THE ENGINEER.

DECEMBER.

The New Battleships.

IN the latter half of October ten firms were invited by the Admiralty to submit tenders for the construction of the two 35,000-ton battleships permitted to this country under the terms of the Washington agreement. Shortly afterwards it was rumoured that although the tenders had been duly received, the award of the contracts would probably be considerably delayed on the score of economy. The truth of this rumour was denied by the Admiralty early in November, but nearly another month elapsed before anything further of a definite nature was heard regarding the placing of the work. On December 4th, Mr. Bonar Law announced in the House of Commons that the Government had learned from its legal advisers that unless the ships were laid down by the last day of the year our right to construct them under the Treaty would lapse. At the same time he pledged the Government to come to a decision in the matter before the end of the session. That pledge was fulfilled on the 12th, when it was announced that the contracts had been placed, the hull of one vessel going to Armstrong, Whitworth and its machinery to the Wallsend Slipway, and the hull and machinery of the other to Cammell Laird. The orders for the armour plate were distributed between Sheffield, Manchester and Glasgow, and for the gun mountings between Barrow and Newcastle. The guns are to be built at seven different centres, including Woolwich Arsenal. The work will involve a total wages bill of about £10,000,000, and at the maximum period of activity will give employment to some 40,000 men. Surprise has been expressed that, whereas of the orders for four battleships placed in 1921 and subsequently cancelled, the Clyde received three, on this occasion its share in the work is confined to a portion of the armour plate and of the guns. Speaking in Glasgow, Lord Maclay suggested that the reason was to be found in the reported fact that the output of the Clyde shipyard workers was 10 per cent. below that in other districts. This statement has aroused widespread attention and acrimony. It is known from official sources that the Clyde tenders were "enormously" higher than those from other districts. According to Lord Maclay the excess was £180,000 or over. The truth may well be that, as the Prime Minister has suggested, the successful contractors have taken the work at a loss, and that the Clyde yards were unwilling to do likewise.

French Hydro-electric Schemes.

CRITICISMS that have been made during the month on the preliminary arrangements for utilising the hydraulic resources of the Upper Dordogne, sound somewhat discordant after the praise that was lavished on the national scheme of electrification. Too much has been taken for granted in preparing this vast project, and the objections now being raised will probably check an excessive optimism which might otherwise endanger the success of the undertaking. It is pointed out that the estimated expenditure will probably be very largely exceeded, and as the State has a great part of the financial responsibility, there is a risk of the burden falling upon the taxpayer, while the State participation in these various hydraulic ventures is creating a new system of semi-State control which will prove to be monopolies in disguise. It is evident that neither the Chambers of Commerce nor the Departments will be able to provide the necessary funds, which can only be obtained by means of State guaranteed loans, and thus a further drain will be made upon the public reserves at a time when it is already very difficult to secure money for industrial expansion. Supposing that with the State assistance the necessary funds are forthcoming, and the undertakings, in which so many interests are involved, are carried out in a satisfactory manner, it has still to be considered whether customers will be found in an exclusively agricultural region for the 400,000 horse-power that may be available for distribution. It is true that it is hoped to create new industrial centres by the offer of cheap power, but it is feared that in estimating the future cost of energy the promoters will find themselves as far wide of the mark as they probably will be over the cost of installation. Moreover, it is doubtful whether industries would migrate into new centres, even with the offer of cheap motive power. The critics of the scheme therefore suggest that the money to be spent upon the Upper Dordogne would be more usefully employed in the industrial districts where financial assistance is badly needed.

Isolation of the Isle of Sheppey.

ON the 17th, as the Norwegian steamer Gyp was passing along the Swale at the point where the Sittingbourne–Sheerness branch of the South-Eastern and Chatham Railway crosses that river, she struck the pier which carries the opening portion of the bridge, so that the latter was displaced and could not be used. All communication by road and rail between the mainland and the Isle of Sheppey was thus destroyed. A boat service was put in use between Port Victoria and Queenborough for the convenience of passengers from and to London and all stations west of Gravesend, but others have still to use a bridge of rafts that has been built across the Swale. The bridge in question is the property of the South-Eastern and Chatham Company, and carries a single line of railway and a public road. The branch is controlled by the electrical tablet, which is interlocked with the mechanism for raising the bridge.

Damage by Gales at Barmouth.

MUCH damage was done to the sea wall and promenade at Barmouth by the heavy seas of a fortnight ago, and the Urban Council is now faced with a considerable expenditure to make good the ravages. The Min-y-Mor sea wall, 200 yards long, which was built between 1916–1920, was undermined by the tides, and collapsed, and some £3000 will have to be expended on its reconstruction. The encroachment of the sea also caused an erosion of something like two acres, and the situation thus created is one of great seriousness to the local authority. Much of the damage caused might have been avoided if proper precautions had been taken by the Barmouth Urban Council to groyne the shore and thus prevent the undermining of the foundations. Mr. Harold Boardman, engineer and surveyor to the Council, advises the construction of a new sea wall outside the present wall and suitable groynes, but the Council is short of funds, and is about to ask the Government for a grant towards the cost of the work.

Desert Transport.

THE experiment which has been carried out during the month of opening up communication between Algeria and the Niger Valley across the Sahara Desert by means of small motor cars running on a special type of rubber endless track, will, if entirely successful, prove to be of considerable value in aiding the development of colonial territories which are at present practically inaccessible. The vehicles have so far negotiated the most varied and difficult routes offered by the desert, from the shifting sands to the rocky bottoms of the *oueds*, or nullahs, and although the journey appears to be very trying to the drivers, the progress so far has been satisfactory, and there is every reason for believing that the experiment has already shown the possibility of utilising these vehicles for supplying stores to the aviation depôts which it is proposed to establish across the desert. Preparations are even being made to organise flights between Algeria and the Niger Valley early this year. The change from camels to motor cars and aeroplanes under conditions which precluded the use of any transitional means of vehicular conveyance is probably the most remarkable instance of progress in transport on record.

A Broken Engine Axle.

ON the 4th of the month, whilst the London and North-Western 10.25 a.m. express, Euston to Liverpool, was being drawn by a 4–6–0 tender engine of the "Claughton" class, No. 2511, the crank axle broke at the boss of the right-hand driving wheel near Castlethorpe. That wheel left the rails and ran in the "four-foot," supported by the engine framing. Something struck the intermediate coupled wheel, so that it shed its tire, and the right-hand coupling and connecting-rods were buckled. On examination, a large flaw was found in the axle, mainly in the centre, but, being within the boss, it could not be detected by examination. The axle was made of nickel steel. The accident was inquired into by Colonel Pringle, whose report will appear in due course. The annual railway accidents returns since 1905, giving the number of reported failures of crank or driving axles, show that during the seventeen years 1905–1921, exclusive of the war years 1916–1918, there were 609 failures, or an average of 43.5 per annum, and that in the three years since the war—1919, 1920 and 1921—there were 34, 41 and 24 respectively. Failures of a crank or driving axle are thus not uncommon, but as they are usually discovered on examination in the sheds or shops, there has rarely been occasion for an inquiry into an accident arising therefrom.

British Traders in France.

AMONG the most reactionary Bills introduced of late years in any country is that which has passed through the French Chamber of Deputies without discussion, modifying the status of foreigners in France, and especially of those carrying on business there. The object of the Bill is to prevent foreigners from acquiring property in France without special permission of the State, and if the measure passes the Senate and becomes law, no foreign company will be able to carry on business except with a board of Directors, of which the majority of members, including the managing director, must be of French nationality. A list of shareholders showing the proportion of shares in French hands must also be communicated. If the Senate approves of the Bill in its present form, it will become retrospective, which means that foreign companies established in France will find it practically impossible to do business at all. At a time when France, as well as ourselves, sees the necessity of creating an atmosphere of confidence and of fostering commercial relations abroad, this attitude of our former Allies is, to say the least, disconcerting. It would be interesting to know how far the proposed law is in harmony with existing treaties according the same privileges to British subjects as to the French.

Power Station Extensions.

THE second annual report of the Electricity Commissioners, which has just been issued, shows that during the period covered, namely April 1st, 1921, to March 31st, 1922, permission was given to forty-six authorised undertakings to extend their generating stations, the total capacity of the plant involved being 143,700 kilowatts. Special reference is made to large extensions at the generating stations of the Aberdeen, Belfast and Bristol Corporations, the

Stepney Borough Council and the Charing Cross, West End and City Electricity Supply Company, Limited. Since the work of reorganising the electricity supplies was first undertaken by the Electricity Commissioners permission to extend existing stations and to build new ones has, of course, been granted to other supply authorities, and two interesting examples of such work were described in THE ENGINEER during the past month, namely, the new station built by the Leicester Corporation and formally opened on December 8th, and the extensions to the Birchmills station of the Walsall electricity supply undertaking. In the former case the generating plant at present consists of a 10,000-kilowatt turbo-generator set, built by the English Electric Company, which was awarded the main contract for the station, whilst the new generating plant at Walsall is composed of a 5000-kilowatt Ljungstrom turbine built by the Brush Electrical Engineering Company. An interesting feature of the Leicester plant is that an automatic self-cleaning evaporating plant has been provided for supplying distilled water for the make-up feed, the type of plant selected being that described in THE ENGINEER of May 12th, 1922. The official trials on the Ljungstrom set at Walsall show that excellent results are being obtained, and the rapid progress which this type of turbine is making in places where really large units are unnecessary is scarcely to be wondered at.

A Fatal Railway Accident.

THERE were during 1922 three accidents to passenger trains in which passengers were killed. The first was at Blisworth on January 27th, when one passenger was killed ; the second was near Gravesend on August 21st, when three were killed ; the third occurred on the 6th of December at Birkenhead Park, a station owned jointly by the Mersey and Wirral railway companies. The trains of the latter company from West Kirby enter a long line and the engine then " runs round " its train, and takes it out to West Kirby again, passing to the down line by means of a crossover road. This connection is protected by an outer home signal, 222 yards away, and by an inner home signal at the points. The distant signal is fastened in the " on " position. There is an exemption from block working on condition that the speed does not exceed 10 miles per hour. On the afternoon of the day in question, the driver of an arriving train failed to stop at the outer home signal, and overran the inner home signal, with the result that his train struck an outgoing passenger train. One passenger died soon after from shock. The coroner's jury on the 20th considered the driver to have been guilty only of an error of judgment.

Working Hours.

THE eight hours' working day is regarded on the Continent as one of the chief factors in the present unsatisfactory state of industry, since it increases the cost of production and raises the transport charges to a level that seriously interferes with the efforts to develop a foreign business. The higher cost of goods also restricts consumption on the home market. The eight hours' working day was enforced at a time when politicians were very eager, after the Armistice, to satisfy the demands of labour ; but as the new legislation in France was conditional on the men producing as much in eight hours as they formerly did in ten, it was possible to carry out certain modifications when it was found that the shorter working day was giving disastrous results. The railwaymen have already been obliged to put in what is equivalent to a nine and even ten hours' day, and in many industries employers have arranged with the men to work additional hours whenever necessary. In the merchant marine the eight hours' day has been suppressed after a long struggle with the seamen. In Belgium a similar movement has grown up during the month in favour of " contracting out " of the short working day legislation. The compulsory eight hours' day has been followed by a diminishing production everywhere. In some cases the reduction is as much as 28 per cent. The trouble in Belgium is that the law did not provide for any means of recuperating lost time, due to holidays and accidental circumstances, with the result that in the engineering trades the number of hours works out at between forty-two and forty-three a week. It is argued that something must be done to put an end to this state of things, and it is proposed, as a transitional measure, to allow employers and the men to settle the question of working hours amongst themselves, the Government to act as arbitrator where necessary. Some of the men's unions are in favour of this compromise, which, however, is strongly opposed by the Socialists, but it is regarded as inevitable that Belgium will fall into line with France in giving a more liberal interpretation to the principle of the eight hours' working day.

Chinese Engineering Notes.

(From our own Correspondents.)

November 9th, 1922.

Peking.

THE industrial unrest amongst the Chinese that has been in evidence in South China for some years has now spread to the North. During October the Chinese on the Peking-Mukden Railway workshops at Tongshan succeeded in enforcing concessions from the administration, which at any other time would never have been conceded. No sooner had these concessions been obtained than the miners employed by the Kailan Mining Administration in the same vicinity made demands which it will be quite impossible to concede. The Kailan Mining Administration has taken up a firm stand in this matter, and at the moment practically all its mines are idle. That there is Bolshevik money and propaganda behind this movement there can be no doubt. Another strike has occurred on the Peking-Suiyuan Railway between Peking and Kalgan, and for some days the line was completely shut down. The situation at the Kailan mines, however, is really very serious, and there is no doubt that if any weakness is shown by the Kailan management serious trouble is likely to occur throughout the industrial workshops and factories in this part of China. It will be remembered that at the Washington Conference the Japanese agreed to withdraw all their military forces from Siberia. This undertaking had no sooner been given effect to than the whites in the Vladivostock area were attacked by the forces of the Far Eastern Republic and driven out of the Maritime Provinces. A large number of these whites have crossed the frontier into Manchuria and have been disarmed, but it is questionable whether their presence in Manchuria is beneficial to China. The Bolshevik menace to China has now considerably increased by the fact that the whole of the territory north of Manchuria is in the hands of the Reds. So far General Chang Tso Lin has kept Manchuria fairly clear of the Bolshevik element, but his task is getting increasingly difficult. There is only one solution to the present serious situation in China, and that is a speedy understanding between the various political and military factions. If it does not come about soon China will become a second Russia. It is understood that the Central Government is alive to the Bolshevik danger, and is taking certain precautions, but the danger is much more serious than it has ever been before. The Bolsheviks still control Mongolia, and are likely to continue to do so, because the Chinese have neither the money nor an army capable of expelling them. The continued political uncertainty and industrial unrest in North China has brought trade almost to a standstill. The engineering business has been particularly hard hit, for the reason that those Chinese who are in the market for equipment of cotton, flour and oil mills will not take the risk of ordering machinery which is likely to be held up after arrival in Shanghai or Tientsin. The conditions on the railways have not improved, and whenever the authorities begin to move troops on a fairly large scale ordinary cargo is dumped in the goods yards and remains there, as owing to the absence of roads, there is no secondary means of transport.

Shanghai.

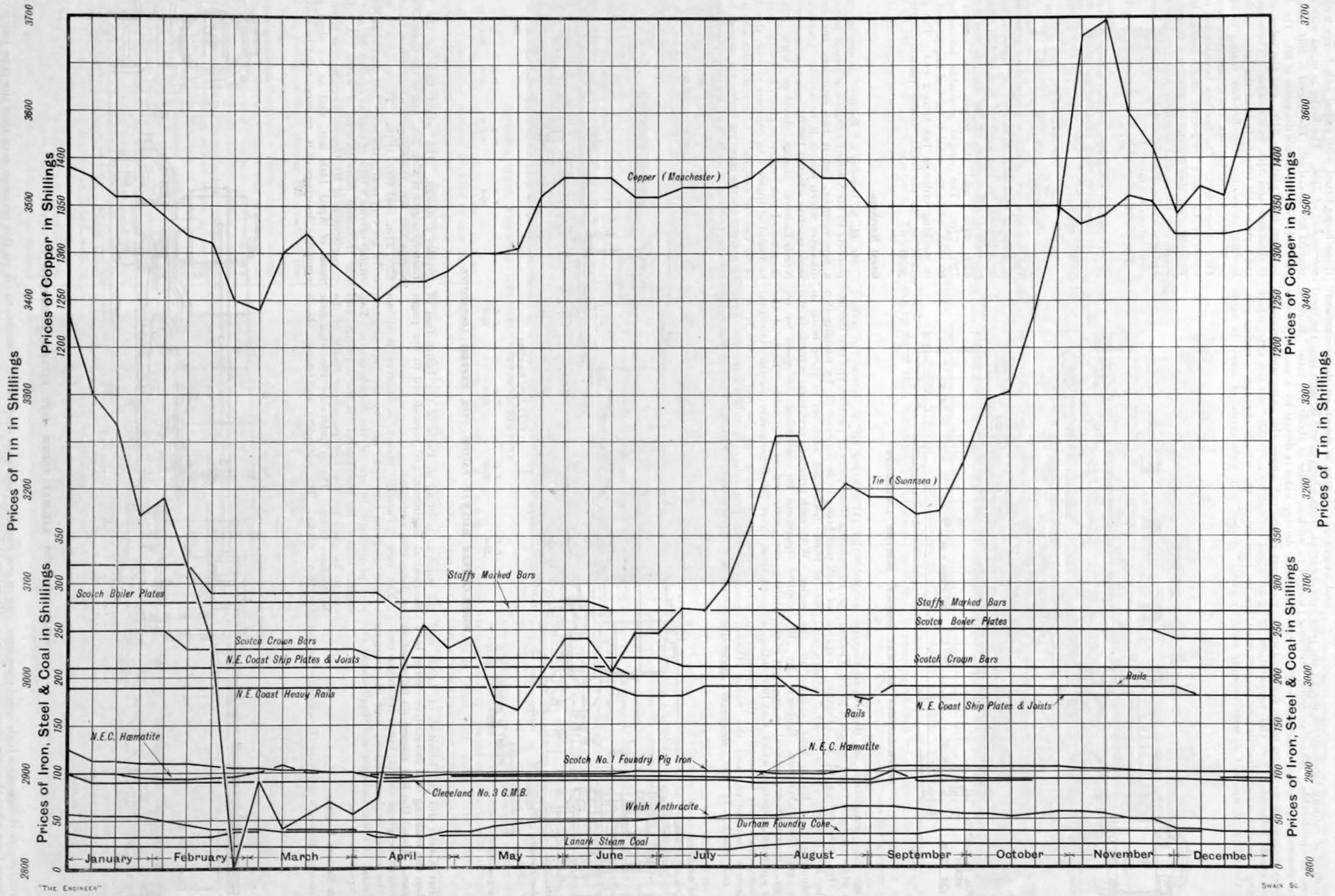
There really is a slump in property development now, and Chinese pessimists see no hope of recovery for at least a year. The reason given by Chinese is that money is so expensive. The Chinese banks want at least 15 per cent. interest per annum on advances, and, as showing that all the Chinese business is done with the help of the banks, it may be noted that there are 400 native banks in Shanghai. The wealthy Chinese does not sell his shares or his landed estates when he wants, with others, to go into business as a factory owner. He gets three or more of his friends of about equal wealth to guarantee so many shares in the undertaking, and as a company they draw on the bank or banks for the money required. They do not deposit shares or deeds as collateral security, but draw on the strength of their own stability, so that when the bank raises the rate of interest beyond the rate at which profits can be made in the business, the business falls through. And it takes a fairly good business to return more than 15 per cent. on capital invested. The Chinese does not consider that his stocks and shares and landed estate are earning him anything in connection with the factory business because these assets are not in the hands of the bank, although the bank is lending him money on the strength of his possession of them. This is fundamentally the cause of China's financial instability. The system works well in very prosperous times, as almost any system would, but when times are hard and the banks begin to protect themselves against gambling, as they are doing now, and refuse to have large amounts outstanding against unrealisable security, it causes a slump in development work, and until the Chinese are willing to put realisable security into the business they have in hand, the position will continue to get worse. There were in Shanghai about thirty so-called exchanges doing business in stocks in various staple products a year ago. By cornering the markets in their various lines they earned their nominal shareholders 25 per cent. for a time, and this dividend sent up the value of products beyond the buying capacity of the proletariat, which has its limit of endurance. The result was financial disaster to the exchanges and their nominal shareholders ; the original promoters being the only ones who made any money. There are only two such exchanges left now, one dealing in silk ; but people will soon find they can really do without silk, and that exchange will go, too. It is in this particular class of business that the Sino-foreign Bank is assisting China, for the reason that it will not allow a customer to strain his credit, because it insists on holding his assets and securities before making any advances. Such banks discourage gambling in stocks and shares in that they will not recognise any of these bonds as security unless the concern they represent is financially sound. In fact, such banks assist their clients in determining the soundness of any industrial enterprise and guide finance in the right direction.

Hong Kong.

Some little time ago an eminent Japanese Professor of Economics visited this Colony. He was most anxious to obtain information concerning the history of the introduction of machinery generally, and especially the locomotive, to Japan. Curiously enough the news that a well-known British firm of engineers had just booked an order worth rather more than half a million pounds sterling for electric locomotives in Japan had been mentioned a day earlier. The Japanese professor had a cutting from a London engineering journal to the effect that a locomotive was moved from Shanghai to Nagasaki in the 'sixties, but in all other records it is stated that this first railway in China, which was removed owing to the great hostility of the Chinese, was sent over to Formosa. Some day a history of engineering in the Far East will appear, and the one thing that future generations will marvel at will be the great contrast between the enthusiasm of the Japanese and the conservatism of the Chinese concerning engineering science. One interesting item of engineering history which may be recorded is that the first steam vessel to be seen in Chinese waters was the Jardine, which arrived in Macao in 1835. That was before Hong Kong became a British Colony, but it is highly probable that the Jardine anchored in the harbour of Hong Kong. It was on January 1st, 1836, that this steamer first attempted to proceed up the river to the neighbouring Chinese City of Canton, but the Chinese authorities absolutely refused to allow her to proceed, and their forts opened fire on her. The story goes that, in consequence of this opposition, the machinery was removed from the Jardine and she was then used as a schooner. The first P. and O. steamer to arrive was the Lady Mary Wood ; she came out in 1850. She was the first of a long line of steamers sent out to the Far East by that famous company. At present the finest steamers which have called at this port are the Empress of Canada and the Empress of Australia.

One of the men most famous in the Far East as a railway builder and a general pioneer of communications in China is Mr. W. F. Carey. He holds contracts for the construction of 1100 miles of Chinese railways and the improvement of the Grand Canal. He has been in this country and has made many friends among the Chinese. He recently expressed the opinion that the time will never come when Europe can offer such splendid chances for railway contractors as China is now offering. " If Americans do not build China's railways," he said, " and make the vast profits they will yield, Europeans will." The railway that will affect South China most of all is that which will one day join Canton with Hankow. A great deal of work has been done on this line, but the most difficult engineering work still remains to be completed. When this line is finished there will be an enormous volume of trade coming down from the interior to Hong Kong. Preparations for this are being made in Hong Kong. For months we have eagerly awaited the publication of the report by Sir Maurice Fitz-Maurice concerning the proposed harbour improvements. The growth of industries in this colony during the last few years has been very remarkable, but it will fade into comparative insignificance once that railway link is completed. Sir Paul Chater, who has lived for more than fifty years in Hong Kong, and has been the pioneer of many of the local industries, has recently stated in London that he is sanguine of manufacturing iron and steel in this Colony. The problem will be solved if we can obtain coal from the neighbouring province of Kwangtung. There is a very great deal of coal available, but the officials have not permitted it to be exported : concessions have been obtained but have not been carried out. If a supply of cheap and plentiful coal can be obtained, it is inevitable that in a few years Hong Kong will become one of the largest industrial centres in the world. It is already one of the three largest ports in the world, and nothing but comparatively dear coal has retarded its industrial growth. Meantime, despite the trade depression all over the world, many of the local industries are in a flourishing condition. Some good orders for British machinery have been given out from this Colony during the last few months.

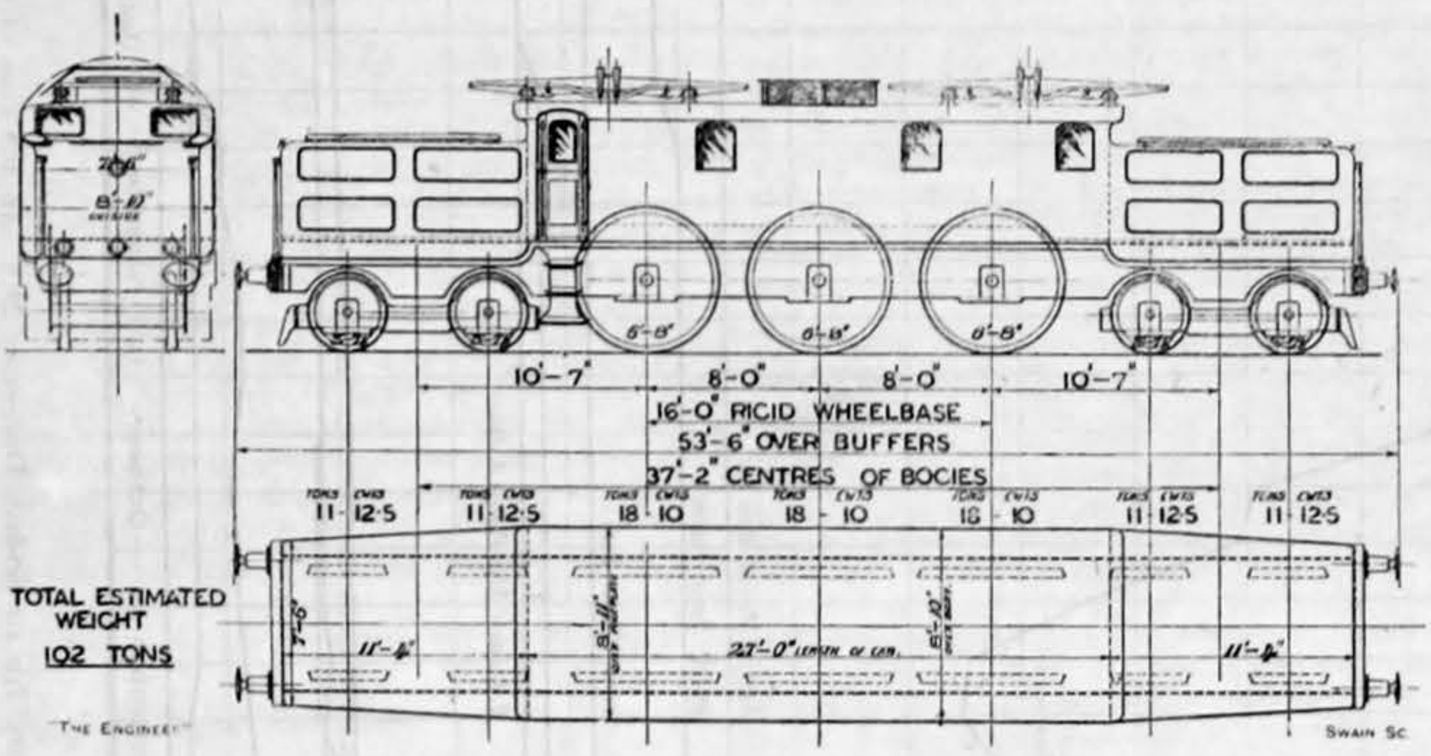
FLUCTUATIONS IN THE PRICES OF ENGINEERING MATERIALS DURING THE YEAR 1922



The prices are all given in shillings, with separate zeros for Tin and Copper. The horizontal divisions are weeks, taken from Friday, January 7th to Friday, December 29th. In the case of coals the prices are those quoted for export, as it is practically impossible to give market prices for industrial consumption at home.

Locomotives of 1922.

THE output of railway locomotives during the past year was inconsiderable. Manufacturers, suffering from the general depression, built few engines, and the railway companies were too much occupied with, and too much influenced by, the preparation of "grouping" to give much time to new construction. Yet, on the whole, it was not an uninteresting year, for it saw the completion on the North-Eastern Railway of two notable types designed by Sir Vincent Raven, the introduction of a "Pacific" express engine by Mr. Gresley, on the Great Northern, and the production of a Baltic tank engine for the Glasgow and South-Western Railway, by Mr. Whitelegg. Furthermore, several engines out of the ordinary appeared, amongst which may be mentioned the Ramsay condensing locomotive, the Ljungström turbo-electric locomotive, and the Sulzer Diesel-electric rail coach. It was, moreover, generally known that Kitson and Co., Limited, of Leeds, had undertaken the building of a locomotive driven by a Still engine. About the last named no information can, of course, be given as yet, but a few notes concerning the other engines follow, and illustrations will be found of them amongst our Supplements to-day and upon these pages.



NORTH-EASTERN RAILWAY—1800-H.P. ELECTRIC LOCOMOTIVE

The North-Eastern Engines.

Sir Vincent Raven's electric locomotive is an experimental engine designed for high-speed passenger traffic on main lines when they are electrified. It was built at the Darlington works of the company, the electrical equipment being supplied by the Metropolitan Vickers Company. It has been tried on the Newport-Shildon branch—1500 volts—and has satisfied Sir Vincent that when the time comes it will be able to maintain a higher average speed than any steam locomotive, and that it will take heavy passenger traffic up steep gradients more rapidly than existing steam engines. The general arrangement and weight distribution is shown on the accompanying diagram, from which it will be seen that the total weight in working order is about 110 tons. Each of the three driving axles is driven by a pair of motors mounted in the cab above the axles, and driving a gear wheel carried by a "quill" on the axle, which in its turn drives the wheels through a spring connected "spider." A wide range of speed is made available by (1) running all six motors in series; (2) by running three pairs in parallel, the two motors of each pair being in series; and (3) by running two sets of three in parallel, each set of three being in series. With each grouping provision is made in the control equipment for regulating the speed by reducing the excitation of the fields. Each of the motors can exert 300 horse-power, so that the total power—one hour rating—at the rail is 1800 horse-power. Many particulars of this locomotive were given in a paper presented by Sir Vincent Raven at the summer meeting in Paris of the Institution of Mechanical Engineers, and reproduced in our pages on June 16th and 23rd.

The new "Pacific" steam locomotive is shown by the diagram herewith, and by the reproduction of a photograph in one of the Supplements. Two engines have so far been built from the drawings, and are to be used for the fast passenger traffic of the North-East Coast. The cylinders are 19in. diameter by 26in. stroke. The cylinders and steam chests are in one casting, the steam chest being common to all, while the three exhaust chambers are separate to the bottom of the blast pipe, where they combine. The cylinders are fitted with piston valves 8¾in. in diameter, and the valve gear—Stephenson's link motion—is applied direct to each of the cylinders. The driving wheels are 6ft. 8in. in diameter, and the rigid wheel base is 15ft., the total wheel base for the engine being 37ft. 2in. The bogie wheels are 3ft. 1¼in. in diameter, and arranged on a wheel base of 6ft. 6in., carrying wheels 3ft. 9¼in. in diameter are employed, these being fitted with radial axle boxes with a side movement of 3½in. The boiler is fitted with a round topped fire-box shell. The barrel is 26ft. long and is parallel, with an outside diameter of 6ft. The distance between tube plates is 21ft., and the tubes are 2¼in. in diameter and 5¼in. in diameter. There are 119 of the former and twenty-four of the latter with superheating elements. The fire-box casing is 8ft. long by 6ft. 5in. at the bottom, the actual grate area being 41.5 square feet. The fire-box is extended into the barrel of the boiler, its overall length being 11ft. 1⅞in. The effect of this extension has been to reduce the length of tubes and increase the fire-box heating surface, whilst the extension acts as an additional combustion chamber.

The distribution of heating surface is as follows:—

	Square feet.
119 ordinary tubes, 2¼in. diameter outside ..	1472
24 superheater tubes, 5¼in. diameter outside	692.7
24 superheater elements	509.9
Fire-box	200
Total	2874.6
Grate area	41.5

The tenders are of the self-trimming type, carrying 5½ tons of coal and 4125 gals. of water. They are six-wheeled, having a wheel base of 12ft. 8in. The combined wheel base of the engine and tender is 62ft. 2¾in., and the length over buffers overall 72ft. 7¼in. The weight available for adhesion is 60 tons, while the total weight of engine and tender in working order is 148 tons 2 cwt. The tractive effort at 85 per cent. boiler pressure—200 lb.—is 29,918 lb.

NORTH-EASTERN RAILWAY—PACIFIC TYPE EXPRESS LOCOMOTIVE

Great Northern.

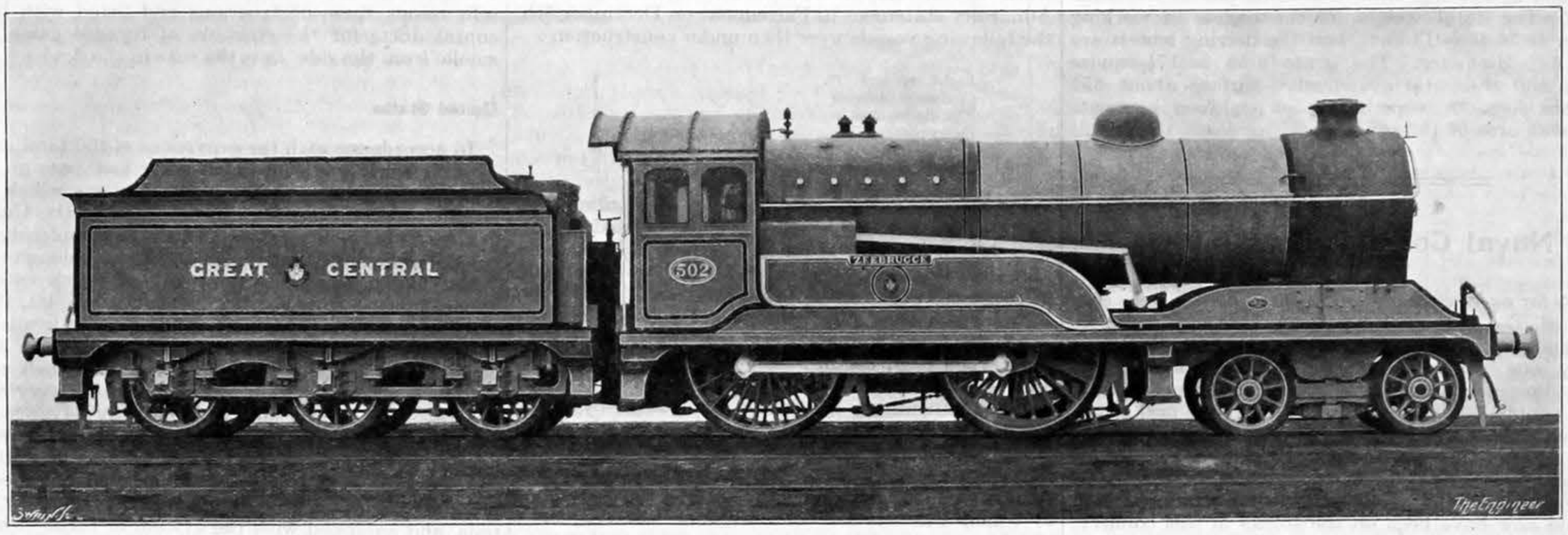
Mr. H. N. Gresley's "Pacific" is similar in many respects to Sir Vincent's engine, which it preceded by a few months, but it has cylinders 1in. larger in diameter which enable it to develop practically the same tractive effort at 180 lb. boiler pressure which the North-Eastern engine develops with 200 lb. A diagram of this engine is given herewith, and it will be found of interest to compare it with the diagram of Sir Vincent's engine. Characteristics which should be noticed are the tapering boiler, the outside bearings for the trailing wheels, and the larger tender in Mr. Gresley's design. The wheel base of the North-Eastern engine is 37ft. 2in., and of the Great Northern engine 35ft. 9in., the respective total wheel bases being 62ft. 2¾in. and 60ft. 10⅛in. The weights in working order are very nearly the same, but the Great Northern engine carries 8 tons of coal as against 5½, and nearly one thousand more gallons of water. A full table of particulars of Mr. Gresley's engine was given in our issue of April 14th last, and as we shall present complete drawings of it, no more need be said about it on this occasion save that the type has proved so successful that besides the original pair ten more are in hand and will take the road early this year.

GREAT NORTHERN RAILWAY—PACIFIC TYPE EXPRESS LOCOMOTIVE

Glasgow and South-Western.

Mr. Robert Whitelegg's fine Baltic tank engine, which was described in our issues of June 16th and

November 10th—drawings—and of which a view is presented in one of to-day's Supplements, was designed to deal with the heavy and fast traffic to the Ayrshire coast. It has a pair of cylinders 22in. diameter by 26in. stroke, which at 85 per cent. of the working boiler pressure of 180 lb. give a tractive effort of 26,740 lb. on 6ft. driving wheels. The total weight of the engine in working order is over 99 tons, and the load on each of the three main axles is 18 tons. The total evaporative surface is 1730 square feet; superheater surface, 255 square feet; and grate area, 30 square feet. Six of these "Baltics" have been built. On a test run with 440 tons behind the draw bar, one of them sustained an average speed of nearly 52 miles per hour between Carlisle and Kilmarnock, with a maximum speed of 69 miles per hour. It is interesting to note that the average coal consumption on test runs was .166 per ton-mile, but has been reduced as the enginemen have gained greater experience.



GREAT CENTRAL RAILWAY—FOUR-COUPLED SUPERHEATER PASSENGER ENGINE

Great Central.

Mr. J. G. Robinson built during the year, at the Gorton Works, a series of 4–4–0 superheater main line express passenger engines. These engines belong to the modified "Director" class, and are duplicate with the original "Director" class in many respects. The chief difference between the two classes consists in the steam distribution, the new class having inside steam admission, the piston valves being driven by link motion through the medium of rocking shafts, whereas in the earlier engines outside admission piston valves with direct link motion were employed.

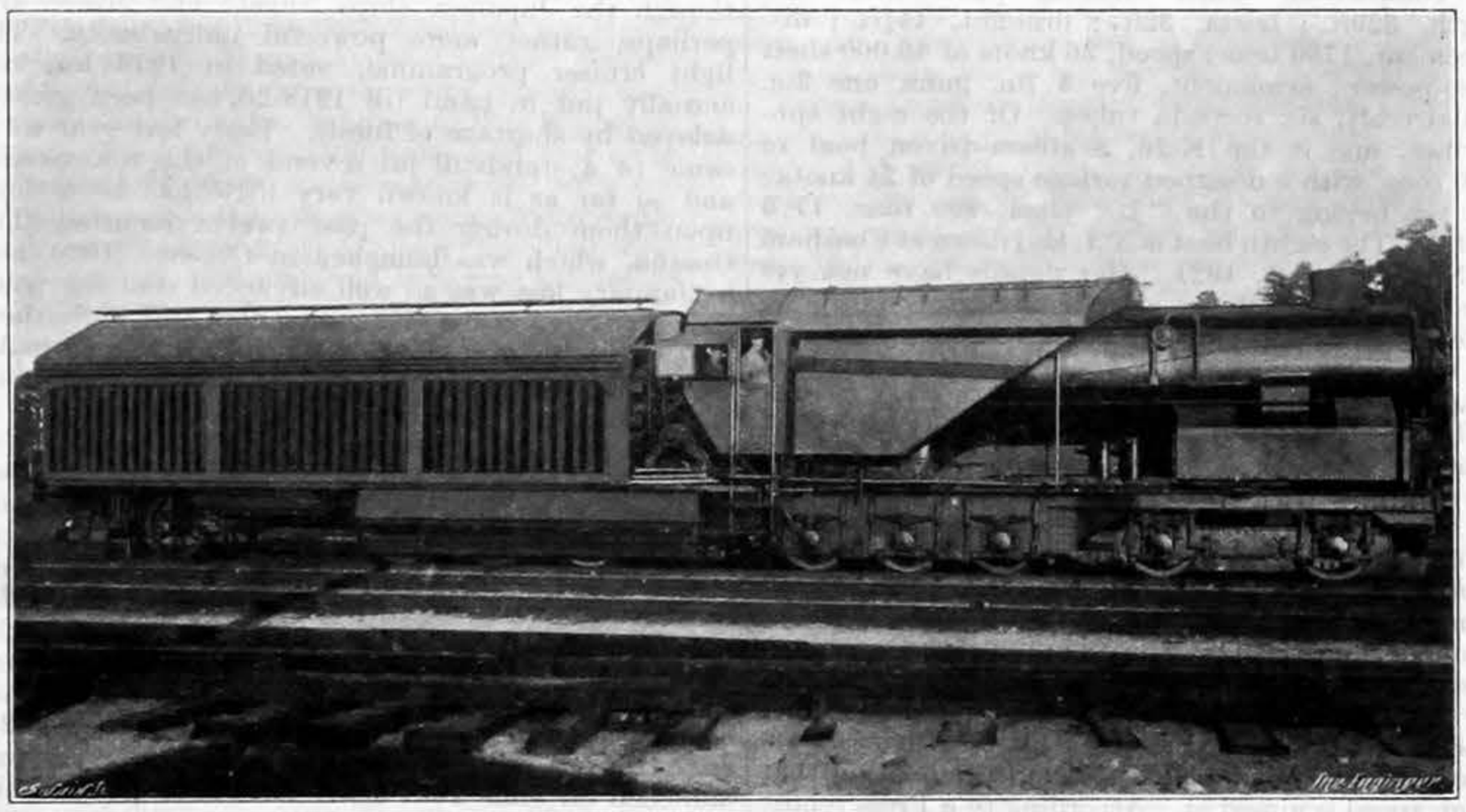
The boiler, which is a duplicate of that used for the 2–6–4 goods tank engine, as well as for the original "Director" class, is fitted with a Robinson superheater of twenty-four elements, provided with Mr. Robinson's header discharge valve and steam circulating device, and the smoke-box is fitted with a steam ash lifter. The cab is of the pattern now generally fitted to all Mr. Robinson's modern engines, is very commodious, and is provided with two sliding windows on each side, in addition to the usual hinged front windows.

These engines are engaged in working the express passenger service between Marylebone and Manchester, &c., and have given great satisfaction.

The cylinders are 20in. by 26in., the driving wheels 6ft. 9in. in diameter, and the working pressure 180 lb. The weight of the engine alone in working order is 61 tons 3 cwt., and of the tender 48 tons 6 cwt., making a total of 109 tons 9 cwt. The load on the driving wheels is nearly up to the maximum allowed, namely, 20 tons.

The Turbo-Locomotive.

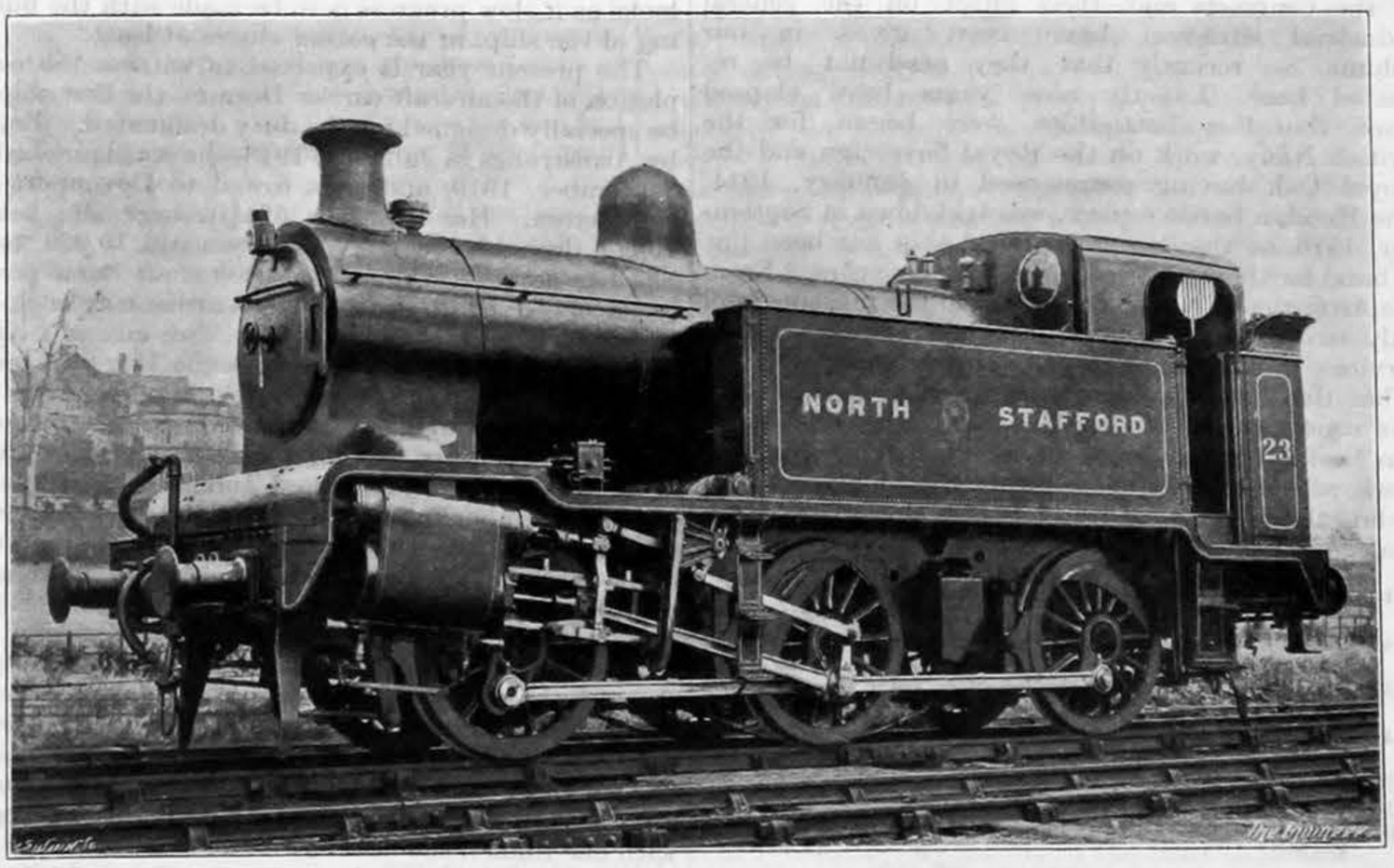
The remarkable engine constructed by the Aktiebolaget Ljungström Angturbin was completed in the spring of 1921, but entered into service upon the Swedish State Railways last year. A general view of it is given on this page. It is a full sized engine, weighing 126 tons in running order, and is driven by a condensing steam turbine of 1800 horse-power, which is geared to the three coupled axles under that part of the machine which looks like the tender, but is really the engine-room, the forward portion being wholly occupied by the steam generator. The boiler, working at 300 lb. pressure, is of the superheater locomotive type, but the hot gases before passing to the funnel traverse a rectangular box under the smoke-box, which is, in fact, an air-heater. The hot air enters the ash pan. The huge saddle over the boiler is the coal hopper. The main turbine is not of the familiar Ljungström or radial flow type, but is an ordinary impulse reaction machine designed for a maximum speed of 9200 revolutions per minute. Reversal is effected by dropping the main wheel out of mesh with the pinion and interposing an idle pinion. The condenser occupies the greater part of the engine-room. It consists of a combination of tanks holding the water of condensation, and flattened copper tubes aggregating in area 1000 square metres. Three fans, which can be driven at variable speeds, draw air through the interstices between the tubes, and an air ejector takes the place of an air pump. It is claimed for this remarkable locomotive that its consumption of coal per ton-mile is only half that of an ordinary steam locomotive on similar service.



SWEDISH STATE RAILWAYS—LJUNGSTROM TURBO LOCOMOTIVE

The Ramsay Locomotive.

There was completed during the year at the Scotswood works of Sir W. G. Armstrong and Co., Limited, the turbo-electric condensing locomotive, which is illustrated in one of our Supplements to-day. This huge machine—it weighs over 130 tons in running order—was designed by Mr. D. M. Ramsay, and built for the Ramsay Condensing Locomotive Company, Limited, of Glasgow. Steam raised and superheated in a locomotive boiler drives an Oerlikon turbo-generator which supplies current to four three-phase motors, two on the forward and two on the rear portion of the machine. The motors drive countershafts, which are coupled by rods to the driving wheels. Each motor is capable of developing 275 horse-power. The condenser, which occupies the greater part of the rear engine, consists essentially of a cage composed of tubes through which the steam passes. This cage is continuously rotated on a horizontal axis in a tank partially filled with water. The wetted tubes, as they emerge from the water, are subjected to a strong current of air produced by a fan, which occupies the whole of the end of the engine. The condenser is, therefore, one of the evaporative type.



NORTH STAFFORDSHIRE RAILWAY—FOUR-CYLINDER TANK ENGINE

North Staffordshire Railway.

Another locomotive of the year which presents some features of exceptional interest is a

four-cylinder side tank engine, designed by Mr. J. A. Hookham for the North Staffordshire Railway. The four cylinders, each 14in. in diameter by 24in. stroke, are placed in a line under the smoke-box, and inclined at 1 in 9. The crank arrangement is rather curious. the two outside crank pins being pitched at 135 deg. from the inside pin on the same side. The total weight of the engine in working order is 56 tons 13 cwt., and the driving wheels are 4ft. 6in. diameter. The grate area is 17½ square feet, and the total evaporative surface about 857 square feet. A superheater of eighteen elements gives an area of 195 square feet.

Naval Construction in 1922.

So far as Europe and the United States were concerned, the past year was one of almost complete stagnation in the sphere of naval shipbuilding. Only one capital ship was actually laid down, and no new programme of heavy construction was adopted. This inactivity was due in part to the economic embarrassments bequeathed by the war, and in part to the Limitation Treaty negotiated at Washington. As a direct consequence of the latter, four capital ships of the largest dimensions, which would now have been on the stocks in this country, were cancelled in November, 1921, and building operations on thirteen similar vessels for the United States Navy were suspended at or about the same date. France, having definitely discarded the battleships she was building at the outbreak of war, made a start last year with her modest programme of light construction, which is limited to three cruisers, twenty-four destroyers, and twelve submarines. Italy is at work on a few small craft, but her cruiser programme foreshadowed in 1921 has not yet matured. With the exception of Spain, none of the secondary Powers is paying much attention to naval development, and to most of them the present building costs, even for the smallest types of craft, are prohibitive. Only in Japan were the shipyards busily employed throughout the year on naval construction. There the effects of the Washington Treaty, which put a stop to the capital ship programme, were partly mitigated by the Government'a decision to press on with the building of ships outside the scope of the agreement, and that has been done to such purpose that the aggregate of fighting tonnage now under construction in Japan greatly exceeds the total for Europe and America combined.

Great Britain.

The outstanding event of the year was, of course, the allocation during the second week in December of the contracts for the two capital ships, each of 35,000 tons, which Great Britain is empowered to build under the Limitation Treaty. One is to be built by Armstrong, Whitworth and Co., Limited, at their Walker yard on the Tyne, the engines and boilers being manufactured by the Wallsend Slipway Company, Limited; and the other by Cammell Laird and Co., Limited, on the Mersey, the propelling machinery in this case being supplied by the builders. Preliminary work was begun immediately after the contracts had been awarded, and the keel of the Cammell Laird ship was laid at Birkenhead on December 29th. Further particulars of the contracts and their effect on the general industrial situation have been given in our columns so recently that they need not be repeated here. Exactly nine years have elapsed since the last battleships were begun for the British Navy, work on the Royal Sovereign and the Royal Oak having commenced in January, 1914. The Hood, a battle cruiser, was laid down in September, 1916, so that no new capital ship has been put in hand for this country for well over six years. From the Armistice of November, 1918, to the present date, only two new keels have been laid for the naval service—a submarine and a mine-laying cruiser. What this almost complete cessation of naval orders has meant to the shipbuilding and allied industries can best be appreciated by recalling the volume of work which they enjoyed during the four years preceding the war, from 1911 to 1914 inclusive. Within that period the following vessels were laid down :—

4 battleships, "King George V." class, each 23,000 tons .. .. =	92,000	tons
4 battleships, "Iron Duke" class, each 25,000 tons .. .. =	100,000	,,
5 battleships, "Queen Elizabeth" class, each 27,500 tons .. .. =	137,500	,,
5 battleships, "Royal Sovereign" class, each 25,750 tons .. .. =	128,750	,,
1 battle-cruiser, "Queen Mary," 26,500 tons 1 battle-cruiser, "Tiger," 28,500 tons =	55,000	,,
6 light cruisers, "Town" class, each 5400 tons .. .. =	32,400	,,
16 light cruisers, "Arethusa" class, each 3500 tons .. .. =	56,000	,,
75 destroyers, each averaging 800 tons .. =	60,000	,,
30 submarines, each averaging 650 tons .. =	19,500	,,
147 vessels Aggregate displacement	681,150	tons

In addition to the above, many auxiliary ships were built for the Admiralty, and a considerable number of foreign naval contracts—including four battleships—were booked during the four years in question. These figures justify the assertion that the shipbuilding and naval armament industry has suffered more severely than any other branch of trade by reason of the post-war policy of retrenchment.

