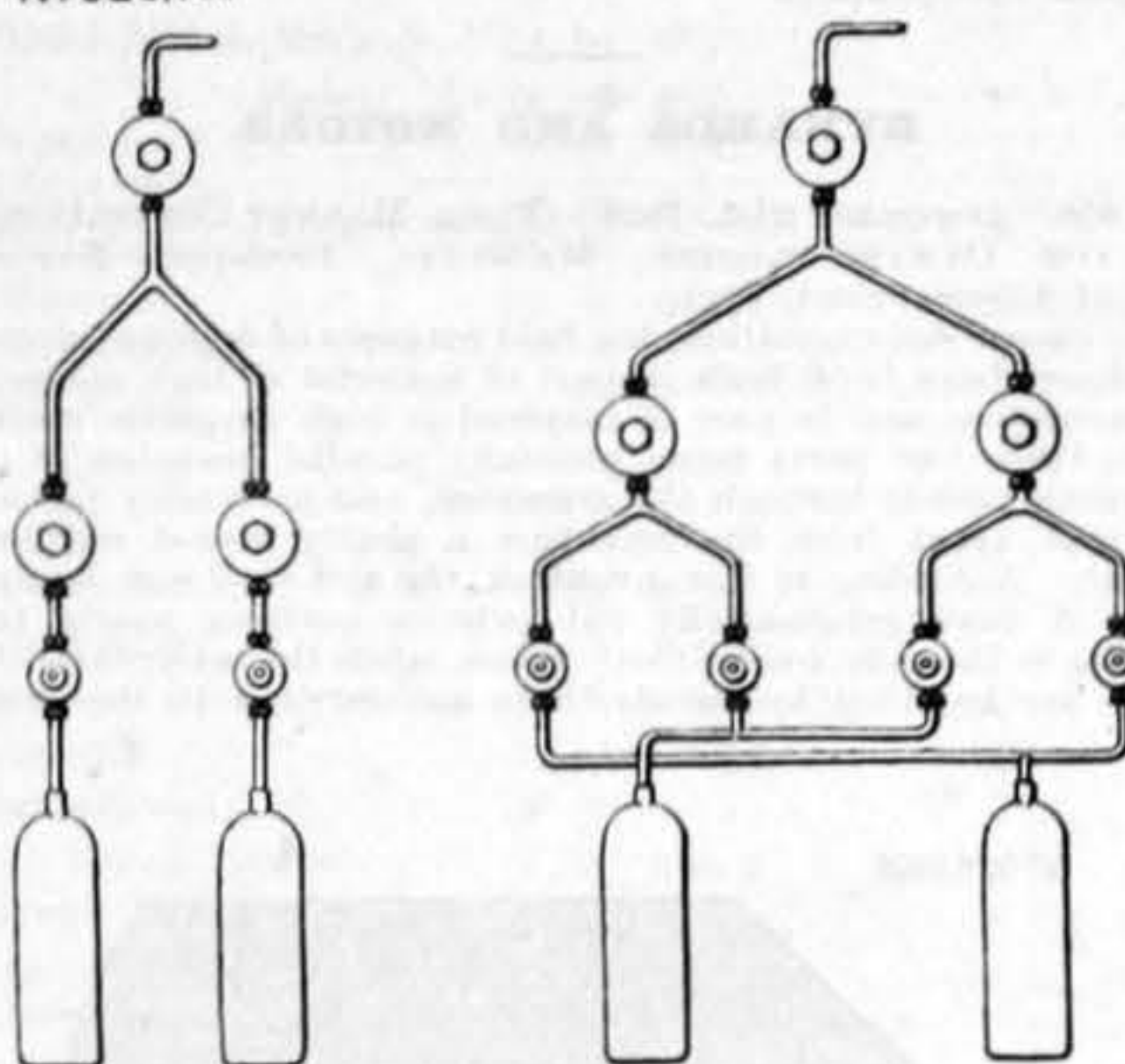
WATER PURIFICATION.

325,161. April 16th, 1929.—THE PURIFICATION OF WATER, F. P. Candy, 14, Church-road, Hanwell, Middlesex.