The completion of ships begun under the war programme has continued to give a limited amount of work to the Royal Dockyards. According to an Admiralty statement in Parliament on December 5th, the following vessels were then under construction :—

Light cruisers	4
Cruiser minelayer	1
Flotilla leaders	2
Destroyers	4
Submarines	8
Coastal motor boats	3

Excepting the cruiser minelayer, one submarine, and the three C.M.B.'s, all the above-named vessels were begun during the war. The four light cruisers are : the Frobisher, 9750 tons, laid down at Devonport in August, 1916, and launched in March, 1920; the Effingham, a sister ship, commenced at Portsmouth in April, 1917, and launched in June, 1921; the Enterprise, 7600 tons, begun at Clydebank in June, 1918, and launched in December of the following year; and the Emerald, a sister ship, laid down by Armstrongs in September, 1918, and launched in May, 1920. As we have previously described these ships, it is only necessary to say that the first two belong to the well-known "Raleigh" class—the nameship of which was wrecked off Labrador last August—which combines high speed, great cruising endurance, and heavy armament; while the second pair were specially designed for fast steaming and are expected to attain 33 knots in light condition. The flotilla leaders are the Keppel and Broke—formerly Rooke—sister boats begun just before the Armistice by Thornycrofts, and subsequently towed to Portsmouth for completion. Their leading particulars are : length, 329ft.; beam, 32ft.; draught, 14¾ft.; displacement, 1750 tons; speed, 36 knots at 40,000 shaft horse-power; armament, five 4.7in. guns, one 3in. anti-aircraft, six torpedo tubes. Of the eight submarines, one is the K 26, a steam-driven boat of 1880 tons, with a designed surface speed of 24 knots; and six belong to the "L" class, 890 tons, 17.5 knots. The eighth boat is X 1, laid down at Chatham on November 1st, 1921. Her details have not yet been published, but she is understood to be of large dimensions and to embody novel features suggested by war experience. The building operations are being conducted with great secrecy.

The keel plate of the cruiser minelayer, to be named Adventure, was laid at Devonport on November 29th. She represents a type new to the British Navy, but her functions are sufficiently indicated by the description. During the war Germany built two small cruisers, Brummer and Bremse, of very high speed, for the special work of laying mines. The ship building at Devonport appears to be considerably larger than these. Her dimensions are unofficially stated to be :—Length, 500ft.; beam, 58ft.; displacement, 7000 tons; the ratio of breadth to length indicating that a high speed is aimed at. According to a Press report published last month, the design, which is the work of Sir E. H. Tennyson d'Eyncourt, "marks a new departure, so that she may be regarded as an experimental ship; and although the character of her armament is at present confidential, it is believed that she will be heavily armed for a vessel of this class." As the Navy Estimates for the current fiscal year provide for only £294,990 to be spent upon her, it looks as if slow progress is to be made with the building of the ship, in the earlier stages at least.

The present year is expected to witness the completion of the aircraft carrier Hermes, the first ship to be specially designed for the duty designated. Begun by Armstrongs in January, 1918, she was launched in September, 1919, and then towed to Devonport for completion. Her length is 594½ft. over all; beam, 70ft.; draught, 18¾ft.; displacement, 10,950 tons. She has geared turbines of 40,000 shaft horse-power for a speed of 25 knots. The armament includes seven 6in. guns and four 4in. anti-aircraft. The boiler uptakes are led into a single large elliptical funnel which, together with a light superstructure and a tripod foremast, is placed on the extreme starboard side, thus leaving a large area of deck space clear for machines to take off and alight. The ship has light armour over vital parts, and it is protected against underwater attack by bulges. Another aircraft carrier, the Eagle, which although nominally completed in 1920 has since undergone a refit involving partial reconstruction, is also expected to hoist the pennant this year. Laid down as a battleship for the Chilean Government, but taken over by the Admiralty and converted into an aircraft carrier, the Eagle is 661ft. long, 104ft. in beam, and displaces 22,790 tons. She burns coal and oil, and has a designed speed of 24 knots. Originally equipped with one funnel, she now has two, and these, with the upperworks and tripod mast, are disposed on the starboard side, as in the Hermes. The hull has armour and bulge protection. Armament : nine 6in. guns, six 4in. anti-aircraft. The number of aeroplanes she will carry when in service has not been disclosed. A third vessel of the same generic type, the Furious—designed initially as a fast cruiser to mount two 18in. guns and afterwards converted into a carrier—has been at Devonport since last June, undergoing a refit, the extensive nature of which is indicated by the large sum, £300,315, set apart in the current Estimates to be spent on her. As the centre-line position of her huge funnel tended to cause "air pockets," and the superstructure was inconveniently placed for machines alighting on the deck, it is understood that she will emerge from her refit minus these obstructions and fitted with horizontal ducts for the emission of furnace gases and smoke from the side, as is the case in the Argus.

United States.

In accordance with the provisions of the Limitation Treaty, work was suspended early last year on the seven battleships and six battle cruisers which are surplus to the tonnage ratio accorded to the United States, and the only capital ships now completing are the Colorado and West Virginia. These belong to the "Maryland" class, the nameship of which entered service in the autumn of 1921. On October 1st, 1922, the latest date for which official figures are available, the Colorado was 93.8 and the West Virginia 84.1 per cent. complete. The money voted for their completion is so limited that they have made very slow progress, and neither ship is sufficiently advanced as yet to be ready for her trials. The probable dates of completion are noted as July and September, 1923, respectively. The ships have been fully described in previous issues of this journal. Displacing 32,600 tons, and equipped with the system of turbo-electric drive, which has been adopted for all recent capital ships of the United States Navy, they incorporate many structural and military features based upon war data. Their armour and sub-surface protection is particularly strong. When commissioned they will form, with the Maryland, a squadron of post-Jutland battleships unequalled as a tactical unit, though the Japanese ships Nagato and Mutsu are, perhaps, rather more powerful individually. The light cruiser programme, voted in 1916 but not actually put in hand till 1918-20, has been greatly delayed by shortage of funds. Early last year work came to a standstill on several of the ten vessels, and so far as is known very little has been done upon them during the past twelve months. The Omaha, which was launched in October, 1920, and in January last was so well advanced that her trials were anticipated for the summer, is still unfinished. A few months of active work would suffice to make ready for sea the Milwaukee, Cincinnati, Detroit, Richmond, and Concord, but at the present rate of progress it is impossible to say when they will be in service.* At the close of the year there remained on the stocks the Raleigh, Trenton, Marblehead, and Memphis. The first, laid down at Fore River in August, 1920, was 61.9 per cent. complete in July last; the second, building at Philadelphia since August, 1920, was 52 per cent. complete; the Marblehead, also begun at Philadelphia at the same time, was 36 per cent.; and the Memphis, which has been in hand at the same yard since October, 1920, only 28 per cent. complete. The Detroit was launched on June 29th last. All ten ships are built to a standard design of 7500 tons, and have geared turbines of 90,000 shaft horse-power for a speed of 33.7 knots. If this velocity is attained they will be the swiftest cruisers in the world. The design, it will be recalled, was modified late in 1920, the armament being increased from eight 6in. guns to twelve, this involving an increase in displacement and a corresponding reduction in speed. They will be the first American ships of war to be fitted with a tripod foremast.

Three destroyers, the Trever, Perry, and Decatur, were delivered last year, leaving no further vessels of this type under construction. The boats named are "flush deckers" of 1215 tons and 35 knots, and were built at the Mare Island Navy Yard. On July 1st, 1922, there were forty submarines still under construction, but about twelve of these have since been delivered. Thirty-seven are of the "S" class, displacing from 800 to 990 tons, with a surface speed of 15 knots. They are regarded as the most successful type of submarine which has been built in the United States so far. The majority of the class have the following dimensions : length, 231ft.; beam, 21ft.; draught, 12½ft.; displacement, 854 tons on surface, 1052 tons submerged. Two sets of 600 brake horse-power Diesel engines are fitted, and the fuel supply is sufficient for a run of 5000 miles at 11 knots speed. They are armed with four 21in. bow tubes—five in a few boats—and one 3in. or 4in. gun. A special feature of this class is the heavy construction and careful subdivision, intended to minimise the effect of depth-charge attack. The remaining three boats, V 1 to V 3, are "fleet submarines," or submersible cruisers, 335ft. long and displacing 2025 tons in surface trim. They are understood to be fitted with two sets of 2400 brake horse-power engines for a speed of 21 knots. Armament : four bow and two stern tubes, and one 5in. 51-calibre gun. Their cruising radius is estimated at 12,000 miles. Work has been resumed on the former battle cruisers, Lexington and Saratoga.

* According to latest figures, the completion dates of the ten light cruisers are as follows : Omaha, January, 1923; Milwaukee, March, 1923; Cincinnati, July, 1923; Raleigh, "Indefinite"; Detroit, February, 1923; Richmond, February, 1923; Concord, May, 1923; Trenton, "Indefinite"; Marblehead, "Indefinite"; Memphis, "Indefinite."

which are in process of conversion to aircraft carriers, displacing 33,000 tons each. The machinery, which will remain unchanged, will develop 180,000 horse-power through sixteen boilers and General Electric turbines with electric drive. Authentic details of their armament and capacity for aeroplanes are not yet available. They will be rigged with one large funnel placed on the extreme starboard side, a cage mast, and a light superstructure. Other vessels building, and all much delayed, are: the repair ship Medusa, 10,000 tons; the destroyer tenders Dobbin and Whitney, each 10,600 tons; and the submarine tender Holland, 10,600 tons. As Congress does not appear to have made any further appropriations for speeding up the completion of unfinished ships, it is expected that work on these vessels will continue at the same leisurely pace during the present year. A new programme—including sixteen cruisers each of 10,000 tons—which it was proposed to introduce last month, is understood to have been deferred for financial reasons.

Japan.

The Washington Treaty having put a stop to all capital ship construction in Japan, the shipyards there have been compensated by large orders for cruiser, destroyer, submarine, and auxiliary tonnage. This has been made possible, not by increasing the number of these vessels projected before the Treaty came into force—the original programme has, in fact, been curtailed—but by increasing their dimensions and antedating by one year the period in which the programme is to be completed. Two light cruisers were launched last year: the Yura, at Sasebo, on February 15th, and the Kinu, at Kobe, on April 29th. They are modified versions of the "Kuma" class, displacing about 5600 tons and designed for a speed of 33 knots. The armament consists of seven 5.5in. guns. The following light cruisers are on the stocks or about to be laid down: Ayase, Otonase, Minase, Abukuma—believed to be sister ships of the Yura; the Yubari, Kako, Naka, Sendai, Jintsu. Kinugasa, and Furutori—of 7000 to 7500 tons; and four ships not yet named, of 10,000 tons, to be armed with 8in. guns. All Japanese light cruisers completed recently have proved very fast, most of them exceeding their designed speed of 33 knots, and behaving admirably at sea. Twelve or more destroyers are completing afloat, and a further twenty-four, with an average displacement of 1500 tons, are to be begun at an early date. The present position with regard to submarines is uncertain. It is believed, however, that eighteen or twenty boats are in various stages of construction, and that twenty-four more are soon to be laid down. Among the boats launched last year was No. 62, on April 13th, with a surface displacement of 1500 tons. The former battle cruisers Amagi and Akagi, re-designed as aircraft carriers of 33,000 tons, are building at Yokosuka and Kure respectively, and both are expected to take the water this year.

France.

A start was made last year on the new naval programme, and the following vessels are now, or shortly will be, under construction:—

Three light cruisers: Duguay-Trouin, Lamotte-Piquet, Primaguet; displacement, 8000 tons; geared turbines and eight oil-fired boilers, 98,000 shaft horse-power = 34 knots; radius of action, 4875 miles at 15 knots. Armament: eight 6in. guns in four turrets on the centre-line, two forward and two aft; four 3in. anti-aircraft guns, and twelve 22in. torpedo tubes. The Duguay-Trouin and Primaguet are building at Brest, and the Lamotte-Piquet at Lorient.

Six flotilla leaders: Jaguar, Panthère, Léopard, Lynx, Chacal, Tigre. Displacement, 2500 tons; 48,000 shaft horse-power = 35.5 knots; radius of action, 2600 miles at 18 knots. Armament: six 5.1in. guns, twin-mounted; two 3in. anti-aircraft guns, and six 22in. torpedo tubes. Their large size and powerful armament bring these vessels very near the light cruiser type.

Twelve destroyers: Bourrasque, Cyclône, Mistral, Orage, Ouragan, Sicque, Sirocco, Tempête, Tramontane, Tighbe, Typhon, Tornade. Displacement: 1400 tons; 30,000 shaft horse-power = 32.5 knots. Armament: four 5.1in. guns, two 3in. anti-aircraft, and four 22in. torpedo tubes.

Six first-class submarines: Requin, Morse, Narval, Dauphin, Marsouin, Souffleur. Displacement: 1100 tons; two 1400 brake horse-power engines = 16 knots.

Six submarines "de moyenne patrouille": Siréne, Ariane, Circé, Calypso, Naiade, Ondine. Displacement: 600 tons, 14 knots.

The former battleship Béarn is undergoing reconstruction as an aircraft carrier. No naval vessels were launched last year.

Italy.

The new Italian Government is reported to have proposed the construction of two cruisers, four destroyers, and four submarines, at an estimated cost of 200,000,000 lire. According to Press reports, one cruiser is to be built at the Orlando yard, Leghorn, and the other at the Cantiere San Rocco, Trieste. Naval work during the past year was limited to the completion of the three "scouts," or destroyers, Leone, Pantera, and Tigre, 2200 tons and 34 knots; six smaller destroyers, "Generale" class, of 813 tons and 33 knots; and a few small gunboats of 230 tons. The project of reconditioning the battleship Leonardo da Vinci, which was sunk by an explosion and afterwards salved, has been given up.

Minor Navies.

There is little of interest to report in connection with the smaller navies. On August 1st there was launched at Horten Arsenal the first submarine boat to be entirely built and engined in Norway. She is of 420 tons and 14.5 knots speed. Another boat, similar in type, is on the stocks. Germany is building at Wilhelmshaven a light cruiser of 5600 tons, which will probably be launched this year. Holland is completing the two cruisers, Sumatra and Java, of 7050 tons and 30 knots, and three small submarines. Spain is building two 4725-ton crusiers of 29 knots speed; three gunboats of 1335 tons; and five submarines of 610 tons.

Electrical Engineering in 1922.

No. I.

EVERY year it becomes more difficult to do justice, within a few columns, to progress in electrical engineering, and it must suffice to deal mainly with the work that has been undertaken in the factories of the large electrical firms. It is known, of course, that while a state of general depression prevailed during the period under review, business in the electrical industry was, relatively speaking, good. Although the electrical factories did not work at their full capacities they had plenty to keep them going. Turbo-generators, large motors, converters, switchboards, &c., were turned out in considerable quantities, and there was a fair amount of export trade. The British Thomson-Houston Company reports, for example, that important contracts were secured in all parts of the world, including orders for the sub-station equipments of the South African railways. There was great activity in the wireless field, and especially in connection with wireless telephony, which has created more public enthusiasm than any other branch of electrical science. The thermionic valve has led to extraordinary developments which no one would have dreamt of a few years back.

In the domestic field there was also progress. Mr. J. W. Beauchamp, of the British Electrical Development Association, informs us that in one district where a forward campaign was launched only nine months ago, over one hundred cooking ranges have been installed, and every user has given unqualified testimony to the satisfaction he has obtained. Experience gained in certain parts of the country has shown that supply undertakings can, if they try, put forward sound commercial tariffs, hire out apparatus, and conduct their business on lines which cause the station output to increase by leaps and bounds. What some have done others can do, and the difference in the electrical facilities offered in various parts is no doubt attributable in a very large measure to differences in management. Records of the Electrical Development Association show that only about 10 per cent. of the houses in this country are connected to electricity supply systems as compared with some 30 per cent. in the United States, whilst the percentage of consumers which are using electricity for anything beyond lighting is very much smaller. The position is, however, rapidly changing, and there are now, we are told, not less than a score of districts in which the rates for domestic electricity supply are competitive with the charges for gas and coal, whilst the most expensive pieces of the equipment can be obtained on hire. In the near future interesting developments are expected to materialise in connection with the use of electricity in flats and hotels. Plans have been laid in some districts for supplying electrical energy at strictly competitive prices to dwellers in large blocks of flats, and the cable work and distribution arrangements, we are told, will constitute a radical departure from orthodox practice.

Coming now to some of the electrical matters that were dealt with in THE ENGINEER during 1922, the Gennevilliers electric power station, which is illustrated in a Supplement published with this issue, is certainly one of the most important power stations that has been set to work during recent times. Another great French station is at Comines and is also illustrated in the Supplement, and will be described in an early issue. The initial capacity of this station, which has been erected by La Société l'Energie Electrique du Nord du la France, will be 50,000 kilowatts, but at a later date the capacity will be doubled. One of the largest and most interesting English stations which was under construction during the year was the new Nechells station of the Birmingham Corporation, which will have an ultimate capacity of 105,000 kilowatts. In a series of articles on "Developments in Power Station Design," which appeared in THE ENGINEER during part of the period under review, descriptions were given of various modern schemes which have been devised to promote economy and improve the general operation of power plants. Extensions to a fair number of stations were described at different times during the year, the most recent being at Hastings, Walsall and Leicester. In the latter case a new power station was constructed by the English Electric Company, which has also obtained an order from the Preston Corporation for the erection of a 20,000-kilowatt station at Penwortham. Another important order secured by this company during the year was for two 6000-kilowatt generating units for the Indian Electric Supply Company, Cawnpore.

As regards meetings, the year was one of exceptional activity. The commemoration meetings of the Institution of Electrical Engineers will, we feel sure, long be remembered by those who attended them. Similarly, the summer meeting in Scotland proved a great success. With the papers that were read and discussed during the year we scarcely need deal, but it is worth recalling that Mr. Frank Gill's presidential address, delivered before the Institution in November, dealt with an important subject, namely, the unsatisfactory condition of long-distance telephony in Europe, and contained valuable suggestions concerning the steps that should be taken to provide a service comparable with that which exists in America. Whilst referring to telephony, the opportunity may be taken of mentioning that the Fleetwood automatic telephone exchange, which is illustrated in a Supplement, was put into service during the year by the Post Office. This exchange, which was installed by the Relay Automatic Telephone Company, is designed for an ultimate capacity of 920 lines, with forty outgoing and incoming junctions to and from Blackpool and other exchanges, and it occupies a total floor space of 875 square feet.

Turbo Generator Sets.

A turbine which is making good progress in stations in which very large units are unnecessary is the Ljungström turbine, made by the Brush Electrical Engineering Company. During 1922 5000-kilowatt units were installed in stations belonging to the Luton Corporation, the Midland Electric Corporation, the North Metropolitan Electric Power Company, the St. Pancras Borough Council, the Stockport Corporation, the Wallasey Corporation, and the Walsall Corporation. A set of this output was also put to work in the Ferguslie mills of J. and P. Coats, of Paisley. Two 7000-kilowatt and three 5000-kilowatt units are also under construction at the present time. One thousand-kilowatt capacity units were supplied to a paper mill in India, to the Malta Government, to the Federated Malay States, and to a portland cement factory at Mozambique. Three 1000-kilowatt sets are also being put into service in China. In the case of the Mozambique contract the Brush Company supplied the complete equipment for the electrification of the factory.

Between January and December of 1922 the total output of steam turbines coupled to Parsons' alternators amounted to 140,950 kilowatts. The principal sets included in the above total are an 18,750-kilowatt 25-cycle turbo-alternator set with surface condensing plant for the Treforest Electrical Consumers' Company, Limited, Wales, and a 20,000-kilowatt, 1500-revolution machine for the Shanghai Municipal Council. The stator of the alternator belonging to the latter set was shipped complete with its windings, and is thought to be the largest stator that has ever been shipped in that condition. Geared turbines with an aggregate capacity of 16,600 kilowatts were supplied in addition to the plant mentioned for use with slow-speed generators or for mechanical mill drives. Alternator air coolers for plant with a total capacity of 83,000 kilowatts were also completed during the year.

Important orders were received for turbo-alternators by the Metropolitan-Vickers Electrical Company, Limited. Among the most interesting sets were three 10,000-kilowatt units for the new Salford super-power station and two 10,000-kilowatt sets for the Stepney Borough Council, the speed of each of these sets being 3000 revolutions per minute. Another machine designed for the same speed and rated at 22,600 kilovolt-ampères is under construction, and it is claimed to be the largest machine that has been built for a speed of 3000 revolutions per minute in this country. The company's closed circuit ventilating system made material progress. Equipments were built for fifty turbo-alternators with a total capacity of 410,000 kilowatts and ranging in size from 1000 to 25,000 kilowatts.

The British Thomson-Houston Company reports that during the year the orders received for turbo-alternators showed a very large increase in comparison with the orders for the preceding year. Orders were obtained from corporations, supply companies, collieries, and many industrial undertakings. A 10,000-kilowatt, 3000-revolution turbo-alternator which the British Thomson-Houston Company supplied to the Halifax Corporation is said to have given extremely satisfactory results at the time of the test, the steam consumptions being considerably below those guaranteed. Two 22,000 kilovolt-ampère sets were also installed in the Nechells station of the Birmingham Corporation, these machines being designed for a steam pressure of 325 lb. per square inch and a total temperature of 700 deg. Fah. Many orders were received by the British Thomson-Houston Company for extraction turbines for combined heating and power, and house service turbines for central

stations. Several turbine-driven gas exhausters and compressors were also built. Two alternators built by the same firm are 40-pole, 150-revolution machines, which are driven by uniflow engines in the works of Courtaulds Limited. A number of smaller alternators were supplied to various industrial concerns. At the Witton works of the General Electric Company a 22,500 kilovolt-ampère turbo-alternator set was built for the Birmingham Corporation, a 16,000 kilovolt-ampère set for Sydney, and many other turbine-driven machines for British municipalities and industrial concerns.

Electric Power.

Because of the low power factor troubles that are frequently experienced in consequence of the employment of ordinary induction motors on an extensive scale, it became necessary to introduce motors which do not draw a wattless current from the mains. The increasing demand for Crompton self-starting and self-synchronising or "auto-synchronous" motors is, we are told, being maintained, and an order for two of the largest machines of this type that have been constructed either in this country or abroad was secured during the year. Foreign firms also tendered for the contract, but the order is said to have come to this country on account of the better performance guaranteed. The British Thomson-Houston Company also reports good business in connection with synchronous induction motors. Crompton and Co. state that orders for extensions to existing plants, and also orders for new installations, indicate that manufacturers are recognising the necessity of electric driving in order to reduce manufacturing costs to a minimum. Among the company's principal customers abroad were the Hooghley Docks and the Malacca public supply. The company has in hand at the present time a large number of power plants for the new automatic telephone exchanges which are being constructed by the General Post Office and by telephone authorities abroad. Crompton and Co., Limited, also secured the order for the electrical equipment of the 32-ton coaling crane which was recently ordered by the Clyde Navigation, this being the second repeat order for equipments for a similar size of crane at work on the Clyde.

The period of depression through which the steel industry has been passing greatly retarded the progress of the electric drive, but electric rolling mill work was not by any means brought to a standstill. During the period under review the English Electric Company set a 12,000 horse-power reversing mill motor to work for driving a 36in. cogging and tin bar finishing mill in Campionnet's works in the Saône and Loire district, the motor being supplied from a fly-wheel equaliser set. A similar machine rated at 12,000 horse-power and designed for driving a 30in. plate mill was set to work at the works of David Colville and Sons, Limited. This equipment is of particular interest, for the mill is of the continuous running three-high type, whilst the drive is on the same lines as that employed for a reversing mill. A reversing mill order was also placed with the company during the year. The motor in this case is a single-armature machine which is capable of dealing with a peak load of 8600 horse-power, and is for the finishing stand of the rail mill at Guest, Keen and Nettlefold's Dowlais works. The prevailing depression also had a retarding effect upon the supply of equipments for the smaller continuous running mills, but a number of motors were put down for this class of work. Electric driving was, for example, applied by the English Electric Company to an 8in. and 9in. merchant mill at the works of Monks, Hall and Co. The demand for specially heavy mill motors for live rolls and similar work was found by the above company to be fairly good, and the Consett Company placed an order for about forty machines for driving heavy duty cranes, coke-oven plant, &c. The electrical equipment of the new 12in. merchant and 10in. strip mills at the Templeborough Works of the United Strip and Bar Mills, Limited, carried out by the British Thomson-Houston Company, was one of the most important electrical installations described in THE ENGINEER during the year, and a view of the finishing mill motor, contactor panels and regulating machine is shown in our Supplement.

Electric Traction Equipments.

While railway electrification in this country is practically at a standstill, the electrical manufacturers have not been completely without traction orders. The English Electric Company completed during 1922 the passenger and goods locomotives ordered by the New Zealand Government for the Arthur's Pass section of the Midland Railway. These engines, which were built in the Dick, Kerr works, are designed for a line pressure of 1500 volts, and are equipped with four 170 horse-power motors. In conjunction with its associate, the Constructions Electriques de France, considerable progress was made by the English Electric Company with the contract for the electrification of the Chemins de Fer du Midi, and the first passenger and goods locomotives made at the Dick, Kerr works, Preston, are already in service. The company also obtained a contract from the Japanese Government railways for the whole of the thirty-four passenger and goods locomotives required for carrying out the Japanese Government's electrification programme up to the end of 1923. Contracts are also in hand for the motor coach equipments for the Chemins de Fer du Midi, for the Noord Zuid Hollandsche Tramweg Company (Holland) for the Cataluna railway, Spain, and for the Nagoya, Ome, Keisei, Keihan, and other Japanese railways. The Brush Electrical Engineering Company has done a fair amount in the way of building rolling stock, one of its contracts being for seventy-five top-covered bogie tramcars for the London County Council.

Some important traction contracts were secured by the Metropolitan-Vickers Electrical Company. The company completed a number of locomotives for use in this country, and some heavy multiple-unit trains were also put into service in South America. Important orders for electric tramway equipments were secured and new and improved traction apparatus was also designed. One of the most interesting equipments which the company completed was for the 1800 horse-power high-speed 1500-volt main line passenger engine for the North-Eastern Railway. A view of this locomotive is given in one of our Supplements. The twenty locomotives which the company is building for the Metropolitan Railway are now nearly completed. Work is progressing satisfactorily on the Glencoe-Maritzburg section of the South African railways, for which seventy-eight 3000-volt double-bogie electric locomotives are being built. A similar engine is being constructed for Japan, but in this instance the working pressure is only 1500 volts. An order was also secured from the Western Government of Australia for a double-bogie shunting locomotive, which is to operate on 600-volt system. The London Electric Railway Company ordered from the Metropolitan-Vickers Electrical Company eighty-six motor coach equipments and ninety-six controller equipments for the railway companies' new trains. Multiple-unit equipments are being built for use on a portion of the Amsterdam to Rotterdam coast line, which works at a pressure of 1500 volts, and eighty railway motors are also under construction for Japan. Other traction contracts of this company include new motor coach equipments with electro-pneumatic control for the Mersey Railway, and tramway motors for the London County Council and Edinburgh Corporation tramways. During the year the company developed a low-platform battery truck for goods depôts. One of the most important traction contracts which was secured during the year was that awarded to the General Electric Company, of Witton, Birmingham, by the Brighton and South Coast Railway. This contract was for the supply of additional single-phase equipment, and it is satisfactory to find that work of this kind is now being undertaken in this country.

Wireless Telegraphy and Telephony.

The most important wireless development was perhaps the use of very short waves—from 5 m. to 50 m. long—for communication over considerable distances with or without the aid of reflectors, as designed by Mr. C. S. Franklin. A revolving reflector system, emitting signals with wave lengths of only 5 m., was installed at Inchkeith with the co-operation of the Commissioners of Northern Lights, and during November a very successful demonstration was carried out before representatives of the British naval, military, and other authorities. The new system is intended to replace the lighthouse fog beacons and to enable ships to steer their way into port by means of wireless apparatus. Radiotelephone experiments with reflectors and short waves up to 50 m. long were carried out between Birmingham and Hendon, and it was demonstrated that with waves of this length reception is possible during the day time at a distance of 280 miles or more. Experiments with medium short waves were conducted throughout the year, and a detailed study of the variations and peculiarities of waves having a length of 100 m. to 200 m. have been made over distances up to 300 miles.

The commencement of wireless broadcasting, which enables anyone with a simple receiving set to pick up music and news, created a big demand for receiving apparatus and component parts. Broadcasting stations were put into operation at London, Birmingham and Manchester, and many thousands of people are now "listening in."

For lighthouses and harbours in which a continuous watch is not kept, the provision of a radiotelephone calling device which will attract attention to the wireless apparatus when another station is calling is essential, and during 1922 a call bell system, equivalent to the call bell on the ordinary land line telephone system was devised. Several of these call-up devices have been put into service on the Mersey with very satisfactory results. Much attention was also given during the year to the use of medium short waves in connection with aircraft. Some valuable data were collected, and new aircraft apparatus was designed to conform with the most up-to-date technical knowledge. The standard aircraft receiver was given directional properties so that machines may be guided to landing stations. The development of the thermionic valve transmitter continued, and a number of new radiotelegraphic stations working commercial services were put into operation in various parts of the world. On account of the capture of the Clifden and Letterfrack stations in Ireland by the rebels, the European end of the Canadian wireless service had to be transferred to the Ongar station—near London—which is working the service satisfactorily with a small valve transmitter, notwithstanding the increased distance of working. Commercial high-speed wireless telegraphic services are also being carried out from Ongar to Berne, in Switzerland, and between Paris and Madrid. The normal working speed of the first two of these services is 80 to 120 words per minute.

A new public wireless telegraphy office was opened by the Marconi Company at Radio House, Wilson-street, E.C., and it is fitted with all the latest apparatus for the rapid automatic handling of incoming and outgoing Marconigrams, and direct services are now being handled from that office with France, Switzerland, America, Canada, and Spain. In connection with long-distance working to North and South America, Australia and Africa, important experiments were made and are still in progress for the study of the strength of signals and atmospheric disturbances at those places. Important research was also carried out on the efficiency of transmission and the production of high power valve transmitting apparatus and also with regard to the improvement of direction-finding apparatus and high-speed receivers. Much was done in connection with the standardisation of that apparatus.

PROPOSED PORT IMPROVEMENTS AT PERNAMBUCO.

NOTWITHSTANDING the expressed intention of the Brazilian President to cut down all construction expenses for a period of two years, it has been decided to proceed with the port improvements at Pernambuco (Recife). Arrangements have been made for the flotation of a loan of between £400,000 and £600,000 by the State of Pernambuco, and tenders will shortly be called for carrying out the work, which will include dredging to a depth of 10 m. from the entrance to the beginning of the 8 m. quay section and to a depth of 8 m. from there to within 200 m. of the southern extremity of the quays. Submerged reefs at the entrance will have to be blown up, in addition to others that may be found to interfere with the depth required. The space between the new quay walls and the shore will be filled in, and seven warehouses constructed on the northern portion, together with other buildings that may be required.

The plans also include the construction of a breakwater commencing from the Picao lighthouse in the north, and constructed on the reef out to a depth of 9 m. at low tide, length 1147 m., and a stone jetty perpendicular to the quays, with a length of 798 m. into the same depth of water. The quay walls will give a depth of 10 m. at low tide between the northern extremity and the port of Brum (574 m.); of 9 m. along a curved portion beyond that point for another 60 m.; of 8 m. for 1311 m. until the south of the town is reached; and 2.50 m. along a short section of 153 m. reaching as far as the Customs House. These plans were decided upon as far back as 1915, and it is improbable that they will undergo any serious modification.

CHANGE OF TITLE OF THE CONCRETE INSTITUTE.—Pursuant to an Order of Court made by Mr. Justice Eve on November 28th, 1922, and confirmed by the Board of Trade, the title of the Concrete Institute has been altered to "The Institution of Structural Engineers." The address continues for the moment to be Denison House, Vauxhall Bridge-road, Westminster, but we learn that there is a prospect that in the near future the Institution will acquire a home of its own.

THE A-L CLUB'S DINNER.—The A-L Club's fifteenth annual dinner (Allen-Liversidge, Limited) was held at the Cannon-street Hotel on Friday, December 22nd. Mr. Harry Stevenson presided and, in addition to the chairman, several of the company's directors were present, including Messrs. T. G. Allen, P. B. Liversidge, E. W. Sprott, Fred Wettern, and F. H. Rogers. The toasts were limited to those of "The King" and "The Company." After the speeches there was a musical entertainment, and a most enjoyable evening was spent.

DIESEL ENGINE USERS' ASSOCIATION.—At the last meeting of the Diesel Engine Users' Association, Mr. A. E. Farrow, A.M.I.E.E., engineer to the Windsor Electrical Installation Company, Limited, was elected President for the ensuing year, and Mr. Percy Still, M.I.E.E., M.I. Pet. Tech., was re-elected honorary secretary. It was announced that the Committee had given consideration to the suggestion that the name of the Association should be altered to "The Heavy Oil Engine Users' Association," but no definite decision was arrived at, and the matter was left to be dealt with further at a later date.

SHIPBUILDING IN HONG KONG.—We are informed by the Hong Kong and Whampoa Dock Company, Limited, that the following vessels have been launched and engined during the year:—Two oil tankers of 5716 gross tons with triple-expansion engines of 3100 indicated horse-power; one small water boat, with compound engines; one tugboat and two police launches, with triple-expansion machinery. The work in hand includes two passenger and cargo steamers of 3400 tons deadweight capacity, one river steamer to carry 130 passengers, and two 80-ton pontoons, in addition to repair work.

CONTRACTS.—The Fuller Engineering Company has recently received orders for a complete pulverised coal installation to a boiler plant of nearly 5000 horse-power capacity, and also for a set of its pulverised coal equipment for application to locomotives.—J. Blakeborough and Sons, Limited, of London and Brighouse, have recently received instructions to supply all the valves and circulating pipes required in connection with the electrification of the Glencoe–Pietermaritzburg section of the South African Railways.—George Kent, Limited, of 199–201, High Holborn, London, W.C. 1, have received an order from the Metropolitan Water Board for 100 Kent's Mark III. positive meters.—Among the recent contracts received by the crane department of Sir William Arrol and Co., Limited, are those for one 90-ton overhead traveller; twelve fixed jib cranes of from 1½ to 3½ tons capacity; one 60-ton and several 30, 10, 5, and 3½-ton overhead electric travellers; two 100-ton electric traversers; one special "Temperley" bridge transporter with grab for coal handling. The South Indian Railway Company has placed its order for the steel work for its new shops at Trichinopoly with the firm.

A Seven-Day Journal.

Experiments at Very High Pressures.

ACCORDING to an anonymous correspondent of the *Daily Telegraph* (London), in its issue of Tuesday, Professor P. W. Bridgeman, of the United States, has been experimenting with very high pressures, up to 20,000 atmospheres—nearly 300,000 lb. per square inch—and has found some startling changes in the properties of matter subjected to their influence. We would have felt greater confidence in the statements made by the correspondent had he given us some clue to Professor Bridgeman's identity, and an inkling as to how he carried out his experiments—the latter especially, for it involves a matter which to physicists is almost of as much interest as the alleged results of the alleged investigation. According to the correspondent, one of the outstanding discoveries made by Professor Bridgeman is that liquids are not incompressible as is commonly thought (!), water, for example, occupying only 20 per cent. of its original volume when under a pressure of 12,000 atmospheres. An accepted figure for the coefficient of compressibility of water when exterpolated on the assumption of a straight line law indicates that the volume at 12,000 atmospheres should be about 43 per cent. of the original. If Professor Bridgeman's figure is correct, we get the curious result that at very high pressures the compressibility of water is much greater than at relatively low pressures. The compression of liquids, the correspondent tells us, cannot be continued indefinitely, for they show a tendency to solidify. We cannot express any surprise at this result, as we are no doubt meant to do, for if the temperature of the liquid is below the critical point, the teaching of Andrews would lead us to expect that very long before a pressure of 12,000 atmospheres was reached, any liquid would do something a great deal more definite than "show a tendency to solidify." That rubber at the said pressure becomes harder than soft steel is another curious revelation, for it suggests ignorance of the fact that rubber even at atmospheric pressure is already well known to be almost completely incompressible. The article in our esteemed contemporary is short, but it is given a very prominent position, much too prominent, we would fancy, to please Professor Bridgeman.

The New Railway Groups.

WITH the first day of the year, the new railway groups were brought into legal being without ceremony or celebration. On Monday morning, except for a solitary poster announcing a reduction of rates and fares, and headed "Southern Railway," we failed to see the slightest sign that any change had occurred overnight in the country's railway system. In the pages of the Press, however, the event was duly marked, and we were treated to a variety of articles describing the new groups, their comparative mileage, capital, number of engines, coaches and wagons, directors and servants, and so on. The railway companies themselves lent their assistance to the flood of matter in the Press, and vied with each other in their efforts to impress upon the public the unrivalled facilities for business and pleasure afforded by their lines, their determination to maintain the traditions inherited from their constituent companies, and their concern to preserve and even surpass their previous reputations for safety, punctuality and comfort. In one announcement of a particularly flowery nature, published by the "Northern Division" of the London, Midland and Scottish Railway, we noticed that an effort was made to secure the adoption of "L.M.S." as an abbreviated title for the group as a whole. The appropriateness of the letters was emphasised by a reference to Liverpool, Manchester and Sheffield as the centres of the great industrial districts of England. This coincidence of initials will hardly reconcile the sturdy Scots patriot to the suppression of the titles "Caledonian" and "Highland," however glad he may be to hear the last of the "North British" in connection with the Eastern Group. It is to be hoped, however, that in his patriotic fervour he will maintain his well-known respect for his aitches, and not offend English susceptibilities by hinting that the proposed abbreviation conveys a suggestion of slight confusion.

Another Peculiar Gas Tragedy.

IN the Journal for November 10th we called attention to a mishap to a gas main at Stafford, whereby two people lost their lives as a result of a leak from the broken main in the street through the subsoil into the adjoining houses. Last Friday an apparently exactly similar type of accident occurred in a street in Bethnal Green, North-East London. A leakage of gas had been noticed in the street for some days previously, but nothing apparently was done to stop it until early in the morning of Friday, when one of the inhabitants became alarmed and informed the police. Precautions were at once taken by arousing all the occupants of the houses. At several the inhabitants were found to be suffering from gas poisoning, and at one three were discovered dead. At the latter house and at another at which the inhabitants suffered severely, the gas was not laid on to the building. It seems therefore almost certain that the accident was caused by the fracture of the main, by the confinement of the escaping gas to the subsoil by the road surfacing material, and by the percolation of the gas upwards into the houses through basements insufficiently protected against subsoil exhalations. At the coroner's inquest on Wednesday, it was revealed that the main was laid in 1880, and that the fracture was probably caused by the settlement of the subsoil except at one point, at which the main was supported on some brickwork.

New Pacific Cables.

THE growth in the business of the Pacific Cable Company has now reached a point at which no further increase can take place until the cables have been duplicated. During the year ending last March, the international traffic amounted to nearly 8½ million paying words, and subsequently it has exceeded a rate equivalent to over 11 million words per year. The company's cable extends from Bamfield, Vancouver Island, to Fanning Island, Fiji, Norfolk Island and Southport, Queensland, and from Norfolk Island to Auckland, New Zealand, and Sydney, the total length being 9288 nautical miles. The Cable Company, in pursuance of its policy of increasing the facilities for handling the growing volume of traffic, has placed an order with the Telegraph Construction and Maintenance Company, of East Greenwich, for 1850 nautical miles of cable. This cable will be laid in two lengths, one covering a distance of over 1310 miles between Fiji and Auckland, apparently direct without touching Norfolk Island, and the other direct between Southport, Queensland, and Sydney, a distance of about 540 miles. The cable will be laid by the cable steamer Colonia, now in the West India Dock, and is to be completed and ready for use by August 14th. It is reported, and we can confirm the report, that the duplication of the section between Bamfield and Fanning Island, a distance of 3458 nautical miles, is being postponed until such time as the Telegraph Construction and Maintenance Company has completed some important experiments now in hand, which promise to result in a new type of cable that will expedite the despatch of messages.

The Einstein Theory.

THE expedition sent out from Greenwich Observatory, under the charge of Mr. Spencer Jones, to Christmas Island to observe the total eclipse of the sun on September 21st last year, has now returned to this country. The eclipse took place under very suitable astronomical conditions, occurring at about local noon, with the sun at an altitude of 78 deg. and lasting at the point selected for its observation for 3 min. 42 sec. Unfortunately, the weather suddenly broke on the morning of the eclipse, and for four days continuous thick cloud accompanied by heavy rain obscured the vision of the heavens. From the point of view of testing the Einstein theory, as applied to the bending of the light rays from the stars during their passage near the sun, the eclipse, even although photographs could have been obtained, would have been less satisfactory than that of 1919, by reason of the fact that the stars in line with the sun at the time of the eclipse were of much reduced brilliancy. It is understood that while the Greenwich party's observations were prevented by the weather conditions, those made by the Lick Observatory's expedition on the north-west coast of Australia were secured in excellent circumstances. The analysis of the photographic records secured by the American party is now being awaited with great interest. The next opportunity for testing the "shift" of the light rays forecast by the Einstein theory, will occur on September 10th this year, when a total eclipse, visible in California and North Mexico, will take place.

A Well-known Naval Constructor Retires.

AFTER serving under the Admiralty for over forty-four years, Mr. S. W. F. Furze-Morrish has relinquished his appointment as Manager of the Constructive Department at Devonport Dockyard, and has retired from the Service. Mr. Furze-Morrish has been connected with the Navy since June, 1878, when he entered the Marlborough at Portsmouth as an engineer student. His training was continued at the Royal Naval Engineering College, at Keyham, when that institution was opened in 1881. At the end of his sixth year, being top student, he was given the option of transferring to the Constructive Branch, and in December, 1884, entered the Royal Naval College at Greenwich as a student of naval construction. In July, 1887, he became a member of the Royal Corps of Naval Constructors, and for the ensuing five years was engaged at the Admiralty Experimental Works at Haslar. Thereafter, until January, 1903, he was engaged at the Admiralty, and was placed in charge of various designs, including sloops and second-class cruisers. In January, 1903, he passed to Pembroke Dockyard, and acted as assistant to Mr. A. E. Richards during the building of the Duke of Edinburgh. A year or so later he went to Devonport as constructor under Mr. J. Black, and in July, 1907, received his promotion to senior constructor. In that capacity he was appointed to Portsmouth in July, 1914, and during the early months of the war served as Acting Manager of the Constructive Department on the night shift. In November, 1914, he was sent to Invergordon as Chief Constructor, and within a period of three months organised and fitted out a dockyard at that station which was able to undertake the complete refitting of a first-class battleship. In July, 1915, he went to Gibraltar, where he remained until October, 1918, when he was appointed to Sheerness. In May, 1919, he was transferred to the post at Devonport from which he has just retired.

The Discharge of Oil from Ships.

FROM Monday of this week henceforward, it will be an offence for a ship to discharge oil, or allow it to escape, into the sea within a distance of 3 miles from the British coast. The Act of Parliament under which such a proceeding has been made punishable with a fine of £100, should serve to remove a just cause of grievance expressed by many visitors to and users of our seashores, for within recent years great discomfort and damage have been caused to many interests by the oily scum or tarry matter which has been washed landwards from ships using oil fuel when cleaning their bunkers or replacing their ballast water. The Act applies not only to ships, but to the discharge or escape of oil from any place on land or from any apparatus used for transferring oil to or from a ship, and definitely forbids its transference during the night time. From our own experience, we know of two places at which the trouble now guarded against has reached acute conditions. At one the oily drift has practically eliminated all off-shore fishing, and at the other the tar deposit has rendered the beach almost useless for pleasure purposes.

Sixty Years Ago.

IT is interesting to the engineer, no less than the general public, to turn back the clock for a period of years, and from the files of an old-established newspaper discover from time to time what our fathers or grandfathers were doing and discussing. Sixty years ago, in our issue of January 2nd, 1863, in our annual review of the year, we were congratulating ourselves—just as we may perhaps do to-day—that the preparations we had been making for what would have been a calamitous war—with the United States—had been rendered unnecessary, and were expressing the belief that industry had now gone through the worst of its troubles. The prospects of a vast increase of our armaments being greatly diminished, a greater sense of security abounded, and we anticipated a better disposition to embark in commercial undertakings at home and abroad. The near approach to completion of the overland telegraph to India was recorded in another article. Within twelve months, we find it written, "London will, in point of time, be within twelve hours' distance of Bombay, Madras, Calcutta and Rangoon!" Fears were expressed, however, regarding the attitude of the fierce tribes living between Bagdad and the Persian Gulf, and it was suggested that a subsidy of £1000 a year might have to be paid to the most powerful of the Arabs to undertake the protection of the line against all comers. The paramount importance of laying immediately an Atlantic telegraph was emphasised in a report of the completion of repairs to the Great Eastern, following an accident, at the entrance to Long Island Sound, for four weeks were required to inform the owners and receive their instructions in the matter of effecting the repairs. The vessel struck a submerged rock, and received a fracture 85ft. long, and in places 4ft. broad. Yet she not only remained afloat, but proceeded a hundred miles farther on her voyage, and safely discharged at New York nearly 1000 passengers and 2000 tons of merchandise. Her double skin saved her, and she might indeed, we find it stated, have been safely navigated back to this country before being repaired. In a note on the "Charing Cross Railway" we recorded that "the great iron girder bridge over the Thames" was nearly completed, and that the entire site for the station had been cleared and the laying of the foundations begun. To-day, of course, there are many who are strongly advocating the demolition of both station and bridge. Perhaps the most interesting item in the issue to the railway engineer of to-day is a table giving the cost of locomotive power per mile run on the twelve principal British railways. The highest value recorded was 10¼d. for the London and North-Western and the London, Brighton and South Coast, and the lowest 6¾d. for the North-Eastern.

Aeronautics in 1922.

ALTHOUGH commercially the aeronautical industry during the past year continued to suffer hardship, several signs lead us to believe that technically the twelve months covered a turning point in its history. Aerial transport under a revised Government subsidy scheme was developed and extended, but it still remains almost entirely in the experimental stage, and is not yet anything like self-supporting. On the other hand, from the point of view of design and construction, it appears to us that the past year's productions reveal the fact that in large measure the industry is at last showing signs of emerging from the influence of the forced developments of the war period. The new machines produced may not be large in number, but they show, in several instances, that designers are, as it were, beginning to recover their breath, following the feverish activity of the war years, and are seeking leisurely but soundly to explore fresh ground.

Among the more interesting machines produced by British firms during the year we would give first place to the all-metal biplane turned out by Boulton and Paul, Limited, at their Norwich works, for the Air Ministry. This machine, a view of which, in the uncovered condition, is given in a Supplement, was referred to in our issue of November 3rd, 1922, in the course of an article dealing generally with the firm's system of metal construction. Messrs. Boulton and Paul have been experimenting for the past four or five years with metal construction, and have to-day reached a stage for which it may fairly be claimed that it represents the establishment of a definite technique about which there is now little that is experimental. It will be recalled that, unlike several other constructions of "all-metal" machines, Boulton and Paul do not view with favour the use of sheet metal for the wing and fuselage covering, but prefer to retain the fabric material characteristic of wooden frame machines. As intimated in our previous article, the firm is now actively engaged in studying the possibilities of using stainless steel, and has secured results sufficiently satisfactory to enable it to contemplate building its next all-metal machine of this material.

A second noteworthy machine of the year—also illustrated in a Supplement—is the Handley Page torpedo-plane with slotted wings. A year or so ago Messrs. Handley Page were still experimenting with the slotted wing, and had not so far built a machine designed from the start for slotted wings. It is, therefore, satisfactory to note that the machine now illustrated has been built to the order of the Air Ministry for work in conjunction with the fleet. The slotted wing machine is particularly adapted to torpedo work, for it permits a heavily loaded machine to take off at a slow speed with a short run, and, therefore, enables it to rise from the deck of a warship instead of requiring an aerodrome as heretofore. The Handley Page torpedo-plane has folding wings for housing purposes, and is equipped with an under-carriage, the struts of which are arranged in the form of an inverted M, in order that the torpedo may be swung centrally close to the under side of the body. A subsidiary feature of interest—found also in other torpedo planes—is the use made of the engine exhaust gases for warming the torpedo when in the air. The engine is a Napier "Lion" of 450 horse-power, giving the machine a top speed, with the slots closed, of 108 miles an hour. When taking off or landing with the slots fully opened the machine has a speed of 40 miles an hour. With its military equipment, the pilot and fuel and oil for five hours' cruising flight at 3000ft., the machine has a total weight of 6487 lb.

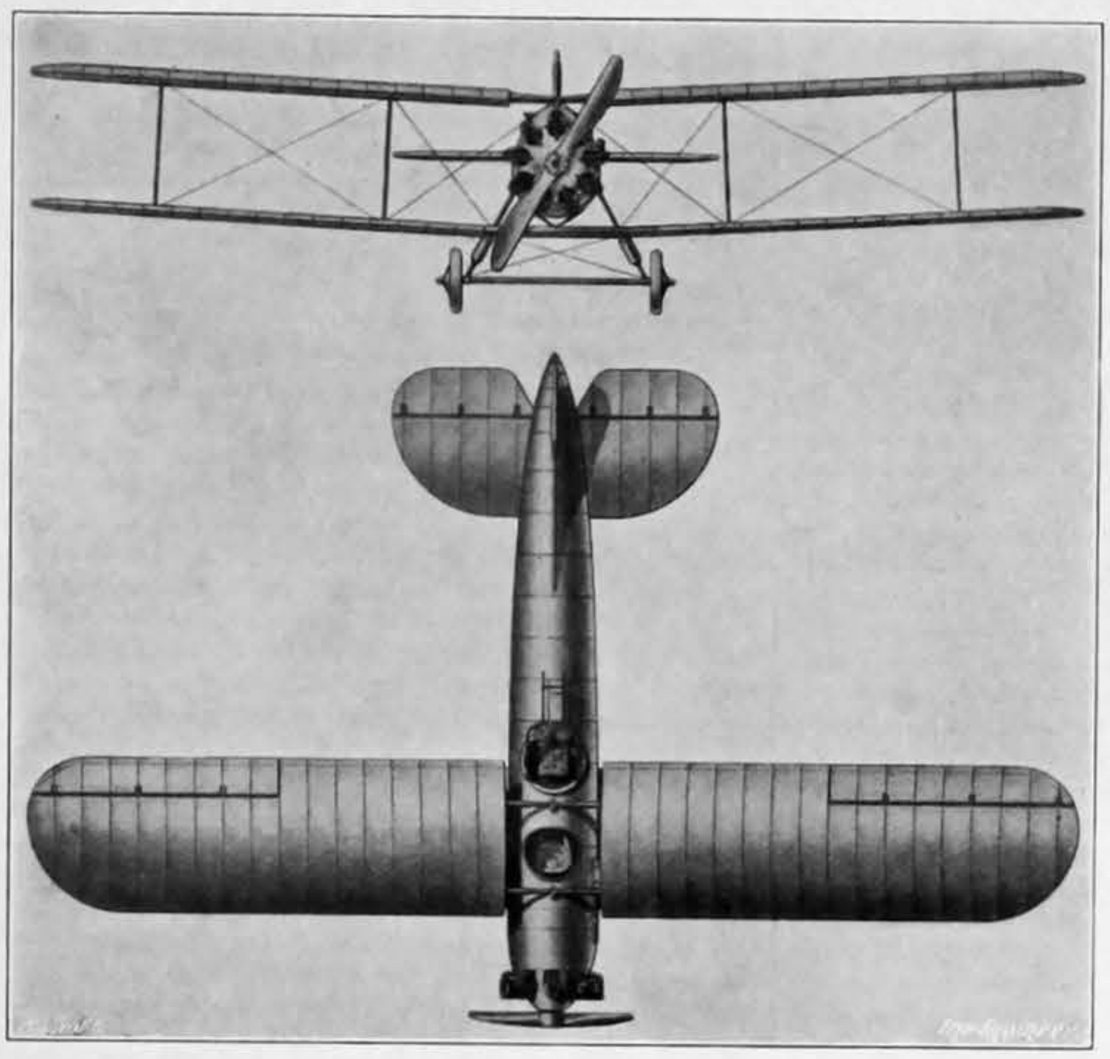
As a means of attacking moving ships it is now generally agreed that the torpedo-plane is a much more certain instrument than the bomber. The latter class of machine is essentially suited for land work, and has continued to receive the close attention of designers. While there is a distinct tendency, as illustrated by the Boulton and Paul all-metal aeroplane to combine bombing, reconnaissance, and other qualities in the one machine, the day of the specialised military aeroplane is not yet passed, and probably in some respects never will be. The two and four-engined heavy bombing, long-distance machines, associated with the name of Handley Page in the later stages of the war, have now been succeeded by a new design, the W 8 military type, a development of the firm's W 8 sixteen-seater passenger machine. We are unfortunately unable to illustrate this new bomber. It may be said, however, that unlike the earlier Handley Page machines, its top speed is sufficiently high for day-bombing work, while, like them, its low landing speed and strength of undercarriage make it suitable also for night work. It is driven by two Napier "Lion" engines, and has a maximum ground level speed of 120 miles an hour, and a landing speed of 54. A crew of four is carried. The front gunner and wireless operator sits in the nose of the fuselage well below the level of the pilot's cockpit, which is immediately behind him. In rear of the pilot sits the navigator and second pilot, while about half-way along the fuselage towards the tail is the cockpit for the after gunner, who controls two guns, one mounted on top of the fuselage to fire sideways and rearwards past the monoplane tail, and the other firing downwards and backwards through the floor of the cockpit. The machine can carry 1425 lb. of bombs, and has a range of 580 miles—290 miles out and home.

Previous to the construction of the Boulton and Paul all-metal machine, referred to above, the outstanding—we believe the only—example of this class of aeroplane built in this country was the "Silver Streak" freight-carrying biplane, produced by Short Brothers, Limited, of Rochester, and described in our issue of July 16th, 1920. The solitary example of that design was acquired by the Air Ministry, and, after being tested in flight with great official caution, was, and so far as we know still is being, submitted to prolonged observational and other tests, to determine its corrosion-resisting qualities. It would appear that the results have so far been satisfactory. At any rate, the Air Ministry is about to receive delivery of two more all-metal machines from Messrs. Short. These machines, of which the first drawing to be published appears on this page, are of the two-seater reconnaissance type, and are being built on exactly the same lines as were followed in the "Silver Streak." The planes are clothed with 28-gauge duralumin, while the spars, fittings, and landing carriage are made of high-tensile non-rusting steel. A special feature of the machine is the cutting out of the central section of the upper plane, in order to afford the pilot a clear view above his head. The method of springing the landing carriage is also noteworthy, in that compressed air and oil dashpots are used to the exclusion of rubber or metal springs. The propeller is made entirely of steel, and is fitted with an arrangement patented by Mr. Oswald Short and his assistant designer, Mr. F. Webber, whereby the pitch of the blades may be adjusted by the pilot while the machine is in flight. Below we give some of the leading particulars of these interesting machines.

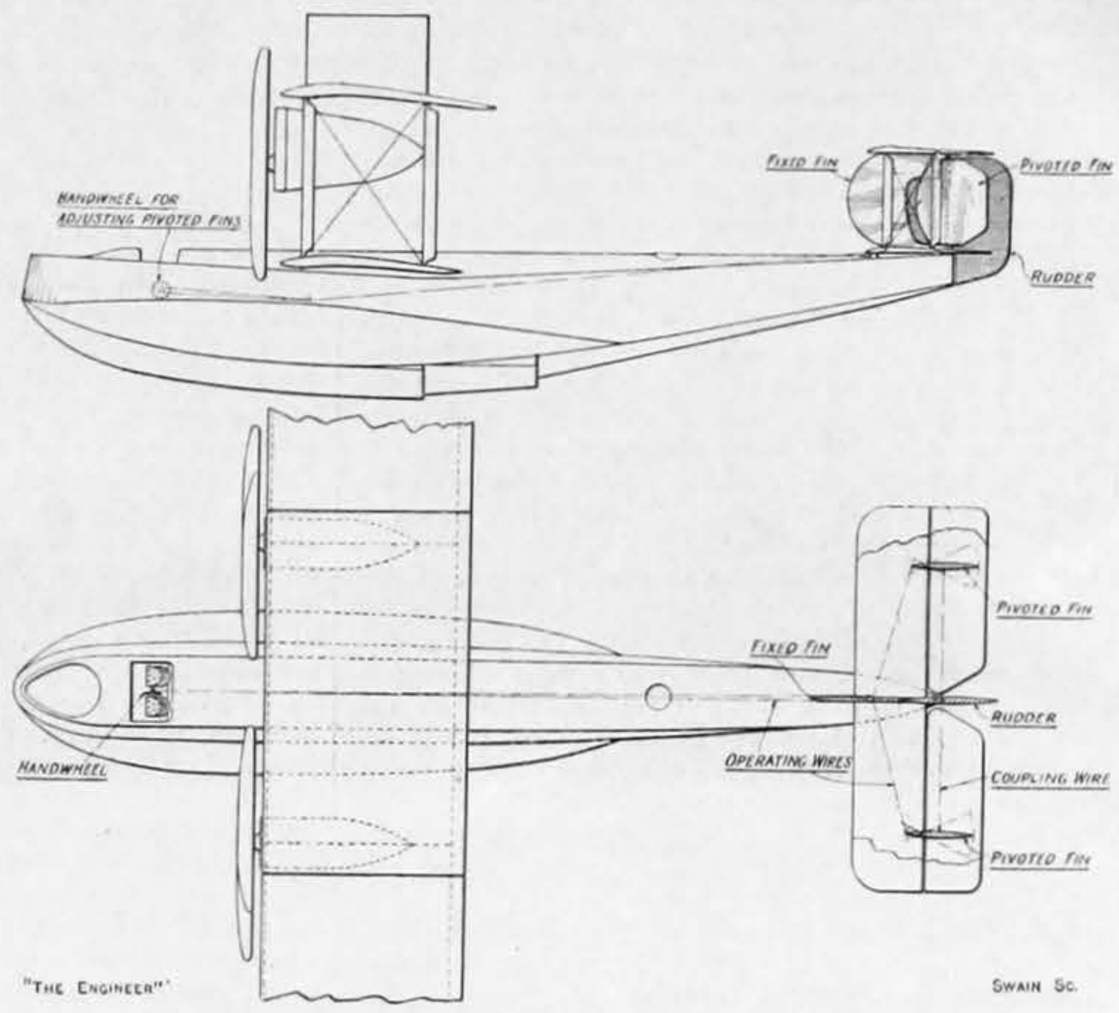
Short "Swift" All-Metal Aeroplane.

Engine : Bristol air-cooled Jupiter, 9 cylinders, 380 horse-power.
Overall span : 42ft. *Overall length :* 27ft. *Overall height :* 10ft. 9in.
Lifting surface : 465 square feet.
Weight : empty, 2200 lb. ; fully loaded, 4100 lb.
Useful load : 1900 lb.
Loading : 8.8 lb. per square foot, 10.8 lb. per horse-power.
Estimated performance : Speed at ground level, 150 miles per hour ; speed at 10,000ft., 135 miles per hour ; landing speed, 50 miles per hour ; climb to 10,000ft., 10 minutes ; maximum ceiling, 22,000ft.

The same firm's "Cromarty" flying boat, of which we give an illustration in a Supplement, although built some two years ago, is worthy of inclusion in our present review, because it has only recently undergone full flying tests. These tests, we are informed, have shown that in spite of its great weight of 20,000 lb., the machine has a very high degree of controllability in the air, a feature which previous smaller aircraft of its class were far from possessing in a noteworthy degree. The "Cromarty" flying boat was primarily designed for operating with fast cruisers, and as a naval machine is equipped with long-distance wireless, a large anti-submarine gun, and bomb-dropping gear. It is driven by two 600 horse-power Rolls-Royce "Condor" engines, and carries a crew of five. It is also capable of being adapted as a commercial machine for the carriage of eighteen passengers, with 50 lb. of luggage each. An interesting constructional feature of the machine is to be found in the provision of two auxiliary rudders or pivoted fins between the tail planes, which can be brought into action during a flight should a



SHORT "SWIFT" ALL-METAL RECONNAISSANCE BIPLANE

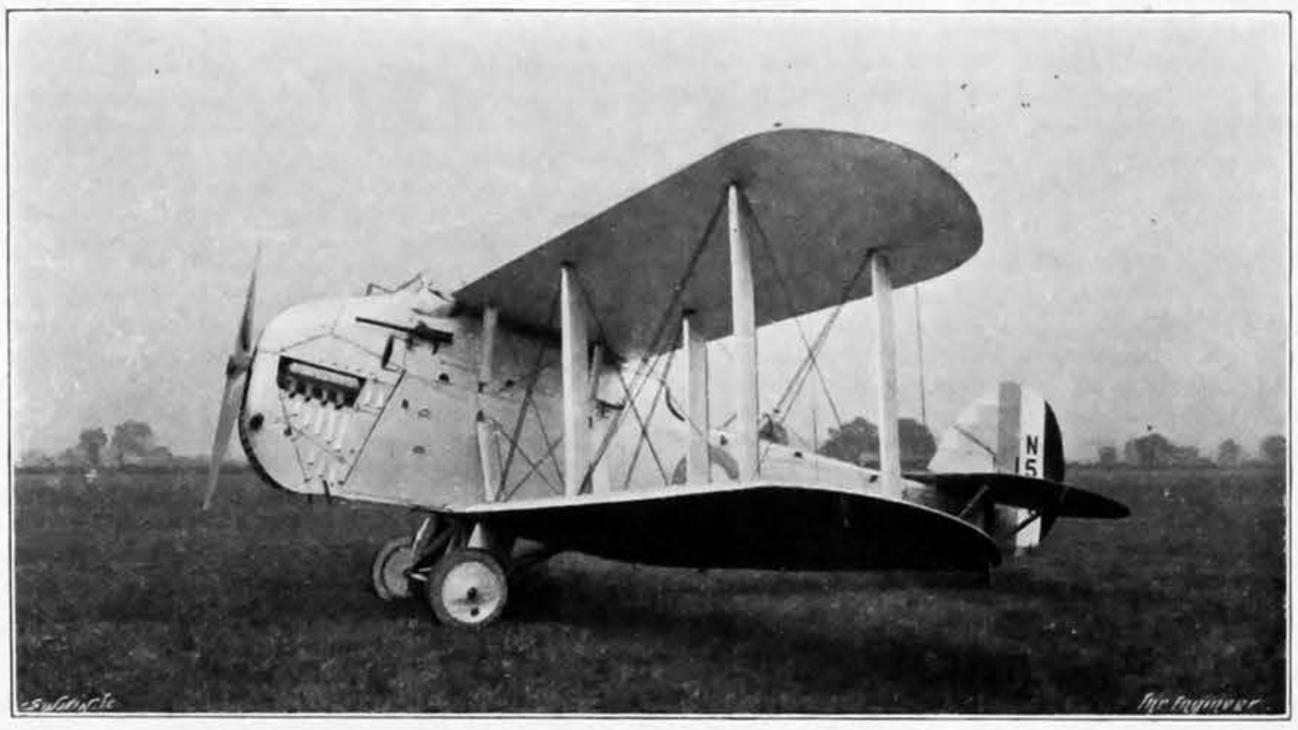


SHORT "CROMARTY" FLYING BOAT WITH PIVOTED FINS

AVRO "ALDERSHOT" WITH 1000-H.P. ENGINE

non-central thrust be developed by the stopping of one of the engines or from any other cause. We reproduce a drawing herewith, which not only illustrates the arrangement of these fins, but also reveals the form given to the under side of the hull.

Some very interesting work was done during the year by A. V. Roe and Co., Limited, of Manchester and Southampton. The AVRO "Bison," of which we give an illustration in a Supplement, was specially designed for fleet gunnery spotting purposes, to meet the requirements of the Air Ministry, and is constructed to permit its alighting upon and taking off from the deck of a warship. It is driven by a Napier "Lion" 450 horse-power engine, and carries a crew of four. The pilot sits in front of the upper wing in a position enabling him to obtain a very clear view of the ship's deck when alighting. Immediately behind him is a cabin for the wireless operator and the observer, and further to the rear is the gunner's cockpit. The structure of the machine is carried out entirely in steel, except for some parts of the wing frames. The wings are arranged to fold for stowage, and a special form of "oleo" undercarriage is provided. The machine, we are informed, is distinguished by its manœuvrability and its low landing speed, factors of the greatest importance in a deck-landing aeroplane.



BLACKBURN DECK-LANDING NAVAL SPOTTING MACHINE

The Avro "Aldershot" biplane, which is also illustrated in the Supplement, is a long distance bomber, designed to carry a crew of three. Seats for two pilots are provided side by side, and the control gear is duplicated. The spare pilot acts normally as navigator, and can descend to a lower deck carrying wireless apparatus and bomb sighting and release gear. Further behind is a gunner's cockpit, which also communicates with the lower deck. Like the "Bison" the structure is of steel, except for some parts of the wings. It is anticipated, however, that before long steel structured wings will be utilised.

The "Aldershot" machine, as shown in the Supplement, is driven by a Rolls-Royce 650 horse-power "Condor" engine. During the year, however, considerable interest was aroused in tests of the new 1000 horse-power Napier "Cub" engine, fitted to an "Aldershot" machine similar to that illustrated, except that a modified form of undercarriage was provided. The Napier "Cub" engine has sixteen cylinders arranged in the form of an X. Yet, as shown in the view reproduced herewith, it has been housed on the Aldershot machine in such a way as to present little, if any, greater frontal area than that of engines of much smaller power. Particulars of the results of the "Aldershot-Cub" tests are not available, but it is known that the machine gave a very high performance and showed great manœuvrability.

The Blackburn Aeroplane and Motor Company, Limited, of Leeds, continued during the year to devote its attention principally to naval aeroplanes of the torpedo-plane type. The firm's "Swift" type of torpedo-plane, which we illustrated in our Annual Review two years ago, has been supplied to all the principal foreign Governments as well as to our own Air Ministry. The firm's latest development in this direction is a large type of coastal defence torpedo plane and bombing machine, now being built for the British Government. The machine is intended to carry and discharge a 21in. torpedo or bombs weighing 1800 lb. Its long sea range will permit it to work from a coastal basis. The machine will be driven by a Napier "Cub" 1000 horse-power engine, and is claimed to be the first aeroplane specially designed from the beginning to employ that motor.

Another interesting naval machine of the Blackburn Company's production is the deck-landing reconnaissance and spotting machine, of which a photograph is reproduced herewith. This machine carries a crew of four—a pilot, observer, wireless operator and gunner, and is driven by a 450 horse-power Napier "Lion" engine. The machine is designed in such a way that many of its principal elements are interchangeable with those of the firm's "Swift" torpedo-plane—also a deck-landing machine—so that the spare parts carried on board the mother ship may be reduced in variety. The interchangeable units comprise the engine and its mounting, the radiator and piping, the reserve water tank, oil tank, propeller, main planes and ailerons, tail plane and elevators, fin and rudder, tail skid and wheels. The machine is designed to take off after a run of 100ft. on the deck of a ship moving at 20 knots. Should it be necessary to alight on the water, provision is made for dropping the landing wheels. Internal air bags are arranged to keep the machine afloat for a considerable period, and slings are provided for hoisting it on board the mother ship. The pilot sits slightly in front of the leading edge of the top plane, while the observer is stationed just aft of the trailing edge, and is sheltered from the wind—so that he may be the better able to use his field glasses, range finder or camera—by carrying the cowling over his head. The gunner's cockpit is in rear of the observer, while the wireless operator is housed between the pilot and the observer. The pilot can bring an additional gun to bear by firing it through the propeller. The wing spars and the longerons are of spruce, but elsewhere the structure is mainly in steel. The machine is designed to have a top speed of 99 knots, a landing speed of 40 knots, and a ceiling of 16,800ft.

Among the machines now being produced by the de Havilland Aircraft Company, Limited, of Edgware, Middlesex, that known as the D H 34 was completed during the year, and is illustrated herewith. It is a commercial machine, and is constructed to carry two pilots and ten passengers, or from 1800 lb. to 2450 lb. of freight. It has been designed as a development of the well-known D H 18, which has been very extensively employed on the continental air services. The machine made its first trip from London to Paris on April 13th, 1922, and between that date and October 7th it flew 332 times between the two capitals, or a total distance of 79,700 miles, and, in addition, made a trial trip to Berlin and back. It was actually employed on the cross-Channel route on 127 days out of a possible 165 days, and on forty-five days made four single trips between the two cities. The machine, after this period of over 700 actual flying hours, was in excellent condition, and has since remained in active commission. From this record it is obvious that the life of an aeroplane is by no means limited to the usually accepted figure of 200 flying hours. It need hardly be explained that the machine during this period of service was thoroughly inspected at frequent intervals, and repaired or adjusted as soon as the smallest sign of wear or other defect was discovered. The machine is driven by a Napier "Lion" 450 horse-power engine, and has a speed at full power of 120 miles an hour, a cruising speed of 105 miles an hour, and a cruising speed range of 3½ hours. The passengers' cabin is 4ft. wide, 7ft. high, and 12ft. long, and from it a door gives access to a compartment for the pilot and navigator. A constructional feature of technical interest is the differential arrangement fitted to the ailerons, with the object of increasing the control at stalling speeds and when the machine is landing. The two ailerons, as usual, are interconnected in such a way that the movement of one upwards assists the movement of the other downwards. By means of a system of chains, sprockets and levers it is, however, arranged that the angular movement of the down-turning aileron is less than that of the up-turning one. The system is based on the fact that lateral control, particularly at slow speeds, is more effectively and more readily secured by means of an up-turned aileron than by one turned downwards.

The Bristol Aeroplane Company, Limited, continued during the year its programme of experimental and development work, both on aircraft and engines, and, in addition to producing some machines for the Air Ministry, turned out two interesting types of commercial aeroplanes. One of these, the Bristol ten-seater, is almost identical with the machine illustrated and described in our last Annual Review, and in our issue of July 15th, 1921. The leading dimensions have been slightly modified, and a two-wheeled landing chassis has been substituted for the four-wheeled one originally fitted. The second commercial machine is the Bristol three-seater taxi-plane, illustrated in the Supplement. This machine has been designed to meet the needs of the owner pilot and at the same time to provide the possibility of a sound financial return when it is used on aerial transport work. It is fitted with a Bristol "Lucifer" 100 horse-power, three-cylinder, static-radial, air-cooled engine, an engine which during the year was submitted to, and successfully passed the Air Ministry's type test. Cruising at 80 miles an hour the machine consumes 5 gals. of fuel per hour, or at the rate of about 16 miles to the gallon. The two passengers sit side by side in a cockpit behind the pilot. This cockpit, if desired, can be completely enclosed by means of a detachable top. Behind the passengers' seats is a luggage hatch sufficiently large to take two good-sized suit cases. The engine, as is now usual on Bristol machines, is mounted in such a way that by raising a lever the whole unit may be swung on a vertical hinge, so as to give free access to the carburetter, magnetoes, and the rear side of the engine generally without the removal of any portion of the cowling. The upper and lower wings are made identical and interchangeable, with the object of reducing the number of spare parts required. The undercarriage is of the oleo and spring steel type. The machine has a span of 31ft., an overall length of 23ft. 3in., and a height of 8ft. 10in. It weighs empty 1210 lb., and fully loaded with fuel, oil, passengers and baggage, 2000 lb. At ground level, when fully loaded, its top speed is 90 miles an hour, and at 5000ft. in the same condition, 88 miles an hour.

DE HAVILLAND No. 34 TWELVE-SEATER COMMERCIAL MACHINE

Of the other British manufacturers of aircraft, there is little to record, chiefly because they are engaged on Air Ministry work, concerning which nothing may at present be disclosed. The Gloucestershire Aircraft Company, Limited, has continued to produce its Mars machines, the latest example being the Mars X., a ship-type fighting scout fitted with a 220 horse-power Bentley rotary engine. It is also manufacturing the Nighthawk, the well-known fighting scout produced by the company's chief engineer, Mr. Folland, when he was designer to the Nieuport Company. This machine is now fitted with a 400 horse-power Bristol "Jupiter" engine. The aircraft department of William Beardmore and Co., Limited, did not produce any new machines

during the year, but was engaged on work of an interesting nature, the production of all-metal air screws for the Air Ministry. The screws produced varied from 9ft. to 11ft. in diameter, and were both two and four bladed. At the outset, the company informs us, a considerable number of difficulties had to be overcome in the manufacture of these screws, but success has now been attained, and quantity production of any type can be undertaken. The screws supplied to the Air Ministry, it is added, have given very satisfactory results, and no trouble has been experienced, either with respect to the welded joints or the internal fittings. The department is at present engaged on the design of a metal propeller, the pitch of which may be varied in flight. S. E. Saunders, Limited, of Cowes, were occupied during the year on the production of "Valentia" flying boats to Messrs. Vickers' design. The hulls of these machines are constructed of the firm's "Consuta" sewn plywood, for the manufacture of which a large new works, with a floor space of 75,000 square feet, has been laid down. The Westland Aircraft Works, of Yeovil, completed no new type of machine during the year, but has in hand, we are informed, a very interesting project, which it is hoped will be brought to completion this year.

Railways Jointly Owned.

WHEN Sir Eric Geddes, in June, 1920, outlined his proposed railway policy, he made no mention of jointly-owned railways and jointly-owned stations. They were left for the moment because it was of greater importance that their owners should first be grouped, especially as in many cases the two or more owners would be amalgamated into the same group. Property jointly owned by companies within a group at once ceases to be joint. Thus, to give a well-known illustration, the Great Northern and Great Eastern Joint Line from Godmanchester, through March, Spalding, Sleaford and Lincoln to Doncaster becomes part of the common London and North-Eastern Railway. There are, however, many lines of which the owners will fall into separate groups. Such, for example, is the Shrewsbury and Hereford, and the Midland and Great Northern Joint Line, whilst the outstanding illustration of the difficulty of dealing with jointly-own ed property that comes within two groups is the Cheshire Lines Committee.

In the Railway Returns for 1921 it is shown that twenty-two British companies, exclusive of the Metropolitan and Metropolitan District, have spent £25,417,048 out of their capital on "lines jointly owned" and "lines jointly leased." The same Returns also show that twenty-two joint companies or joint committees have, with the foregoing twenty-five millions, together with capital they have themselves raised, spent £35,356,644 on capital works. In the table, "mileage of line opened for traffic," fourteen of these joint lines are mentioned, and their total length amounts to 593⅜ route miles. Two, the Midland and Great Northern and the Somerset Joint Committee—usually known as the Somerset and Dorset—have their own locomotives; the same two and the Cheshire Lines have their own carriages, and the Cheshire Lines and the Midland and Great Northern their own wagons. The Somerset Joint Committee has only a few wagons.

Jointly-owned railways and stations are more expensive to administer than are those owned by one company. They need joint committees, composed of directors of the companies concerned, at their head, and the members of these committees get fees and expenses. Often, joint lines have their own officers under whom are minor officers, clerks, inspectors, &c. These officers usually have little power, and the owning companies have to be approached on most matters. This means additional correspondence. In the eyes of the Ministry of Transport each joint committee is a separate company from whom individual returns are required. A weakness about joint lines is that frequently the maintenance, supply of stores and administration are taken for periods of two, three or five years alternately by the owning companies. There is thus a lack of continuity. But a worse matter is that a jointly-owned line often has little interest for either of its owners and it gets neglected. If the partner can be forced to take more than its fair share of any expense that is frequently done.

Among the lines that will cease to be jointly owned there will, besides the Great Northern and Great Eastern Joint already mentioned, be the Furness and Midland, between Wennington and Carnforth; the Ashby and Nuneaton in South Leicestershire, between Nuneaton and Moira and Coalville; the Hull and Barnsley and Great Central from Carlton to Braithwell; the various lines, centred on Preston, extending from Euxton Junction to Fleetwood, Blackpool and Longridge, and that between Boars Head, near Wigan, and Cherry Tree, near Blackburn, which belonged to the Lancashire and Yorkshire and the London and North-Western; the West Riding and Grimsby, between Wakefield and Doncaster, belonging to the Great Northern and Great Central, and the Nottingham, Victoria, joint station belonging to the last-named two companies. The biggest joint concern that will, under grouping, cease to exist, is the Portpatrick and Wigtownshire from Castle Douglas to Portpatrick and Whithorn, the property of the London and North-Western, Midland, Caledonian and Glasgow and South-Western Companies. These four companies also jointly own the goods lines on the west side of Carlisle station, whilst Carlisle passenger station is the property of the London and North-Western and Caledonian.

Among the lines that will be jointly owned by groups will be the Cheshire Lines extending from Manchester to Liverpool, from Godley to Glazebrook, and from Baguley to Chester; the many lines around Manchester owned jointly by the London and North-Western and Great Central; the London and North-Western and Great Northern lines, centred on Melton Mowbray, between Market Harborough and Nottingham, which give the former company access to the Notts and Derby coalfields; the Great Western and Great Central joint line which is part of the Great Western's two-hour London to Birmingham route; the Midland and Great Northern Joint Line between Peterboro' and Yarmouth, with connections with Bourne, Cromer and Norwich; the Shrewsbury and Hereford and the Birkenhead of the London and North-Western and Great Western, and the Somerset and Dorset, between Bath and Wimborne, and Burnham and Evercreech, of the London and South-Western and Midland.

There are many stations that are jointly owned with the approaches thereto owned by individual companies. It is surprising, though, how few of these—for the moment we can only think of Nottingham, Victoria, and those, like Huddersfield and Oldham, on the London and North-Western and Lancashire and Yorkshire—will cease to be joint property. Belonging to separate groups there will continue to be such important stations as Aberdeen, Perth, Chester, Leeds (New), Leeds (Central), Normanton, Halifax, Wakefield (Westgate and Kirkgate), Knottingley, Stalybridge, Worcester (Shrub Hill), and Bristol.

It will be of interest to watch developments on some of the railways that continue to be jointly owned. The outstanding example is the Cheshire Lines Committee, of which the London and North-Eastern, because of the Great Central and Great Northern, will be two-thirds owner and the London, Midland and Scottish, through the Midland, one-third. Where the interest lies is that by the Cheshire Lines the London and North-Eastern gains access to Liverpool and Birkenhead. The separate ownership by the Great Western and London and North-Eastern of the Great Western and Great Central Joint Line is not likely to be any disadvantage, as it is apparent that these two combinations are likely to move together. The Midland and Great Northern Joint Line has also an interesting future When the Great Northern joined the Midland to buy up the Eastern and Midlands and other lines, the object was to compete with the Great Eastern. From Peterborough access to the Norfolk coast is as convenient *viâ* the present Great Eastern route as by the Joint Line, and the Great Northern might now surrender its interest therein. The Shrewsbury and Hereford line is part of the Severn Tunnel North-West route. The express trains that now travel over that route between Manchester, Liverpool and the North and Bristol will probably go *viâ* Birmingham and Gloucester, and so save the Great Western proportion and the Severn Tunnel toll.

The Water Supply of Belfast.

THE city of Belfast is supplied with water by gravitation works from the three following separate sources:—(1) Woodburn District, Co. Antrim; (2) Stonyford District, Co. Antrim; (3) Mourne Mountains District, Co. Down.

The Woodburn source is situated about 11 miles on the north-west side of the city and has an upland catchment area of about 7000 acres at an average elevation of about 750ft. over sea level. There are seven storage reservoirs and three service reservoirs, which have a total storage capacity of about 1880 million gallons, and can provide an average daily supply of water to the city of 11 million gallons. All the water drawn from this source of supply is first treated by a careful system of slow sand filtration before use by the consumers. The Stonyford source lies about 8½ miles on the south-west side of the city and has an upland catchment area of about 5400 acres, at an average elevation of about 750ft. over sea level. There are two storage reservoirs and one service reservoir, the combined storage capacity of which is about 932 million gallons, and which can provide an average daily supply of water to the city of 4 million gallons. All the water drawn from this source is also treated by a careful system of slow sand filtration before use in the city.

The Mourne Mountains source is the latest and most extensive addition in connection with the water supply of the city. It is situated in the uninhabited districts adjoining the Kilkeel and Annalong rivers, which flow through the valleys of the Mourne Mountains in the county of Down. This source is at a distance of over 40 miles on the south side of the city and has a catchment area consisting largely of the steep mountain slopes of granite and heather of about 9000 acres, with an average elevation of 1725ft. over sea level. This newest source of water supply is as yet only partially developed, but it has a main aqueduct which is sufficient in capacity to deliver, when required, the maximum quantity of water which will be available from this source when fully developed of over 30 million gallons per day into a service reservoir having a storage of 100 million gallons, which was constructed some years ago at Knockbreckan, at a distance of 5½ miles on the south side of the city, and from which this very first-class mountain water is delivered through some 6 miles of 36in. diameter trunk mains into the city and adjoining districts.

There will eventually be two large storage reservoirs constructed in the mountain valleys in connection with the full development of this source of supply, and the negotiations are now almost completed with the contractors for the immediate construction of the first of these reservoirs in the Silent Valley on the Kilkeel River.

This contract will include the construction of the Silent Valley reservoir, which will have a storage capacity of 3000 million gallons, with an earthen embankment across the valley of over 1500ft. in length, 90ft. in height, with a top width of 20ft., and a width at the base of 560ft. A concrete trench will extend below ground along the entire length of the bank to a maximum depth of about 75ft. below the river bed level. The main outlet tunnel for dealing with the floods during construction and for the permanent water supply to the city, will be constructed through the granite rock round the east end of the main bank and will have a flood discharge capacity of over 1200 million gallons per day. There will also be an overflow weir and extensive waste channel from top water level on the west side of the main bank to take the flood waters from this reservoir after the completion of the works. The usual screening and measuring chambers will be constructed on the existing aqueduct in this valley immediately below the main embankment.

The contract will also include the construction and working of over 6½ miles of works railway from near the harbour in the town of Annalong up to the site of the reservoir in the Silent Valley, by which the workmen and materials required will be conveyed to the site. It is expected these extensive works will take from six to seven years to construct and will cost about one million pounds when completed, after which Belfast will be provided with a water supply of the finest quality and in quantity equal to the contemplated growth of the city for many years to come.

Letters to the Editor.

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

THE NICOLSON BOILER.

SIR,—On page 672 of the current number of THE ENGINEER, in quoting Mr. Stromeyer's report, you state that the result of Dr. Nicolson's experiments was "disastrous."

This was far from being the case, as you can judge from Michael Longridge's report to Dr. Nicolson, dated December, 1909.

The experiments were carried out at these works, and the arrangement of the plant is clearly shown on the drawing accompanying the report. An ordinary single-flued Cornish boiler was taken and adapted for the purpose of the experiments, and some remarkable results were obtained—and confirmed by Mr. Michael Longridge—the temperature of the gases being brought down to under 300 deg. Fah., and heat transmission of 40,000 B.Th.U. per square foot per hour was obtained in parts of the boiler.

The boiler was afterwards dismantled and sold by us in the ordinary course of business, so that it is obvious that nothing "disastrous" could have occurred.

JOSEPH ADAMSON AND CO.

Hyde, December 27th, 1922.

SIR,—I beg to thank you for the very full notice which you have taken of my memorandum and hope that you can find space for a protest by Messrs. Joseph Adamson and Co., with reference to my remark on page 672 that the "result of his—Dr. Nicolson's experiment was disastrous." They enclose a copy of Mr. Michael Longridge's report, December 31st, 1909, and point out that the rate of heat transmission was 40,000 B.Th.U. per square foot per hour, and that the boiler was dismantled and sold as an ordinary Cornish boiler.

My use of the word "disastrous" is perhaps not justifiable in a literary sense, but at the time of writing I tried to look on the experiment from the inventor's point of view, and feel sure that his conclusion to abandon his cherished idea must have been to him, if not a disaster, at any rate a terrible disappointment.

C. E. STROMEYER.

Manchester, December 28th, 1922.

THE THICKNESS OF OIL FILMS.

SIR,—I notice in the leading article in your issue of December 8th last, in a discussion on the Thomas Hawksley lecture delivered by Dr. Stanton before the Institution of Mechanical Engineers, a reference to the thickness of the oil film between Johansson gauges, when wrung together, the tenuity of which, you state, cannot be greatly different from that arrived at by Dr. Stanton in the course of his experiments on lubricated journals, viz., 0.000046in.

It may not be generally known that the thickness of the "wringing film" has actually been measured, by the method of optical interference, at the Bureau International des Poids et Mesures. Its amount, rather unexpectedly, was found to be very nearly independent of the nature of the lubricant used, and approximately 0.000003in. Other experiments on similar lines carried out at the National Physical Laboratory by two quite different methods have roughly confirmed this figure, though small differences between different lubricants have been detected. But in any case, if the film is appreciably thicker than 0.000003in. the blocks will not "wring," but slide over each other more or less freely, according to the amount of lubricant present.

This figure is only one-fifteenth of that reached by Dr. Stanton in his lubrication experiments, and while I should not presume to say what influence boundary attraction may actually have in the lubrication problem, I do not think that the argument of the wringing film can fairly be adduced in criticism of Dr. Stanton's work.

J. E. SEARS,

Superintendent, Metrology Department, N.P.L.

Railway Matters.

THE fifty uncompleted locomotives at Woolwich, which cost £551,000—the fifty completed ones cost £780,000, and none have been sold—are not to be finished, and their parts are to be sold as they lie.

IN a severe gale of wind on Christmas Day two coaches of a passenger train on the Burtonport extension of the Londonderry and Lough Swilly Railway were blown off the rails near Dunfanaghy-road Station, a very bleak spot.

ON Monday last, the 1st instant, the 25 per cent. increase on ordinary fares made in August, 1920, was removed and the fares become 50 per cent. above pre-war rates. A uniform rate of 1½d. per mile for third-class and 2½d. per mile for first-class is now charged. No reduction will, in future, be made on return tickets.

THE Chairman of the Victorian Railway Commissioners is hoping during the present (Australian) summer vacation to give the senior boys of public schools, accompanied by their fathers, a week's trip, covering about 1000 miles, so that they may see something of the state in which they live. The cost will be about £15 15s. a head and will be inclusive.

BEGINNING on Monday last, the 1st instant, the London, Midland and Scottish Company ran the former Midland 8.28 a.m. train from Thorpe Bay and 8.37 from Southend to the former North London terminus at Broad-street. The train travels over the old Tilbury and Southend line to Bromley and then over the Bow curve on to what was the North London, and thence *viâ* Homerton and Dalston Junction to Broad-street.

THE departmental lists of New Year Honours include a knighthood for Colonel C. L. Morgan, a director of the Southern Railway and, until February, 1917, chief engineer of the Brighton Railway, and for Colonel W. D. Waghorn, the President of the Indian Railway Board. Mr. C. L. N. Felling, late of the South African Railways, and now general manager of the Uganda Railway, receives the C.M.G., and Mr. W. G. J. Hill, of the former, is made a C.B.E.

ONE of the London and North-Eastern (North-Eastern Division) electrically operated goods trains was in collision with a steam-worked train at Carlton, near Stockton, on the 29th ultimo. The former was a loaded mineral train from Shildon to Newport Yard, Middlesbrough, and the latter was an empty wagon train from Port Clarence to Ferryhill, so that the trains were crossing each other's paths in opposite directions. Both engines were derailed and badly damaged, as were also twenty to thirty wagons.

THE contract for the construction of the Metropolitan and Great Central jointly owned branch to Watford has been let to Messrs. Logan and Hemingway, of Doncaster. It will leave the main line at Sandy Lodge Station and, turning east, will pass through Crossley Green, where there will be a station, to Watford, when the station will pass near Cassiobury Park. The powers for the new railway include also a connection to the Watford branch from the north by a junction at Rickmansworth. This part of the scheme is not to be put in hand at present.

THE provision of third-class sleeping cars has again been urged in Parliament, and Colonel Ashley has replied that the railway companies have always maintained that third-class sleeping accommodation was not commercially feasible. This, we would say, may be so, but not for the reasons the answer implies. The companies fear that many of their first-class season-ticket holders would take out third-class seasons were there third-class "sleepers." We think, though, that this would not be so; the greater comforts on a long journey that come to the first-class passenger are not lightly surrendered.

No official announcement has yet been made as to the civil and mechanical engineering appointments for the London and North-Eastern Railway. An intimation has, however, appeared that Sir Vincent Raven has joined the board of the Metropolitan-Vickers Electrical Company. The interim organisation of the London, Midland and Scottish Company provides for Mr. E. C. Trench to be the chief engineer, Mr. George Hughes to be the chief mechanical and electrical engineer, and Mr. R. W. Reid to be the carriage and wagon superintendent. Sir Henry Fowler remains at Derby as Deputy Chief Mechanical Engineer.

THE statement is made by the *Manchester Guardian* that the Great Western Railway Company has made an offer of £19,000,000 for the acquisition of the property of the Cheshire Lines Committee, but that it has been declined. If this be true, we are not surprised at the offer nor that it has been refused. Its possession would give the Great Western independent access into Manchester instead of by running powers over the London, Midland and Scottish, and an entry into Liverpool which it does not now possess. The sale would, however, rob the London and North-Eastern of a foothold in Liverpool, which practically settles the matter. The former Midland Company is no longer so vitally interested in the Cheshire Lines, but would require to have connections with the former London and North-Western Railway near Stockport, so as to get from Derby and Sheffield to Liverpool; from these two towns to Manchester it could go, as was done before the Central Station was opened, to London-road Station.

SECTION 14 of the Railways Act provided that "The Railway Clearing House may submit to the (Railway) Amalgamation Tribunal, and the Amalgamation Tribunal shall settle, a scheme to effect such alterations of the Acts and regulations applicable to the Railway Clearing House as may be rendered necessary by reason of the constitution of the amalgamated companies." This scheme came before the Tribunal on the 18th ultimo and was approved. The fifty-eight companies hitherto represented become the four grouped companies and there are sixteen others, but the four larger companies are each to have four delegates, and thus there will be a total of thirty-two delegates. The quorum has been reduced from ten to six, but the number and dates of the meetings are left to the members and now as laid down in the Act. The Tribunal requires, however, that there shall be at least two meetings a year. The scheme provided that delegates should be paid fees for their attendance, but the Tribunal did not consider it had power to order this and the clause was deleted.

Notes and Memoranda.

THE Transvaal gold output in November amounted to 764,476 oz., valued at £3,478,366, on the basis of £4 11s. per ounce, compared with October figures of 778,159 oz., valued at £3,579,531 on the basis of £4 12s. per ounce. Natives employed in the gold mines in the Transvaal number 173,173 compared with 175,129 in October.

IN an article in the *Bulletin* of the Swiss Electrical Engineers' Association the following particulars are given regarding the Swiss aluminium industry. From 10,000 tons per year in 1913, the Swiss output rose to 15,000 tons in 1917 and 1918, or an increase of 50 per cent. The share of Switzerland in the world's output was, in 1914, 11.75 per cent.; in 1921, 8.68 per cent.; and this year it is reckoned it will only be 5.85 per cent.

RECENTLY Dr. W. Clow gave a lecture on "The Medical Aspects of Electricity" before the Paisley Association of Electrical Engineers. The speaker commenced by observing that there was probably no activity of animal mechanism which was not accompanied by a demonstrable difference of potential. He then spoke of the possibilities of X-rays both for examination and curative treatment, and from this proceeded to high-frequency currents and ionisation, and illustrated his remarks by means of lantern slides.

THE Lathe Tools Research Committee of the Manchester Association of Engineers has carried out a series of investigations, extending over several years, in connection with the heat treatment, form, durability and power consumption of lathe tools. At the request of the Association, the Department of Scientific and Industrial Research has now published the report of the Committee. The aims of the Committee were to discover a heat treatment which could be recommended to give consistent results, to evolve a test which could be employed in the workshop as a measure of the durability of a tool, to ascertain the variations in the durability of tools corresponding to changes in the cutting speed, shape, cutting angle, nose radius, &c., and to investigate the component forces acting upon a tool and the power consumed during cutting.

PARTICULARS are given in the *Chemical Trades Journal* of the liquid chlorine plant which has been completed at the works of the Canadian Salt Company, Limited, at Sandwich, Ontario. The plant, which is the first in the Dominion to manufacture this commodity, has been in operation for nearly two months and has an annual production capacity of 3600 tons. The liquefying process used is what is known as a partial refrigeration and pressure system. The concentrated chlorine gas as made in the Gibbs cells is first dried by means of refrigeration, and then passed through a 40ft. sulphuric acid tower to remove the last traces of moisture. The thoroughly dried gas is then subjected to approximately 35 lb. pressure and afterwards cooled to — 20 deg. Cent. For large customers the material is shipped in 15-ton lots in specially constructed tank cars, and for small customers it is supplied in 150 lb. cylinders.

IN an article on "Electric Generating Sets," appearing in the *Ironmonger*, the author points out that the voltage should not be below 50, and that it is better that it should be as high as 100 volts. It is true that these small generating outfits are intended principally for lighting, but almost invariably and quite naturally the advantages soon prompt the owner to require some other service attendant on the use of electricity. This extra load is not really practicable with the supply under 50 volts, because of the large ampèrage required for even small appliances. The additional current used makes too heavy a demand on the accumulator battery, with possible trouble from the wiring portion of the installation. With small installations for lighting only, 25 and 32-volt sets are practicable, but wherever electric irons or vacuum cleaners are required, 50 or 100-volt installations should be employed.

AN interesting paper on "Modern Electrolytic Methods" was read by Mr. Alex. E. Tucker, of Birmingham, before a meeting of the Birmingham and Midland Section of the Society of Chemical Industry on Tuesday, December 19th. Mr. Tucker confined his remarks to the effects of various reagents under varying conditions on the more important metals used in the arts. In speaking of the importance of current in bringing about the results, it will be admitted, he said, that all such actions where reagents affect the surface of the metal are in the ultimate meaning of the term essentially electrical. The simplest illustration is that of the immersion of an iron or zinc surface in copper sulphate when copper is deposited. Again, if a piece of pickled zinc is immersed in a dilute solution of copper tartrate and caustic soda, the colouring is slow and may be arrested at any stage from a violet to purple red. Zinc castings may be bronzed by treating them with a mixture of ammonium chloride, potassium oxalate, and vinegar. Here, there is apparently no metal capable of being deposited, and the effect would appear to be due entirely to the altered surface of the zinc and its consequent effect on incident light rays.

FROM Kashira to Moscow, where electrical energy is delivered at 105,000 volts, is a distance of about 81 miles. According to the *Electrician*, lack of suitable materials for the transmission line between these places necessitated the use of hastily improvised substitutes, and many types of line towers and insulators have been pressed into service. Single-phase 4000 kilovolt-ampère delta-star connected transformers raise the voltage from 3000 to 115,000 for transmission to Moscow, where it is reduced to 6600 volts for local distribution. The transmission cable is stranded copper, with a cross section of 0.11 square inch. The transmission line runs close to the highway, and to ensure rapid repairs six stores, with stocks of small line apparatus, have been established at intervals along the line. Much of the material employed, although only of a temporary character, is of native manufacture, as the Russians insist upon the use of home products, but the generating plant, transformers and insulators came from Switzerland or America. Our contemporary adds that there appears to be little of an exceptional character about the scheme, but that credit must be given to the engineers for their ingenuity in overcoming economic difficulties.

Miscellanea.

VANCOUVER is to get the big pulp and paper plant which the Seaman Paper Mills Company, of Chicago, proposes to build in British Columbia, according to *Canada*. The mills will get their power from Bridge River, 100 miles up the Pacific Great Eastern Railway.

A SPECIAL high-tension transmission line will be required in Vancouver on account of the British Columbia Electric Company having contracted for the delivery of from 4500 to 6000 horse-power to the Howe Sound Company, operating the Britannia Mine. The line will be 30 miles long, and reach from the Lake Buntzen power plant to Britannia Beach.

DURING the past month arrangements have been made by the British Cast Iron Research Association for the early prosecution of definite and systematic research on some of the fundamental properties of cast iron. The range of irons to be examined in the first place will include the full run of commercial grey irons and semi-steels. Special attention will be given to liquid shrinkage and solid contraction. This will be supplemented by a correlation of chemical, mechanical, thermal, structural and magnetic properties.

THE Polish wire and nail manufacturers, states the *Iron and Coal Trades Review*, have for some time complained of the lack of wire rods on the home market. The Polish mills in many cases refuse orders or offer unacceptable dates for deliveries. The manufacturers interested have, therefore, approached the Ministry of Commerce and Industry with a request that the duty on wire rods should be suspended until such time as the Polish mills are again able to cover the country's requirements. The question has been laid before the Tariff Committee for decision, the efficacy of this measure being doubted in Government circles.

IT is reported that an Anti-Dazzle Light Bill will be introduced into Parliament during the next session by the Ministry of Transport. Its chief provisions will be: No lamp may be used with a forward illumination exceeding 150ft. unless it complies with the anti-dazzle regulations. Lamps exceeding a forward range of 150ft. must throw the main beam below the vision of pedestrians and drivers of other vehicles. There will also be a provision that cyclists must carry rear lamps. France is also considering means of stopping the dazzle-light nuisance, and unless some common policy is adopted it may mean that motorists wishing to visit France will have to buy new lamps. As to the need for dazzle-light regulations most motorists are agreed.

THE Fife Coal Company, which has just been celebrating its jubilee, presented its older workers of twenty-five years' service and over with a bonus, ranging from £5 to £10 each. The total sum presented was over £5000. In the Cowdenbeath district over 400 men received bonuses. Twenty of them have each over fifty years' service, while one man has a record of sixty-three years and his son thirty-eight years. Over 350 men participated in the presentations at Kelty. It was at Kelty in 1782 that the Fife Coal Company commenced operations, when it acquired the Lindsay Colliery from the old Kelty Coal Company. This accounts for the large number of old servants in Kelty in proportion to the population. The celebration coincides with the jubilee of Mr. Cartowe's connection with the Fife Coal Company, and he is to be presented with his portrait in oils from the other directors.

COMPARED with October, the number of totally unemployed in Switzerland has risen by 2910, chiefly in the machinery and building industries. At the end of November the figures were 51,128, as against 80,692 in November, 1921. The number of partially unemployed is 21,900, as against 56,869 at the same time last year. In the machinery industry 5000 operatives are working with a reduction of hours of about 40 per cent., compared with 6000 last month, and about 2000—as in the previous month—with over 40 per cent. reduction of working hours. In the chemical industry 32 per cent. of the hands are working reduced hours, whereas the pharmaceutical industry has been well occupied recently, as well as the boot and shoe, straw weavers and hosiery trades. The situation of the watchmaking industry has likewise improved. In the cotton, wool and silk industries 2 to 3 per cent. of the workers are on short time.

THE industrial depression during the year 1921-22 has not been without its effect upon the number of applications made to the Electricity Commissioners under the Act of 1919 for consent to the establishment of new generating stations and to the extension of existing stations, the plant capacity of the stations and extensions sanctioned during the year amounting to approximately 174,000 kilowatts only, as compared with 697,000 kilowatts for the preceding fourteen months ending March 31st, 1921. It must be noted, however, that the position was also influenced by the marked progress made during those fourteen months in overtaking arrears occasioned by the war and in meeting the requirements of the trade boom which followed immediately afterwards, for the provision thus made left many undertakers with an ample margin of plant when the depression commenced and the demands for power supplies for industrial purposes diminished accordingly.

A COPY of the "Readers' Bulletin," sent to us by the City Librarian of Coventry, contains a select bibliography of books and periodicals on wireless telegraphy and telephony to which Sir William Noble, chairman of the Broadcasting Company, has contributed a foreword. A great impetus has been given, states Sir William, to wireless telephony by the introduction of what is known as "Broadcasting." Eight wireless telephone trans mitting stations are to be erected in this country—in London, Plymouth, Cardiff, Birmingham, Manchester, Newcastle, Glasgow and Aberdeen—and it is believed that these eight stations will provide a service covering the whole country. Every evening between the hours of five and eleven, concerts—instrumental and vocal—addresses, weather reports and a short synopsis of the world's news will be sent out from each of these stations, "broadcasted" through the æther, so that anyone with a wireless receiving set can listen-in.