This invention is concerned with the sterilisation of water by means of chlorine taken from "bottles" of liquid chlorine, and has for its object the maintenance of the supply of chlorine during the absence of the attendant. The inventor describes the apparatus as follows:—"I provide two cylinders or two groups of cylinders of liquid chlorine and two pressure-reducing valves, one of which—which I will call the higher-pressure reducing valve—is arranged to reduce the gas to a slightly higher pressure than the other—which I will call the lower-pressure reducing valve. Stop valves are provided, preferably so that each chlorine cylinder can supply gas to either of the reducing valves at will, the stop valves being preferably provided with means to indicate whether they are open or shut. The outlet

from each of the pressure-reducing valves is connected to a common outlet pipe, which supplies a third pressure-reducing valve by means of which the gas is brought to the pressure finally desired. The method of working is as follows:—No. 1 chlorine cylinder is put in connection with the higher-pressure reducing valve only, and No. 2 chlorine cylinder is put in connection with the lower-pressure reducing valve only, the result being that as long as gas is available in No. 1 cylinder it passes from that cylinder only, no gas passing from No. 2 cylinder because the higher pressure of the reduced gas coming from No. 1 cylinder puts a check on the lower-pressure reducing valve—fed from No. 2 cylinder—causing it to remain closed. When No. 1 cylinder is exhausted, and can no longer supply gas through the

Nº325,161



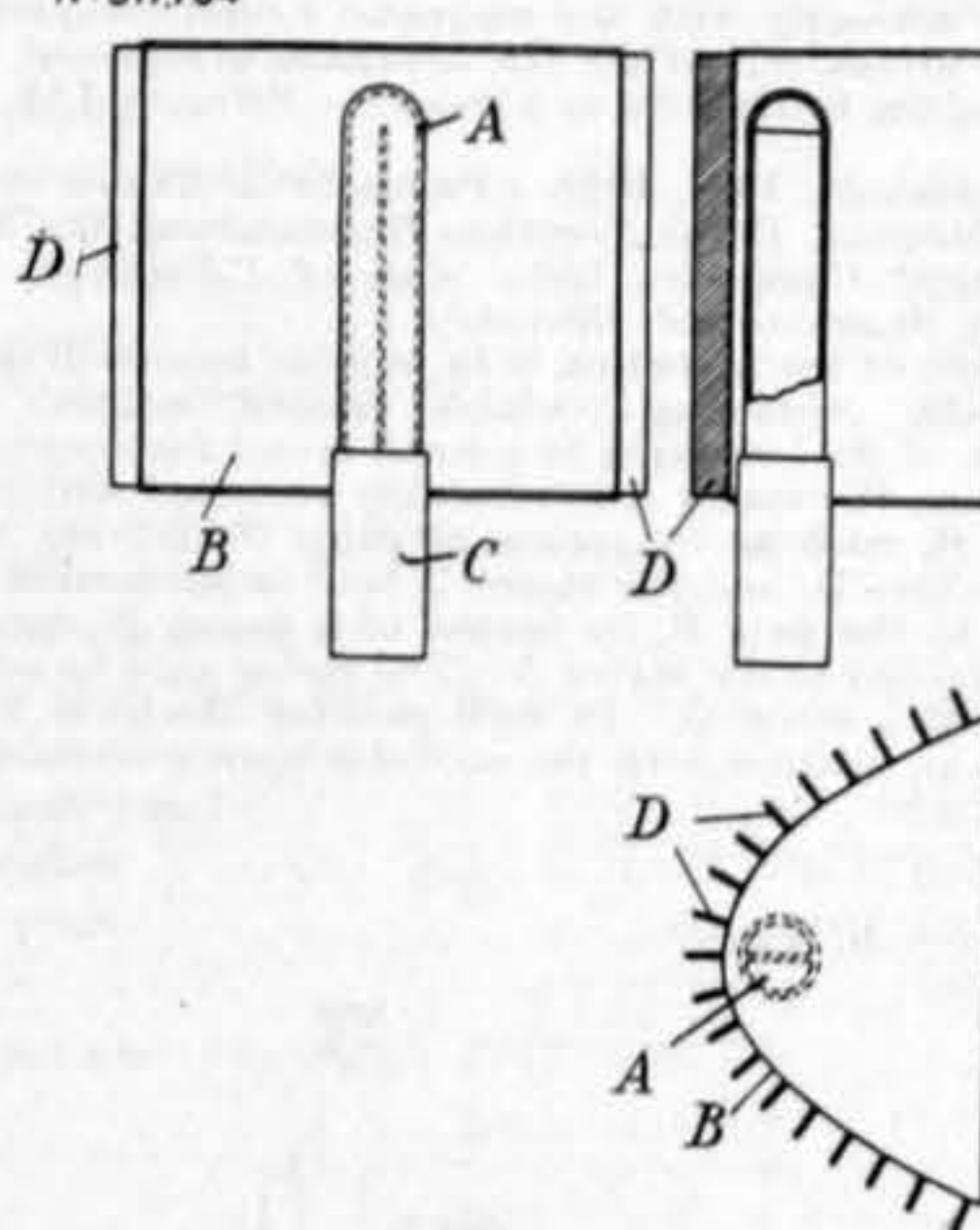
higher pressure reducing valve, the check on the lower-pressure reducing valve no longer exists, so that No. 2 cylinder continues the supply through the lower-pressure reducing valve. When this has occurred, the attendant, at a convenient time, manipulates the stop valves so as to put No. 2 cylinder in connection with the higher-pressure reducing valve, and to disconnect it from the lower-pressure reducing valve. The empty chlorine cylinder is removed, and its place taken by a new cylinder, which is connected to the lower-pressure reducing valve, thus re-obtaining the original conditions. In this way a continuous supply of gas is conveniently ensured, as each cylinder or each group of cylinders is provided of such capacity that it will afford a supply of gas for a conveniently long period of time." The illustrations represent two alternative arrangements of the valve and piping systems.—February 13th, 1930.