THE EXTRACTION OF OIL FROM BITUMINOUS MATERIALS

THE FUSION CORPORATION, LIMITED, MIDDLEWICH, ENGINEERS

(*For description see page 22*)

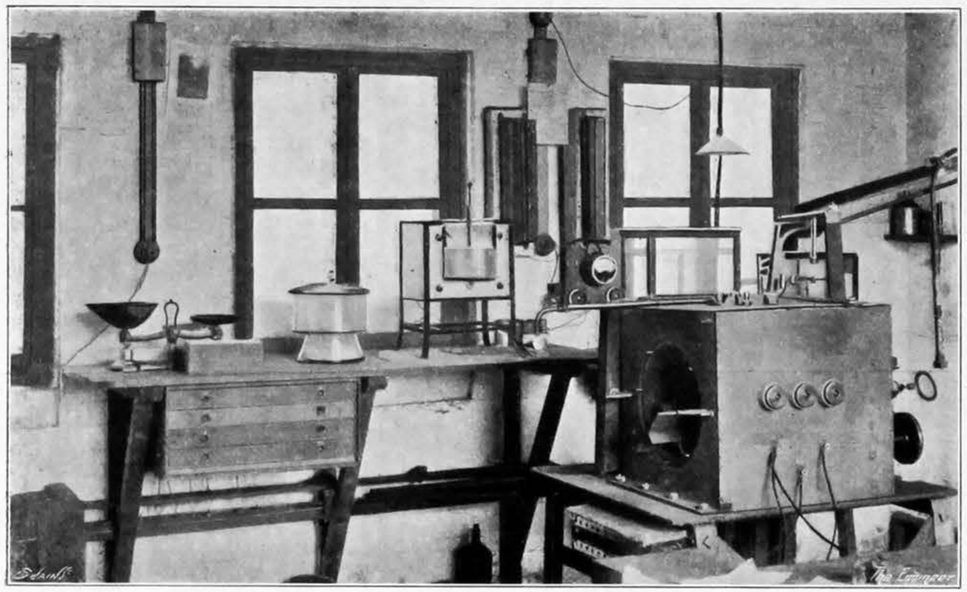


FIG. 1—INTERIOR VIEW OF THE EXPERIMENTAL LABORATORY

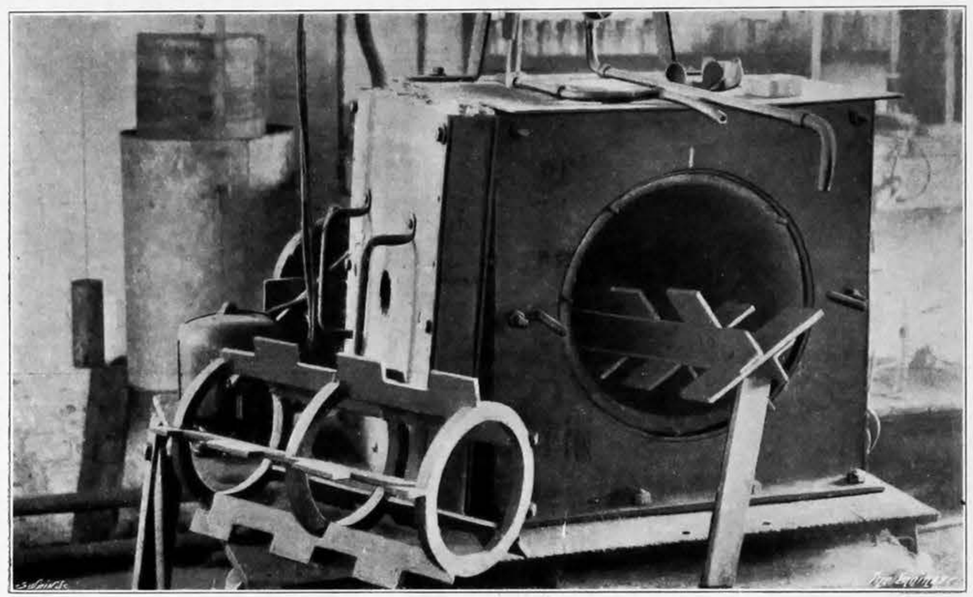


FIG. 2—LABORATORY RETORT, SHOWING BREAKER

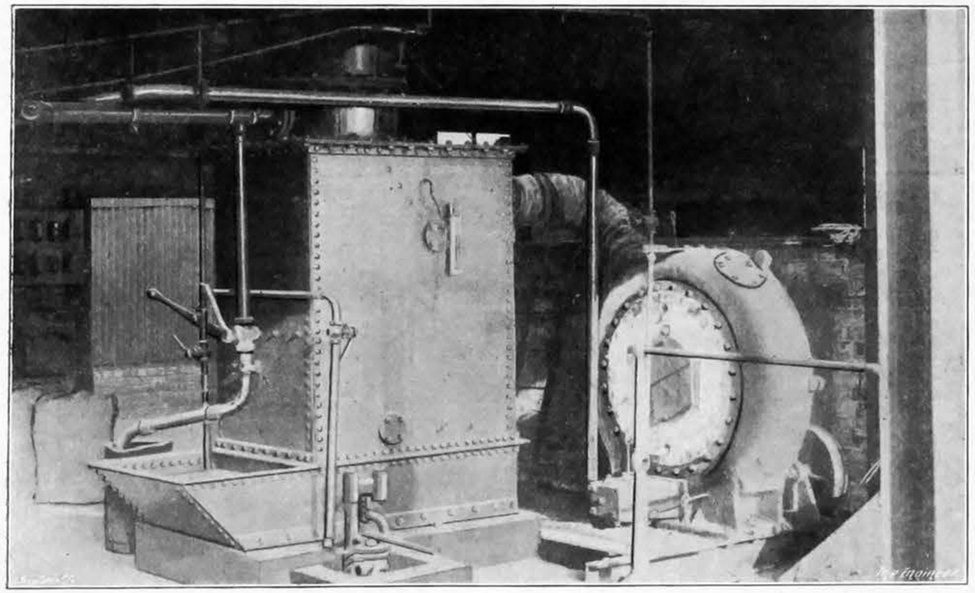


FIG. 3—DISCHARGE END OF 5-TON RETORT

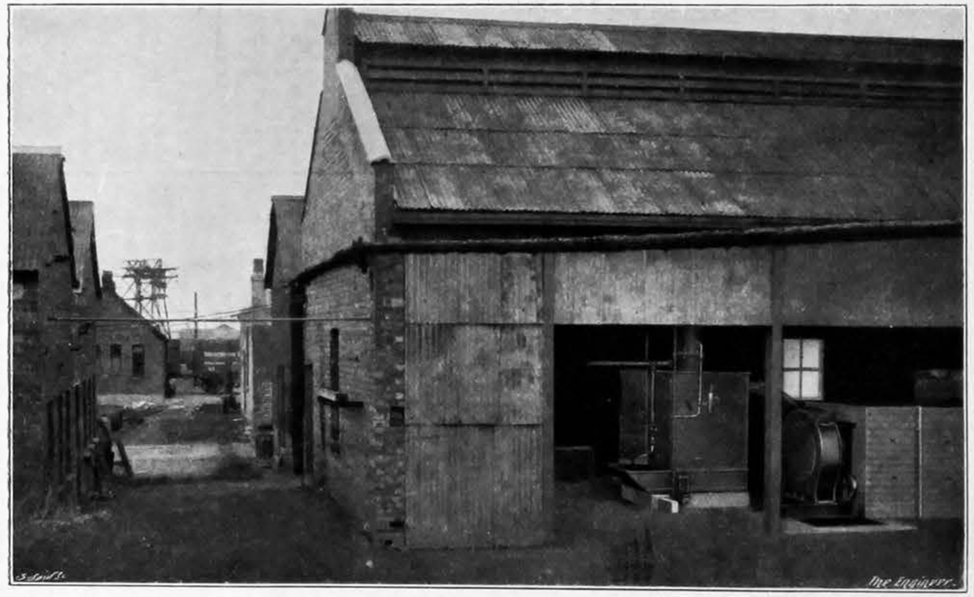


FIG. 4—RETORT HOUSE AND OIL CONDENSERS

Contents.

THE ENGINEER.

JANUARY 5, 1923.

1922—A Retrospect.

FEW indeed are they who have a good word to say for the past year; rather must one endure on all sides complaints of its hardness and listen to rejoicings at its departure. Yet years, like men, are never wholly bad, and 1922 had many redeeming features. Perchance some of its ills were of our own making. We grumbled and complained and abused until we had worked ourselves into a state of depression which made matters worse than before. Could we have maintained a more cheerful courage, could we have put a better face on untoward happenings, we should not only have seen more good in 1922, but more good would have actually existed in it. Slackness breeds slackness, and it is to be feared that a part of the depression was caused by a lack of energy. We all know that when things are going well it is easy to be energetic; there is a spice of profitable adventure, a pleasurable excitement that maintains interest at a high point of efficiency. A winning army is always a dangerous army, and a losing one does less than justice to its own qualities. Thus it came about that we did not do even as much as we might have done. Furthermore, there was still, despite the reduction in the income tax, very high taxation, and excessive taxation reduces energy. There is less pleasure in making a hundred pounds when twenty-five of it must go immediately to the tax collector than when nearly the whole of it may be retained. The financial returns for the nine months of the fiscal year are better than Sir Robert Horne anticipated. Let us hope that the remaining three months will be so good that the new Government will see its way to take another shilling off the burden on incomes and to wipe out entirely the ill-conceived and ill-founded Corporation Profits Tax.

We have said that the year was not without its good features. They began to manifest themselves quite clearly in the closing months, when little or no doubt remained that we had passed the trough of the wave and had begun the ascent to the crest. It is, unfortunately, impossible to lay one's hand upon particular events and say "this and this show the improvement." We have to rely for our optimism mainly on the opinions of those engaged in manufactures and trades. They say that the clouds are lifting, that there are more inquiries, even more firm orders. But we may see, too, that the amount of unemployment is diminishing; all too slowly indeed with the worst of the winter months ahead of us, yet diminishing. That must mean that more men are being taken on, and hence that there is more work about. The placing of the orders for two battleships must of necessity have its effect and will help to hearten everyone up; and, finally, there is not a single big strike on foot and not even a rumour of one. The year, then, leaves us not so ill-off after all, and with a little more determination to make the best of things instead of the worst, we may face 1923 with bright hopes.

Unemployment.

We open this brief Retrospect with the subject that has haunted us all for the past twelve months. Unemployment was the spectre of 1922, not only to those who suffered from it, but to all who have bowels of compassion. Even at the present moment there are over one and a-quarter million of people insufficiently employed in all trades. If we put the industrial population at roughly fourteen millions, that means that about nine in every hundred are out of work. The conditions of trade make a certain amount of unemployment always inevitable, but the amount should not exceed one to one and a-half per cent., and, in healthy circumstances, is due to movements in men and industries, and not, as at present, to slackness of trade. But as years go by, as populations increase, as new countries that were once purchasers become producers, the problem of unemployment tends to become more and more permanent, and the necessity of finding a fundamental cure for it grows more and more insistent. It is not unlikely that in a few months' time, when history repeats itself and trade booms again, we shall forget the grim figure of workless and starving millions that has brooded over us for twelve months and more. We must endeavour to turn our feet aside from that pitfall. The unemployment problem can be best faced when there is no unemployment and when there is enough money to build up insurance schemes to meet the slump that sooner or later is sure to come.

Throughout the whole history of the industrial world unemployment has always puzzled and worried economists and politicians. We are tempted to say that it is as incurable as the weather. We may forecast the coming of the storm, but we are powerless to hinder it; we may foresee the industrial depression, but we cannot arrest it. Hence it comes about that thinkers have reached the conclusion—and never more noticeably than in the past few months—that the best we can do is to insure against it. Now, the problem of insurance, whilst actuarily soluble, is beset with difficulties of another kind. Hitherto the State has been the insurance office, but a feeling has grown rapidly that it would be better if the State could be left out altogether. This is no place to go into all the reasons, most of which are fairly obvious; but the opinion has at last gained a firm foothold that the best way is to entrust the insurance of workers to the industries employing them. Unfortunately, admirable as the scheme is, it is beset with difficulties once we depart from single industries and face industry as a whole. Mr. McCurdy has shown that a perfectly practicable scheme is available for the Northampton boot and shoe trade, but no one has yet been able to advance any plan that meets the case of casual labour and of that large proportion of labour which is on the border line between several industries and which is almost unorganised and always in a state of movement. It is estimated that about six million workers do not belong to unions or other organisations, and the problem of administering the funds of these people is one that has to be handled.

The difficulties are so great that after many months of hard work no solution had been found by the end of the year. But early in December the Minister of Labour issued a Memorandum which forms a valuable basis for further discussion. Assuming—we believe rightly—that the solution must be found in insurance by industries, he placed three alternatives before investigators. By the first the whole control and management would be left entirely to the employers and their work-people. The employers' agencies would collect the contributions and distribute them. By the second method, the present State insurance scheme would be strengthened and enlarged. By the third both private insurance by industries, and State help for the part of the industrial population outside the scope of such schemes, would be instituted. It must suffice to give this brief outline of the Memorandum and to refer our readers to our issue of December 8th, in which it may be found in full. It is certain that when Parliament re-assembles it will give early attention to this very pressing matter. In our view it would be wisest to remove State control altogether, but it is difficult to see

how that object can at present be reached, and probably a transition scheme will have to be adopted, partial State control remaining until such time as the industries can take up the complete management.

Labour Disputes.

There were only two serious disputes in the engineering trades during the year, of which the long struggle in the shipyards was the most serious. It turned on the removal of the 26s. 6d. war bonus, and, beginning in January, did not end till the eighth of May, many men ceasing work early in April, after the employers had asserted their intention to reduce the bonus in two stages, beginning with a cut of 10s. Of it, it may be said, in short, that the men were "pawning the stove to buy coal," for their insistence on high rates of pay sent many orders abroad. The second dispute was the shop management lock-out. It arose through a memorandum issued in February by the Engineering Employers' and National Employers' Federations, in which the following clause appeared: "The trade union (the A.E.U.) shall not interfere with the right of the employers to exercise managerial functions in their establishments, and the Federation shall not interfere with the proper functions of the trade union." The lock-out began on March 14th. On May 6th Sir William Mackenzie opened a Court of Inquiry, which led to further discussion; but the dispute did not come to an end till June 20th. The amount of harm done by two disputes of such great duration cannot be estimated, but in part we must attribute the depression of the year to them. With pleasure we record that towards the end of the year industrial peace prevailed, and the gradual removal of war bonuses proceeded without further friction.

Technical Progress.

Whilst it cannot be said that 1922 was distinguished by any notable events in technical or scientific engineering, yet it was far from uninteresting, and in one direction at least—the development of the internal combustion engine for marine propulsion—distinct progress—as we show on another page—was made. The machine tool trade was, as one would have anticipated, very quiet. The lack of work in all branches of industry decreased the demand for machines, and the shortness of money led manufacturers to satisfy their requirements from the seemingly inexhaustible stock of war stores. A few important orders for big power plants were completed, a record of which may be found in our review of electrical engineering during the year; but nothing of outstanding novelty. The locomotive building trade was badly hit, and the big order from Roumania, which it was hoped would mature, fell through from failure to make satisfactory financial arrangements. The railway companies, on their side, did relatively little, the most notable locomotives of the year being Mr. Gresley's and Sir Vincent Raven's three-cylinder "Pacifics" and Sir Vincent Raven's electric passenger engine. All these are dealt with on another page. Air transport, as we show elsewhere, had to face a sea of troubles; but, on the whole, it made progress, and several interesting machines, amongst which an all-metal biplane may be mentioned, were turned out. Relatively little was heard about airships, but it might be premature to say that lighter-than-air machines have lost ground. In a year when money was scarce their costliness stood in the way of further developments. From this brief summary, and more especially from the reviews of the year's progress which occupy the greater part of our space to-day, it will be seen that, whilst there is no remarkable development to put down to the credit of 1922, neither was it such a barren and hopeless year as at times it seemed to be.

China.

It is in years of depression such as that through which we have just passed that one recognises with exceptional clearness the dependence of Great Britain on her foreign markets. When trade is good there is so much money available and the home demand is so great that we are apt to overlook the fact that overseas commerce is the life-blood of our industries. A very great, a very important market has been lost to us in Russia and in the Central European States; Australia is becoming more and more self-supporting for engineering products; and India is developing her resources in a way that causes anxiety in this country. If we desire to support an increasing population more work is essential, and we must therefore keep our eyes open to every prospective market. For that reason THE ENGINEER appointed quite early in the year a number of correspondents in China, and it issued at intervals through many months of 1922 letters and articles by these gentlemen. China must some day depart from its traditional slowness and advance under the pressure of the West. When that day comes she will require vast supplies of engineering materials of all kinds. America and Germany—particularly the former—are leaving no stone unturned to secure a firm footing in the prospective markets. Great Britain must not be behind them, and the object of our action is to encourage British manufacturing engineers to take a greater interest in China. We hope to achieve it partly by creating an atmosphere—as the saying goes—and partly, as opportunity offers, by giving specific information upon what action can be taken. It is unfortunate that in this first year of a costly venture China has been so disturbed by a revolution of more than ordinary dimensions that the early progress for which we looked has been greatly delayed. But we are as certain as ever that it will come, and we would urge engineers not to cease their efforts to secure a firm footing in a field which holds out vast prospects.

Conclusion.

Looking, then, at the past year as a whole, we venture to say that it was not so bad after all, for at any rate it began to improve towards the end, and it left us with high hopes for the coming twelve months. It carried us, moreover, a long way towards the end of the transition period between war and the restoration of normal peaceful conditions, and it did so without a single one of those social convulsions which at one time were greatly feared. It may indeed be said of the social position that it more than fully justified belief in the sterling qualities of the British people when face to face with difficulties. Not alone in the working classes, but in professional classes too, great hardships had to be borne and a gradual lowering of wages and salaries had to be faced. If it would be vain to say that the strain was borne cheerfully, we can fairly assert that it was at least accepted with resignation and patience. After the struggle with the shipyards in the early portion of the year there was, as we have seen, no strike connected with the reduction of wages, and the temper of the working men and women of Great Britain during an extremely trying period deserves and demands recognition. To it we owe much of the progress that has been made towards the re-establishment of the British financial position, and if under the improving conditions which are now before us it is maintained, the whole community will ere long find itself in a more prosperous, a more contented, a happier condition than it has enjoyed since the fateful days of August, 1914.

Motor Ships in 1922.

THE returns of motor ships built and completed during the year show that the output for 1921—approximately 330,000 tons—was exceeded by nearly 100,000 tons, and that in spite of two years of serious shipbuilding depression the tonnage of motor ships is continually increasing. More important is the fact that Great Britain now stands at the head of the list for motor shipbuilding. About a score of motor ships, representing close upon 180,000 tons, were completed during 1922. This fact is significant at a time when, owing to various types of propelling machinery which may be built, the future of marine engineering may truly be said to be in the melting pot. Happily, there are many signs that the importance of the motor ship has been recognised by both shipowners and shipbuilders. According to a recent authority there are now five designs of four-stroke cycle engines manufactured by eight different firms in this country, while six designs of two-stroke cycle engines are being built by fourteen firms. A detailed analysis of these various types of machinery would extend beyond the scope of the present article, but the progress of the year may be traced by briefly dealing with each of the principal types and outlining what has been done.

The Burmeister and Wain Type of Engine.

This type of standard marine oil engine occupies the foremost place in the returns of motor ships, over thirty sets of machinery having been completed by the parent firm and its various licensees. At Burmeister and Wain's works in Copenhagen engines were built for eight ships, representing 19,400 indicated horse-power and a deadweight tonnage of over 60,000. A typical vessel of the year is the Tennessee, an 11,000-ton ship built for Wilhelm Wilhelmsen, of Tonsberg. The Tennessee is a 444ft. vessel fitted with standard twin-screw engines of the six-cylinder type designed to develop 1550 indicated horse-power at a speed of 125 revolutions per minute. The normal consumption of fuel averages about 10 tons per twenty-four hours, and the oil fuel capacity of the tanks is estimated to be sufficient for a radius of action of about 30,000 miles. The Götaverken, of Gothenburg also built four ships engined with similar machinery. Two sets of engines were constructed for the large ore-carrying ships, the Lulea and Luossa, 399ft. 8300-ton vessels for the Grängesburg Oxelösund Company. They are 1400 indicated horse-power units with 23¾in. bore cylinders and a stroke of 35½in. Two sets of long-stroke engines, bore 24¾in. by 51¼in., were also completed and installed in the cargo ships, Hjelmaren and the Kolenaren respectively. At the close of the year the Götawerken had thirteen vessels in hand aggregating 70,000 tons with Diesel engines of a total of 15,000 indicated horse-power. Considerable progress was made with the building of the Burmeister and Wain type of engine in Germany at the Deutsche Werft, in Hamburg, and at the A.E.G. works in Berlin. Seven ships were completed during the year, and other sets of machinery are in hand. Two of the vessels on order are very large—26,000 tons—ore carriers for Swedish owners. Harland and Wolff own the sole rights for the Burmeister and Wain type of engine in Great Britain, and their works achieved a large output of this type of machinery. During the year standard ships for the Glen Line, the Royal Mail Steam Packet Company, and the Holland-America Line were completed. One of the notable vessels of the year is the Adda—the Elder Dempster passenger liner which was described in our issues of December 1st and 15th. The Ediba, the third motor ship for the Elder Dempster Line, has also been recently launched. The first set of long-stroke engines to be built in this country were erected and tested at Harland and Wolff's Glasgow works. They were built for John G. Kincaid and Co., Limited, Greenock, who are sub-licensees of Harland and Wolff. W. H. Allen, Sons and Co., Limited, of Bedford, have acquired a licence from Harland and Wolff to build engines of the Burmeister and Wain type for ships' auxiliary machinery and for land use. In America the Californian and the Missourian—10,000-ton cargo ships built by the Camp Shipyards and engined with machinery of the Burmeister and Wain type—have proved very successful in operation.

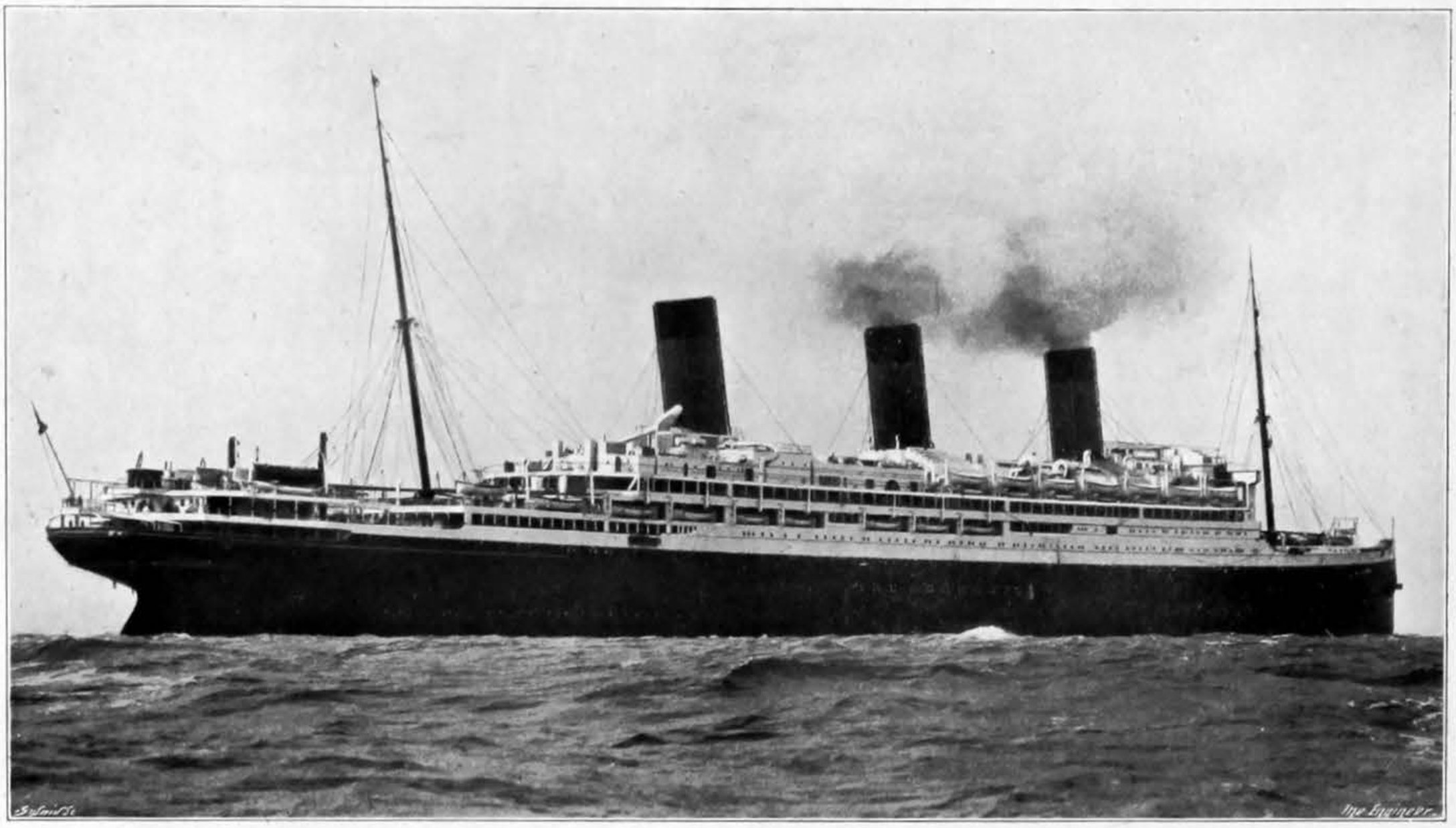
The Beardmore-Tosi Type of Engine.

The first Beardmore motor ship, the Pinzon, was built for MacAndrews, of London, and entered the firm's Spanish and Mediterranean services early in the year. The machinery comprises a six-cylinder Beardmore-Tosi engine having 24⅜in. diameter cylinders with a stroke of 38⅜in., the power developed being about 1250 brake horse-power when running at a speed of 120 revolutions per minute. The arrangement of the machinery and the electrical auxiliary equipment was described in THE ENGINEER for the 10th of February. Some interesting particulars are now available with regard to the performance of this ship. The Pinzon has no boilers, and the deck winches are of the electric type. An eight-hour working day suffices to work the cargo, and during this time the ship can be lighted and the pumps run for a total fuel consumption of less than one-fifth of a ton. Taking the price of fuel oil at 72s. 6d. per ton, the whole of the duties of the ship when working cargo can be performed at a fuel cost of 14s. 6d., whereas with a steamer of the same size the amount of coal consumed would probably be of the order of 5 tons, costing nearly eight times as much. The running costs of this ship are illustrated by the results obtained during a recent voyage from Liverpool to Barcelona and other Spanish ports and a return voyage to Glasgow *viâ* Liverpool. The total distance covered during the voyage was 4241 miles, and the total time spent at sea 14 days 9½ hours, giving an average speed of 11.4 knots. During this time the fuel used by the main engine at sea was 76.54 tons, and that used by the auxiliary engines 2.1 tons, while the total amount of fuel used in working cargo in ports amounted to 4.03 tons. The combined fuel consumption for all purposes works out at 5.465 tons per 24 hours at sea, and it is stated by the makers that this figure corresponds to a fuel consumption of 0.328 lb. of oil per indicated horse-power for all purposes. During the year there was a slight falling off in the amount of fuel consumed, which is explained by the gradual bedding in of piston rings and bearings to normal running services. The special features of this engine, the fuel valve, air induction system, and the combined air and exhaust valve arrangement with director control valves, have proved highly satisfactory. The sister ship to the Pinzon, the Pizarro, recently completed her trials on the Clyde, and orders for a further set of machinery for a new ship are in hand. The Beardmore-Tosi type of engine is also being built on the North-East Coast by Richardsons, Westgarth, Limited, and there also engines are in course of completion.

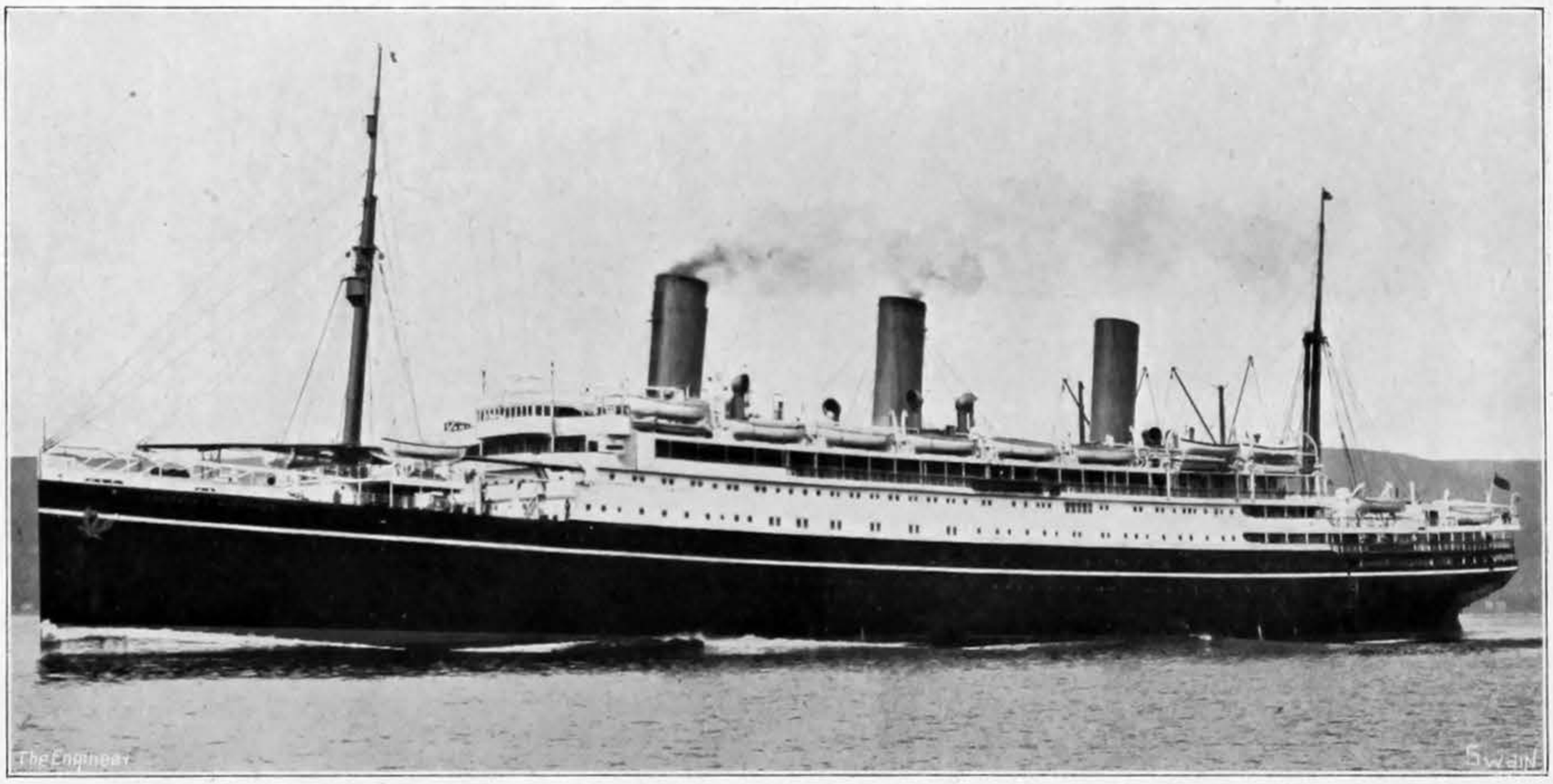
The Camellaird-Fullagar Type of Engine.

In our last year's Review reference was made to the motor ship Malia, owned by the Brocklebank Line,

SOME OCEAN LINERS OF 1922



THE WHITE STAR LINER MAJESTIC

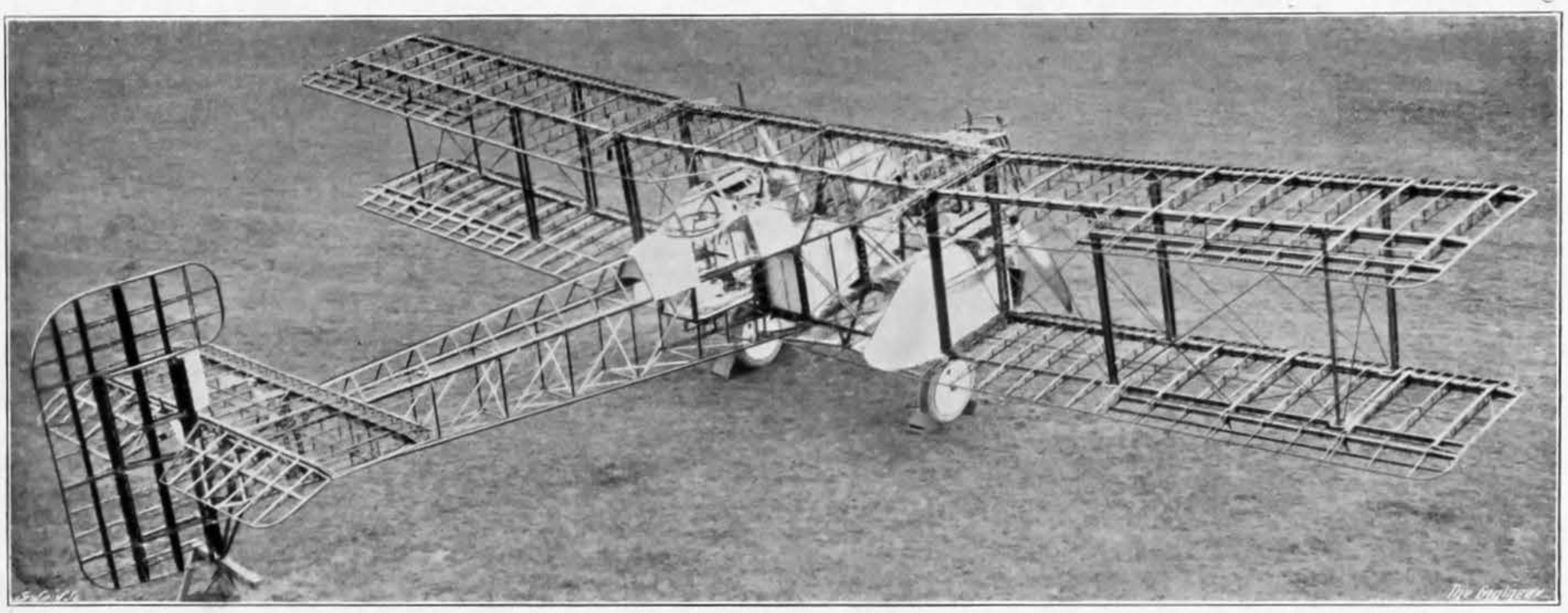


THE CANADIAN PACIFIC LINER EMPRESS OF AUSTRALIA

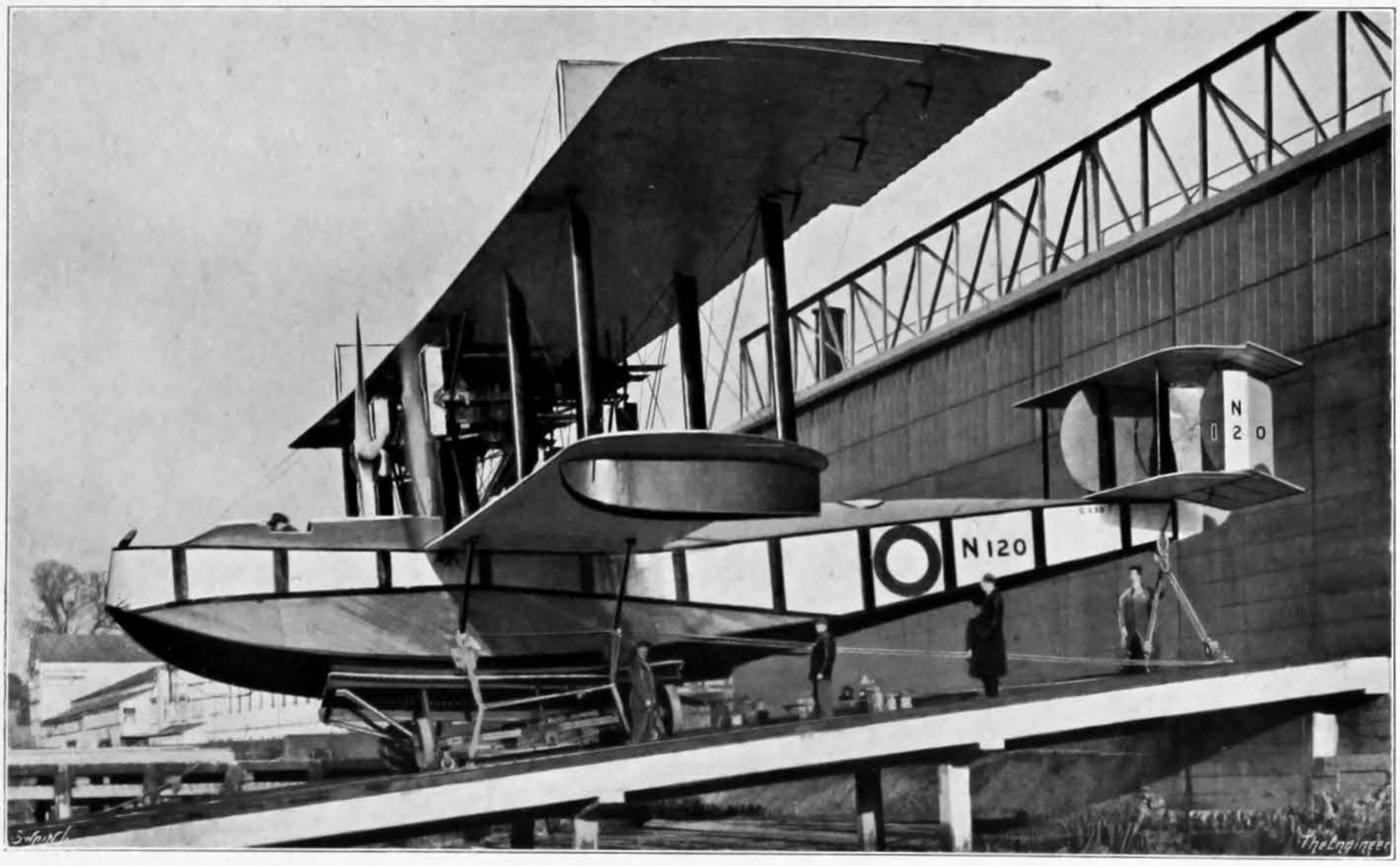
THE ELLERMAN LINER CITY OF NAGPUR

SOME BRITISH AEROPLANES OF 1922

HANDLEY-PAGE SLOTTED-WING TORPEDO PLANE



BOULTON AND PAUL ALL-STEEL "BOLTON" BIPLANE

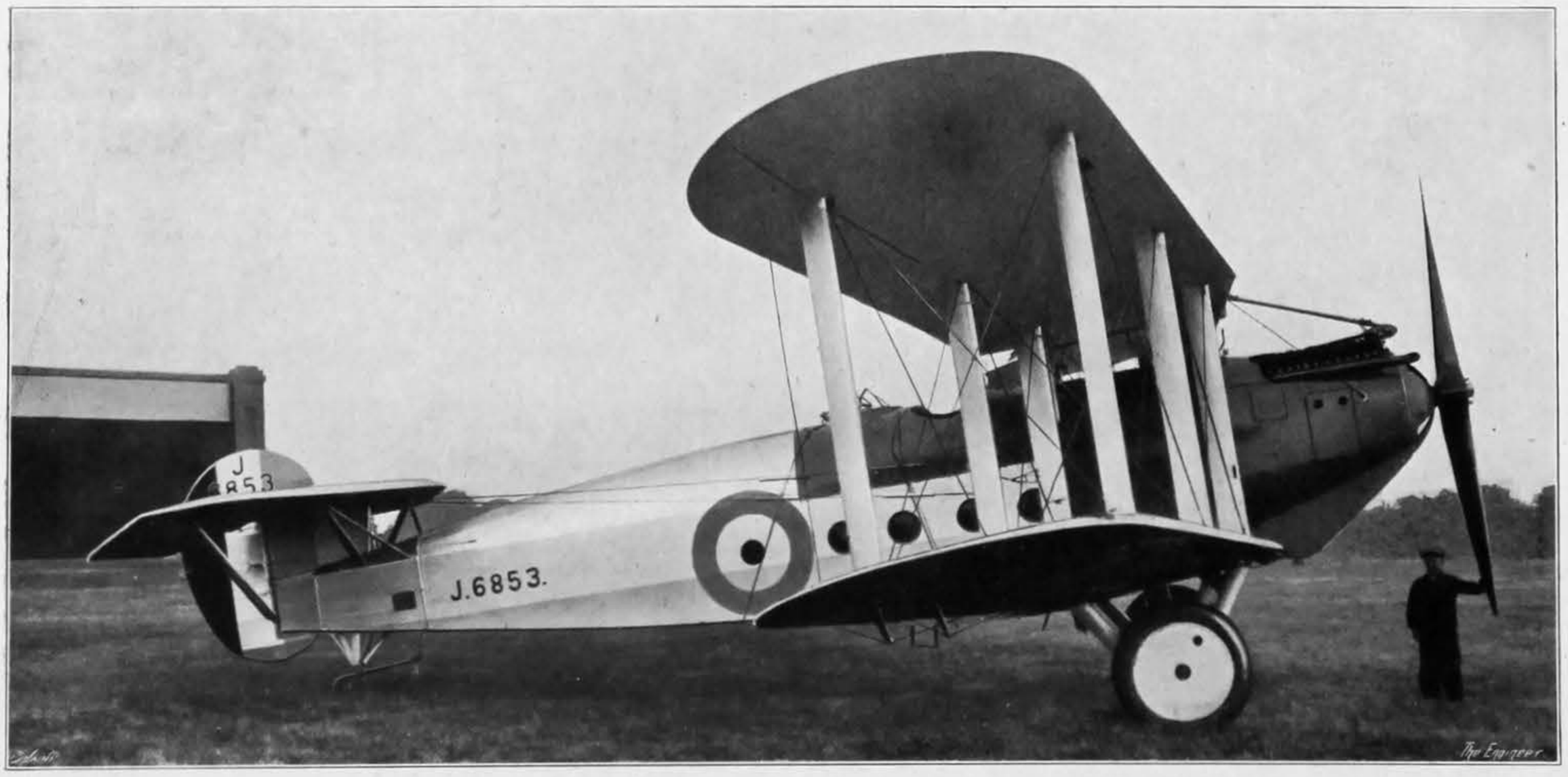


SHORT "CROMARTY" FLYING BOAT

SOME BRITISH AEROPLANES OF 1922

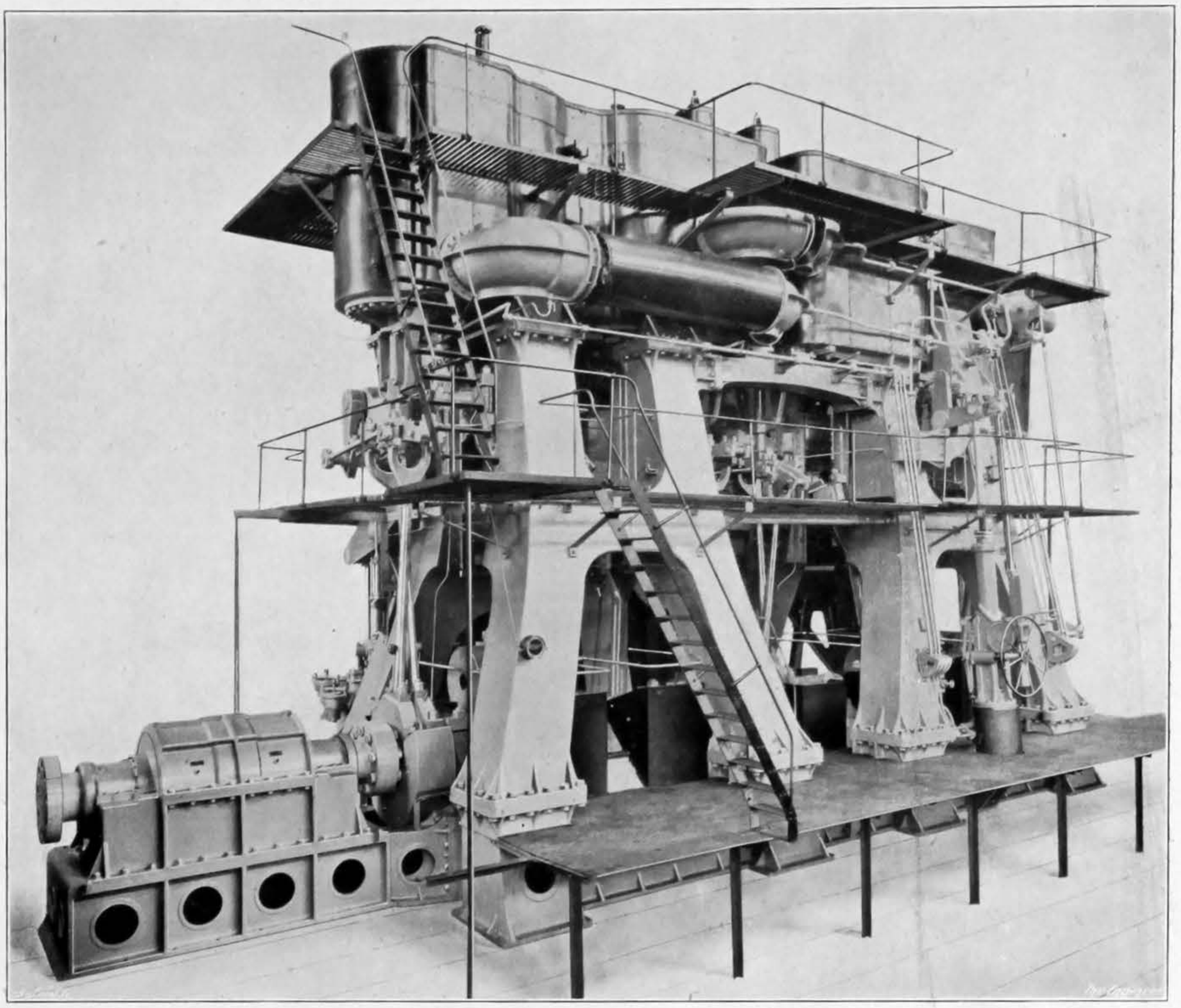
BRISTOL THREE-SEATER TAXIPLANE

AVRO "BISON" FLEET SPOTTER

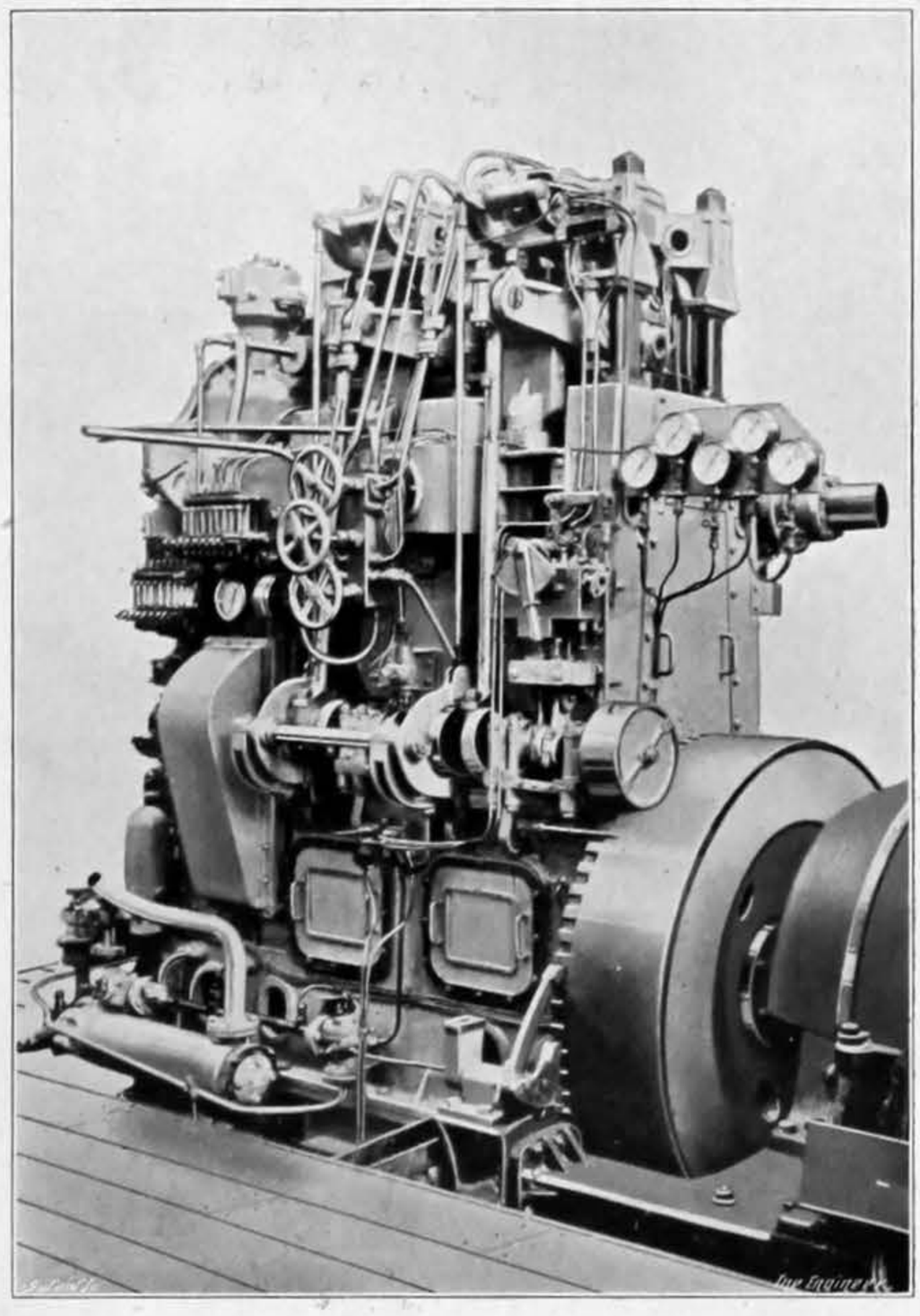


AVRO "ALDERSHOT" LONG-DISTANCE BOMBER

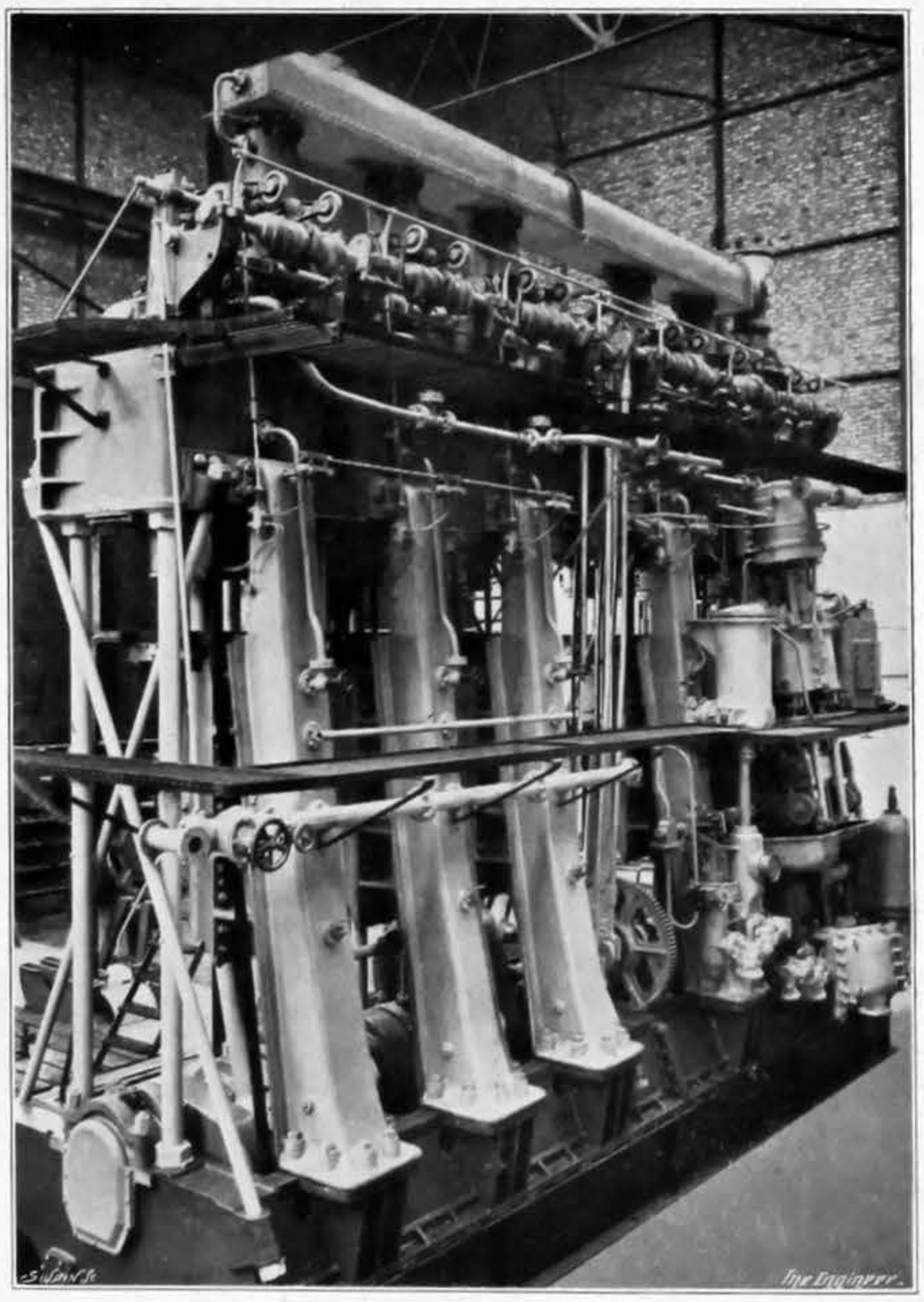
SOME MARINE ENGINES OF 1922



THE ENGINES OF THE S.S. CITY OF NAGPUR, 6000-I.H.P.