LIGHTING AND HEATING.

311,704. April 23rd, 1929.—LOW-PRESSURE METALLIC VAPOUR LAMPS, Dr. Stephan von Bogdandy, of 28, Dorotheenstrasse, Berlin, N.W. 7, and Dr. Laszlo Wamoscher, of the same address.

This invention relates to vacuum or low-pressure metallic vapour lamps, and its object is to improve the cooling of the electrodes of such lamps. In the drawings, A is the lamp and

Nº311,704



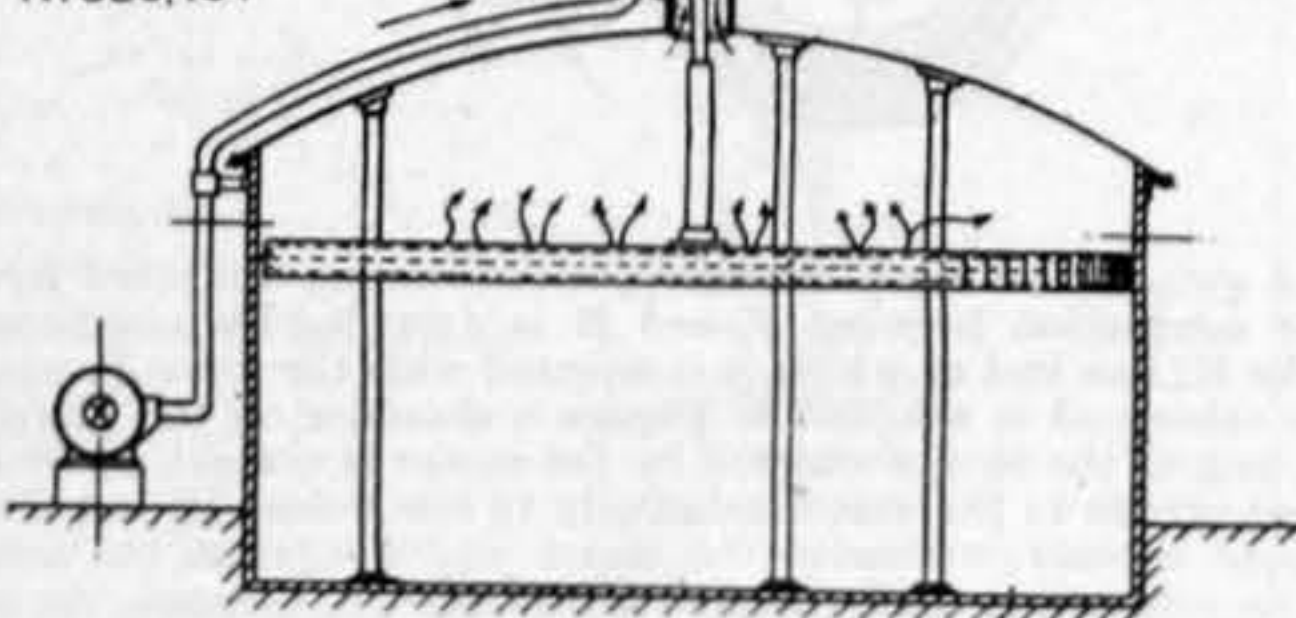
B its metal reflector. The part of the lamp containing the electrodes is closely surrounded by a metal sheath C, and this is connected in good heat-conducting fashion with the reflector B. The latter being of large area, will dissipate heat fairly easily, but if desired, it may be fitted with radiating fins D. Where the electrodes are at opposite ends of the lamp or otherwise in separate containers, one or both may be fitted with metal sheaths in good thermal contact with the reflector.—February 13th, 1930.

MISCELLANEOUS.

325,184. June 11th, 1929.—TANKS FOR THE STORAGE OF VOLATILE LIQUIDS, G. V. Tontet, 1049, Fragues-street, Buenos Aires, Argentina.

In order to reduce the evaporation of the contents of petrol

Nº325,184

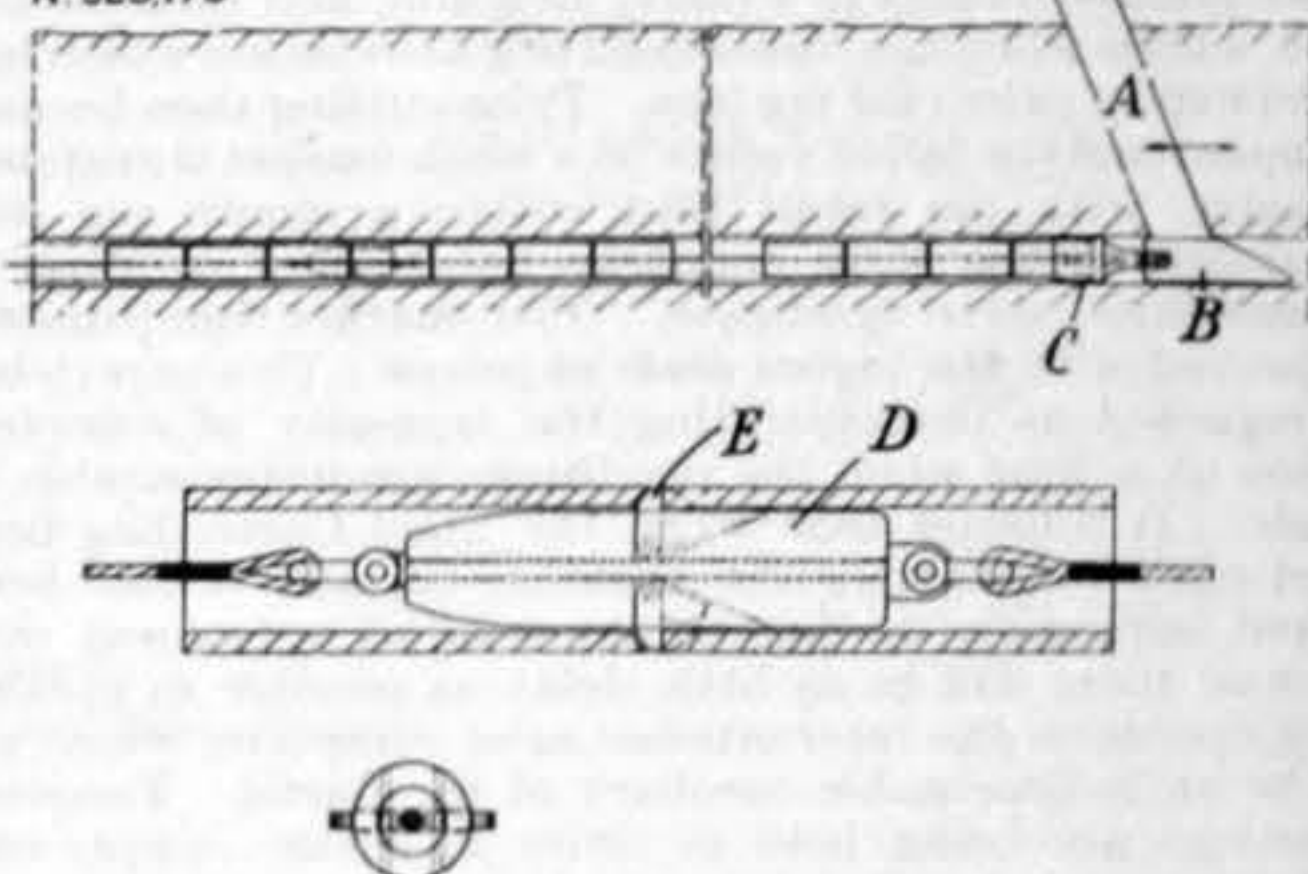


tanks and similar receptacles, the inventor provides a hollow float to rest on the surface of the liquid, and circulates air through it to reduce its temperature. The drawing is self-explanatory.—February 13th, 1930.