NORTH BRITISH 240-B.H.P. TWO-CYCLE DOUBLE-ACTING MARINE ENGINE



NORTH-EASTERN-WERKSPOOR 1400-H.P. MARINE DIESEL ENGINE

and fitted with two 500 brake horse-power Camellaird-Fullagar engines. Several successful voyages were made during the year with this ship, but it was recently decided to take out the existing engines and replace them with two larger engines of 1000 brake horse-power each, which were originally built for the vessel. The trials of these engines under tropical conditions, and when using boiler oil, were described in our issue of August 11th, and the results were given. This work is now proceeding at Birkenhead, and the Malia is expected to be again ready for service in the early part of the year.

Great interest centres around three ships ordered for the United Fruit Company, of Boston, which are to be fitted with electrical-propelling equipment. Each set of machinery will comprise four Camellaird-Fullagar engines of special construction, with cylinders 14in. diameter by 16in. stroke, each engine developing about 825 brake horse-power, at a speed of 250 revolutions per minute. As regards the general design, we understand that the construction of the engine will be similar to that of the land type of engine built by the English Electric Company, Limited, and described in our issue of April 28th, but that in the new engines, the opening of the fuel valves will be controlled by rods operated from cams on the main crank shaft. Each engine is to be directly coupled to a 500-kilowatt and a 200-kilowatt direct-current generator, both in line, the electrical equipment being supplied by the British Thomson-Houston Company, Limited. The 500-kilowatt generators will be connected in series to the main propelling motor of 2500 shaft horse-power, which will be placed close to the stern of the ship. The 200-kilowatt generators will serve the electrically-driven engine-room auxiliaries on a 220-volt circuit. The construction of this machinery is proceeding satisfactorily.

One of the first of the Camellaird licensees to complete an engine is the firm of John Brown and Co., Limited, which recently tested a two-unit Brown-Fullagar engine, which forms part of the two 2250 brake horse-power engines the firm is building for Japanese owners. The third unit of the first engine and also the second engine is rapidly approaching completion. Another Clyde firm, David Rowan and Co., Limited, also has under construction a six-cylinder engine, having cylinders 18½in. diameter by 25in. stroke, and designed to develop 1500 to 1800 brake horse-power, at a speed of 115 revolutions per minute; this engine is being built for a Clyde vessel. At Palmer's Shipbuilding and Iron Company, Limited, engines are being built for British-owned boats. They are also six-cylinder units with 23in. bore cylinders, having a stroke of 36in. They are designed for 2650 brake horse-power, at the low speed of 86 revolutions per minute. During the year Carels Frères, of Ghent, Belgium, acquired a licence to build Fullagar engines, and they will shortly begin to construct engines of this type.

The North British Diesel Engine.

The year has been a busy one at Whiteinch, and four vessels have been fitted with machinery. We reproduce in a Supplement a view of the motor ship Hauraki, built for the Union Steamship Company of New Zealand, Limited. Other vessels completed for the British India Steam Navigation Company, Limited, are the Durenda, the Dumra and the Dwarka. The Durenda is engined with twin-screw machinery, each engine being designed for an output of 2330 indicated horse-power, at a speed of 96 revolutions per minute. There are six cylinders to each engine, 26½in. bore by 47in. stroke. The Dumra is a smaller vessel of 2050 tons deadweight capacity, and twin-screw engines of a new type developing 500 brake horse-power per shaft are installed. The cylinders are 15in. bore, with a stroke of 30in., and the speed of the engine is 165 revolutions per minute. One of the new engines of the year is the two-stroke cycle double-acting engine, an illustration of which is reproduced in a Supplement to-day. The 240 brake horse-power unit was built for dynamo driving, and will form part of the auxiliary machinery of a new motor ship. The new principle has, however, proved so successful that a main engine of larger power is being constructed. The passenger liner Domala has made successful runs during the year.

The Neptune Type of Engine.

In Fig. 1 we illustrate a new type of two-stroke cycle engine, built by Swan, Hunter and Wigham Richardson, at Neptune Works. The engine was designed under licence from the Atlas Diesel Company, Limited, of Stockholm, and presents several new features in its construction. Two sets of machinery of this type are being built for the tanker Arnus, and each unit is rated at 1400 indicated horse-power, when running at a speed of 125 revolutions per minute. There are six cylinders of 17in. diameter, and the stroke of the engine is 35in. Successful tests of the first set of machinery have been carried out.

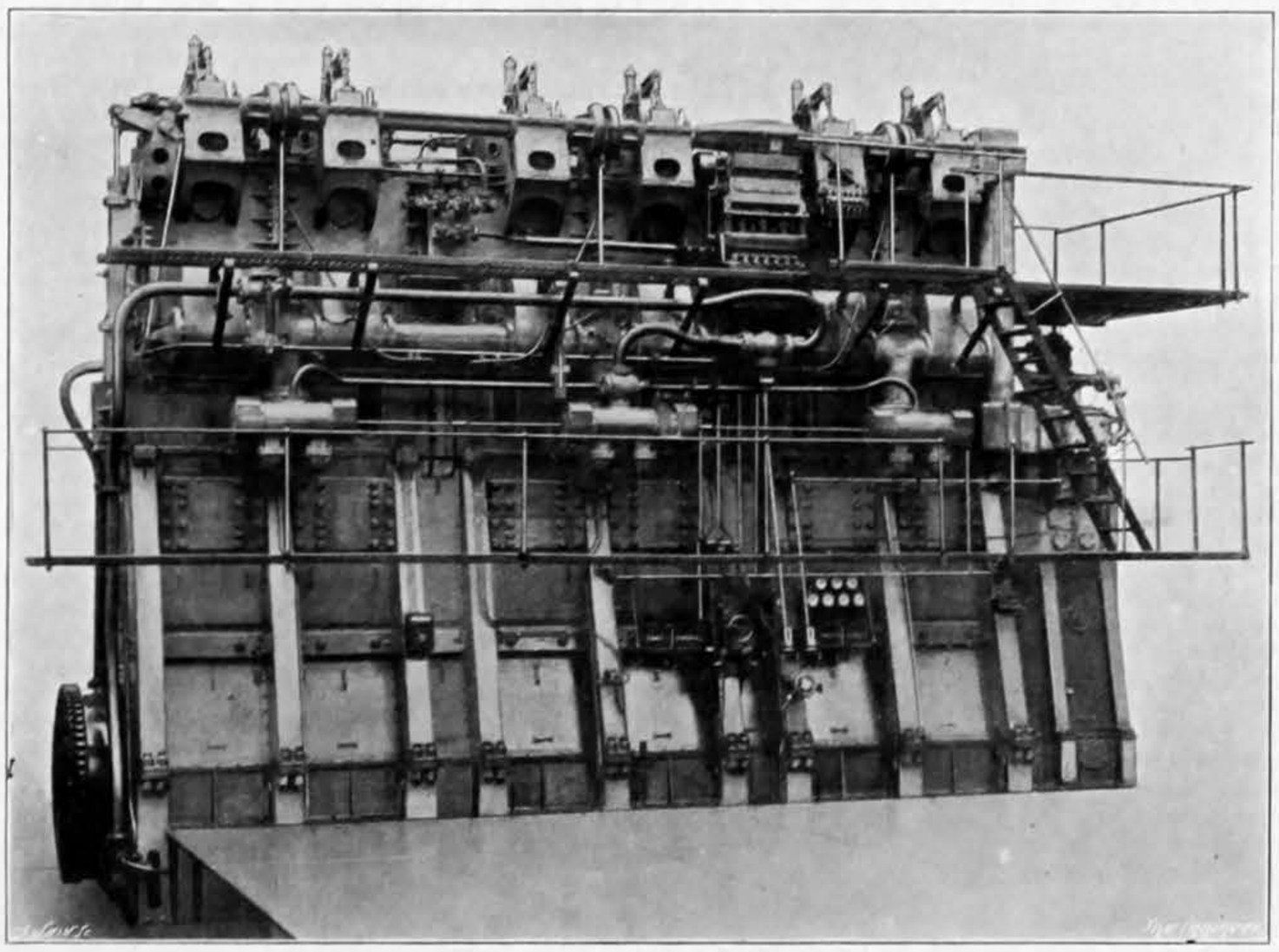


FIG. 1—1400 I.H.P. "NEPTUNE" MARINE OIL ENGINE

The Nobel Engine.

In the early part of the year particulars were published in THE ENGINEER—see issues for January 27th and February 3rd—of a new design of Nobel marine Diesel engine, of 1600 brake horse-power, and the results of tests made on this engine by Professor Rosborg, of Stockholm, were given. The engine, which is robust in build, embodies the experience of the Nobel firm gained in construction of a large number of Diesel engines for Russian river work and for service on the Caspian Sea. We are informed that the engine will shortly be installed in an oil tanker. There are interesting points in the design and construction of the Nobel engine, and a further development of this type for marine and land work may be looked for.

The Still Engine.

The paper read by Mr. A. Rennie before the Institution of Engineers and Shipbuilders in Scotland, and reprinted in the issues of THE ENGINEER for February 17th and 24th of last year made known to our readers the experimental work which had been carried out on this engine by Scotts Shipbuilding and Engineering Company, Limited, of Greenock. An 8000-ton vessel, built to the order of Alfred Holt and Co., Limited, of Liverpool, is now under construction, and will be fitted with twin-screw Scott-Still engines, which are designed to develop a total power of 2500 brake horse-power when in sea service. Each 1250 brake horse-power engine has four cylinders of 22in. diameter, with a stroke of 36in., the speed of the engine being about 120 revolutions per minute. The first set of engines is approaching completion, and it is expected that it will run test bed trials in the early part of the year, and that the ship will be ready for sea trials somewhere about the middle of the year. It is of interest to note that Still engines of the land type are also being built by Peter Brotherhood, Limited. A 250 brake horse-power Brotherhood-Still engine, with cylinders 12½in. bore by 15in. stroke, running at a speed of 250 revolutions per minute, is now under construction.

The Sulzer Type of Engine.

The type of two-stroke cycle marine engine evolved by this well-known firm of Swiss engineers made considerable progress during the year. The Conde de Churrucha, built by Armstrong-Whitworth, showed good results in operation, and the Norwegian-built ship, the Handicap, the first vessel to be fitted with turbo blowers for scavenging purposes, also made excellent voyages. During the period 1921 to 1922, the total number of marine engines of all kinds, including those for submarines, constructed at Winterthur numbered thirty-four, representing 38,000 indicated horse-power. Experimental work has also been carried on, and the new R.V. solid injection type of engine, which will be built in Great Britain by G. and J. Weir, Limited, has been perfected. The illustration reproduced in Fig. 2 shows a two-cylinder unit of this type. The R.V. engine has not yet been developed for large powers, and it is expected that for the meantime it will be built in sizes up to about 200 brake horse-power. Satisfactory experimental progress is being made, we understand, with the application of this principle to large engines. Two firms on the Clyde have Sulzer type Diesel machinery under construction. At William Denny and Brothers, Dumbarton, twin-screw machinery of the two-stroke cycle Sulzer type, having an aggregate brake horse-power of 2500, is in course of completion. The first set has successfully passed through the shop tests, and the second set will shortly be ready for testing. Diesel engines of the same type, a twin-screw set for 300 aggregate horse-power, have also been used on vane wheel propulsion trials, and for other tests, including the use of Mexican fuel oil, and have worked satisfactorily.

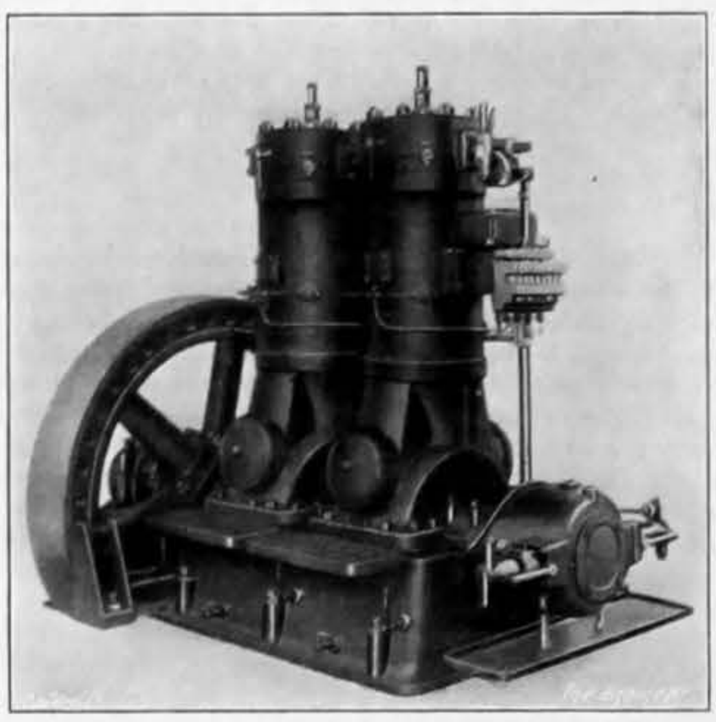


FIG. 2—THE SULZER R.V. TYPE ENGINE

At the Linthouse yard of Alexander Stephen and Sons, Limited, the machinery for the Dalgoma, a cargo vessel for the British India Steam Navigation Company, is also nearing completion, and the ship is expected to be launched early in the year. We recently inspected these engines, and they are of special interest, because they are the first British-built engines to be fitted with turbo scavenging. There are two turbo blowers, one for each engine, supplied by Brown, Boveri and Co., and William Reavell and Co., Limited, of Ipswich.

The most important motor ship order of the year was undoubtedly that placed with the Fairfield Shipbuilding and Engineering Company, Limited, by the Union Steamship Company of New Zealand, for a 600ft. motor passenger liner for its New Zealand-Vancouver service. This large quadruple-screw liner will be propelled by four sets of six-cylinder two-stroke cycle Fairfield-Sulzer engines, each unit developing about 3000 brake horse-power, and running at 135 revolutions per minute. The cylinders will have a diameter of 27in. and a piston stroke of 39in. The scavenging air will be supplied by three electrically-driven turbo blowers of such size that two will supply all the air required by the four main engines. The auxiliary machinery will include four two-stroke cycle Sulzer engines, each directly coupled to dynamos, and designed for an output of 400 brake horse-power each, at a speed of 200 revolutions per minute. Work on the bed-plates and columns of the main engine has, we understand, already begun. The progress and results of this machinery installation will be watched with the keenest interest, for it represents the greatest step forward which has been made in motor ship construction in recent years.

The Vickers Type of Engine.

The Scottish Musician, built for Tankers, Limited, was added to the well-known fleet of oil-carrying ships engined by Vickers Limited. During the last weeks of the year the motor vessel Narraganset was overhauled. This Anglo-American oil ship has been in service since it was delivered in May, 1920, until December 15th, 1922. The total number of miles run during this period, as taken from the copies of the ship's log, is 117,860 miles. Designed for an average speed of 10.5 knots, the average speed taken from the log is 10.09 knots, and the daily consumption of fuel oil for the main engines is given by the makers as 9.65 tons.

The Doxford Opposed Piston Engine.

Very satisfactory results were achieved by the Yngaren, the first vessel engined by Wm. Doxford and Sons, Limited, and the second ship, the Dominion Miller, a 9300-ton cargo boat, built for Furness, Withy and Co., Limited, was completed early in the year. This vessel is also engined with single-screw, 3000 indicated horse-power machinery, but in this case the deck auxiliaries are steam driven. Later in the year the sister ship to the Yngaren, the Eknaren, was completed and delivered to the Transatlantic Steamship Company of Gothenburg. We reproduce an illustration of this ship. Extensive trials were carried out on an engine similar in all respects to those installed in the above-mentioned vessels, and interesting results were obtained. The trials demonstrated that, using the solid injection principle, high mean pressures up to 100 lb. per square inch can be maintained, and that boiler oil can be quite well used with this engine. The overload tests also showed that the engine gave a better fuel consumption at the maximum piston speeds of 750ft. to 800ft. per minute. That good combustion takes place under such conditions is rather astonishing when it is borne in mind that the separation speed of the two pistons is 1500ft. to 1600ft. per minute. Experiments on the amount of air used in starting the engine showed the quantity to be very small. Two sets of Doxford type engines are being built in America by the Sun Shipbuilding Company, Limited.

The Werkspoor Type of Engine.

The output of the Amsterdam Diesel works during 1922 was affected by the depression in shipbuilding, and only three vessels were delivered, these being the San Andrès, a 3000-ton vessel with 1420 brake horse-power engines; the Hallfried, a vessel of 2250 tons deadweight capacity and engines of 1870 brake horse-power; and the motor ship Rhea, of 6800 tons deadweight capacity and engined with 780 brake horse-power machinery. An interesting feature of the Rhea is the special arrangement of mechanically operated windlasses, which are driven by a steam engine fed from the donkey boiler. A further set of engines for the motor ship Indra, a sister ship of the Hallfried, are now nearly complete.

At the North-Eastern Marine Engineering Company, Limited, Wallsend-on-Tyne, the Segovia, a sister ship to the Sevilla, has been built and delivered for the Fred Olsen Line, of Christiania. These vessels have a length of 270ft. and a deadweight capacity of 2000 tons, and they are engined with single-screw North-Eastern-Werkspoor machinery developing 1400 indicated horse-power at a speed of about 120 revolutions per minute in six cylinders, 560 mm. bore by 1000 mm. stroke. A set of similar machinery is under construction for another ship shortly to be launched. A back view of one of these engines is reproduced in the Supplement.

German Motor Ship Progress.

The returns for the year show that the position of Germany with regard to motor ship construction is second to that of the United Kingdom, while Sweden is third. Various types of engines have been constructed by Krupps, Blohm and Voss, the Deutsche Werft, Hamburg, and A.E.G., Berlin, and also the Deutsche Werke at Kiel, while a M.A.N. design of slow-speed engine has been built at Bremen. The large shipowning companies are not only ordering cargo boats, but also passenger liners for the Atlantic and South American services.

Testing Motor Ships.

At the spring meetings of the Institution of Naval Architects it was announced that, in conjunction with the Institutions of Civil and Mechanical Engineers, a committee had been formed to test motor ships under service conditions. It is satisfactory to report that this committee has been appointed and has begun its work, and that several builders are placing ships at the disposal of the committee for the purpose of testing them.

French and Italian Motor Ships.

French and Italian motor shipbuilding has been characterised by marked depression, but we have to record tests made on the Schneider type of cargo boat engine at Havre, and some ships are to be built for French owners. At the Ansaldo San Giorgio Works, in Turin, several sets of machinery have been completed. A notable ship was the Adriana, a 339ft. cargo boat with twin-screw, 1350 brake horse-power Ansaldo engines. This vessel was built with a new type of hull construction.

Smaller Craft.

Camper and Nicholson, of Southampton, have refitted the Ara, the largest motor yacht, which is propelled by twin-screw Atlas Polar Diesel engines. Each engine has six cylinders and is rated at 825 brake horse-power, and Gardner auxiliary machinery is fitted. Another yacht built by the same firm was the Sona, engined by Vickers-Petters, with two 450 brake horse-power semi-Diesel machinery. Several launches have been fitted with Bolinder, Kromhout, Robey, Plenty, and Gardner engines. From the reports received from J. Crichton and Co., Limited, and John I. Thornycroft, we learn that there were more inquiries for small craft towards the end of the year, indicating signs of a revival.

The Trend of Development.

Undoubtedly the general trend of development is in the direction of greater standardisation of engine sizes, with complete interchangeability of parts. These factors will assist in reducing the cost of motor ship machinery, but it must always be borne in mind that the Diesel engine requires a very high standard of material and workmanship, and in this sense it can never be a cheap engine. It is significant that two firms having considerable experience in the manufacture of marine auxiliary machinery have decided to build Diesel auxiliaries, and again this points to standard types of auxiliary engines being evolved. Engine speeds for merchant ship work incline to be kept low or moderate, and only in the case of submarine or naval engines do high speeds come into question. The majority of the engines built during the year do not exceed about 3000 brake horse-power per shaft; but the evolution of the higher powered engine is slowly being realised, and to-day powers up to 6000 brake horse-power per shaft would not present serious difficulty for the builders of large Diesel engines.

Water Supply and Sanitary Engineering in 1922.

The Effects of the Drought of 1921.

THE effects of the drought of 1921 and of the slight winter rainfall made themselves felt over a large area of the country throughout the year. During the first six months the water position in many parts was acute, quite a large percentage of water undertakings flying signs of distress, and though, later, the rainfall was sufficient to relieve the anxiety of water authorities in most localities, there still remained places in which, at the end of the year, conditions were by no means normal. Various authorities, including the Ministry of Health, issued warnings quite early in the year as to the necessity of taking care in the use of water and advocating the employment, if possible, of other than pure waters for non-domestic purposes. With a view to investigating the best means of rendering supplies, hitherto regarded as not being potable, fit for domestic consumption, Sir Alfred Mond in January appointed a Departmental Committee made up of experts including Sir A. C. Houston. In many cases supply had to be curtailed, while in others supplies actually failed. Towns as widely separated as Northampton, Bath and Folkestone—to name just a few—were anything but happily placed. Bath, in its trouble just referred to, engaged the services of a water diviner with, apparently, most beneficial results. It was at first reported that springs had been discovered which were capable of yielding as much as 65,000,000 gallons per year, and that 150,000 gallons were being fed from them into the reservoirs each day. In later reports the daily quantity obtained was given as 400,000 gallons, and still later the figure quoted was over 1,300,000 gallons per day. The additional supplies were, we understand, obtained without the construction of any reservoirs. There were districts into which water had to be taken by rail, and others in which it was so scarce that it was retailed by the bucketful at the charge of 1d. or more. What would have been the state of affairs had we had another year of lengthy rainless periods it is not pleasant to contemplate, and even now it is not possible to say that all trouble is at an end, for deep-seated springs have by no means in all cases been filled up to their normal levels. The chalk springs in the valleys of the Thames and its tributaries may be quoted as instances. Unless there are fairly heavy rains between this and, say, April next it is certainly possible that difficulties in some places may be experienced during subsequent months, though the heavy precipitation towards the end of the year will, undoubtedly, have helped matters.

The Metropolitan Water Board.

The construction of the Littleton reservoir works made good progress during the year. Out of a total length of 6921½ lineal yards of puddle trench only about 650 lineal yards excavation remain to be bottomed up and about 900 lineal yards of puddle filling remain to be done. The outlet works were completed. They include a concrete paved apron and forebay; an octagonal shaft within the reservoir with seven sluices 6ft. deep by 5ft. wide at various levels; an approach bridge of four segmental arches faced with granite, and one semi-circular abutment arch of concrete; a tunnel 136ft. 6in. long and 9ft. 9in. internal diameter in the London clay, between the inner and outer shafts, constructed of cast iron segments lined with brindle bricks and concrete; and an outer shaft with a pair of sluices controlling twin discharge conduits of reinforced concrete, each having a diameter of 8ft. The inlet works, which consist of four lines of 60in. steel pipes over the embankment, carried upon a block of 10 to 1 concrete pierced transversely by arched openings which are filled with earthwork and discharge basin 32ft. long and the forebay and apron constructed of concrete, were nearly completed. The foundations for the pumping station, together with a suction basin 94ft. long and 20ft. wide and concrete tubes commencing at 7ft. diameter, and reducing to 5ft. diameter, leading from the basin to the suctions of the centrifugal pumps, were nearly finished. The excavation of the intake channel for rather less than half its length was completed, and the lining with smooth-faced concrete blocks is in course of construction. A concrete bridge of two 12ft. spans faced with granite is in course of construction for carrying the road from Ashford to Laleham over this channel. In addition to the foregoing the 5,000,000-gallon service reservoir at Grove Park, Bromley, and the 1,500,000-gallon reservoir at Sundridge Park, Bickley, were practically completed. An additional well was sunk at West Wickham, and a well was sunk in the chalk at Eynsford to a depth of 86ft., with a 24in. borehole extending to a depth of 308ft. An iron elimination plant to deal with 2,000,000 gallons per day was put to work at the Waltham Abbey pumping station, and a gravity rapid filtration plant has been installed in connection with the slow sand filters at Barn Elms. It is proposed to prefilter through the new installation at a rate of about 130 gallons per square foot per hour, and to pass the filtrate on to the slow sand filters, increasing their capacity from two to three times. Contingent upon the establishment of this plant, it was necessary to extend the existing engine-house at Barn Elms. The foundations for a building to be erected at Walton to contain pumping machinery for the supply of filtered water to the Board's southern district were practically completed. A stand-by pumping plant at Hampton, consisting of two Diesel engines of 400 brake horse-power, driving centrifugal pumps through gearing, each capable of lifting 4,500,000 gallons per day against a head of 300ft., and the recently installed electrically-driven pumping plant at the Shooter's Hill station, were brought into use during the past year. The laying of a 42in. main between the Lea Bridge and Old Ford pumping stations was proceeded with, as was also the laying of a 48in. main, lessening to 36in., from the pumping station in course of erection at Walton to the Honor Oak reservoir.

Waterworks in Progress or in Contemplation.

The economic position has, unhappily, not as yet become so far bettered that anything like the normal amount of work in connection with water supplies is being carried out in this country. Indeed, practically nothing which is not of an absolutely urgent nature is being done. Still, in one way and another, progress was made, and if it was not all constructive work, it was in preparation for constructive work to be carried out. Manchester has been engaged in the laying of the fourth Thirlmere pipe line, which is to be 54in. in diameter and to have a total length of 32.3 miles, 27.2 miles of which are to be of steel pipes, 4.1 miles—part of the Ribble syphon—of reinforced concrete pipes, and 1.0 mile—part of the Keer syphon—of concrete-lined cast iron pipes. Up to the middle of December, 5.5 miles of the steel pipes—20 per cent.—and 1.5 miles—37 per cent.—of the reinforced concrete had been laid, but none of the concrete-lined cast iron pipes had been got into place. The capacity of the settling pool at Dunmail Raise, Grasmere, has been increased from one to two million gallons. In addition to work on the Thirlmere aqueduct, the overflow sill of Bottoms reservoir in Longdendale has been raised 7ft., and the capacity of the reservoir thereby increased by about 100 million gallons. Work has also been continued on the construction of the Heaton Park service reservoir, and in this connection it may be mentioned that puddling clay of excellent quality has been found near the site.

Glasgow continued the preparatory operations which are necessary in order to raise the level of Loch Katrine by another 5ft. The most tedious portion of this work is the reconstruction and raising of the road on the north shore of the loch so as to bring it well above the new level and to make it safe against the action of the water. So far two contracts have been entered into. The first—which was completed during the year—was only for a thousand yards near the Trossachs, and it included the construction of an extensive turning place for vehicles adjoining the Trossachs Pier. The work was difficult because it involved the blasting of cliffs which came down to the landward side of the shore road. Work in connection

with the second contract, which extends to 2.3 miles, was so well advanced during the year that it is anticipated that by the middle of this year the road will be entirely renewed for a distance of almost 3 miles from the Trossachs. The Bristol Waterworks Company proceeded during the year with the scheme for the caplation of water from the Cheddar springs. The work is nearly completed; indeed, before the end of the year some water had already been pumped into the company's reservoir. The important scheme, known as the Bertha, which was introduced about a year ago to provide an additional supply of water to Perth has not been proceeded with. Sanction to borrow £160,000 for water supply purposes was obtained, but for no specific scheme, and as the Bertha proposals necessitate double pumping there appears to be a likelihood of its being abandoned in favour of a gravitation scheme. In connection with Aberdeen's waterworks extensions the three slow sand filter beds—1½ acres—were brought into a well-advanced state of completion. For the 24 million gallon storage reservoir the excavations were practically completed, the walls were finished, and about one-half of the floor is laid. About 5 miles of the aqueduct is now in hand, 3½ miles being cement-lined steel pipes 4ft. in diameter and the remainder in concrete cut and cover and tunnel. It is expected that a further length of the aqueduct will be put in hand during the coming year. The Durham County Water Board obtained an Act for the construction of a new storage reservoir, part of the water from which is allocated to the Sunderland and South Shields Water Company. The Newcastle and Gateshead Company also obtained an Act conferring on it further powers. The Tees Valley Water Board (Stockton, Middlesbrough and Thornaby) has applied for powers to lay new mains and construct additional filtration works at an estimated cost of £275,000. The works of which the Cowlyd dam forms part were formally opened in September. This undertaking is interesting because the water impounded is partly used for domestic purposes by the Conway and Colwyn Bay Joint Water Board and partly for producing electrical energy by the Aluminium Corporation, Limited.

Quite early in the year there was a Ministry of Health inquiry into Wolverhampton's proposal to sink a deep well—500ft. to 600ft.—at Dimingsdale. After experimental borings at Holymoorside and other places, the Corporation of Chesterfield decided to spend £65,000 in boring further permanent wells. Skegness, too, has put down a new borehole. The Bolton Corporation obtained an Act for the sinking of wells and the acquisition of protective areas. The Colne Valley Water Company obtained an Act for the sinking of a new well, the acquisition of lands, the construction of a service reservoir, and new softening tanks, the provision of pumping machinery, and the laying of additional mains. The South Staffordshire Water Company also obtained an Act giving it powers to sink four new wells, to build service reservoirs, and to lay additional mains. An interesting scheme is that for which Oldham and Rochdale are proposing to acquire, jointly, the whole of the reservoirs and works of the Rochdale Canal Company, the idea being that the two towns shall give the Canal Company enough water to work its canal and divide the surplus—which is estimated at about 2½ million gallons a day—between them in the proportions of two-thirds and one-third. It is understood that the purchase price is in the neighbourhood of £400,000.

The Halifax Corporation obtained an Act for the taking of further waters into its existing reservoirs. Axminster prepared a scheme for extending its waterworks, and is now awaiting the necessary Ministry of Health inquiry. Scunthorpe early in the year obtained permission to construct a 1,000,000-gallon reservoir, to lay additional mains, &c., at a cost of about £50,000. A portion of one of the walls of the small balancing tank recently constructed in connection with the scheme of pumping water from the river Don below the sewage disposal works to a point in the river before it flows through Sheffield failed on January 11th. Repairs were effected by August, since which time the tank has remained filled. Hucknall completed the construction of a new reservoir and the laying of additional mains at a total cost of about £25,000. Chelmsford late in the year decided to spend some £66,000 in obtaining 750,000 gallons of water per day from the river Chelmer, the necessary works including a subsidiary reservoir, filtration beds, pumping plant, &c.

Cardiff made good progress with the construction by administration of the Llwynon reservoir, which when completed will have a capacity of 1,260,000,000 gallons. The embankment, which will have a maximum depth of 87ft., was brought up to within 20ft. of finished level, and the valve shaft to within 15ft. of finished level. The masonry in the by-wash was completed as far as the centre line of the dam and the bulk of the excavation of the remainder of the by-wash and for the overflow weir was finished, as also was the construction of the pool except for the weir. The Abernant masonry bridge was completed, and the abutment for the steel bridge over the river Taff above Pontardaf was put in, and the steel work is in course of erection. The excavations for the roughing filter house and the clear water well were practically completed, and the concrete work for the latter is now in hand. In connection with the high-level district of the Cardiff water area the construction of two sand filters at Rhiwbina was completed during the year and excavations were made for the construction of a storage reservoir at the Wenallt, about 4 miles from the city, which will have a capacity of 15 million gallons.

The Belfast City and District Water Commissioners were engaged during the year in making the final arrangements and letting the contract for the construction of a large impounding reservoir on the Kilkeel River in the "Silent Valley" of the Mourne Mountains. This work is referred to in detail in another column of this issue. The Corporation of Liverpool continued the construction of the Aber tunnel, which will provide an alternative to the existing Hirnant tunnel for drawing off water from Lake Vyrnwy. The tunnel will be 7ft. in diameter and 3330 yards long. It will have a gradient of 1 in 2400, and will have a maximum carrying capacity of 50 million gallons a day.

Works Abroad.

Experimental pumping was carried out on the Val de Loire during the year in order to see if the subterranean water level would be likely to suffer were that source to be drawn upon to provide an additional supply for Paris. However, while the scheme is regarded as offering the only possible practical solution of the problem of bringing to Paris an adequate supply of water, the project remains in abeyance on account partly of local opposition, but more especially of the impossibility, at the present moment, of procuring the necessary funds. A good deal was done in connection with the supply of water to the devastated regions of France, but there is nothing of outstanding importance to record. Three dams, two of them of large dimensions, are being built in New South Wales. For the supply of Sydney there are the Cordeaux dam, which is to have a height of 170ft. above the river bed and will impound 20,600,000,000 gallons, and the Avon dam, the height of which had not, when our last advices came to hand, been determined upon, but which at 200ft.—the lowest contemplated—would hold up the vast volume of 43,000,000,000 gallons of water. The third structure is the Chichester dam for the Hunter district water supply, concerning the dimensions of which we are not in possession of particulars. A Bill introduced into the Victoria Parliament towards the end of the year sought powers to authorise the expenditure of £1,693,000 on irrigation water supply, drainage, &c. The main allocations include £275,000 for the Sugarloaf Reservoir, and £332,000 for operations under the Murray River Waters Acts. It is hoped to complete the Hume Reservoir near Albury, which is to cost £1,600,000, by 1929. A report was made by Mr. Martin Deacon, to the Municipality of Singapore on various schemes which had been brought forward for providing an additional supply for the town and district. The report recommended a scheme which embodies the bringing of water by gravity from the Pulai district, a distance of over 30 miles, the pipe line being led over the Johore Causeway, which is now in course of construction. The Vaal River barrage for providing a further supply—ultimately 20,000,000 gallons per day—for the Rand Water Board was completed during the year. For its construction there was adopted the somewhat unusual course of cutting into the river banks on both sides, so that the length of the barrage, and hence the width of the opening in it, might be made such as would more than compensate the obstruction offered to the flow of water during floods by the piers and other works. In the barrage there are thirty-five piers each 8ft. wide, which make thirty-six openings each 30ft. wide. The Government of Mauritius received during the year from a firm of consulting engineers in Westminster a report on matters relating to water supply and sewerage for Port Louis and the Plaines Wilhems towns, the proposed works involving an expenditure of about 1½ millions sterling. Work was continued on the 18 mile long Shandaken tunnel and the other works connected with the aqueduct for leading an additional supply of water to New York from the Catskill Mountains.

Sanitary Engineering—General Outlook.

Exactly what has been said regarding water supply can be said of sanitary engineering—comparatively little is being done throughout the country. There were no new developments of any kind during the year. Of the various novelties referred to in last year's article on "Sanitary Engineering," there is, with one exception, not much to report. The experimental investigations instituted by Mr. John D. Watson, engineer to the Birmingham Tame and Rea District Drainage Board, in connection with the production of gas from sewage sludge were continued, but so far no particulars as to results are available for publication. The application of the Walshaw system of sewage disposal and gas production for treating the sewage from an institution containing 700 persons has been under consideration, but has not yet been adopted. The proposal is to use the gas produced to drive an engine of 15 brake horse-power for working machinery. Although there are engineers of very high standing and wide experience who maintain that with properly designed and formed filter beds there should be no "ponding," yet the inoculation of beds with the insect *Achorutes Viaticus* was increasingly adopted. It is now reported that at Glasgow the introduction of this "scavenger" into the beds has already saved the Corporation thousands of pounds in working expenses, and that its continued use will result in a very appreciable reduction in the capital expenditure on plant. The activated sludge system of treatment continues to gain ground, it having been adopted in a number of fresh cases during the year. Among its latest applications is that for the treatment of milk wastes from a chocolate factory. We refer to this system again later. A plant for dealing solely with the contents of cesspits on the Aer-sed-con system was completed at Egham towards the end of the year.

The exception referred to above was the bio-aeration method of treatment which was worked out by Mr. John Haworth, the general manager of the Sheffield disposal works. During the year the large unit operating on that system at Wincobank, which was described in our last year's article, worked continuously with, we are informed, most satisfactory results in respect both of purification and costs. The extension or reconstruction of the main works was continued and is still proceeding. The two units each designed to deal with 1¼ million gallons per day in dry weather, and three times that volume in wet weather, were under construction, and it is expected that one of them will be completed and put into operation in about three months time. Quite recently the Ministry of Health sanctioned the construction of two further units, work upon which will be commenced immediately, the estimated cost being £64,000. It may be added that the "Sheffield Bio-aeration system" has been adopted by East Ham, Mansfield, Rotherham, and Wakefield, all of which have been engaged in laying down installations to work in accordance with it. In addition, a scheme to employ it has been prepared by Stockport, and several other towns are making experiments on similar lines with a view to adopting the process. We gather, too, that the system has been chosen for the new works at Minworth of the Birmingham Tame and Rea District Drainage Board.

Although, however, the total volume of work carried out during the past twelve months cannot be regarded as large, and although many schemes for borough extensions, which would have meant a considerable amount of re-arrangement of sewage disposal works and sewerage, were abandoned as the result of the Leeds Extension Bill being thrown out by Parliament, yet it cannot be said that nothing has been done, and there are one or two places in which something approaching activity has prevailed.

London Main Drainage and Sewage Disposal.

If we take London, for example, we find than, it all, quite a lot of work in connection with main drainage was done by the London County Council under the direction of its chief engineer, Mr. G. W. Humphreys. The north-eastern storm relief sewer, which is about 4 miles in length, is intended for the relief of flooding in the north-eastern portions of the county, the outlet being into the Thames at Shadwell. It consists of a brick sewer, 8ft. to 9ft. in diameter and about 2½ miles long, the remaining 1½ miles being 11ft. 4in. diameter and constructed of cast iron lined with concrete. The greater part of the brick portion was completed, and good progress made with the cast iron portion. A new storm water pumping station is being built at Hammersmith for relieving the sewers in the low-lying parts of that district and of Kensington. The connecting sewer, which is about a mile in length, was nearly completed, and the pumping machinery, which is to be capable of dealing with 1000 tons of storm water per minute, is in hand. The Fleet sewer in Farringdon-street consists, for a part of its length, of two brick culverts which were built in the bed of the old river nearly 200 years ago. These culverts are being repaired with new brickwork—an operation of some difficulty owing to the necessity of maintaining the flow of sewage. Considerable progress was made with the Wandle Valley sewer, which is a new relief sewer in Wandsworth about 2 miles in length. It is being constructed in brickwork of various sizes up to 7ft. in diameter. A weir and a relief sewer for the discharge of storm water into the river Wandle will be provided. The greater part of the work in connection with the Charlton storm relief sewer was completed. This sewer, which is largely of reinforced concrete and has an outlet into the Thames at Charlton, is designed to relieve the southern high-level sewer in times of storm. The river Graveney improvement, which consists of a concrete channel, about 2 miles long, and takes the place of a natural watercourse which was liable to overflow at times, was nearly finished. A new 1500-ton sludge vessel was ordered, and the experiments on the treatment of London sewage by the activated sludge process were continued during the year.

Other Works.

Then, again, the large undertaking of the Thurrock Grays and Tilbury Joint Sewerage Board, of which we made mention last year, has been proceeded with, and it is hoped to bring the works into full operation in about six months time. A portion of the works has, in fact, been completed and in use, the sewage being treated at the existing purification works.

Although the ground in which the foundations are being built is of a most difficult character, the West Kent main sewerage outfall works at Dartford proceeded satisfactorily during the year. About 6 acres of new sludge beds were completed and are working satisfactorily, and some 250 yards of 5ft. 6in. outfall sewer were built. The foundations for some of the buildings were got in, the excavation for the tanks is well in hand, and the construction of the wall and floors of the detritus tanks was commenced. All the piles for the wharf, which is to be 500ft. in length, were driven, and the west end of the wall constructed in reinforced concrete. Various works in connection with local drainage and sewers were also carried out. A large extension of the activated sludge plant at the Withington works of the Manchester Corporation was ordered during the year. It is to deal with over one million gallons of sewage—average dry-weather flow—per day, and will make the third large-scale plant working on the activated sludge system owned by the city. In this connection it may be mentioned that in one of the existing plants which originally treated an average of under 550,000 gallons per day was "speeded up" to deal with some 1,000,000 gallons per day, and the consumption of air was found to be not more than 1.5 cubic feet of free air per gallon of sewage treated. Activated sludge plants are also being constructed or have been ordered for the Hanley works of Stoke-on-Trent, the Central Ordnance Depôt at Chilwell, near Nottingham, and Hale (Lancs.). A commencement will be made with the construction of the activated sludge tanks at Reading within the next few weeks, tenders for the structural works having been received. It is probable that Hertford, which is reconstructing its sewage works, will also adopt the activated sludge process.

In addition to the foregoing, the Ministry of Health has sanctioned a loan of £55,000 for the purpose of constructing a large outfall sewer for Folkestone, which is to discharge into the sea at Copt Point. Richmond (Surrey) put into service two vertical-spindle electrically driven centrifugal pumps, each capable of lifting from 3 to 5 million gallons of sewage per day against a maximum head, including friction, of 42ft. The improved purification works which are being carried out at Swindon made good progress, and it is hoped to bring them into operation within six months. Radlett completed its new works, which have cost some £20,000. Crewe has in hand a scheme of sewerage and sewage disposal which, it is estimated, will cost about £30,000. Havant is expending rather over £22,000 in sewering a hitherto undrained area. Considerable progress was made with the works for the prevention of flooding in Portsmouth. A new rising main 42in. in diameter from the Eastney pumping station to the storage tanks was completed, and the additional pumping machinery, engine house and suction tank are well in hand. Chichester installed an automatic rotary distributor of particularly large diameter. Newark is engaged in carrying out a new sewerage scheme which is to cost some £55,000. Farnham completed the drainage scheme and purification works which were rendered necessary by the extension of its area made before the war. Works of varying importance and nature are also either in progress or in contemplation at Bognor, Bury, Chelmsford, Cockermouth, Darlington, Elland, Matlock, Middlesbrough, Oldham, Preston Park and Steyning, Skegness, Woking and other places. The Paris Municipal Council, in the last days of the year, approved a scheme for taking for treatment at Achères a volume of no less than 800,000 cubic metres —say 176,000,000 gallons—of sewage per day. The cost of the work is estimated at 127,500,000f.

Shipbuilding in 1922.

The Year in Retrospect.

LOOKING over the shipbuilding industry and the allied engineering trades for the last twenty to thirty years, the period under review stands out as a year of unprecedented trade depression and minimum output. The slump which so seriously affected commercial shipbuilding was further accentuated by the fact that during the year no naval construction of importance took place in private yards, while the uncertain labour position in the earlier part of the year dealt a severe blow to any prospect of trade revival. At the close of 1921 we were witnessing a steady decline in the amount of tonnage launched, and when the New Year was entered there was an instinctive feeling that the bottom of the depression had not been reached. A broad survey of the position of the shipbuilding industry in all parts of the world revealed a complete stagnation in almost all countries, and the inquiry for new vessels was relatively insignificant except for motor ships, oil tankers, and a few special ships of the liner class which were needed to complete post-war building programmes. The cause of the slump in shipbuilding was seen to be directly due to the coincidence of a period of high building and operating costs with a time of generally depressed trade, poor markets, and consequently fewer goods to be carried.

The suggestion might be advanced that a considerable amount of the tonnage thus laid by was more or less obsolete. Some interesting facts concerning the relative amount of old tonnage in the merchant fleets of various countries are given in a Lloyd's report on the age and size of the world's ships, which bears on this subject, but a little reflection will show that it is not economical for the shipowner to replace this tonnage with newer types of ships unless the earning power of the new ship warrants the capital expended on it. In order to attract new orders it was essential, therefore, that the high costs of construction should be reduced. Early in January a conference was called between the shipbuilding employers and the shipyard workers, and was held at Carlisle. The continued depressed state of shipbuilding was discussed and means were sought to withdraw the 26s. 6d. war bonus in such a manner that no unnecessary hardship would be inflicted on the men. Agreement was not reached, and the employers intimated that in any event it was their intention to withdraw 16s. 6d. as on and from March 15th, the question of the manner of withdrawing the final 10s. being left over for further discussion. A ballot of workers recorded a large majority against this cut, and a deadlock ensued. Protracted negotiations between the parties concerned took place, and notice was eventually given by the Employers' Federation of a cut of 10s. 6d. per week from March 29th, and a further reduction of 6s. per week a month later. A strike of shipyard workers subsequently took place, which lasted until May 15th.

At this period of the year the engineers' strike over the question of overtime and shop management, which lasted from March 13th till June 13th, also took place, and seriously affected engine building and the allied industries. About the middle of September the Shipbuilding Employers' Federation made representations to the workers' trades unions with a view to removing the final 10s. of the 26s. 6d. war bonus. Voting by ballot, the unions gave power to their negotiating committee to secure the best possible terms, and modified proposals resulted in the employers fixing a minimum wage of 37s. 6d. per week and arranging to remove the 10s. in three stages, the first reduction took place in November. The placing of the battleship contracts on the Mersey and the Tyne led to some discussion of the measure and value of the work done by the Clyde shipyard worker as compared with similar workers on the Tyne and Mersey. The statement has been made that the Clyde workers' efficiency, as measured by output, is lower than that of some other centres, which fact, it was stated, was sufficient to explain the higher tenders submitted by Scottish firms for the new capital ships and also for repair work. On the other hand, however, we have the declaration of well-known Clyde employers, who maintain that the measure and standard of Clyde workmanship was never higher than it stands to-day. Referring to the latter half, and particularly the closing months of the year, some orders for new ships were booked at prices made up on the basis of the reduced labour costs.

It is as yet too early to forecast the future, but it is safe to say that the general feeling is that the worst of the depression has passed and the tendency of the industry is towards a steady upward development.

Some Liners and Passenger Ships.

The returns of ships launched and placed in commission show that during the year liners formed a large proportion of the more important ships. Post-war building programmes were completed in some cases, older ships were reconditioned, and special liners purchased from the Reparations Commission were refitted and entered service for the first time during the year. Among such ships the outstanding large Atlantic vessel of the year is undoubtedly the White Star liner Majestic. This ship is illustrated in one of our Supplements to-day, and was described in the issues of THE ENGINEER for May 12th and 19th respectively. Built originally as the Bismarck for the Hamburg-America Line by Blohm and Voss, and re-named the Majestic, this vessel was finally completed to conform with White Star practice, and both from the point of view of naval architecture and marine engineering she is a fine example of liner construction. Although the largest vessel afloat, having a length of 956ft., a breadth of 100ft., and a gross tonnage of 56,000 tons, her speed is moderate, and a good performance was made on the return maiden voyage when a speed of 24.25 knots was averaged. Throughout the season the Majestic ran exceedingly well. Towards the end of the season she was dry-docked in the United States, examined, and her hull scraped. It is hoped that within a year the new floating dry dock which is being built by Sir W. G. Armstrong, Whitworth and Co., Limited, on the Tyne for the London and South-Western Railway, will be delivered at Southampton, and will be available for all large li..ers calling at that port. The sister ship to the Majestic, the Leviathan, now in American ownership, is being reconditioned and overhauled at the yard of the Newport News Shipbuilding and Dock Company, and extensive structural alterations are being made, which will be completed in the present year.

A fine example of a British-built White Star liner is the Pittsburgh, by Harland and Wolff, which we illustrate in one of the Supplements. She has an overall length of 600ft. and a gross tonnage of 16,600, and is a triple-screw vessel with reciprocating engines on the wing propellers, and a low-pressure turbine driving the centre shaft. A feature of this ship is the very complete electrical equipment she carries, to which we refer more especially in another section of this article. The Cunard Line has also carried out an extensive programme of development during the year, which included not only new ships which have entered service, but also the reconditioning and re-equipping of the Mauretania and the Berengaria for oil burning. The alterations were done on the Tyne, Swan, Hunter and Wigham Richardson being the contractors for the former ship, and Sir W. G. Armstrong, Whitworth and Co., Limited, for the latter. Both ships, after their conversion performed excellent runs, and the Mauretania, in particular, surpassed her earlier world's record of 26.06 knots—made when she was a coal-burning ship—by touching a speed of 27.5 knots toward the end of her second homeward voyage at the end of July. This record speed was exceeded by the Olympic at the end of one of her voyages, but on arrival at port it was discovered that her stern post was cracked. Other Cunard vessels which were placed in commission during the period under review, include the Samaria, built by Cammell Laird and Co., Limited, and the Laconia; while in addition to the Tyrrhenia, three of the smaller class of vessels specially built for the Canadian trade, were completed and delivered. They are the Ausonia, the Antonia, and the Andania; we reproduce in the Supplement a view of the Vickers-built Antonia. Shortly before the end of the year the 20,000-ton Cunard liner Franconia was launched at the Clydebank yard of John Brown and Co., Limited.

Another company which made considerable additions to its passenger carrying fleet is the Canadian Pacific Steamship Company. Three vessels of the "M" class, the Montcalm, Montrose and Montclare, have entered the Liverpool service. The Montrose—illustrated in Fig. 2—is a Fairfield-built ship of 16,400 tons gross propelled by geared turbines. The two sister ships were built and engined by John Brown and Co., Limited, at Clyde Bank. Another Fairfield ship, the Empress of Canada, entered the Pacific service in July. Three ex-German ships, the Empress of Scotland, the Empress of India, and the Empress of Australia, were placed in commission. The Empress of Australia is deserving of special mention on account of her Föttinger transformers, which were described in the issues of THE ENGINEER for June 23rd

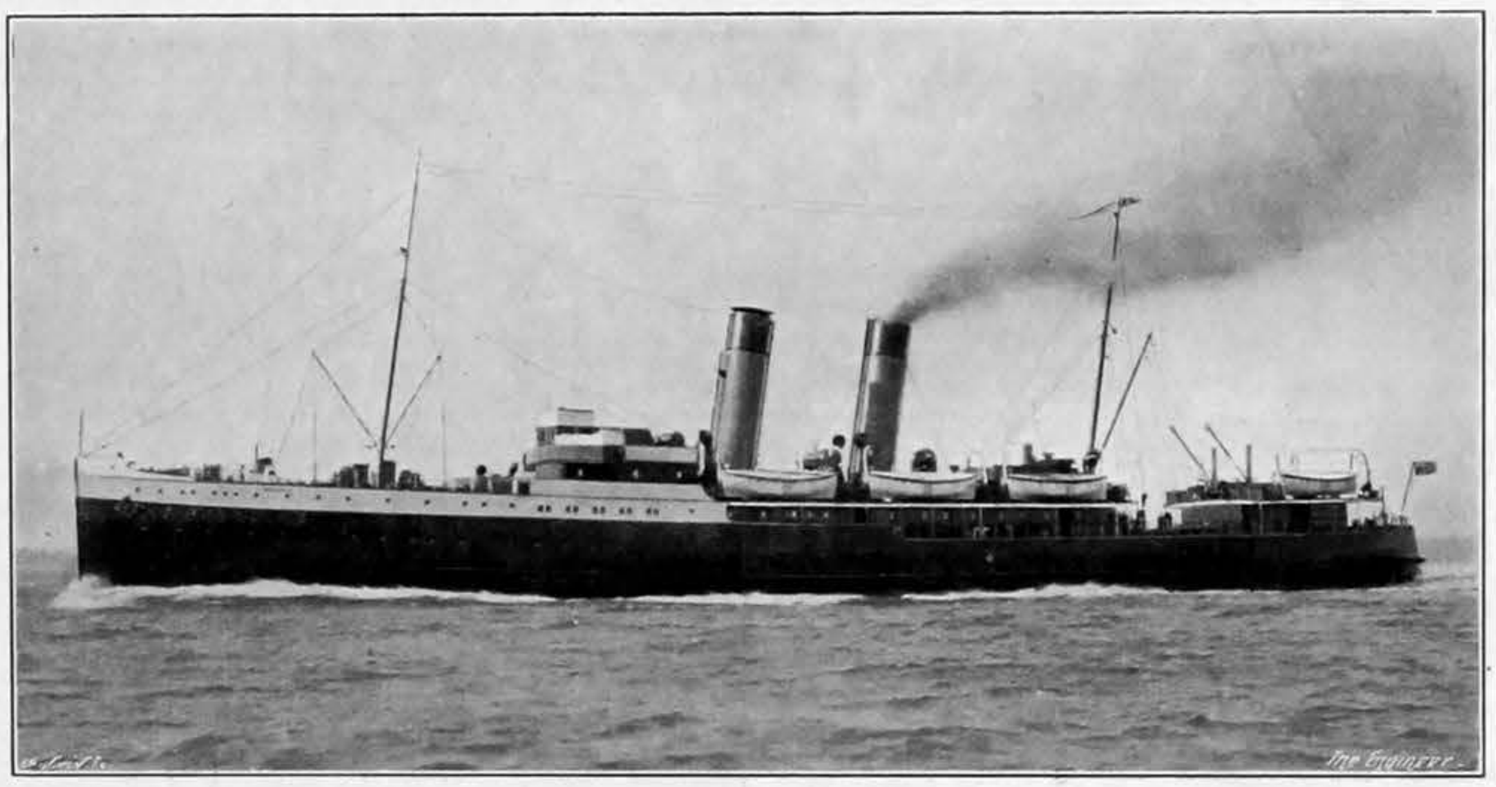


FIG. 1—G.E.R. CROSS-CHANNEL STEAMER MALINES

and July 7th. A view of this vessel is reproduced in a Supplement to the present issue. Some work has been necessary in order to bring the machinery into line with Canadian-Pacific standards, but we are informed that now that this has been done, the operation of the vessel is very satisfactory, the last run between Vancouver and Hong Kong being a very good one.