325,175. May 11th, 1929.—APPARATUS FOR LAYING TILE DRAINS, G. Henderson and W. M. Henderson, The Garrage, Catrine, Ayrshire.

For the purpose of draining land, the inventors first make mole drains in the usual fashion by means of a coulter and mole-driving tool. They then draw into the tunnel thus formed a series of hollow tiles, by means of a coulter A and pilot tool B.

Nº325,175



To these there is attached a shield C embracing the first tile of a string, and a wire rope for dragging the tiles forward. Engagement with the tiles is effected by drivers D, which are provided with triggers E to catch the rear ends of the tiles. When the tiles have been drawn into place, the triggers will collapse and allow the drivers to be drawn out backwards.—February 13th, 1930.

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 its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday 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.

SATURDAY, MARCH 29TH.

FINESBURY TECHNICAL COLLEGE OLD STUDENTS' ASSOCIATION.—The Trocadero. Annual dinner.

MONDAY, MARCH 31st.

INSTITUTION OF ELECTRICAL ENGINEERS: SOUTH MIDLAND CENTRE.—The University, Edmund-street, Birmingham. "The Medical and Surgical Applications of Electricity," by Mr. B. Leggett. 7 p.m.

TUESDAY, APRIL 1st.

SHEFFIELD METALLURGICAL SOCIETY.—198, West-street, Sheffield. "The Heat Treatment of Cast Iron," by Mr. R. Whitfield. 7.30 p.m.

WEDNESDAY, APRIL 2nd.

INSTITUTION OF CIVIL ENGINEERS: STUDENTS' SECTION.—Great George-street, S.W. 1. "Some Notes on Electric Traction in England," by Mr. J. L. L. North. 6.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: WIRELESS SECTION.—Savoy-place, W.C. 2. "Recent Developments in Direction-finding Apparatus: Part 1, Medium Wave Apparatus, 250 m. to 600 m.; Part 2, Short Wave Apparatus, 12 m. to 60 m.," by Mr. R. H. Barfield. 6 p.m.

THURSDAY, APRIL 3rd.

INSTITUTION OF LOCOMOTIVE ENGINEERS.—Denison House, Vauxhall Bridge-road, London, S.W. 1. "What Others are Doing in the Locomotive World," by Mr. W. F. Pettigrew. 6 p.m.

ROYAL AERONAUTICAL SOCIETY.—Royal Society of Arts, 18, John-street, Adelphi, W.C. 2. "The Technical Organisation of the Compagnie Generale Aeropostale," by Monsieur P. Grimault. 6.30 p.m.

FRIDAY, APRIL 4th.

INSTITUTION OF CHEMICAL ENGINEERS.—Hotel Victoria, Northumberland-avenue, London, W.C. 2. Annual dinner. 7 p.m. for 7.30 p.m.

INSTITUTION OF ENGINEERS-IN-CHARGE.—Venetian Chamber, Holborn Restaurant, London, W.C. 1. Annual dinner. 6.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIP-BUILDERS.—Bolbec Hall, Newcastle-on-Tyne. "Ships' Electrical Deck Auxiliaries," by Mr. A. Read. 6 p.m.

SATURDAY, APRIL 5th.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—The College of Technology, Sackville-street, Manchester. "Some Aspects of Foundry Service to Engineers," by Messrs. E. J. L. Howard and H. Milner. 4 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Students' visit to the works of the Ford Motor Company under construction at Dagenham.

TUESDAY, APRIL 8th.

INSTITUTE OF MARINE ENGINEERS.—The Minories, E.C. 3. "Recent Metallurgical Research in Relation to Marine Engineering," by Mr. S. L. Archbutt. 6.30 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, S.W. 1. "The Rebuilding of the Bassein Bridges on the Bombay, Baroda and Central India Railway," by Mr. B. B. Haskew; "The Reconstruction of the Attock Bridge Across the River Indus on the North-Western Railway, India," by Mr. W. T. Everall. 8 p.m.

WEDNESDAY, APRIL 9th.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, S.W. 1. "Recent Developments in Railway Permanent Way Practice, with Particular Reference to the Use of Metal Sleepers," by Mr. S. T. Dutton, M. Inst. C.E. 6 p.m.

THURSDAY, APRIL 10th.

INSTITUTE OF MARINE ENGINEERS: JUNIOR SECTION.—The Minories, E.C. 3. A film display featuring "The Manufacture and Operation of the Babcock and Wilcox Water-tube Boiler, &c." 7 p.m.

FRIDAY, APRIL 11th.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. "Gas in Japan and the Far East," by Mr. W. T. Dunn. 7.30 p.m.