Another outstanding ship of the year is the Ellerman liner, the City of Nagpur, built and engined by Workman, Clark and Co., Ltd., at Belfast. We illustrate the ship and its machinery in a Supplement. Designed and equipped for passenger service between Great Britain and India, this liner has a length of 490ft. and a gross tonnage of 10,200 tons. She is of the shelter-deck type, with a cruiser stern. The set of quadruple expansion engines form a particularly fine example of a type of marine engine which in these days of turbines and oil engines is becoming more rare.

During the year William Beardmore completed the Lloyd Sabaudo liner Conte Rosso, which we illustrate in a Supplement to-day. This vessel has taken up her service between Italy and America. She is 18,500-ton ship, having a length of 591ft. and a sea speed of 18½ knots with geared turbine machinery. The Conte Verde, her sister ship, was launched at Dalmuir towards the end of the year, and is now fitting out. Brief mention may be made of the Moldavia, built for the Peninsular and Oriental Steam Navigation Company. The Moldavia was built by Cammell Laird and Co., Limited, at Birkenhead. Other vessels completed by the firm are the Patia for Elders and Fyffes, Limited; Gouverneur General Chanzy, for the French Government; Maid of Psara, for the Byron Steamship Company, Limited; and the London Maru and Paris Maru for the Osaka Shosen Kaisha.

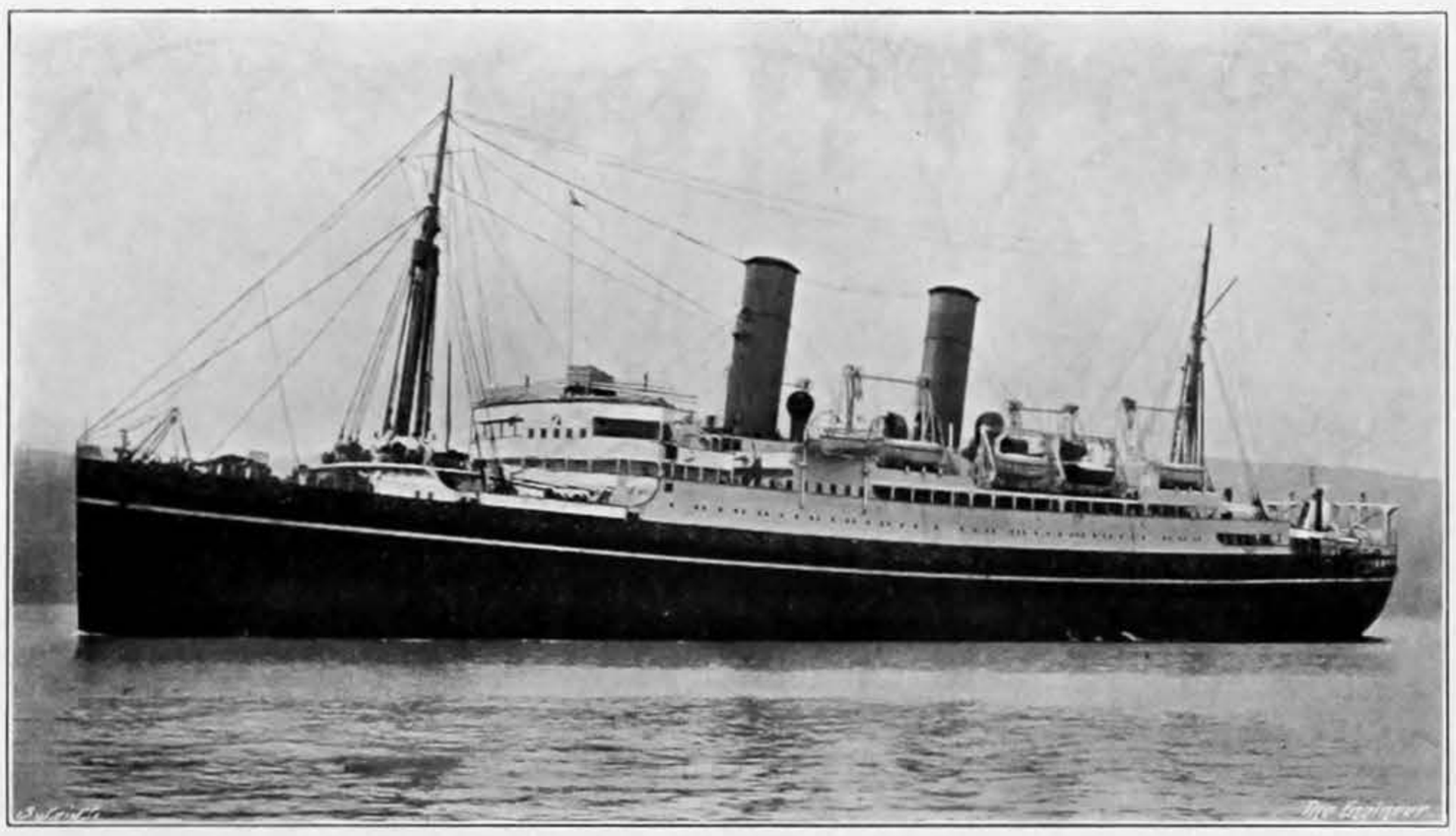


FIG. 2—C.P.R. LINER MONTROSE

The Anchor Line added an important vessel to its fleet in the Tuscania, built by the Fairfield Shipbuilding and Engineering Company, Limited. She is one of the largest and most up-to-date passenger vessels sailing from the Clyde. Her overall length is 578ft., her breadth 70ft., and her gross tonnage 17,200. She is propelled by twin-screw geared turbine machinery, and has a service speed of 16 knots. During the year the Fairfield Company also launched the Athenia, a 12,000-ton twin-screw geared turbine passenger ship for the Anchor-Donaldson Line's North Atlantic service.

Among cross-Channel boats we would chronicle the Malines—illustrated in Fig. 1—built for the Harwich-Antwerp service of the Great Eastern Railway Company, by Sir W. G. Armstrong Whitworth and Co., Limited. She is a 337ft. 2800-ton vessel, with twin-screw geared turbine machinery, and she forms a notable addition to the Harwich service.

Tankers and Dredging Machinery.

Oil tankers figure prominently in the returns of the year. Typical vessels are the British Merchant, a 10,000-ton tanker, built by William Beardmore: the British Workman, one of two 6994-ton vessels, built by Workman-Clark; and the British Scout, of 2000 tons, by Swan, Hunter and Wigham Richardson, Limited. Palmers also completed a number of vessels for British Tankers, Limited, during the year, and the Scottish Musician is a further addition to the tanker fleet of Diesel-driven ships built by Vickers Limited at Barrow. William Simons and Co., of Renfrew, completed three large and one small suction dredgers. Other orders for colonial and foreign owners were carried out by the various Clyde firms specialising in this class of machinery.

Developments in Design and Construction.

The Duct Keel.—The successful trials of the steamers Manchester Regiment and the Nataliana aroused interest in the duct keel system of ship construction. In a duct keel vessel the main longitudinal member of the double bottom framing, instead of being a single vertical plate, is made in the form of a box-shaped girder, which is oil-tight and water-tight and free from internal stiffening. It thus provides a clear fore-and-aft passage within which the piping for the bilge and oil fuel systems may be accommodated. The pipe joints are accessible for examination and no bulkheads need be pierced. We understand that the two new liners ordered for the Orient Company will be built on this system.

Vane Wheel Propulsion.—Some large-scale experiments were carried out during the year by Wm. Denny and Bros. on vane wheel propulsion, and the results show that such wheels have a high propulsive efficiency and impart ease of manœuvring to the ship, while they are effective for varying draughts and high speeds of revolution. In the experimental ship the vane wheels were partly immersed and mounted with their axes above water and parallel with the keel. When they are rotated the inclined vanes exert a thrust against the water and drive the vessel forward just as a partially submerged propeller would do. Vane wheel propulsion has been proved successful in smooth or partially smooth water, but its application to other conditions remains to be tested. Subject to this proviso, the makers believe that vane wheels may be applied for any draught and may replace any other form of ship propulsion.

The Flettner Rudder.—This streamline rudder, named after the inventor, Anton Flettner, aroused considerable attention in shipping circles, because it makes possible the hand steering of even large ships, thus obviating the necessity of large steam or electric-hydraulic steering gears. The Flettner rudder consists of a main and an auxiliary rudder, the latter having a very much smaller surface than the former. The power required to turn the auxiliary rudder is relatively small and the arrangement is such that any movement of the smaller rudder causes a pressure difference on the large rudder and automatically moves it. The present form is the outcome of a large amount of experimental work done on aeroplanes and in the experimental tank in Germany, and further experience has been gained on a small 210-ton Dutch steamer fitted with this form of rudder, which has been in operation for some months. The first large installation is to be fitted on the 8000-ton Hamburg-America Line motor ship Odenwald, now in course of completion.

Speed Reduction Gearing.

Reviewing the outlook in this important section of present-day marine engineering, it may be said that improvements have been made in the accuracy of large gear-cutting machines, in tooth grinding, and in the instruments used for testing the accuracy of tooth form and spacing. Speaking of single reduction gearing, it may be taken that the size of a wheel is only limited by the life of the hub or tool cutting it. Single-geared installations have, on the whole, given uniform satisfaction; but, unfortunately, the same cannot be said with regard to double-geared installations, either as regards noise, vibration or endurance. There still remain important problems to be solved before this form of speed reduction gear can be regarded as reasonably free from the possibility of trouble. A large number of gears have been cut during the year, principally by Parsons, the Power Plant Company, and Metropolitan-Vickers. The latter firm has introduced a new floating frame which allows the pinion to adjust itself to the gear wheel in the event of distortion taking place. Some builders and gear cutters have experienced no difficulties, others have been less fortunate; but there is no reason why the difficulties should not be overcome if the mathematical, mechanical and physical complications of the problem be frankly faced. The papers of Dr. Smith and Mr. J. Wilkie on the Nodal drive fitted to the Melmore Head provided an opportunity of a discussion of the subject of reduction gearing at the spring meetings of the Institution of Naval Architects. It is satisfactory to learn that no troubles have been experienced on the six ships fitted with the Nodal drive, representing a total shaft horse-power of 47,000.

Electrical Developments.

A noteworthy feature of some of the ships of the year is the increase in size of the electrical equipment and the extended use of electrically driven auxiliary machinery in the engine-room, on deck and about the ship for ventilating, heating and domestic machinery. The White Star liner Pittsburgh and the Holland-America liner Volendam, both built by Harland and Wolff, are good examples of this type of ship, with well laid out engine-rooms free from steam piping. Progress was made with electrical winch machinery, which is not only being used more extensively on British ships, but is finding its way into Scandinavian markets. The first electrically propelled fruit carrier, San Benito, built by Workman-Clark in 1921, and fitted with turbo-generating machinery by the British Thomson-Houston Company, Limited, continued to give good results, and three other electrically propelled motor ships were ordered by the same owners and are referred to elsewhere in this issue. Among smaller electrical apparatus we may recall the Cheruikeef electric log, described in our issue of September 22nd, and the new anti-fouling device fitted on the motor ship Adda by J. Stone and Co., Limited.

New Rules and Standards.

Revised rules for the construction and classification of steel ships were issued by Lloyd's Register about the middle of the year. The previous set of rules date from the year 1899, and the new rules embody the findings of research and experience since that date. They should materially assist in simplifying designs and in reducing the weight of steel employed. A new set of rules dealing with oil ships is shortly expected. The report of the Committee of the British Engineering Standards Association on the standardisation of marine tail shafts was issued towards the close of the year. It has been arranged that for ordinary single-screw cargo boats with shafts from 6in. to 20in. in diameter at least there shall only be thirteen standard lengths of tail shafts. The coned end of the shaft taking the propeller has been standardised, so that in future it will be possible to take shafts from one vessel and fit them to another with the same diameter of tail shaft with every confidence. Propellers and propeller bosses may be prepared beforehand, and with the loyal co-operation of shipowners and marine superintendents the new standards should prove very important in effecting quick replacements and repairs.

Repairs and Reconditioning.

Although in the early part of the year a large number of repairs were diverted to German, Belgian and Dutch yards by reason of lower costs and steadier labour conditions on the Continent, British yards dealt with some important overhauls, and in some cases it was possible thus to employ a larger number of men. We have referred to the conversion of the Mauretania and Berengaria to oil burning. Another large repair job was the T.S.S. Ascanius, of the Holt Line, which was reconditioned and fitted with Schmidt superheaters at Palmer's yard, while on the North Coast generally a large number of ships were dry-docked and repaired. Repair work on the Clyde included the first turbine steamer built for commercial work, the King Edward, the machinery being brought up to date. An early Allan liner, the Victorian, also had her turbines renewed and was fitted with single reduction gearing at the Fairfield yard. The Harland and Wolff establishments at Belfast and Glasgow also completed a large amount of repair work.

The growing importance of Southampton as the chief Atlantic port for large liners has made increased repairing facilities necessary at the establishments of both Harland and Wolff and John I. Thornycroft, Limited. An interesting repair carried out at the former yard was the making good of the stern post of the Olympic. At the Thornycroft yard a large number of repairs and refits were done to oil tankers and turbines and Diesel engines were dealt with. Special incidents were the docking of the Aquitania for the first time in the Trafalgar Dock, and later the docking of the Berengaria. The latter vessel is the largest ship ever docked in Southampton, and when in dock she had only 18in. clearance on the whole length between the dock gate and the head of the dock and only 8in. difference between her beam and the width of the dock entrance. The Berengaria has been successfully docked on three occasions, and on one occasion the whole operation was accomplished in the short time of twenty-eight minutes. In addition to doing all the repair work for the Cunard Company, John I. Thornycroft also arranged to do any repairs and refits required by Canadian Steamships, Limited.

The Extraction of Oil from Bituminous Materials.

ANY new process which has for its object the transformation or conversion of materials which have hitherto been regarded as useless into valuable commodities, such, for instance, as oil, is always sure to command public attention. In addition to oil shales, torbanite and similar minerals, materials such as sawdust, peat and waste animal matter are all capable of yielding valuable products if only a plant can be provided for the purpose by which the process is capable of being made a commercial success. The Fusion Corporation, Limited, of Middlewich, Cheshire, has designed and constructed a plant embracing several novel features, which has been at work for some time with excellent results on all kinds of materials. It comprises a rotary retort, into which the material to be treated is introduced at slightly above the atmospheric temperature, and is gradually heated as it travels forward with uniform speed and thickness. By an ingenious but extremely simple device scaling and caking inside the tube are prevented without poking. In most cases oil commences to come off at slightly above 250 deg. Cent. and continues to be given off up to temperatures varying between 400 deg. and 600 deg. Cent., according to the material and method of treatment.

Views of the company's laboratory, where experiments are carried out on samples of materials from a few pounds in weight, are given in Figs. 1 and 2, page 14, while Figs. 3 and 4 show a plant, which is capable of dealing with materials on a large scale. Fig. 5 shows a longitudinal and transverse section of the larger retort, and Fig. 6 shows diagrammatically the action of the pulverisers or breakers in the retort, on which the successful action of the apparatus largely depends.

The full-size plant consists of the following parts :—The gas producer, combustion chamber and furnace, the retort rotating in the furnace and its stationary feeding chamber, and the oil condensers. Referring to the sectional views, Fig. 5, A is the raw material hopper, B the air-tight feed valve, E the breakers or pulverisers, F the rotating tube, G the ports or dampers for conveying the products of combustion to the furnace round the tube, H the spent material hopper fitted with an air-tight valve for discharge, K gas feed conduit, L gas inlet port to the combustion chamber N, M air inlet port to the chamber, P flue to the chimney, R an asbestos packing ring for making the joint between the feed chamber and the tube F. T is the gearing for rotating the tube, V rollers upon which the tube runs, and W is the oil vapour and gas outlet. The retort is horizontal, the material being fed in at one end flows along the tube until it reaches the other end, where it is ejected. The breakers or pulverisers, which may be in one or more lengths, are carried through practically the full length of the tube.

The function of the breaker or pulveriser is to prevent scaling on the walls of the tube or retort, to avoid the caking or "balling" of the material and to break up the material during treatment. These breakers are not separately or positively driven, but are placed loosely in the tube. As the tube revolves it takes the breaker round with it until the latter arrives at a point where it overbalances. The material then falls over on to another point or arm of the breaker—see Fig. 7. This point does not come in contact with the metal of the tube, but falls on to a layer of the material being treated, and the result, in practice, is a gentle thud. Thus the retort, when working, is almost noiseless. In operation these breakers have a hammer action, not a scraping action.

The joint between the rotating retort and the stationary chamber is made air-tight by means of a gland of the following construction. A thin iron diaphragm, rendered additionally flexible by circular corrugations, is attached to the stationary chamber and pressed by springs against the end of the rotating retort.

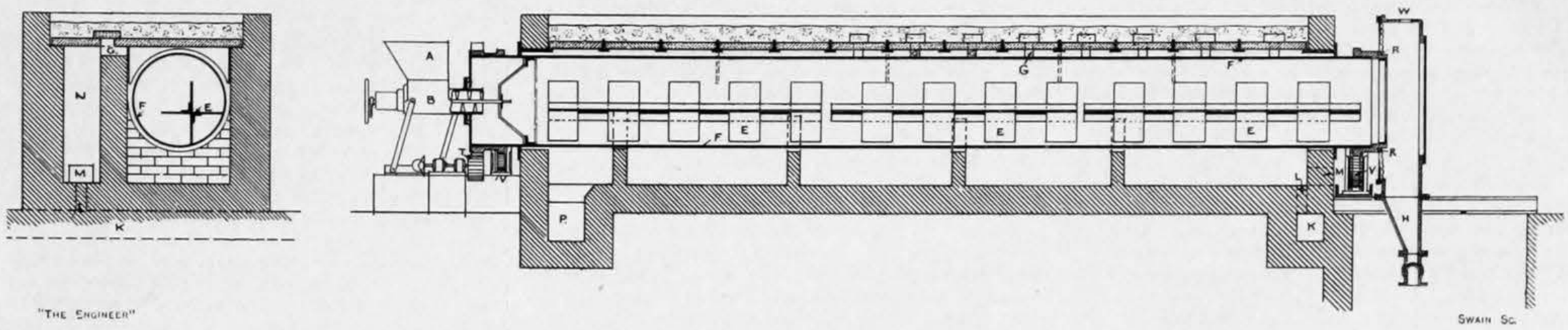
A connection is mounted on the stationary chamber for the purpose of carrying off the gas and oil vapours. The latter go to the condensers, which may be of any approved type, and the gas may be utilised in the combustion chamber, if not wanted for other purposes. There are sight holes and examination doors in the walls of the chamber. The heating producer, if required, is of the simple type, so as to save the necessity of a boiler. Some of the spent material itself can be used as fuel in the producer, when coals or certain cannels or torbanite are being treated. The gas generated in the producer is conveyed into the combustion chamber, where it meets an appropriate supply of air and combustion takes place. The resulting hot gases pass on to the furnace, where they play round the rotating retort, and are then carried away to the chimney.

The walls of the furnace closely surround the retort and are carried to within a few inches of each end. At each end of the retort which projects from the furnace there is mounted a circular iron ring which rests on rollers, thus forming the bearings upon which the retort rotates, the rotation being effected by a spur wheel and pinion.

The company also makes a double-tube type of retort with inner and outer concentric cylinders. In this case the material delivered into the retort flows along the inner tube until it reaches the end where it falls into the outer tube, flowing back through the annular space between the tubes and being finally ejected at the same end at which it is fed in.

One of the first questions which the reader is likely to ask is, "The tube being horizontal, how is the material caused to flow from one end to the other ?" The question arises, perhaps, quite naturally from the fact that in other rotary tube appliances for drying and calcining materials the tube is inclined. Mr. Hutchins has found that the inclination is unnecessary, all that is required being a "head" on the granular material. In other words, granular material under agitation will tend to find its own level. It is found in this retort that the head required is about 2in.; but, of course, it varies with the quantity being treated in a given time and to some extent with the amount of agitation, &c., or speed of rotation and the number of blades in the pulveriser. A further variation may take place according to the grading of the material being treated. Owing to the fact that the different materials treated require longer or shorter heat treatment, the quantity to be treated in a given time varies, and consequently the head required varies. But, as previously explained, the average head required in the retort is about 2in.; that is, at the feed end of the retort the depth of the material is about 2in. greater than at the outlet end. By placing the retort horizontal the "flow" of the material is not retarded or otherwise interfered with by the skin friction of the tube, but is entirely dependent upon the head, and therefore the "flow" is more regular and uniform than is the case with an inclined tube—a very essential point in heat treatment of oil shales and the like.

Hitherto the use of rotary tubes for certain purposes has been restricted owing to the difficulty of making a suitable gland of a large diameter. Many varied forms of glands have been tried, but the trouble has been due, not only to the diameter, but also to the fact that the tube must sooner or later not run exactly true. In this case the nose of the rotating tube enters the stationary chamber, the rotating tube being, say, 2ft. 6in. diameter and the cast iron chamber, say, 5ft. diameter. Mounted on the side of the cast iron chamber is an annulus of thin steel plate, say, of 26 gauge thickness, which, for the purpose of making its movement uniform and stopping twisting or warping, and to add additional flexibility, has annular corrugations formed in it. The annulus, the outside diameter of which is 5ft., is fixed to the stationary chamber. The hole in the annulus is slightly over 2ft. 6in. in diameter, and fastened to the inner edge of the hole is a stiffening ring about



"THE ENGINEER" SWAIN Sc.

FIG. 5—TRANSVERSE AND LONGITUDINAL SECTIONS OF RETORT FOR EXTRACTING OIL

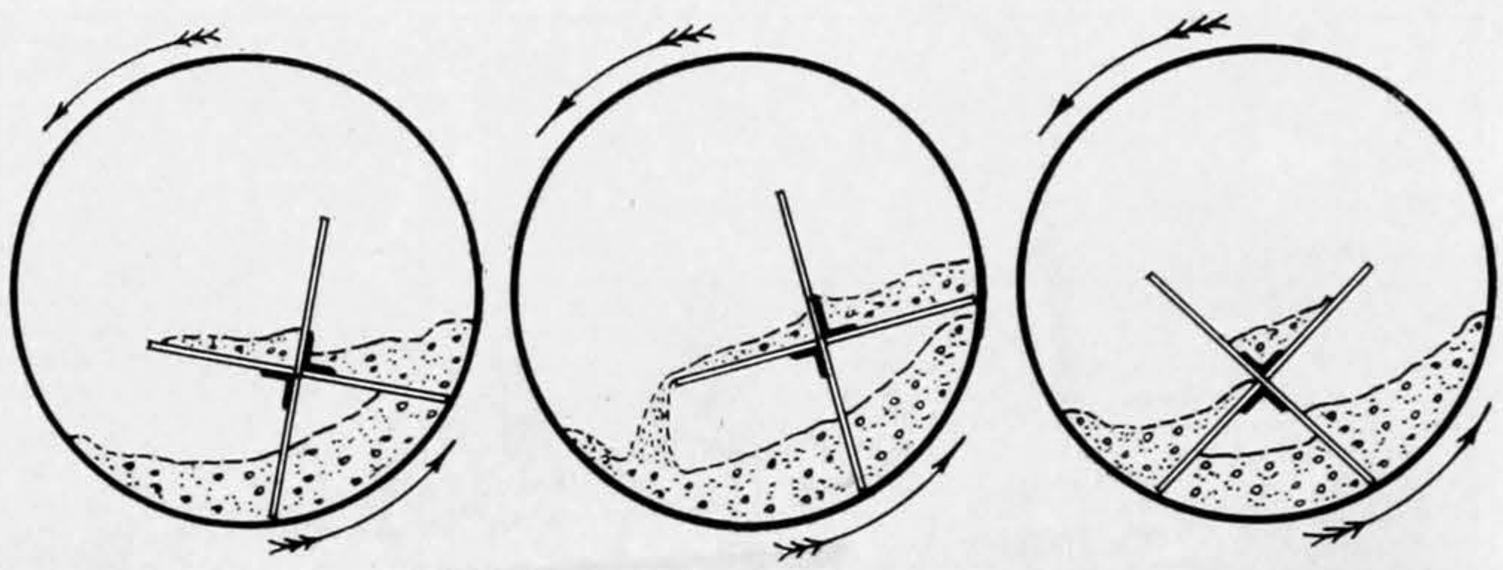


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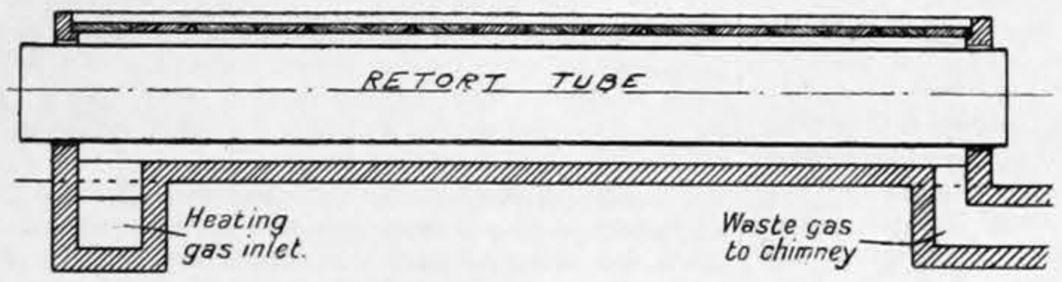
FIG. 7—DIAGRAMS ILLUSTRATING THE ACTION OF THE PULVERISERS IN THE RETORT



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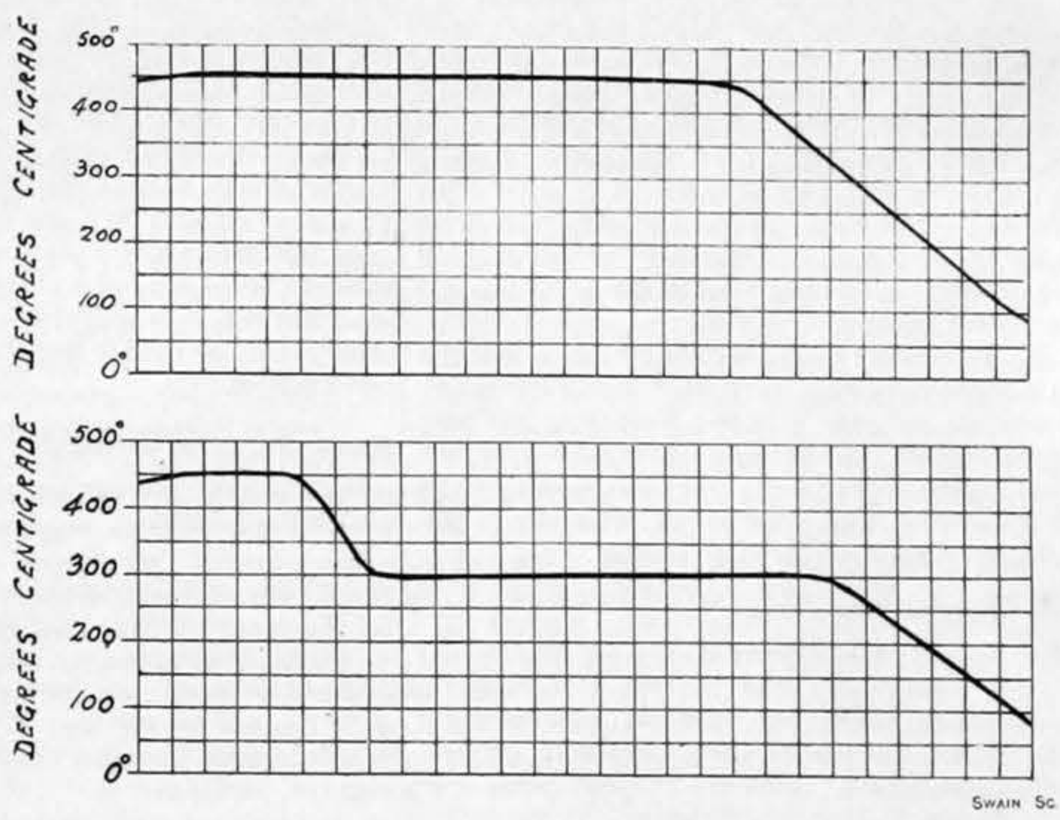

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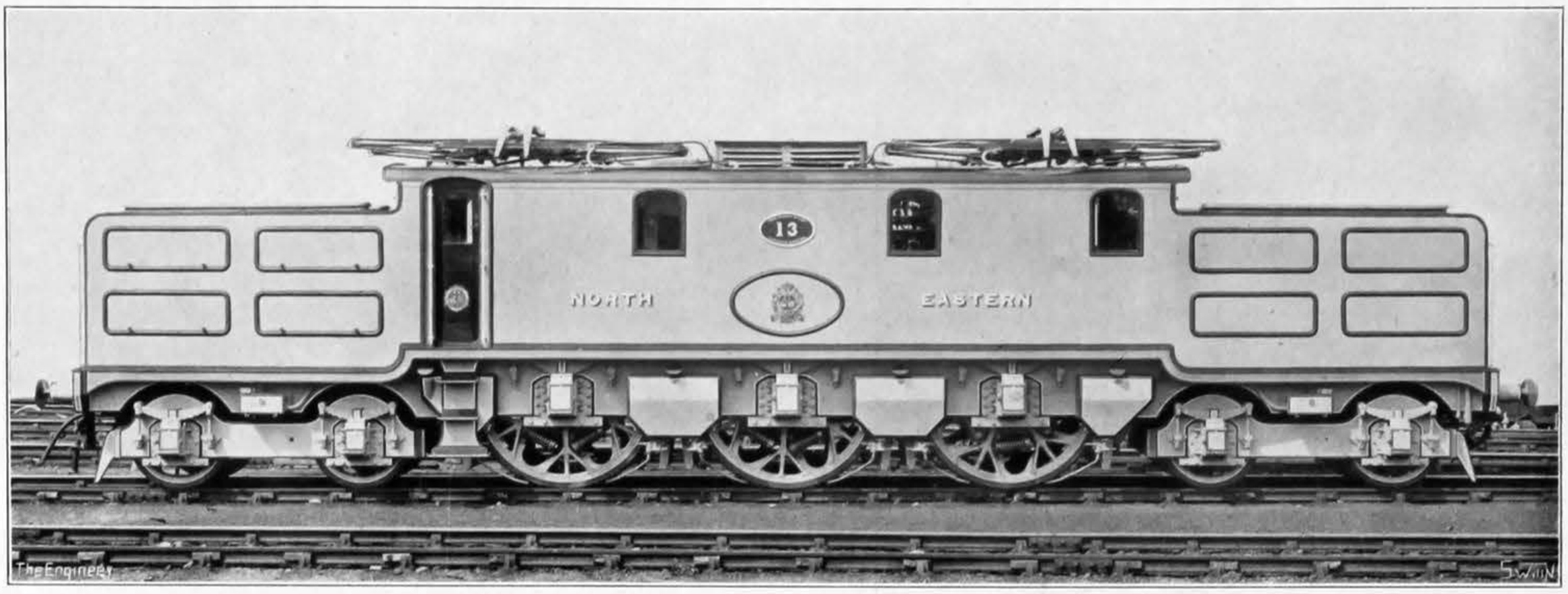
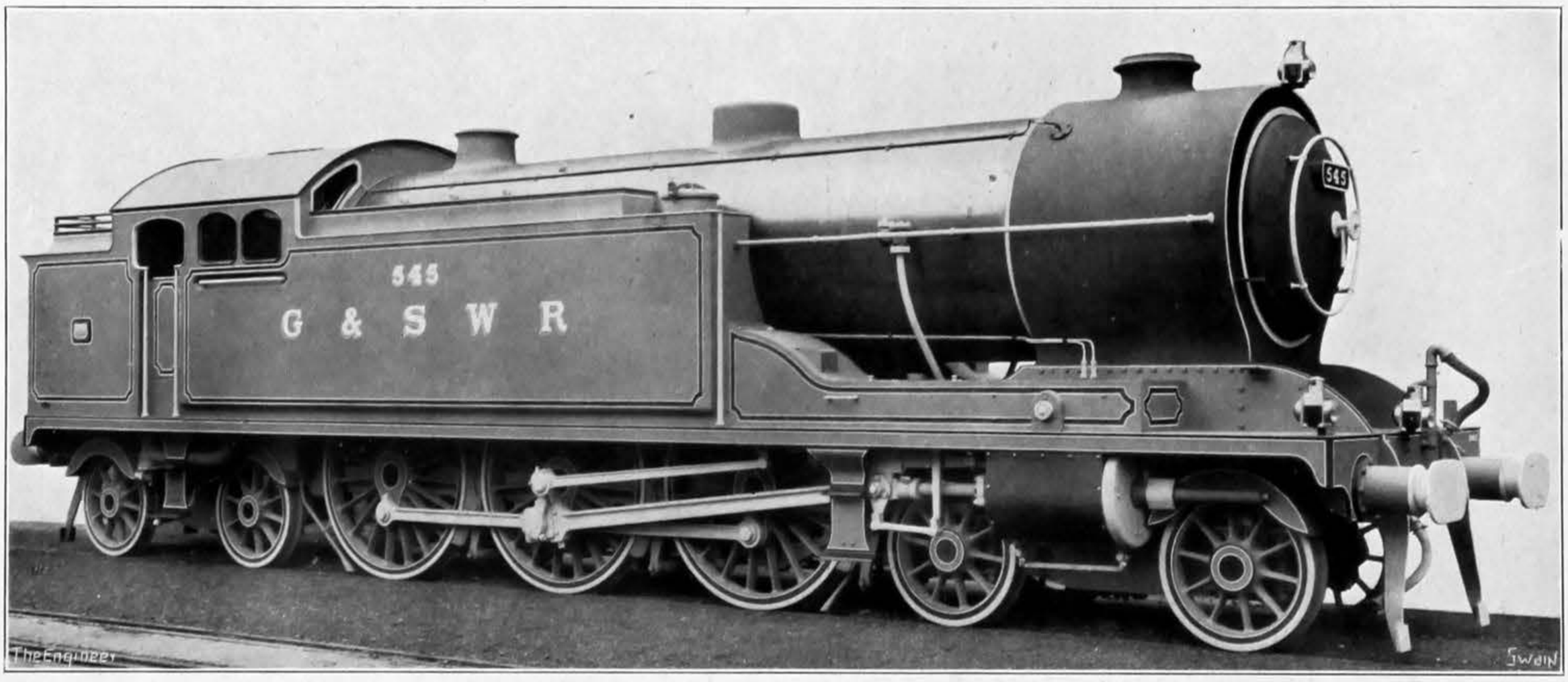
FIG. 6—CURVES SHOWING RETORT TEMPERATURES

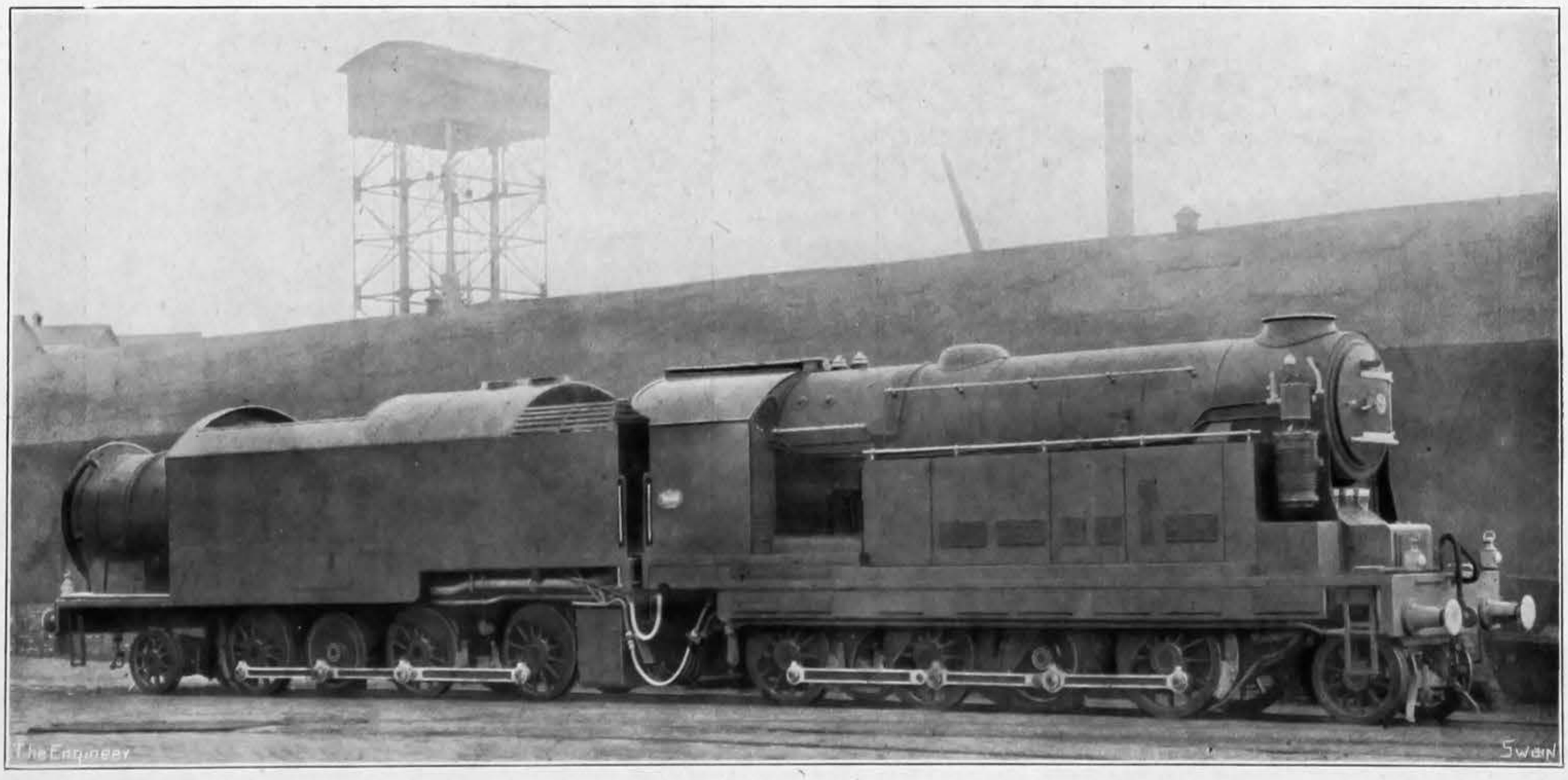
SOME LOCOMOTIVES OF 1922



NORTH-EASTERN RAILWAY—1800 H.P. ELECTRIC LOCOMOTIVE

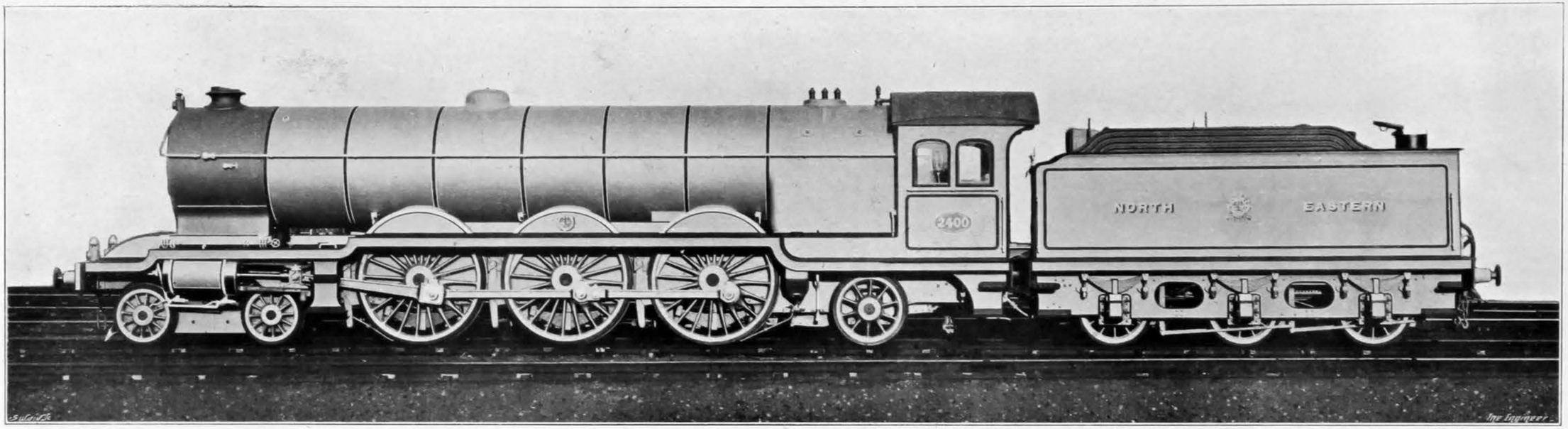


GLASGOW AND SOUTH-WESTERN RAILWAY—BALTIC TANK LOCOMOTIVE



RAMSAY CONDENSING TURBO-ELECTRIC LOCOMOTIVE

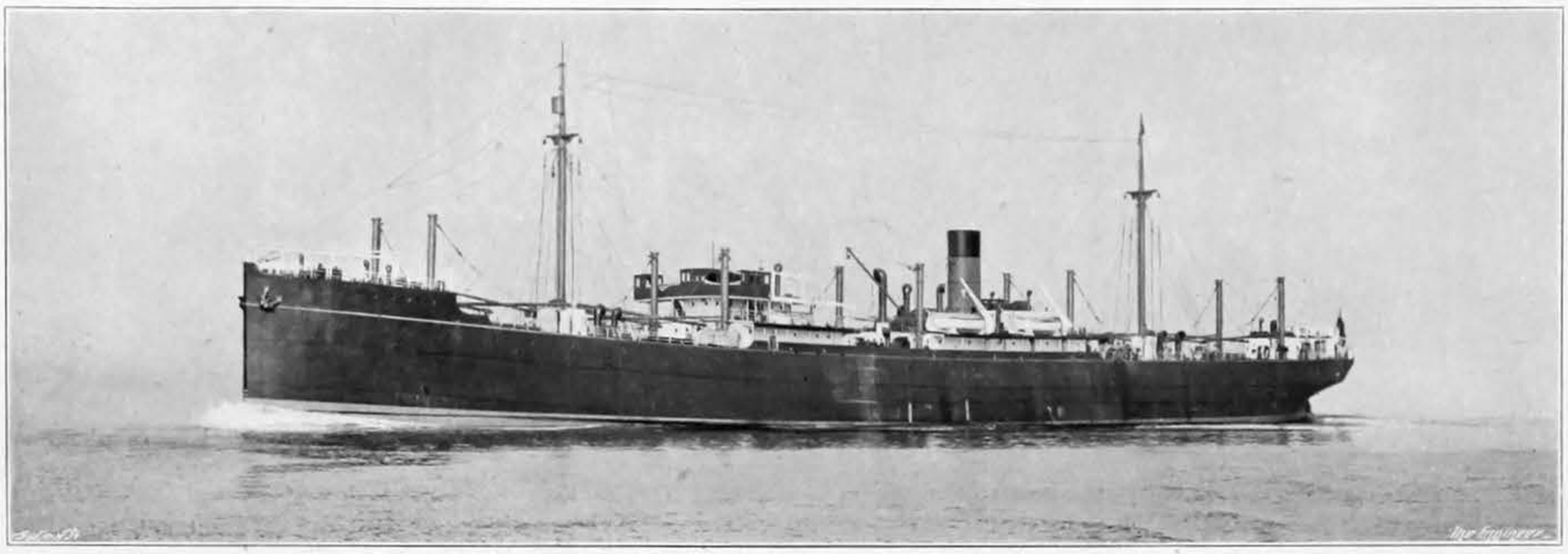
TWO THREE-CYLINDER LOCOMOTIVES OF 1922



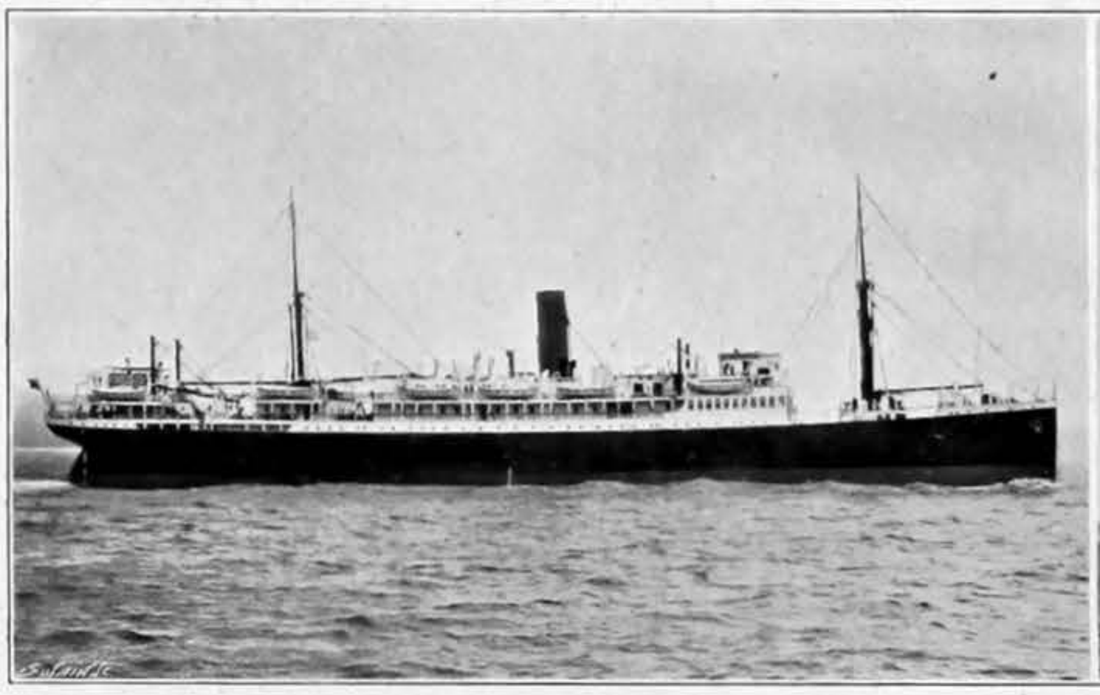
N.E.R. THREE-CYLINDER "PACIFIC" TYPE PASSENGER ENGINE

G.N.R. THREE-CYLINDER "PACIFIC" TYPE PASSENGER ENGINE

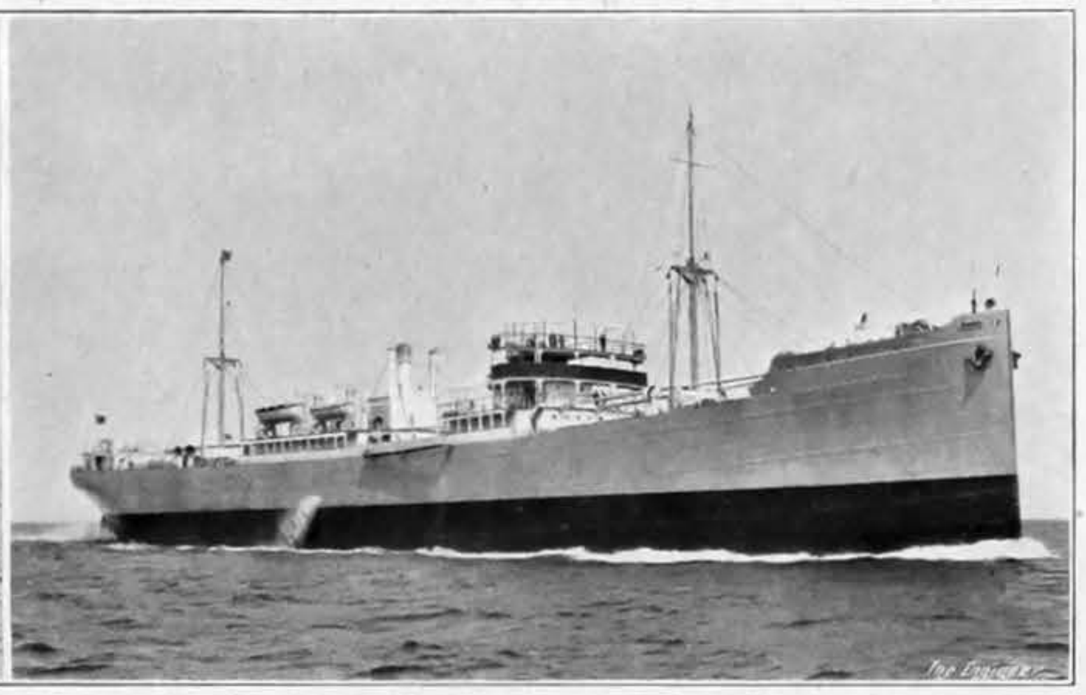
SOME MOTOR SHIPS AND LINERS OF 1922



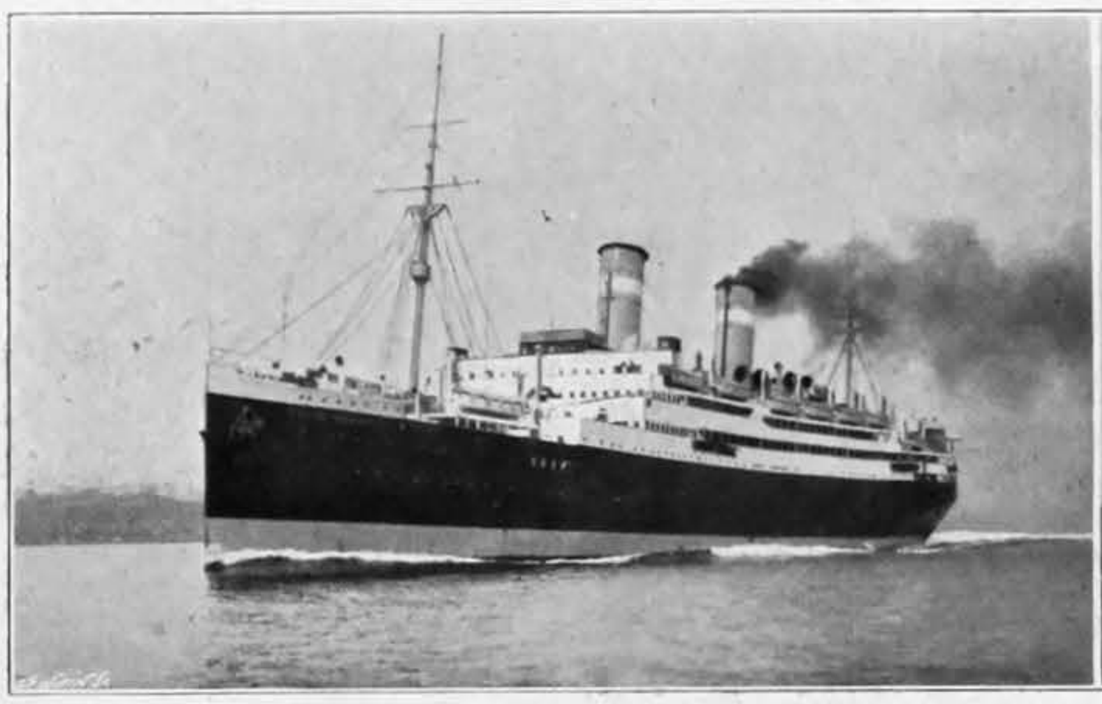
THE UNION STEAMSHIP COMPANY OF NEW ZEALAND'S MOTOR SHIP HAURAKI



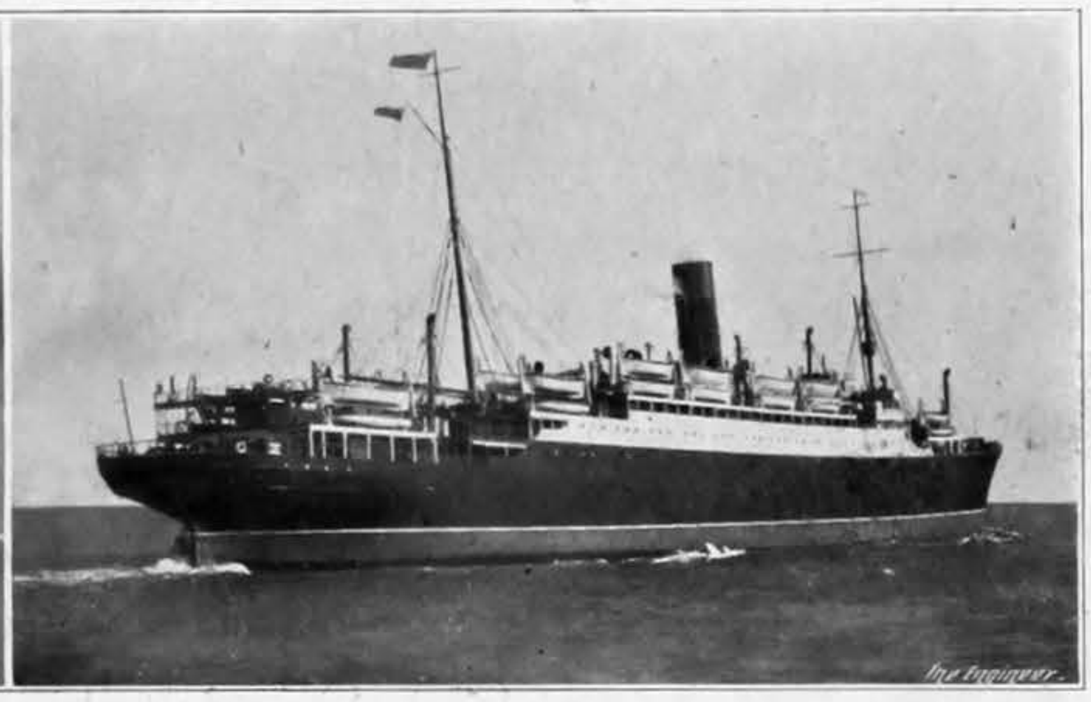
THE ELDER-DEMPSTER MOTOR LINER ADDA



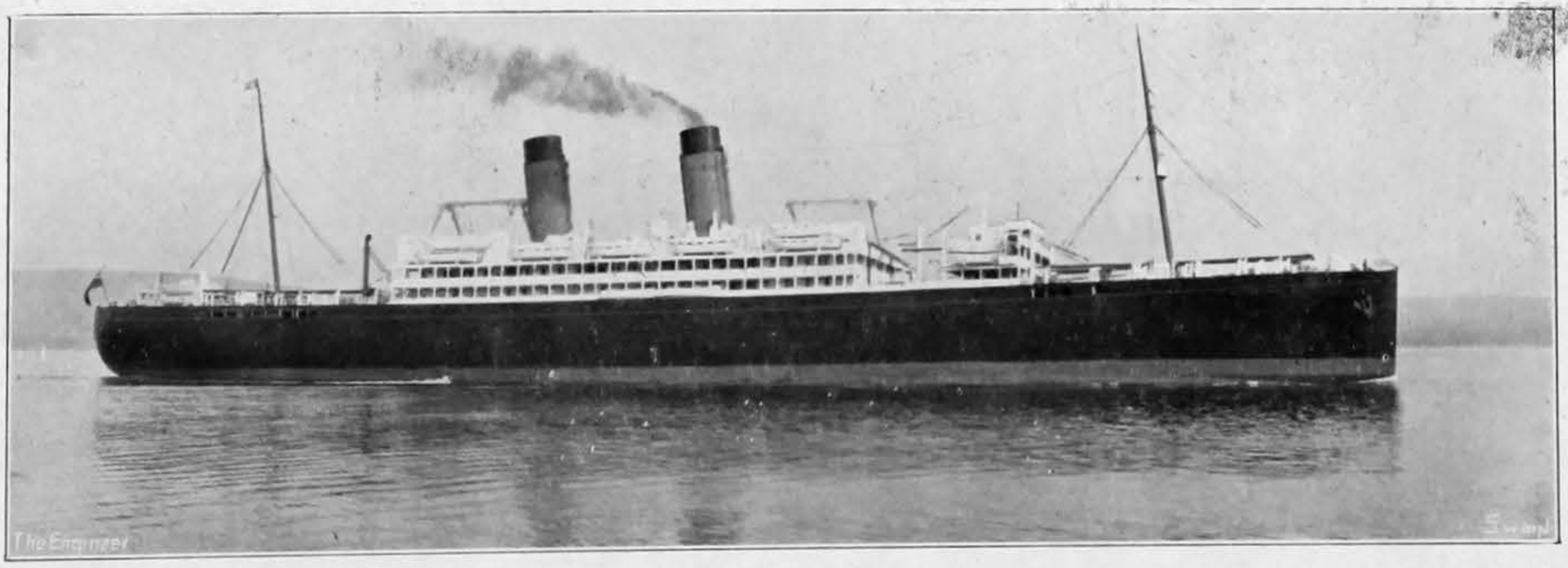
THE DOXFORD-ENGINED MOTOR SHIP EKNAREN



THE LLOYD SABAUDO LINER CONTE ROSSO

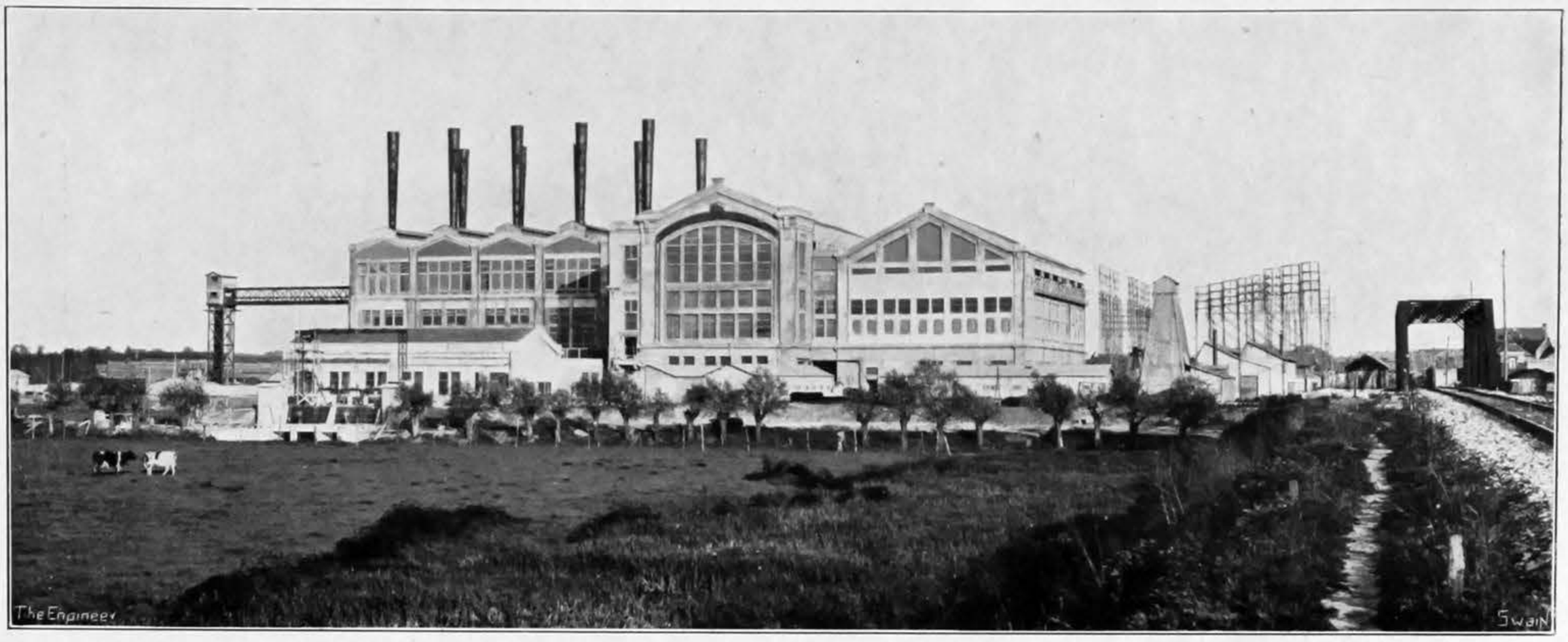


THE CUNARD LINER ANTONIA

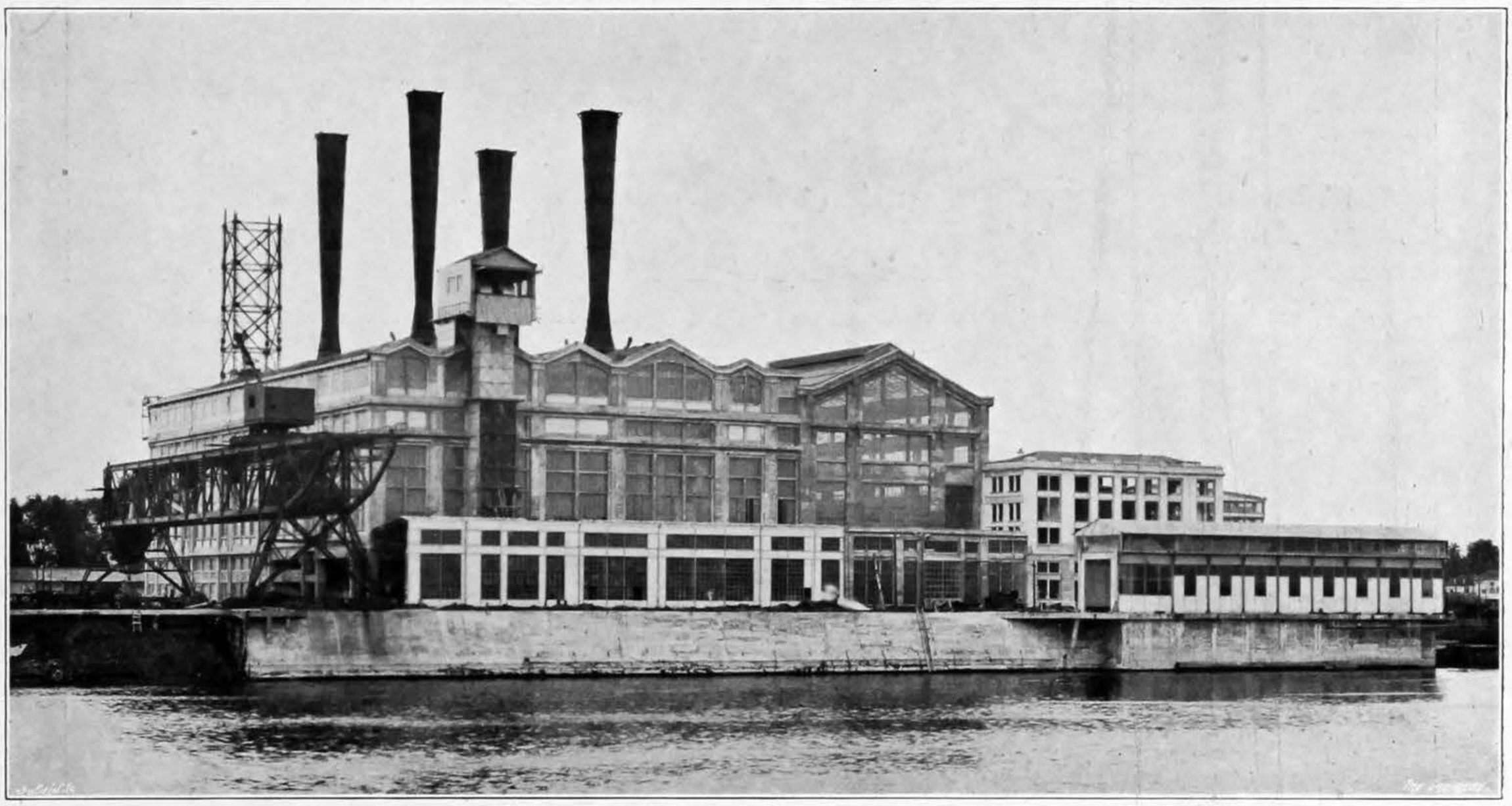


THE TRIPLE-SCREW WHITE STAR LINER PITTSBURGH

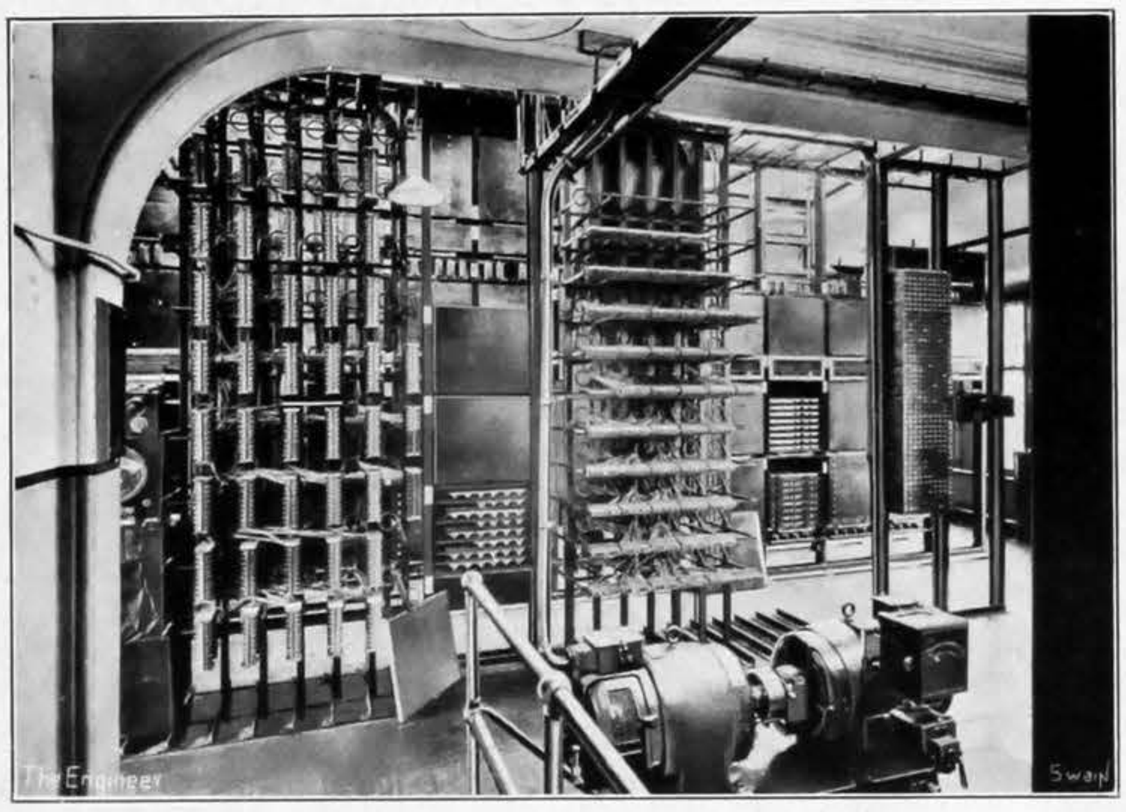
ELECTRICAL ENGINEERING IN 1922



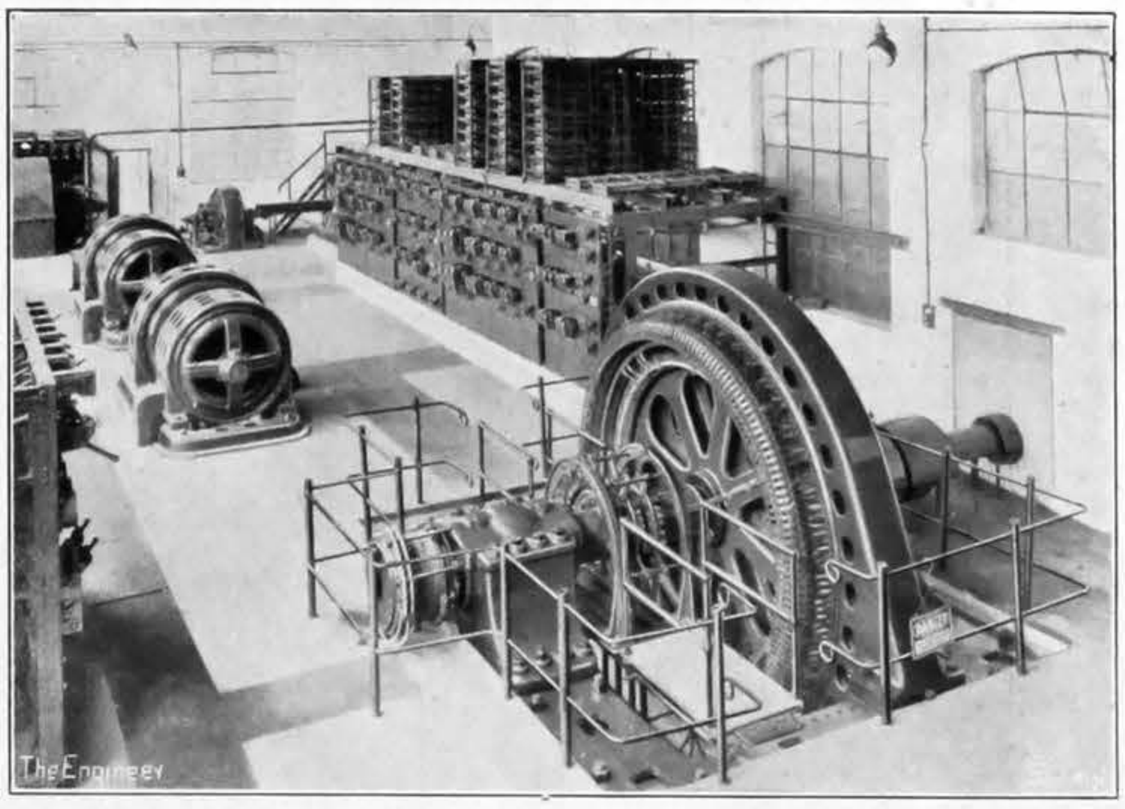
CENTRAL ELECTRIC POWER STATION AT COMINES, NEAR LILLE



CENTRAL ELECTRIC POWER STATION AT GENNEVILLIERS, NEAR PARIS



AUTOMATIC TELEPHONE EXCHANGE FLEETWOOD



ELECTRICAL ROLLING MILL, SHEFFIELD

lin. by lin., which, by means of flat springs, is pressed against the asbestos ring R mounted on the rotating tube.

It will be noted that the gas from the producer enters the furnace surrounding the retort at one end of the apparatus, and the material to be treated at the other end, so that the latter is subjected to a gradual rise in temperature. The heat can be regulated by the flues and dampers shown at G in Fig. 5 to suit different materials. In the series of diagrams given in Fig. 7, A shows the heat curve steadily rising from 100 deg. to 450 deg. Cent.; B shows a quick rise during one-third of the length of the retort, after which the heat remains constant ; and C shows the heat regulated in defined stages. This arrangement enables the retort to treat different kinds of materials with equally efficient results. Some give off their oils within a few minutes, when subjected to the correct temperature ; others must be kept at that temperature for longer periods, in some cases for an hour. In diagram A the time factor is short, in B it is long, while in C exothermic action takes place.

The plant is not expensive to install, requires very little power to operate, and is entirely self-acting, the materials being charged into and discharged from the retort automatically. The makers claim that 1.5 horse-power is sufficient for driving the feed, the retort, and the discharge for a 5-ton unit. It is further claimed that the production of gas rarely exceeds 1800 cubic feet per ton of material treated, and has been as low as 1100 cubic feet, showing that the lighter oils are not "cracked" or destroyed ; hence there is a larger yield at a lower specific gravity.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Pig Iron Trade and January Quarterly Meeting Prospects.

THE quarterly meeting is due on the 11th inst. in Birmingham, and it is hoped that by that time the forward movement will be fairly in progress. Consumers are taking much more interest than they have done for some time in their future supplies of pig iron, and have kept more or less constantly in touch with the sellers, with a view to testing prices. It is respecting pig iron that the quarterly meeting presents the most interesting probabilities. Most brands of pig iron are from 1s. to 1s. 6d. dearer than they were. It is agreed that more iron will be called for in the New Year, and the general tendency is to place heavier contracts. The manufacturer, however, is by no means anxious for forward business at the present finely cut prices. The South Staffordshire furnace which stopped a little while ago has been restarted, and a furnace belonging to a Northampton firm extinguished at the same time, has also resumed operations. A constant difficulty is still the high price of coke. The sellers of this fuel are quoting £1 3s. at the ovens for Yorkshire coke, a figure which represents a rise of 5s. as compared with the quotation a year ago. Until the consumer is prepared to pay a better price for pig iron, long contracts are extremely unlikely.

1923 Finished Iron Prospects.

There are better prospects for the South Staffordshire finished iron trade in 1923. Production costs are still disproportionately high, owing to the distance from which raw material has to be imported. Some relief has, however, been afforded by the readjustment of railway rates, and the concessions granted at the beginning of December have put fresh hope into iron and steel masters. But inward and outward traffic must yet be carried at much less cost than at present. The course of the deflation of Midland and Staffordshire iron and steel prices since the boom of 1920 can be traced in the following table :—

	1920.	1921.	1922.
	s. d.	s. d.	s. d.
Northants forge	235 to 242 6	.. 82 6	.. 70 0
Northants No. 3 foundry	247 6	.. 90 0	.. 80 0
Derbyshire forge	235 0	.. 87 6	.. 72 6
Derbyshire No. 3 foundry	260 0	.. 92 6	.. 82 6

	1920.	1921.	1922.
	£ s. d.	£ s. d.	£ s. d.
Staffs. marked bars ..	33 10 0	.. 16 0 0	.. 13 10 0
Staffs. unmarked bars	28 10 0	.. 13 0 0	.. 10 5 0*
Iron strip	33 0 0	.. 13 10 0	.. 10 10 0
Galvanised sheets ..	31 0 0	.. 17 0 0*	.. 17 5 0*
Steel hoops	26 15 0	.. 12 10 0	.. 11 0 0
Steel angles	24 0 0	.. 10 0 0	.. 8 15 0
Tees	25 0 0	.. 11 0 0	.. 10 0 0
Joists	24 0 0	.. 10 10 0	.. 9 0 0
Ship, bridge and tank plates	24 5 0	.. 10 10 0	.. 9 0 0*
Steel boiler plates ..	31 0 0	.. 14 10 0	.. 12 10 0
Bessemer billets ..	16 0 0*	.. 17 15 0 to 8 0 0	.. 7 5 0*

* Up.

Current Steel Conditions.

The advance of the last few weeks in Bessemer billets is being well maintained, £7 7s. 6d. being the minimum. Some firms quote well above this figure, a common figure being £7 10s. A short time ago continental billets were obtainable at £6 10s.; but the lowest quotation is now £7, and the uncertainty with regard to delivery discourages business in continental material of all sorts. The re-rolling firms are fairly active, producing railway material and strip for tube making. The makers of sheets have become busier. Several of the local mills have been called upon to furnish black sheets to large galvanising concerns in South Wales and elsewhere. Very good quantities also have been taken by motor car builders for the making of bonnets and various other parts. Galvanised sheets continue at about £17 5s., the turnover being well up to the average. Some advance has taken place in finished steel other than sheets, following the rise in the value of semi-finished steel. It is thought likely that values will advance in the New Year for most manufactured descriptions.

Rising Values for Scrap.

Scrap is in brisk request, and values continue to appreciate. Steel scrap has advanced sharply to 70s. and upwards, while wrought iron scrap commands about 82s. 6d.

Iron Selling Prices in 1922.

It is interesting to find that notwithstanding harassing competition from the Continent, selling prices of manufactured iron ascertained under the Midland Wages Board improved in the late autumn of the last year. From the output figures of the selected firms in the subjoined summary of the five bi-monthly ascertainments to date, it will be seen that there has been a sustained expansion :—

	Tonnage.	Price.
		£ s. d.
January–February ..	12,389	.. 13 2 3
March–April	13,987	.. 11 17 3
May–June	16,462	.. 11 6 5
July–August	19,281	.. 10 16 9
September–October ..	21,974	.. 10 17 9

This gives a mean price of £11 12s. 1d., against £22 14s. 3d. in the corresponding period of 1921, £30 8s. 6d. in 1920, £7 1s. in 1914 and £8 4s. in 1913. The total output for the ten months, 84,093 tons, compares with 60,801 tons in the corresponding period of 1921 and 132,073 tons in 1920.

Engineering Outlook for 1923

I am glad to be able to speak more hopefully of the engineering outlook in this district for 1923. South Staffordshire bridge builders and structural engineers, though better employed than they were a while ago, have not yet anything like enough business to go round. The disadvantage against which this district has always to struggle, especially regarding foreign orders, owing to its inland situation, has been accentuated by the high railway rates. Concessions granted during the year have done something to mitigate the hardship, and traders are grateful for even a small measure of relief. But in times of depression, the handicap of transport from the interior to the seaboard, whatever its degree, must inevitably become more noticeable so far as overseas contracts are concerned. South Staffordshire bridge builders and constructional engineers can but look for compensation at home, where their geographical position gives them ready access to a larger radius than any other industrial district can command. Some substantial orders have been secured for execution this year by the Birmingham railway wagon-building companies on account of the Indian railways, and tentative orders have been forthcoming for other systems abroad, while the expansion of coal exports has begun to stimulate cautious buying by private traders at home. The New Year promises to better its predecessor. India is only now starting on its big programme of railway development ; extensions of the Australian lines are being proceeded with ; many more wagons will be required by South America ; and Africa is moving. Electrification schemes at home are expected to yield valuable orders for rolling stock, and now that the railways of the country are re-grouped, developments which have been in suspense will no doubt go forward. North Staffordshire has participated in orders lately given out for locomotives. The Birmingham machine tool trade has suffered from the arrest of reconstruction work. Surplus resources left over from the war have increased the difficulty of finding new outlets. There are still large accumulations of lathes and other machine tools to be disposed of, but rather more optimism attaches to 1923. Last year manufacturers confined their purchases pretty much to new types of machinery which promised immediate economies in production costs, but this year a better all-round trade is looked for.

The Birmingham Brass Trade.

The beginning of the year finds very little unemployment among the Birmingham brassworkers. General brassfoundry, such as enters into domestic furnishing, was in better request during the latter part of the year just closed. The renewed activity of the motor car industry, though it is only partial, has put additional employment in the way of workers in brass, and in the electrical fittings and plumbers' brassfoundry branches the diversion of trade through the underselling of German makers is now less in eivdence. Selling prices have sunk to an unremunerative level in some departments, particularly in the home trade, for which competition is most severe. We are getting near to pre-war prices in some of the export lines of goods. Australia, it is interesting to note, remains one of our principal markets. The standard of wages has gone up appreciably, as have all dead charges, so that the industry must needs make itself efficient if it is to enjoy material prosperity. Happily, it is doing so. Progress is being constantly made on the technical side of the trade. Considerable attention is concentrated on scientific problems connected with the manufacture of brass. The range of applications is extending, and if the past year has not been marked by any outstanding advance in the equipment of the industry, the effort after greater efficiency is not being relaxed.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

General Outlook.

THE markets open this week with a very cheerful tone, but there is not yet a large business being done. The first day of the year is, of course, a strict holiday in the North, and people are only just beginning to attend to business ; but it is obvious that there is more determination to look on the bright side of things, and there is much more confidence in the stability of prices. It would naturally be a mistake to assume that prices are now permanently on the up grade. This may be the case with regard to one or two of the metal markets, but there is no probability of higher prices in most departments ; and, as a matter of fact, the prospects of industry will be much better if prices are kept low. A year of low prices for all raw materials is essential for the recovery of activity. The old rule of "small profits and quick returns" should govern business matters through the year on which we have just entered, for extravagant profits are the special curse of war-time trade.

Metals.

The market for copper is steady, but has a very strong appearance. The activity in the speculative market for standard copper in London is an indication that much more interest is now being taken in copper, but it is to be hoped that speculators will not drive the price up beyond what is justified by the improving prospects of trade. At the moment the prices for raw copper and refined ingots are moderate enough, and the only really extravagant prices are to be found in manufactured copper and metals. These are not universal throughout the whole list, for the price of 6½d. per lb. for yellow metal rods is moderate enough, and yellow-made "braziers" at 7¾d. are not extravagantly dear. A puzzling question is why yellow metal "braziers" should be quoted at about £12 more than rods, while copper "braziers" are quoted at £13 10s. per ton less than copper rods. The whole list of "official" prices for manufactured metals wants a drastic revision, and the trade will not be in a satisfactory state until it gets it. Reports from America give a fairly cheerful account of the copper market in the country, but it is obvious that an increase in the production is taking place. There is, of course, a fair increase in the demand, and the principal producers are reported as being well sold forward, but it is too early yet to learn whether the growth in the output is faster than that in the consumption. The idea that copper is now as low as it is likely to be during the current year should have an effect on the holding of stocks by consumers, and if this movement takes place a large part of the burden of holding copper could be transferred from the shoulders of the producer. The market for tin opens with an appearance of strength, which may quite possibly lead to higher prices in the early part of the year. There is a theory that America will soon begin to buy largely, but we are rather in the dark as to the state of the stocks of tin held by American consumers. The engineering trade here will probably be rather a better consumer of tin than it has been in 1922, and there are some signs of improvement in the tin-plate trade, which may lead to a larger consumption. Altogether, the prospects seem to be fairly favourable. With regard to lead, the prospects of an increased supply do not appear to be very good. It seems now doubtful whether we shall obtain any large quantity from Mexico, but this is still one of the possibilities. The price remains high, but no relief is in sight for the consumer. Spelter remains a very steady market for prompt ; but the large backwardation on three months metal, amounting to £3 per ton, is unfavourable.

Pig Iron

The market for foundry iron in Manchester opens well, but there is no definite rise in the price. It is true that some sellers are inclined to ask 1s. more for Midland No. 3 pig iron, delivered in Manchester, say, 91s. to 91s. 6d. per ton, but there are sellers still at 90s., and one does not see that there is much disposition on the part of buyers to pay a higher price. The reason for the stiffer attitude is no doubt the improved position in Cleveland, and the advance to 92s. 6d. on trucks in the price of No. 3 in that district ; but this only affects Manchester indirectly, because the Manchester ironfounder has learned to do without Cleveland iron. It is perhaps a pity that he cannot learn as quickly how to do without Scotch iron, for this remains very uncomfortably dear, and there is no sign that it is going to be cheaper. Hematite iron, although rather higher, is still comparatively cheap, and it seems quite probable that a more substantial rise is coming in this class of material.

Steel.

The market here is certainly animated, although business has scarcely yet recovered from the holidays, and many establishments have taken quite a long holiday this season. There is a tendency to ask at least 5s. per ton more for manufactured steel, although this is not enough to make the producing trade profitable. Consumers, however, seem quite ready, in this case, to meet the advance, so that one may look for rather better prices in the future. At the same time, one cannot expect any serious advance, because many of the works are short of orders, and will not care to risk losing business by asking too much.

Scrap.

The feeling in the markets for scrap iron and steel is very much better, and dealers are much stiffer than they were. Prices have scarcely settled down yet, but it may be confidently expected that scrap is not going to be so ridiculously cheap as it was during the latter part of last year.

The Engineering Trades

After a longer holiday than is customary at this period of the year, the engineering shops in the Manchester district resumed operations on Tuesday, in most cases under distinctly more promising conditions than was the case twelve months ago. The most fortunate section of the engineering industry since the war has been that engaged in the production of textile machinery, many large orders for which had perforce been held up. Most of these orders were for the equipment of new cotton mills in India, China and Japan, and have kept the makers very fully employed at lucrative prices. Although still working at full pressure, it is not to be expected that

textile machinists will continue very much longer to be so favourably situated in view of the depressed conditions which exist in the cotton textile industry at home. Although there are many thousands of workers still waiting to be re-absorbed into industry, the percentage of unemployed persons in this great industrial area tends to lessen in spite of the deplorable condition of the cotton trade. 1922 was by far the worst year on record in the engineering industry, and I fear that, after effecting the most drastic economies, there are few firms in this neighbourhood, outside those engaged in the manufacture of textile machinery, that will be able to present satisfactory balance sheets when their books are made up. Some of the most important manufacturing and trading firms have, in fact, sustained very heavy losses. With one or two exceptions, machine tool makers have been the chief sufferers. Engine builders, both steam and internal combustion, are also having a very lean time, while makers of Lancashire boilers are equally badly off for orders. It is, however, pleasing to be able to report that the outlook is, on the whole, much brighter for 1923, although the economic and international conditions in Europe and the Near East still deprive British engineers of a large volume of the trade which formerly came to this country. Until more settled times, British engineering will have to look chiefly to the Colonies and to the home markets for business. Fortunately, the obstinate and obstructive attitude which prevailed amongst engineering workers for some time after the war has changed greatly for the better, and less has been heard recently of threats of strikes. Engineering labour, at any rate, is now realising that its interests are indissolubly connected with those of the employers. In this connection, the action taken by the Engineering Employers' Federation in combating Communist teaching by propaganda work, if rather belated, is a step in the right direction, and the manner in which it is conducted is calculated to do an incalculable amount of good amongst the workers. The quiet and unobtruslve work of the Manchester Engineering Council, which comprises leading members of engineering firms and workers, who meet periodically and talk over matters of mutual concern unofficially, must also be commended. If these meetings do nothing more than engender a feeling of mutual trust and confidence between the employers and the workers, they will render a good service to the industry as a whole.

BARROW-IN-FURNESS, Thursday.

Hematites.

The improved position in the hematite pig iron trade of North Lancashire and Cumberland already noted is well maintained. In the whole district there are seventeen furnaces in blast, and the whole of the metal smelted is readily disposed of, and to some extent forward business has been done. So far as Barrow is concerned, there is now a good steady local demand for iron on account of steel makers, and the additional output at the Barrow works, consequent upon the putting into operation of a furnace before Christmas, is quite absorbed. Orders are held on overseas account, and prospects are good for a continuance of this trade. For special iron there is only a moderate call, but this branch of trade is expected to improve in the immediate future.

Iron Ore.

There is more activity in the mining areas, and a bigger tonnage of metal is being raised than for a considerable time past. The trade, however, is nearly wholly on local account, although for the higher-grade metals a certain amount of business is being done on outside account. Spanish ores have only been lightly imported for some time.

Steel.

In the steel trade only a short holiday was taken at Barrow, and the works were actively employed again half-way through last week, chiefly on rails. The demand for either finished or semi-finished steel, however, is very quiet. There is a fair amount of work in the foundries, but the hoop mills are quiet this week.

Shipbuilding and Engineering.

Work was resumed in the shipbuilding and engineering trades at Barrow on Tuesday morning, but the programme is only a light one, the only shipbuilding order held being the construction of an Orient liner. The orders for gun mountings will find a certain amount of work in the engineering shops.

Fuel.

For steam coal there is a better demand. Coke is in increasing request for blast-furnaces.

SHEFFIELD.

(From our own Correspondent.)

The Heavy Steel Outlook.

SHEFFIELD has resumed work this week in good New Year spirits. All departments are looking forward to a year of improved trade, and some of them can already see the wave of activity advancing. This is especially the case with the heavy branches. Both basic and acid steel billets are now in good demand, as well as the rolled products of the material. Additional steel furnaces have been put into operation, and their demands for raw material are increasing to such an extent that new blast-furnaces are being called into requisition for the production of the necessary pig iron. The new furnace, which is to be put in blast at Staveley, as already mentioned, will make the sixth to be in operation, and the company is re-lining another furnace with the ultimate object of preparing it for work when conditions justify it. Another interesting item of news of the same kind, although not strictly local, is that the Bestwood iron furnaces, near Nottingham, which have been damped down for the past twenty-one months, are about to restart. Preparations in connection with two of them are already going on, and the other two will quickly follow.

Railway Material.

There is a steady increase in contracts from builders of railway stock, and it is on this department, as we have remarked before, that Sheffield is basing some of its highest hopes of good trade. The general feeling with regard to this branch is pithily summed up by the Master Cutler—Mr. R. W. Matthews—himself a manufacturer of railway steel, in a New Year message. He says: "There has been within the last few weeks a decided revival in many of the trades of the city, and especially in those manufacturing various classes of railway material. Considerable orders have been placed recently for locomotives and rolling stock, both on home and overseas account, which will bring orders for tires, axles, springs, &c., to Sheffield. The new grouping of the home railway companies comes into force to-day, and, with this difficult task accomplished, we may hope for much larger orders from this source than for many months past. Such orders will ultimately benefit many other firms beyond those actually manufacturing railway material. The revival of shipbuilding, slight though it be at present, is another welcome portent." The Master Cutler points out that an immediate boom cannot be expected, with so many markets closed against us, and adds that anything approaching boom conditions just now would do trade ultimately more harm than good. He is convinced, however, that we shall see a steady improvement, day by day and month by month.

The Electrical Trades.

It is not only in its old manufactures of tires, axles, buffers and springs that Sheffield is benefiting from railway work, but also in its electrical industries. The railway electrification schemes in various parts of the world, especially in South Africa, have during the past year supplied the Sheffield workshops with valuable orders, and there is a great deal of work now on hand, with promise of much more. It is reported that a large experimental passenger engine, electrically driven, is being built by a Sheffield firm for one of the leading British companies. The Colonies have recently sent some good orders through for hydro-electric schemes. The steel foundries are looking up, too, and one or two recent orders for big castings have provided them with much-needed work. The effect of the placing of the contracts for the two new battleships is already being felt. The armour plants are being put in order for the early production of plates, and contractors are making inquiries for material and tools which will be required in the making of the armour, guns, machinery, &c.

Coal and Coke.

Among the colliery developments planned locally are some by the Staveley Coal and Iron Company, which is taking steps to increase its supplies of coal, especially for coking purposes. Just on the fringe of its Devonshire works, where the great ranges of coke ovens and blast-furnaces are situated, it is sinking a new pit to win the deep soft coal. Engine-houses and engines have already been installed. The company also intends to re-open its Markham No. 1 Colliery, which has been closed since the coal dispute of 1921. The shaft is to be sunk lower, in order that the deep soft seam may be worked, and afterwards the black shale seam. It is expected that the sinking operations will occupy about a couple of years. The deep soft coal will be used at the coke ovens. The Staveley Company has recently made great extensions of its coking plant, and a new battery of thirty ovens is to be put in commission next week. While on the subject of coking, it may be mentioned that the Koppers Coke Oven Company, Limited, of Sheffield, which is now an all-British concern, has secured a contract for the erection of a battery of sixty regenerative ovens, with by-product recovery plant, for the Horden Collieries, Limited, Durham. The work is an extension of sixty ovens which were erected by the firm during the war. The value of the new contract is in the neighbourhood of £100,000.

The Lighter Trades.

There are still some very weak spots in Sheffield trade, and among them the crucible and high-speed branches are prominent. Until the engineering trades of the country show a great deal more activity, these important sections will not enjoy a prosperous time. The demand for special steels used in the construction of motor cars shows some little improvement, but British motor builders are not at all satisfactorily employed. The file trade is in a very bad state, in respect not only of work but of price as well. Orders have been so scarce for some time that an era of very severe price-cutting has set in, and work has been accepted at rates which could not pay. An agreement has now been entered into by the leading houses for improving this state of things. There is a slow improvement in the demand for the articles, but very formidable American competition has to be met, especially in the Colonies. There is no change to report in the cutlery and plate trades. Most of the works are still closed, the holiday extending to a fortnight. There is a better outlook in both branches, and a fair amount of work is on hand with which to start the operations of the New Year.

Humber Land Reclamation Scheme.

One of the most important public works schemes brought forward for some time is a proposal for the reclamation of 10,000 acres of land at the mouth of the river Humber, between Spurn Point and Sunk Island. It has been suggested by Mr. T. H. Blenkin, of Hull. The area in question is State property, and Mr. Blenkin urges that one portion of the reclaimed land would be suitable for a graving dock near the Humber mouth, while the remainder could be utilised for farms. The filling in of the area would serve a double purpose, as it would form a very profitable dumping ground for the mud from the Humber ports, the disposal of which, in such a way that it will not be washed back, is a very serious problem. This mud would provide rich agricultural land. The scheme would produce twenty-six farms of 230 acres each, which, at an average rent of 35s. per acre, would yield an income of £17,500 per annum. Work could be found for 2000 men, of whom 500 could be started on quarrying chalk as soon as the plans were passed. The Humber ports would be protected by strengthening the land at Kilnsea, where the sea encroaches on the Holderness farms, and coast erosion, which is a serious problem, could be prevented by building a bank where the sea has broken through at Spurn. As to the housing of the workmen engaged on the scheme Mr. Blenkin points out that accommodation could be found for 500 of them at Spurn Battery and 500 more at Kilnsea Battery, while the remainder could be housed in hutments erected in the neighbourhood.

Housing Items.

The Hatfield Main Colliery Company is greatly extending the village of Stainforth, near Doncaster, where the population has increased during the last three years by 2000. Plans for from 250 to 500 houses are to be submitted to the Thorne Rural Council at an early date. The Sheffield Corporation has had an unpleasant experience in connection with some houses recently erected on its Brushes building estate, Firth Park. The ground on the estate, which is steep, and composed mainly of clay and shale, has become so thoroughly soaked by the recent heavy rains that last week it began to slip, to the danger of several houses. The tenants were advised to go at once, and accommodation was found for them in other houses. The building of a retaining wall has now been commenced, and it is expected that this will check any further movement, make the bank secure and eliminate danger.

NORTH OF ENGLAND.

(From our own Correspondent.)

Brighter Prospects for 1923.

ALTHOUGH it is generally recognised that the path to be traversed before full prosperity in industry is attained is still difficult and long, there is an impressive optimism in commercial circles in the North of England that the year 1923 will witness a big forward movement to a normal state of affairs. All the indications point to the fact that the worst is past. For some time to come, however, it is only to be expected that all firms in placing work will move cautiously. The commercial upheaval after the war has not yet subsided. Both at home and abroad unrest is still evident, and until it is quelled merchants, in the circumstances, are not likely to take any risks. There are hopeful signs, however, of a brighter era. The markets are becoming more stable, and the wheels of industry are gradually accelerating their pace. To a peculiar degree the prosperity of the iron and steel trade in the North of England is wrapped up with that of the shipbuilding industry. Many of the works rely almost exclusively on orders for shipbuilding material, and as shipbuilding virtually ceased last year they were severely hit. Many mills usually employed rolling plates, angles, &c., were closed throughout practically the whole of the year. The past month or so has, however, completely changed the outlook. Orders for new tonnage have been placed freely, and the industry will be assured of a steady time again with corresponding benefit to the iron and steel trade. It is understood that work on the Southampton floating dock and on one of the two new battleships will be started immediately at the Walker naval yard of Armstrong, Whitworth and Co. This work will appreciably ease the unemployment situation on Tyneside.

Iron and Steel Exports.

Further evidence of the gradual revival of the iron and steel trade in Cleveland and the recovery of lost overseas markets is afforded in the return of exports for December, the aggregate shipments of 89,329 tons showing an increase of 7742 tons over the total for the previous month. The pig iron shipments reached 44,416 tons as against 39,320 tons, while the exports of manufactured iron and steel amounted to 44,913 tons as compared with 35,932 tons in November. America was the largest customer for pig iron, with a total of 22,450 tons. In total volume the exports for 1922 from the Cleveland district are the best recorded since 1916. In that year the exports of pig iron, manufactured iron and steel just exceeded the million mark; in 1922 they totalled 986,039 tons; in 1921 the total was 449,362 tons. The outstanding feature was the American trade in pig iron. Up to May not a ton of pig iron was shipped from Cleveland to America, but following upon the coal mine and railway strikes in the United States supplies were rapidly snapped up, and during the remaining months of the year about 135,000 tons were shipped across the Atlantic. As in 1921 Belgium was Cleveland's best customer for pig iron (apart from America), but the most remarkable trade phenomenon was the fact that in spite of the mark becoming almost worthless as a factor of international exchange, Germany took nearly 50,000 tons of pig iron from Cleveland, more, in fact, than any other country except Belgium and America. Italy took over 40,000 tons of pig iron, and France about 30,000 tons. The exports of manufactured iron and steel exceeded any recorded since 1915, India and Ceylon taking the biggest share. New markets, however, have been found. An active business was re-established with the Argentine Republic, and, indeed, with all the South American Republics, while new avenues of trade were opened up with the West Coast of Africa, Mesopotamia, and many of the small islands of the Far East.

Cleveland Iron Market.

The Cleveland iron market presents few new features of moment. The market has been under holiday influences, and things will not really settle down until the week has passed. The demand for the time being is quiet, and most of the iron made during the past fortnight has had to go into stock, but there is a busier state of affairs in prospect, and when the consuming works get into swing it will be quickly used up. A further big cargo of pig iron has been shipped to America, and additional shipments across the Atlantic are to follow. There is, moreover, the

possibility of more business with the United States, a few inquiries being reported. Quotations show an upward tendency, No. 1 and siliceous iron being 95s.; No. 3 G.M.B., 91s.; No. 4 foundry, 85s; No. 4 forge, 82s. 6d.; and mottled and white, 80s. per ton f.o.r. or f.o.b.

Hematite Pig Iron.

The East Coast hematite pig iron trade is assured of steady employment for some time to come. Makers are well booked with orders, and everything points to a bigger demand in the near future. Mixed numbers are quoted at 93s., and No. 1 at 93s. 6d. per ton.

Iron-making Meterials,

Coke prices are rising in alarming fashion. The ironmasters are being asked 30s. 6d. and even 31s. per ton for good medium furnace qualities, delivered at the works, and as much as 34s. has been paid for export. This is a serious addition to the ironmasters' costs of production. Foreign ore prices, too, are firmer, and 22s. 6d. per ton is now the minimum for best Rubio ore c.i.f.

Manufactured Iron and Steel.

Most of the steel works reopened on Wednesday with brighter prospects of more active times. The demand has broadened out considerably during the past few weeks, and the inquiries which are at present on the market are deemed a hopeful sign. Prices are unchanged

The Coal Trade.

There are few, if any, changes in the Northern coal trade position, though the steam coal section is rather better than it has been recently, and there is a disposition to regard the outlook as improving. There is a very fair prospect of an expanding export trade. In addition to a quickened German inquiry, there is a number of orders in hand for the United States, while for France, Italy and Scandinavia the demand is improving. The outstanding feature of the market is the apparent strength and assurance of the Durham classes. All the usual well-known brands of gas coals are very firm, with special sorts exceedingly strong, and even the poorer kinds very well placed for quite a while ahead. Coking and bunkers are equally well off for trade, and command good prices for any date before June. Coke is very steady for all makes of foundry, furnace or gas qualities.

Cleveland Miners' Hours.

The Cleveland ironstone mineowners have suggested to the Miners' Association that the men engaged underground should now work eight hours per day from "bank to bank," and the hours of surfacemen should be forty-nine hours per week, a system that obtained in the industry before July, 1919. The present hours of the underground workers are seven per day, exclusive of riding time, and those of the surfacemen forty-six and a-half hours per week exclusive of meal hours. The mineowners offer certain advances on the base rates for various classes of datal men providing the proposed increase in working hours is accepted.

SCOTLAND.

(From our own Correspondent.)

Low Output—But Still Leading.

THE past twelve months has been remarkable for great depression in trade, and no industry has fared worse than shipbuilding. In the Clyde area the total returns for the year show 143 vessels of 388,500 tons, compared with 249 vessels of 511,190 tons in 1921 and 370 vessels of 756,976 tons in 1913. The last figures, of course, are the highest yet touched in the history of the Clyde. Despite the low figures for 1922, the Clyde still leads and has produced one-third of Britain's new vessels. In the record of individual firms Harland and Wolff, Limited, take first place in the world's returns. The outstanding feature of the year has been the great fall in American production, the total figures from that country being only 260,000 tons, compared with 1,043,000 tons in Britain. Thus, from leading the world in 1919–20, America fell to third place in 1922, Britain being first and Germany second. In spite, however, of the loss of battleship contracts, the outlook on the Clyde is full of promise. General orders have already exceeded expectations in point of numbers, and still more contracts are in contemplation. Shipyards which have been closed down have been re-opened, others have gone on full time, while marine engineering shops have been making ready to cope with the increased demand. Altogether the new year is hopefully anticipated.

Pig Iron.

The closing of the year did not find the pig iron trade in a very satisfactory position. The export demand had fallen away to next to nothing, while the home market was stagnant. The change for the better in the consuming industries at home has, however, made producers more hopeful, and though it was thought that some furnaces might be put out of action, no steps have yet been taken in that direction. Thirty-one furnaces are now in blast, twenty-seven of which are making ordinary qualities. Quotations are unchanged, though slightly easier prices could doubtlessly be obtained for immediate business.

Steel and Iron.

A much better feeling is apparent in the Scotch steel and iron trade. Inquiries from all quarters, at home and abroad, are on the increase, while business shows distinct signs of broadening out. Towards the end of December the works were becoming better employed than for months back. Prices, too, showed a tendency to harden a little, and though no change has yet taken place it is quite possible that a continuance and a broadening out of the recent activities will bring higher quotations.

Coal.

Business in the coal markets was very quiet towards the close of the year. The collieries were concentrating all efforts on getting steamers loaded before the stoppage and were not entertaining new business. No pressure was experienced in the home market for supplies over the holidays. Difficulty was found in disposing of the smaller sizes of washed fuels, and these were inclined to fall further in price. The intimation of a reduction in railway rates for coal and dross is hailed with satisfaction, especially in view of the improvement in industrial circles. Export prices are nominally unchanged from the preceding week, apart from the smaller sizes of washed materials already referred to.

Miners' Wages Higher.

The results of the accountants' ascertainment for November in the coal industry in Scotland which rule the wages for the next two months, show that the wages in January and February will be 7d. per shift higher than in November last.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

THE year which has just closed has turned out much better than was ever expected during the first six months. It was during that period that values fell to their lowest level and many coalowners were at their wits' end to keep their pits going. In fact, prices were so unremunerative that a number of pits had to be closed, but the second half of the year witnessed a pronounced change for the better. The strike of miners in America was primarily responsible for the alteration, and ever since shipments from this district commenced to the States on a substantial scale in July last the steam coal trade has gone forward until it is now possible to look back and express satisfaction at the recovery which has been made in regaining foreign markets. Values have, of course, varied, and are not at the highest point touched when the American demand last summer was at its strongest, but this can be said that prices are and have been remunerative, and what may be considered good business has been done in the way of contracts over the current year. Furthermore, there is the prospect of the inquiry for coals for the States and Canada expanding, and therefore the outlook for the near future is very good. Already quite a dozen steamers have been chartered during the past week or so to load coal for the Northern range of American ports and Canada, and before long it is expected that other definite business will be concluded. Apart from Transatlantic operations, there is one factor bearing upon the future of the coal trade which is of great importance, and that is the home demand for coals. Iron and steel and allied undertakings are becoming more active, and this all means that coals for which an outlet had to be found by shipment will now go inland. There will be less for export, and therefore export prices should be strengthened. Without being too optimistic, there is reason to think that the current year should equal the trade of 1913, if only working conditions are favourable at the docks and the facilities are provided to allow of an extension of shipments. The recovery during the latter half of 1922 was no less than remarkable, and when the complete returns are available it will probably be found that foreign coal exports during the year amounted to rather over 26,000,000 tons as against approximately 12,250,000 tons for 1921, and 29,875,000 tons in 1913.

Three Shift System.

At the moment there is no real development regarding the question of the third shift of working at the ports of this district, except that the representatives of the tippers and trimmers agreed to a joint conference with the representatives of the employers on Thursday of this week, when the matter was to be discussed. It was hoped that the former would be more agreeable to falling in with the views of the latter than they have so far been. Representatives of the trimmers and tippers met together at Cardiff on Tuesday to consider their plan of action in connection with the negotiations of Thursday.

Ebbw Vale Settlement.

The New Year opened with good news for the Ebbw Vale district, which has been the scene of conflict for several months past. The trouble over the Galloway award has come to an end, and, in addition, the Prince of Wales Colliery, which has been idle for about nine months, is to be re-started immediately. This announcement was conveyed to a mass meeting of the Ebbw Vale miners on Sunday last, when it was stated that the company and the men had finally arranged the differences that had existed between them on the question of allowances.

Colliery Developments.

Extensive developments have been proceeding for the past twelve months at the Machen collieries, near Newport, one of the groups of collieries controlled by Sir Beddoe Rees, and a seam 8ft. 6in. in thickness of the best Black Vein coal has been struck. The surface developments have been practically completed, and when all is in readiness in a month or two's time it is expected that an output of at least 1000 tons per day will be secured and employment provided for about 1200 men.

Steel and Tinplate.

Expectations are held that next month will see the re-starting of a number of tin-plate mills which have been idle for some time past. These mills will be manned by men returning to the industry from other occupations, which they were compelled to follow owing to the depression formerly existing. The outlook in the steel industry connected with tin-plates is also reported to be brighter. Considerable quantities of ore have been arriving lately at Swansea. About 11,000 tons have recently come to hand for Baldwins, Limited, apart from 2500 tons of pig iron for Morriston works, 1500 tons of a special ore for the National Oil Refineries, 1500 tons of calamine, and nearly 1000 tons of copper slabs, &c., the discharging of which, of course, means employment at the docks.

Miners' Wages.

Throughout the whole of the past year the wages of the miners in this district remained at the minimum, viz., 28 per cent. on the 1915 standard, and the wages are to be on the same basis for the current month. According to the certificate for the month of November, the certified wage payable is 16.09 per cent., but the owners are under an obligation to pay the minimum of 28 per cent., and to do so they have to sacrifice £191,000 of their standard profits. This brings the total amount sacrificed by the owners under the minimum wage clause since November, 1921, to £3,057,000, in addition to which the miners are now paid the subsistence wage fixed by the recent award of Lord Buxton.

Current Business.

Although the outlook in the steam coal trade is good and colliery salesmen are very cautious regarding contracts for further supplies over a period, as they have already booked up to a considerable extent, the position just at the moment is somewhat unsatisfactory for a number of collieries. This is due to the fact that during the past week or two heavy weather at sea has resulted in tonnage getting out of position and being delayed, and consequently loading arrangements are out of gear. Some of the collieries having no ready tonnage have difficulties in securing the release of wagons and are prepared to make concessions in price to any buyer who can take immediate delivery. These concessions run from 6d. to 1s. per ton according to the position of the colliery, but for shipment ahead sellers are firm in their ideas, because later there is the probability of tonnage coming along together and causing heavy pressure. The conditions in the anthracite section are on the whole rather quiet, though the tone shows signs of improving in respect of sized coals, while duff and culm remain very steady and scarce. Pitwood is rather easier, and as regards patent fuel, makers' ideas are comparatively high, as the cost of supplies of pitch is very abnormal, this commodity being in the neighbourhood of 130s. per ton as against 30s. to 35s. per ton in pre-war days. This is having a very harmful effect upon the patent fuel industry as a whole.

Latest News from the Provinces.

LANCASHIRE.

MANCHESTER.

The Safeguarding of Industries Act.

THE result of the referendum taken by the members of the Manchester Chamber of Commerce to decide the attitude of that organisation towards the Safeguarding of Industries and Dyestuffs Acts was announced on Tuesday, and showed a large majority for the repeal of both Acts. The total electorate is 3787, out of which about 1700 made use of the ballot, and the majority in each case was about 1000.

Proposed New Hotel for Manchester.

For such an important city, it is generally agreed that Manchester is very inadequately served by hotel accommodation. This defect seems likely to be remedied in the not far distant future, a syndicate having practically purchased the splendid triangular site near the Exchange Station, and now occupied by the Victoria Buildings, which are the property of the Corporation. The purchase price for the site is about £500,000. The new hotel is to be one of the finest in the kingdom, and will supply a want long felt by business men visiting Manchester.

NORTH OF ENGLAND.

Pig Iron Prices Advanced.

The re-opening of the Cleveland pig iron market after the holidays was marked by the placing of a good deal of business, and an advance in prices. No. 3 G.M.B. Cleveland pig iron is now fully 92s., with some makers asking up to 92s. 6d., whilst No. 1 and siliceous iron are quoted at 96s. to 96s. 6d.; No. 4 foundry, 87s. 6d.; No. 4 forge, 82s. 6d.; and mottled and white iron, 80s.—f.o.b. or f.o.r.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MESSRS. PICKUP AND BALDERSTONE, consulting engineers and mill architects, late of Mercantile Chambers, Burnley, ask us to state that they have transferred their offices to 7A, Hargreaves-street, Burnley.

THE SCARAB OIL BURNING COMPANY, Limited, informs us that it has removed its offices to Carlton House, 11D, Regent-street, London, S.W. 1 (telephone, Regent 4822–4823), to which all communications should be addressed, all goods being sent to the firm's works at 78A, Harlesden-road, Willesden Green, N.W. 10.

MR. REGINALD P. WILSON informs us that he had resigned his position as Director of Aircraft Supplies at the Air Ministry, as from December 31st last, and that he proposes to continue his practice as consulting engineer, having for that purpose taken offices at Central House, Kingsway. His telephone number is Regent 2368.

A. RANSOME AND CO., Limited, Newark-on-Trent, ask us to draw the attention of our readers to the fact that they have not discontinued making several types of woodworking machines, and that they are still making a full range of machines for all woodworking purposes. They ask us to mention this because they keep hearing from different sources that they are now only making the heavier saw mill machinery.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	22/6
(1) Spanish	22/6
(1) N. African	22/6
N.E. COAST—	
Native	—
Foreign (c.i.f.)	22 6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	5 7 6	—
No. 1 Foundry	5 0 0	—
No. 3 Foundry	4 15 0	—
N.E. COAST—		
Hematite Mixed Nos.	4 13 0	4 13 0
No. 1	4 13 6	4 13 6
Cleveland—		
No. 1	4 16 0	4 16 0
Silicious Iron	4 16 0	4 16 0
No. 3 G.M.B.	4 12 0	4 12 0
No. 4 Foundry	4 7 6	4 7 6
No. 4 Forge	4 2 6	4 2 6
Mottled	4 0 0	4 0 0
White	4 0 0	4 0 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
North Staffs. Forge	3 12 6	—
,, ,, Foundry	4 4 0	—
(3) Northampton—		
Foundry No. 3	4 0 0	—
,, Forge	3 10 0	—
(3) Derbyshire—		
No. 3 Foundry	4 2 6 to 4 3 6	
Forge	3 12 6	—
(3) Lincolnshire—		
Basic	4 0 0	—
Foundry	4 2 6	—
Forge	4 0 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.		
Hematite Mixed Nos.	5 10 0	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 10 0	10 10 0
Best ,,	12 0 0	—
N.E. COAST—		
Crown Bars	10 10 0	—
Tees	10 0 0	—
LANCS.—		
Crown Bars	11 10 0	—
Second Quality Bars	10 5 0	—
Hoops	14 0 0	13 15 0
S. YORKS.—		
Crown Bars	11 10 0	—
Best ,,	12 10 0	—
Hoops	14 0 0	—
MIDLANDS—		
Crown Bars	10 7 6 to 10 15 0	
Marked Bars (Staffs.)	13 10 0	—
Nut and Bolt Bars	9 12 6 to 9 15 0	
Gas Tube Strip	10 10 0 to 10 15 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	12 0 0	—
Ship Plates ⅜in. and up	8 15 0	—
Sections	8 7 6	—
Steel Sheets $\frac{3}{16}$in. to ½in.	10 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	17 10 0

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	9 0 0 to 9 10 0	—
Angles	8 15 0 to 9 0 0	—
Boiler Plates	12 10 0	—
Joists	9 0 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 0 0 to 14 0 0	
Channels	13 10 0	—
Hard Billets	8 15 0	—
Soft Billets	8 0 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 10 0	—
Light ,,	9 10 0 to 10 0 0	
Billets	8 10 0	—
MANCHESTER—		
Bars (Round)	9 0 0 to 9 10 0	
,, (others)	9 10 0 to 10 0 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	12 5 0	12 0 0
Plates	9 0 0 to 10 0	
,, (Lancs. Boiler)	13 10 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0	—
Bessemer Billets	12 10 0	—
Hard Basic	8 15 0	—
Soft ,,	7 10 0 to 7 15 0	
Hoops	11 15 0	—
Soft Wire Rods	10 0 0	—
MIDLANDS—		
Small Rolled Bars	9 0 0 to 9 5 0	
Billets and Sheet-bars	7 7 6 to 7 10 0	
Gas Tube Strip	10 0 0 to 10 5 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets (f.o.b. L'pool)	17 5 0 to 17 10 0	
Angles	8 15 0	—
Joists	8 15 0 to 9 0 0	
Tees	9 10 0 to 10 0 0	
Bridge and Tank Plates	9 0 0 to 9 10 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	20/3 to 20 6
Block Tin (cash)	182 5 0
,, (three months)	183 15 0
Copper (cash)	64 12 6
,, (three months)	65 7 6
Spanish Lead (cash)	26 17 6
,, (three months)	26 10 0
Spelter (cash)	36 10 0
,, (three months)	34 10 0
MANCHESTER—	
Copper, Best Selected Ingots	69 10 0
,, Electrolytic	72 0 0
,, Strong Sheets	96 0 0
,, Loco Tubes	0 1 1½
Brass Loco Tubes	0 0 11¾
,, Condenser	0 1 2¾
Lead, English	28 0 0
,, Foreign	27 10 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit
Tungsten Metal Powder	1/11 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23	10/6
,, 6 p.c. to 8 p.c. ,,	£21 0 0	8/-
,, 8 p.c. to 10 p.c. ,,	£20 0 0	8/-
,, Specially Refined		
,, Max. 2 p.c. carbon	£54 0 0	20/-
,, ,, 1 p.c. ,,	£64 0 0	22/6
,, ,, 0·75 p.c. carbon	£72 0 0	25/-
,, carbon free	1/7 per lb.	
Metallic Chromium	4/9 per lb.	
Ferro Manganese (per ton)	£15 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£11 2 6 scale 5/- per unit	
,, ,, 75 p.c.	19 10 0 scale 6/- per unit	
,, Vanadium	17/- per lb.	
,, Molybdenum	9/6 per lb.	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£160	
Cobalt	11/- per lb.	
Aluminium (per ton)	£82 to £100	

(British Official.)

FUELS.

SCOTLAND.	Export
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	23 6
,, ,, Ell	24/-
,, ,, Splint	24/6 to 26/6
,, ,, Trebles	24/-
,, ,, Doubles	21,9
,, ,, Singles	16/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	23,6
,, ,, Splint	24/6
,, ,, Trebles	24/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	22/- to 24/6
Screened Navigation	28/-
Trebles	25/-
Doubles	22/-
Singles	17/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	23 9
Secondary Steam	23/-
Trebles	24/-
Doubles	22/-
Singles	17/6
ENGLAND.	
(8) N.W. COAST—	
Steams	29/6
Household	46/8 to 57/6
Coke	34/-
NORTHUMBERLAND—	
Best Steams	24,6 to 25/-
Second Steams	21.6 to 22/6
Steam Smalls	13/6 to 15/6
Unscreened	20/6
Household	25/- to 28/-
DURHAM—	
Best Gas	24/- to 25/-
Second	22/- to 23/-
Household	25/- to 28/-
Foundry Coke	37/- to 40/-
SHEFFIELD—	INLAND.
Best Hand-picked Branch	32/6 to 34/6 —
Barnsley Best Silkstone	28/- to 30/- —
Derbyshire Best Brights	24/- to 26/- —
,, ,, House	21/6 to 22/6 —
,, ,, Large Nuts	19/6 to 22/6 —
,, ,, Small ,,	15/- to 16/6 —
Yorkshire Hards	20/- to 21/- —
Derbyshire ,,	19/- to 20/6 —
Rough Slacks	9/- to 11/- —
Nutty ,,	7/9 to 9/9 —
Smalls	3 - to 5/- —
Blast Furnace Coke (Inland and Export)	21/- to 30/-
CARDIFF— (9) SOUTH WALES.	
Steam Coals:	
Best Smokeless Large	28 - to 28,6
Second ,, ,,	27/6 to 28/-
Best Dry Large	27/- to 28/-
Ordinary Dry Large	26/- to 27/-
Best Black Vein Large	27,6 to 28/-
Western Valley ,,	27/- to 27/6
Best Eastern Valley Large	27/- to 27/6
Ordinary ,, ,,	24/- to 26/-
Best Steam Smalls	17/6 to 18/6
Ordinary ,,	15/- to 17/-
Washed Nuts	27/6 to 37/6
No. 3 Rhondda Large	29/- to 31/-
,, ,, Smalls	19/- to 21/-
No. 2 ,, Large	24/- to 25/-
,, ,, Through	19/6 to 22/6
,, ,, Smalls	14/- to 15/-
Coke (export)	37/6 to 45/-
Patent Fuel	28/- to 30/-
Pitwood (ex ship)	31/- to 31/
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	32/6 to 35/-
Seconds	30/- to 32/6
Red Vein	28/- to 29/-
Machine-made Cobbles	42,6 to 45/-
Nuts	55/- to 57/6
Beans	42/6 to 45/-
Peas	22/- to 23/-
Breaker Duff	11/- to 11,3
Rubbly Culm	14/- to 14/6
Steam Coals:	
Large	25/- to 26/-
Seconds	23/- to 25/-
Smalls	10/- to 12/-
Cargo Through	17/- to 20/-

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (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.

French Engineering Notes.

(*From our Correspondent in Paris.*)

The Comptoirs.

THE iron and steel trades have always been under the control of *comptoirs* which distributed orders and fixed prices and thereby ensured a certain stability, but since the Saar was brought into the French industrial sphere and a number of mill and forge owners reorganised and developed their production and demanded a larger participation in the orders distributed, it has been found impossible to conciliate the interests of all the iron and steel producers. Consequently, the *comptoirs* have been dissolved, beginning with the once all-powerful Comptoir de Longwy which was followed by the hematite pig iron producers, the Comptoir Sidérurgique, and finally by the *comptoir* of sheet and plate mills. It is difficult to see what effect this is likely to have upon the future situation, but for the moment it cannot influence trade when prices are steadily advancing on account of the higher values of coke and the limited production of pig iron. It is believed that these higher prices will prepare the way for the importation of foreign products, in which event there is bound to be a set-back in values on the home market, and makers will have to reconsider seriously the position and probably arrange for the reconstitution of the *comptoirs* on another basis.

Import Duties.

The controversy between the industrial and commercial communities over the future fiscal policy is becoming increasingly active now that it is proposed to abandon the system of coefficients and prepare a new Tariff Bill, which will probably be introduced into Parliament during the next six months. Although manufacturers are agitating for higher duties, they disclaim all idea of asking for excessive protection, as they are anxious to avoid anything in the way of retaliation which will prevent them from selling their goods abroad; but, unfortunately, the tariff war has already had the effect of making it very difficult to carry on foreign business and the commercial community is therefore insisting upon a reduction of duties, especially on foodstuffs, which, while protecting the agricultural industry, are one of the principal causes of the high living costs and one of the chief impediments to foreign trade. The future lies between the protectionists, who believe that the country's prosperity depends upon buying nothing from abroad and in producing everything at home, and the commercial classes, who know that there can be no real prosperity without an active interchange with foreign countries. The Chambers of Commerce at Toulouse and in other centres have been protesting vigorously against the tendency to place obstacles in the way of foreign trade.

State Electrical Distribution.

Work is proceeding rapidly with the installation of high-tension mains which are to connect up the whole of the industrial districts in the northern and eastern departments, and will be in inter-communication with all the different generating stations, both steam and hydraulic, and also with plants using blast-furnace gases, so that the supply will not be dependent upon any one source. The State was authorised in August, 1920, to devote 135 million francs to the construction of the feeders, and the first section, with a potential of 120,000 volts, has just been completed between Vincey and Valenciennes by way of Nancy, Briey and Longwy. Other feeders of 45,000 volts will be completed in about four months' time at Liart, in the Ardennes, and of 65,000 volts between Landres and Conflans-Jarry in the Meurthe-et-Moselle. As each section is completed it will be handed over to distributing companies which will be more or less under the control of the State.

Motor Fuels.

A further step in the direction of rendering compulsory the use of motor fuels in which there is an admixture of 10 per cent. alcohol has been made by the Commission des Mines et de la Force Motrice, which has prepared a Bill to be presented to the Chamber of Deputies making licences for the importation of petrol, benzol, benzine and other spirits conditional on the importer purchasing each month a quantity of alcohol equal to 10 per cent. of the motor fuel which he brought into the country the previous month. The Government will fix the price of the alcohol, the percentage of the mixture and the price at which it will be sold to the consumer, this being done to ensure that the composite fuel shall not be sold at a higher price than petrol. Meanwhile, experiments are being carried out with methods of employing ordinary power alcohol in association with petrol instead of the dehydrated spirit supplied by the Service des Poudres, since unciluted alcohol will always absorb moisture from the atmosphere, and it is feared that the preliminary operation of passing alcohol vapour through a column of lime will not entirely remove the difficulties incidental to the use of alcohol containing a percentage of water. The Comité Scientifique du Carburant National is now experimenting with a pulveriser which is said to ensure a suitable mixture of petrol and alcohol, at the same time that the water is dissociated into oxygen and hydrogen.

Sewage Disposal.

On account of the increasing population of Paris and the suburbs the Municipal Council has been obliged to consider schemes for a further extension of sewage beds, particularly for the disposal of the 400,000 cubic metres of liquid which are discharged into the Seine daily at Clichy. The necessity of preventing any discharge of sewage into the Seine and Marne has become so urgent that it was proposed at first to create beds between Colombe and Gennevilliers, but so strong were the objections that it was eventually decided to carry the sewage to the existing farms at Achères, although this would entail considerable additional expense. At the same time a similar quantity will have to be disposed of from the suburbs, so that the scheme which has just been approved of by the Municipal Council provides for the distribution to Achères of 800,000 cubic metres a day. The cost is estimated at 127,500,000f.

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.

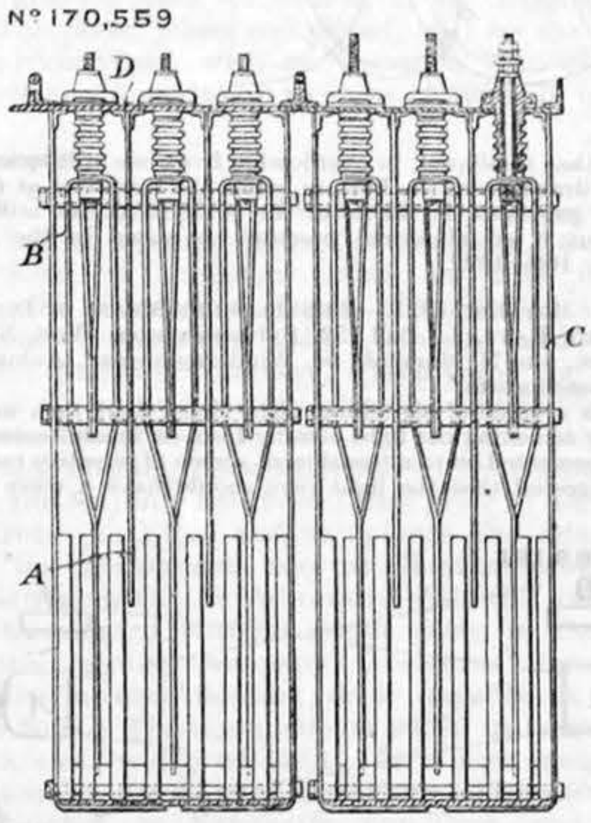
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

SWITCHGEAR.

170,559. September 1st, 1921.—IMPROVEMENTS IN LIQUID RHEOSTATS, *The Metropolitan-Vickers Electrical Company Limited, of* 4, *Central Buildings, Westminster.*

WHEN the electrolyte in the tank of the rheostat is below the electrodes A the main electrodes B are electrically connected to each other by a path through the electrolyte. The two outer electrodes B are connected to each other by a path through the electrolyte, the end plates C and the top member D. The main electrodes B are then connected in delta. Upon the electrolyte

N° 170,559



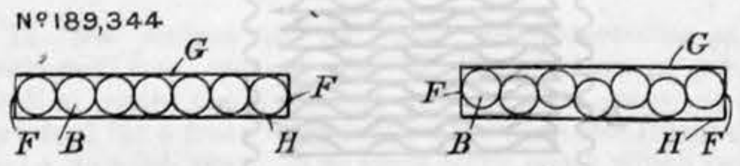
rising in the tank until it immerses a portion of the electrodes A shorter paths are provided between the main electrodes B and the electrodes A, and the latter paths form a star connection. Resistance in the circuit is gradually decreased by increasing the depth of the electrolyte surrounding the electrodes B and A. The delta connection between the main electrodes B is maintained, but it carries relatively less current in comparison with the star connection.—*November* 30*th*, 1922.

TELEGRAPHS AND TELEPHONES.

189,344. November 21st, 1921.—AN IMPROVEMENT RELATING TO ELECTRICAL TELEPHONE TRANSMITTERS, Basil Alexander Pilkington, 13, Melville-place, Edinburgh.

This invention relates to an electrical microphone consisting of a chamber containing a multiplicity of regular-sized spherical shot of carbon or other electricity conducting material arranged in a single layer. The walls of the chamber are spaced and shaped in relation to the shot and to the effective diameter so that the shot cannot become wedged or packed in the chamber, the sides of the chamber being insulated from one another so that the path of electricity through the microphone shall pass

N° 189,344

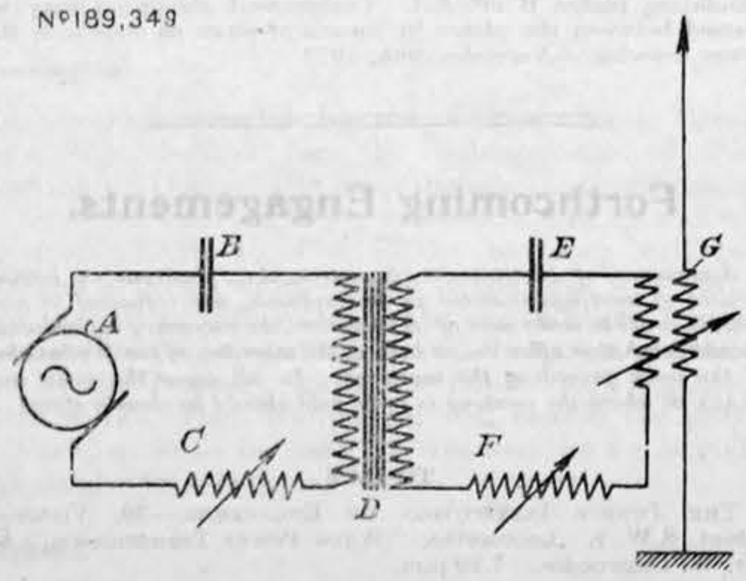


through the shot. The left-hand drawing is a horizontal section of such a microphone. The balls B are in close, but not rigid, formation. The inside line of the lateral framework is indicated by F, while G and H, which are insulated from one another, form the front and back of the microphone. Either H or G or both of them may be diaphragms. The right-hand drawing is another horizontal section of such a microphone with the balls in loose formation, the space between H and G not exceeding 1.75 of the diameter of the balls.—*November* 30*th*, 1922.

189,349. November 30th, 1921.—IMPROVEMENTS IN OR RELATING TO HIGH-FREQUENCY TRANSFORMERS, Walter Dornig, of 37, Fregestrasse, Berlin-Steglitz, Germany.

The object of this invention is to improve the efficiency of high-frequency transformers by a reduction of the iron losses, so that the transformer can be used for the purpose of selecting

N° 189,349



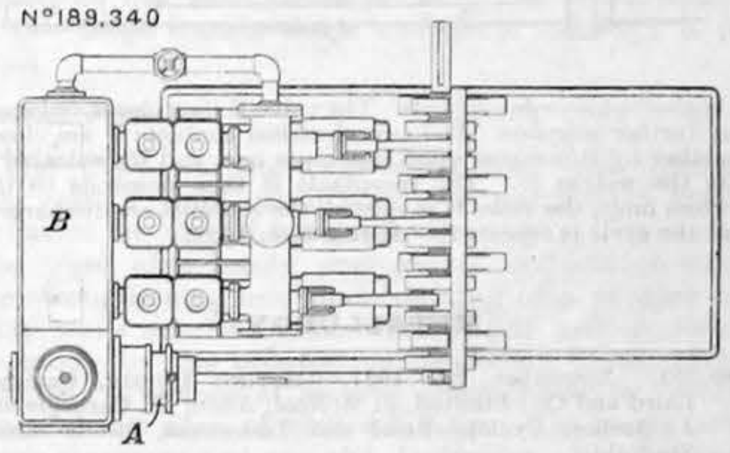
the high multiples of the frequency fundamental by means of resonance circuits. All the multiples of the fundamental frequency can be obtained in a single step of transformation and at an efficiency which is sufficient to make the arrangement commercially practicable. This is accomplished by making the transformer core of very fine iron wire, and the magnetisation of the core can then be extremely high. In the drawing, A is the high-frequency generator, B and C are the primary tuning devices, D indicates the high-frequency transformer, the iron core of which is formed of very thin insulated wire. This transformer is tuned on the secondary side by the tuning devices E and F to a multiple of the fundamental frequency. In this circuit combined harmonic vibrations are discernible with suitable measuring instruments. By simple variations of the tuning devices and by the employment of intermediate circuits any desired harmonic can be selected. The latter can be transmitted to the antenna through a coupling so that other vibrations do not accompany it. In the drawing G is the coupling coil of the antenna.—*November* 30*th*, 1922.

PUMPING AND BLOWING MACHINERY.

189,340. November 16th, 1921.—HIGH-SPEED PUMPS, Lee, Howl and Co., Limited, and J. Grainger, Tipton, Staffs.

The inventors propose to improve the operation of high-speed plunger pumps working against high heads by the simple expedient of relieving them of all suction head. They thus provide

N° 189,340



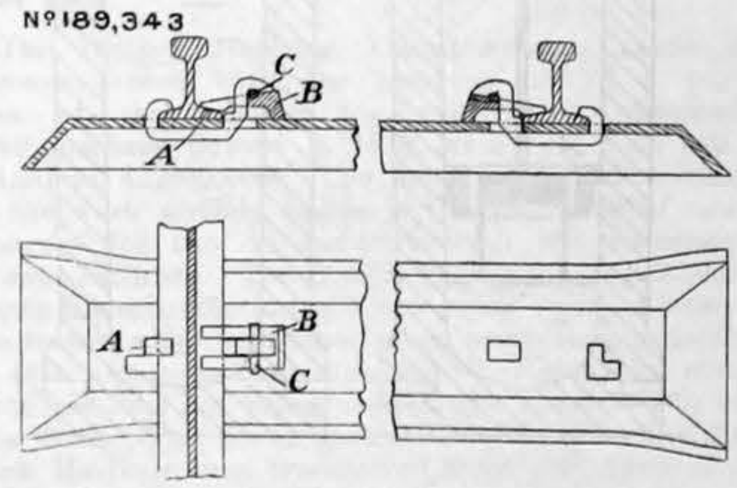
a separate pump A, which draws the water from the sump and delivers it into a tank B with which the main pump suctions are connected. Sufficient water is always kept in the tank to drown the main suction valves.—*November* 30*th*, 1922.

TRAMWAYS AND RAILWAYS.

189,343. November 19th, 1921.—RAILWAY METAL KEYS, D. Colville and Sons, Limited, 195, West George-street, Glasgow and R. W. McBride, Garnockside, Glenghrnock, Ayrshire.

This key is intended for attaching flat-bottomed rails to metal sleepers, and takes the form of a clamp A which is threaded through holes in the sleeper. For this purpose one of the holes

N° 189,343



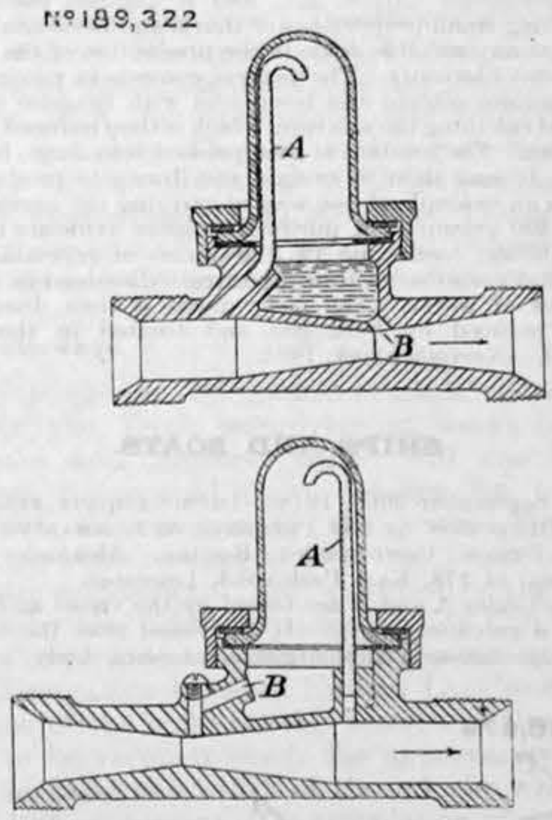
is extended laterally as shown on the right of the figure. A bifurcated wedge B is then put under the clamp and rests on the flange of the rail. Finally a wedge C is driven home to lock the several parts.—*November* 30*th*, 1922.

MEASURING AND TESTING INSTRUMENTS.

189,322. October 29th, 1921.—A LIQUID FLOW INDICATOR, R. and W. Hawthorn, Leslie and Co., Limited, G. Paterson and C. Thew, St. Peter's Works, Newcastle-on-Tyne.

This device is intended to indicate the existence of a flow in a pipe, such as that supplying the lubricating system of a machine. A *vena contracta* is inserted in the length of the pipe as shown, and above it there is mounted a transparent air vessel. A con-

N° 189,322

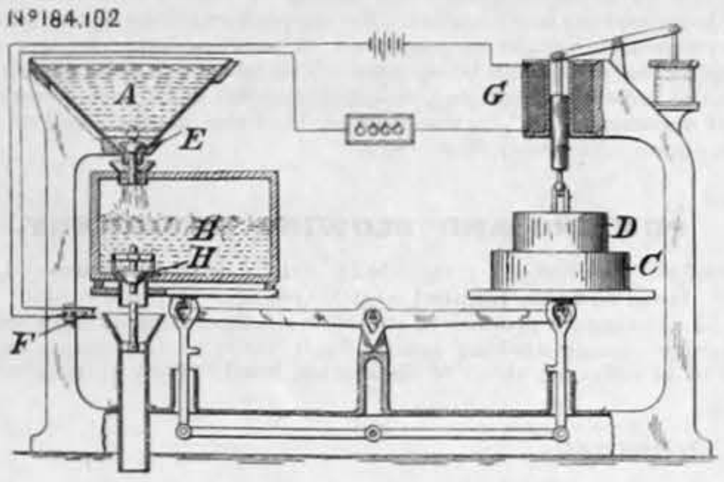


nection A is made with the high-pressure part, either up-stream or down-stream of the narrow part of the orifice, as shown in the two alternative figures. The lower part of the air vessel is in communication with the throat by means of the passage B. So long as a flow persists through the pipe a jet will be seen issuing from A, but when the flow ceases the jet will also stop.—*November* 30*th*, 1922.

184,102. October 25th, 1921.—AUTOMATIC WEIGHING APPARATUS, H. J. Parker, 5, Manor Way, Bromley Common, and J. N. Metcalf, 19, Risebridge-road, Gidea Park.

This apparatus is intended for delivering weighed quantities of fluid. The fluid is supplied through the hopper A to the receptacle B on the balance. The counterpoise C represents the tare weight and D the weight of fluid to be measured. When the quantity of fluid run into the receptacle overbalances D,

N°184,102



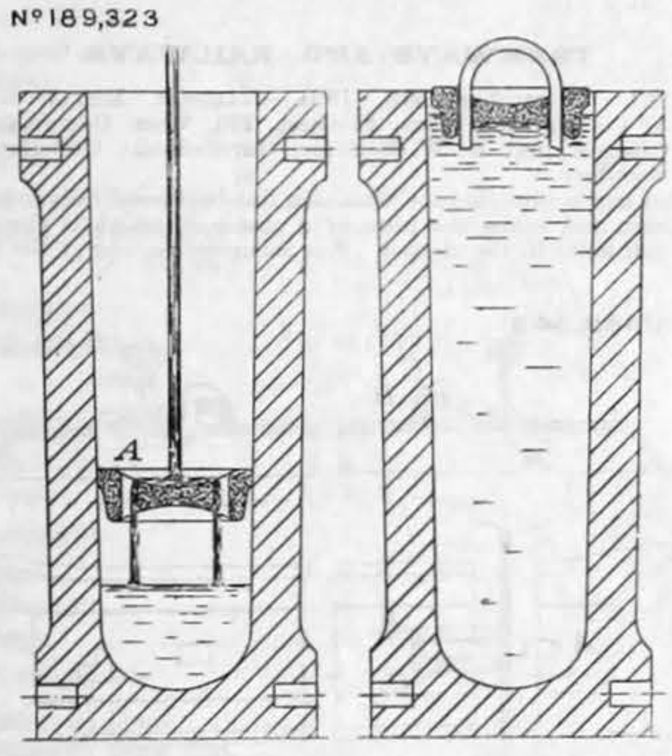
B begins to move downwards. The valve E then closes and stops any further supplies. The two electrical contacts F are closed together by B pressing upon the upper one, and the solenoid G lifts the weight D. The receptacle B then descends to the bottom limit, the valve H is opened, the contents are discharged, and the cycle is repeated.—*August 10th*, 1922.

METALLURGY.

189,323. November 1st, 1921.—CASTING INGOTS, Cammell Laird and Co., Limited, J. McNeal, Allan, W. Carnegie and J. Archer, Cyclops Steel and Ironworks, Saville-street, Sheffield.

In order to reduce piping in ingots the inventors use a stopper A of refractory material, which is lowered into the mould. The molten metal is poured on to this stopper and flows through holes provided for the purpose into the mould below. The

N°189,323



stopper subsequently floats up on the metal until the mould is full and is then removed by means of a staple as shown. An alternative arrangement for use in conjunction with bottom poured moulds is also illustrated.—*November 30th*, 1922.

LIGHTING AND HEATING.

188,706. June 8th, 1921.—IMPROVEMENTS RELATING TO THE PRODUCTION OF TUNGSTEN AND TUNGSTEN FILAMENTS, Siemens Bros. and Co., Limited, of Caxton House, Tothill-street, S.W. 1, and William Henry Le Maréchal, of 69, Beresford-road, Highbury, N. 5.

NO CUT.

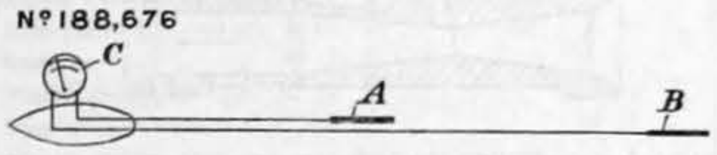
This invention relates to the production of tungsten, and particularly to its production in a form suitable for the manufacture of drawn tungsten filaments for electric incandescent lamps, thermionic valves, &c., and it consists essentially in incorporating small proportions of thoria and boric acid with the tungsten at any suitable stage in the production of the latter for incandescent filaments. The process consists in mixing a solution of thorium nitrate and boric acid with tungstic oxide and drying and calcining the mixture, which is then reduced by means of hydrogen. The product is then pressed into slugs, baked and sintered. It may then be swaged and drawn to produce a filament. As an example of one way of carrying the invention into practice, 800 grammes of purified tungstic oxide are moistened with a solution containing 12.5 grammes of crystallised boric acid and 9.3 grammes of thorium nitrate dissolved in 250 cubic centimetres of water. The pasty mass is then dried gently, calcined, reduced by hydrogen and treated in the manner mentioned.—*November 20th*, 1922.

SHIPS AND BOATS.

188,676. September 20th, 1918.—IMPROVEMENTS RELATING TO THE DETECTION OF THE PRESENCE OF SUBMARINE VESSELS AND OTHER CONDUCTING BODIES, Alexander George Ionides, of 278, East Park-road, Leicester.

Two electrodes A and B are towed by the vessel and are connected to a galvanometer C. If the vessel tows the electrodes over or adjacent to a submerged conducting body, such as a

N°188,676



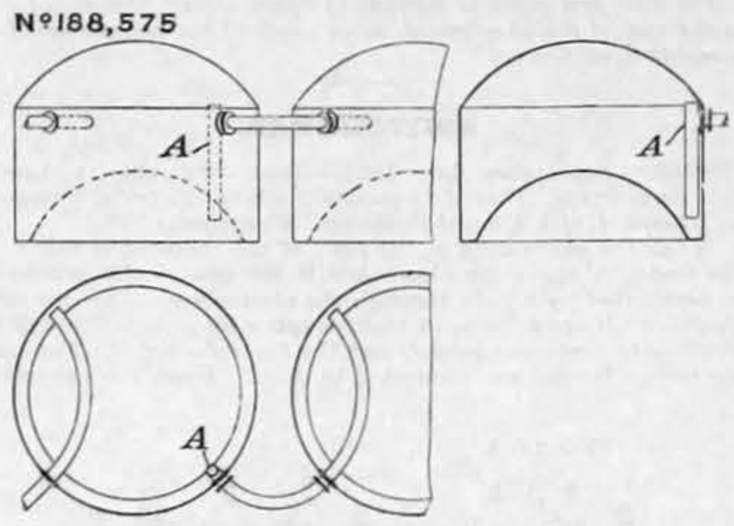
submarine, the presence of this body, the inventor states, can be detected by a deflection of the galvanometer. An alternative scheme is also described for detecting the presence of bodies which are incapable of producing a direct current.—*April 12th* 1919.

MISCELLANEOUS.

188,575. December 28th, 1921.—DISTILLING COAL TAR, F. J. E. China, Downhouse, Esher, Surrey, and Burt, Boulton and Haywood, Limited, Salisbury House, London-wall, E.C. 2.

Stills for the continuous fractional distillation of tar and other liquids are connected together, according to this invention, by means of pipes which have T pieces at their inlet ends. These T pieces A are open at both ends, at the top above the surface of the liquid and below near the bottom of the still. It is thus

N°188,575

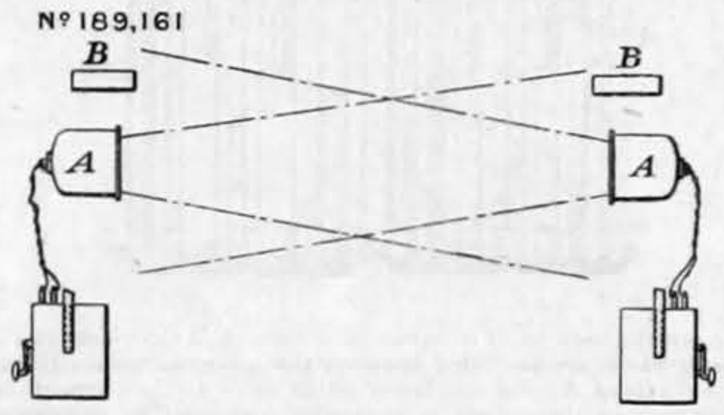


ensured that the liquid, in overflowing from one still to another, must be drawn from the bottom, while the open end at the top of the T prevents the whole of the contents of the still being blown out if an abnormal pressure be raised in the still.—*November 16th*, 1922.

189,161. May 31st, 1921.—SIGNALLING BY MEANS OF INVISIBLE LIGHT RAYS, L. Bell, 32, Sylvan-avenue, West Newton, Mass., and N. Marshall, 54, Windermere-road, Auburndale, Massachusetts.

In this system of signalling ultra-violet light rays are produced by screening the light coming from an incandescent lamp and are projected on to a translucent screen of sensitive material. It is suggested that the light rays should have a wave length

N°189,161

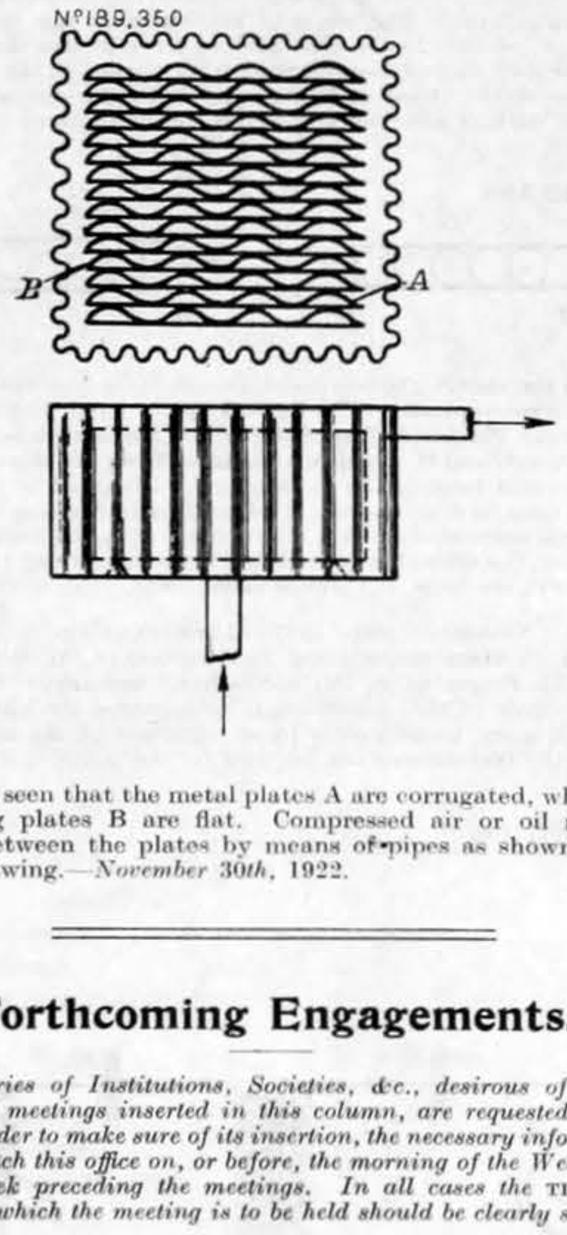


ranging from 400 to 350 micro-millimetres and that the translucent screen should be composed of barium platino cyanide. The diagram shows two projectors A A and receivers B B with their battery boxes.—*November 30th*, 1922.

189,350. November 30th, 1921.—IMPROVEMENTS IN OR RELATING TO ELECTRIC CONDENSERS, Walter Dornig, of 37, Fregestrasse, Berlin-Steglitz, Germany.

The condenser described in this specification is particularly intended for high-frequency work, and the object of the invention is to provide an improved method of cooling such condensers.

N°189,350



It will be seen that the metal plates A are corrugated, whilst the insulating plates B are flat. Compressed air or oil may be passed between the plates by means of pipes as shown in the lower drawing.—*November 30th*, 1922.

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.*

TO-DAY.

THE JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Lecturette, "Wave Power Transmission," by Mr. W. Dinwoodie. 7.30 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS: MANCHESTER CENTRE.—College of Technology, Sackville-street, Manchester. Paper, "South African Railways and Rolling Stock," by Mr. H. K. Bamber. 7 p.m.

FRIDAY TO FRIDAY, JANUARY 5TH TO 12TH.

THE MODEL ENGINEER EXHIBITION.—Royal Horticultural Hall, S.W. 1. 12 to 10 p.m. each day.

SATURDAY, JANUARY 6TH.

WEST YORKSHIRE METALLURGICAL SOCIETY.—Great Northern Hotel, Bradford. Smoking concert. 7 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Juvenile Lecture, "Six Steps Up the Ladder to the Stars"—V.: "Two Streams of Stars," by Dr. H. H. Turner. 3 p.m.

MONDAY, JANUARY 8TH.

BRADFORD ENGINEERING SOCIETY.—Technical College, Bradford. Lecture, "Steel Castings," by Mr. F. C. H. Lantsberry. 7.30 p.m.

TUESDAY, JANUARY 9TH.

INSTITUTE OF MARINE ENGINEERS.—85–88, The Minories, Tower-hill, E. 1. "Gas Engines and Gas Producer Plant," by Mr. Hugh Campbell. 6.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Juvenile Lecture, "Six Steps Up the Ladder to the Stars"—VI.: "The Size of a Star," by Dr. H. H. Turner. 3 p.m.

THE INSTITUTION OF ELECTRICAL ENGINEERS: SCOTTISH CENTRE.—The North British Station Hotel, Edinburgh. Paper, "Domestic Load Building," by Mr. W. A. Gillott. 7 p.m.

THE INSTITUTION OF AUTOMOBILE ENGINEERS: COVENTRY GRADUATES.—Broadgate Café, Coventry. Debate, "Sleeve. Valves *v* Poppet Valves," opened by Messrs. J. T. Hacking and W. H. Craven. 7.45 p.m.

THE INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Paper, "Twelve Years' Operation of Electric Traction on the London, Brighton and South Coast Railway," by Mr. H. W. H. Richards. 6 p.m.

THE INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—Chamber of Commerce, New-street, Birmingham. Paper: "X-rays and Crystal Structure," by Dr. H. B. Keene. 7 p.m.

WEDNESDAY, JANUARY 10TH.

ASSOCIATION OF ENGINEERS-IN-CHARGE.—St. Bride's Institute, Bride-lane, Fleet-street, E.C. 4. Paper, "The Selection of Fans and their Application," by Mr. A. Fleming Brown, 7.30 p.m.

THE INSTITUTION OF STRUCTURAL ENGINEERS: LANCASHIRE AND CHESHIRE BRANCH.—Engineering Laboratory, Victoria University, Manchester. Paper, "An Investigation of the Theory of Flexual Resistance," by Mr. A. S. Spencer. 7.15 p.m.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, W.C. 2. Wireless Section Meeting. "Design of Radio Towers and Masts: Wind Pressure Assumptions," by Mr. C. F. Elwell. 6 p.m.

THE INSTITUTION OF AUTOMOBILE ENGINEERS.—The Institution of Mechanical Engineers, Storey's-gate, S.W. 1. Paper, "Railless Trolley Traction," by Mr. C. W. J. Taffs. 7.45 p.m.

THE ELECTRO-HARMONIC SOCIETY.—Caxton Hall, Westminster, S.W. 1. Smoking concert. 8 p.m.

THURSDAY, JANUARY 11TH.

ROYAL AERONAUTICAL SOCIETY.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Juvenile lecture: "Testing Model Seaplanes," by Mr. R. A. Fraser. 3 p.m.

FRIDAY, JANUARY 12TH.

THE JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Paper, "Transient Phenomena Arising in Transformers from Switching Operations," by Mr. S. A. Stigant. 7.30 p.m.

SATURDAY, JANUARY 13TH.

INSTITUTION OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Grand Hotel, Manchester. Smoking concert. 6 p.m.

KEIGHLEY ASSOCIATION OF ENGINEERS.—Queen's Hotel, Keighley. Annual dinner. 5.45 p.m.

INSTITUTION OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Grand Hotel, Manchester. Paper, "The Evolution of the Foundryman," by Mr. W. H. Sherburn. 4 p.m.

MONDAY, JANUARY 15TH.

THE INSTITUTION OF AUTOMOBILE ENGINEERS: SCOTTISH CENTRE.—Royal Technical College, Glasgow. Paper, "The Technique of Calculation," by Mr. James Watt. 7.30 p.m.

WEDNESDAY, JANUARY 17TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. "Hygienic Methods in Painting: The Damp Rubbing-down Process," by Mr. C. A. Klein. 8 p.m.

THE INSTITUTION OF AUTOMOBILE ENGINEERS: WOLVERHAMPTON CENTRE.—Victoria Hotel, Wolverhampton. Paper, "A New System of Carburation," by Mr. W. A. Whatmough. 7.30 p.m.

THE INSTITUTION OF AUTOMOBILE ENGINEERS: BIRMINGHAM GRADUATES.—Chamber of Commerce, New-street, Birmingham. Paper, "Liquid and Gaseous Fuels for Automobiles," by Mr. J. F. Berry. 7.30 p.m.

THURSDAY, JANUARY 18TH.

ROYAL AERONAUTICAL SOCIETY.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Lecture, "Flying Boats," by Major J. D. Rennie. 5.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: NORTH-WESTERN BRANCH.—Memorial Hall, Manchester. Paper on "Machine Tools for Locomotives," by Mr. C. D. Andrew. 7 p.m.

FRIDAY, JANUARY 19TH.

THE JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Lecturette, "Paraffin as Fuel for Marine Motors," by Mr. S. C. Saunders. 7.30 p.m.

FINSBURY TECHNICAL COLLEGE OLD STUDENTS' ASSOCIATION.—The Engineers' Club, Coventry-street, W. 1. Smoking concert. 8 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, S.W. 1. Symposium of papers on "Indicators." 6 p.m.

THE INSTITUTE OF METALS: LONDON LOCAL SECTION.—Institute of Marine Engineers, 85-88, The Minories, Tower Hill, E. 1. Paper: "Some Aspects of Electro-Deposition," by Mr. W. E. Hughes. 8 p.m.

TUESDAY, JANUARY 23RD.

INSTITUTE OF MARINE ENGINEERS.—85–88, The Minories, Tower-hill, E. 1. Film illustrating works of W. Beardmore, Limited. 6.30 p.m.

THURSDAY, JANUARY 25TH.

LIVERPOOL ENGINEERING SOCIETY.—Midland Adelphi Hotel, Liverpool. Annual dinner. 7 p.m.

THE INSTITUTION OF STRUCTURAL ENGINEERS.—Denison House, 296, Vauxhall Bridge-road, S.W. 1. Paper, "The Relations between the Architect and the Engineer," by Mr. W. J. H. Leverton. 7.30 p.m.