A Seven-Day Journal

New Atlantic Flight Record

A NEW time record for the crossing of the Atlantic Ocean has been set up recently by Captain Pat Eves, an experienced British Airways pilot lent to the Ministry of Aircraft Production, who was flying a new type of American bomber destined for the service of the Royal Air Force. The previous record, we may recall, was 10 h. 33 min., and was set up in September, 1937, by the Imperial Airways flying-boat "Cambria" during an experimental flight from Botwood, Newfoundland, to Foynes, in Eire. Although the new time cannot be stated, nor can the points of starting and arrival be revealed, the new time of crossing must be extremely good, as the pilot, we are given to understand, breakfasted before leaving the American aerodrome, and had tea in this country. That a new record has thus been established is the more satisfactory, as pilots who are engaged in the trans-ocean ferry service do not set out to break records. It is now well known that numbers of American aircraft of varying types are being successfully flown across the Atlantic Ocean. Not only British pilots, but also Americans and Canadians are engaged in this important work, and consistently good crossing times are being kept up. The larger type of machine, such as the Boeing "Flying Fortresses" can be easily flown to their new destination, but in some other types of aircraft it is usual to build in auxiliary fuel tanks for the Atlantic crossing. This practice has been demonstrated on more than one occasion. According to an American air expert, a careful record of cross-Atlantic crossings and accidents caused by mechanical failures has been kept, and the results show that less than 1 per cent. of aircraft would be lost in making the Atlantic crossing under their own power.

Canada's War Industry

MR. HOWE, the Minister of Munitions and Supply in Canada, who travelled with Lord Halifax on the battleship H.M.S. "King George V," proceeded to Washington to attend a conference of the North American Supply Committee which is being held in that city. In a statement made before the meeting he referred to his visit to Great Britain, and said that during that visit plans had been completed on a large scale for the transfer of certain British war industries to Canada. As a result of the investigations made, Mr. Howe said that there would now be an immediate expansion of the industrial war programme, which would mean the construction of some new factories and the enlargement of others. The Department of Munitions and Supply in Canada would, he said, concentrate upon the task of accelerating the output of weapons and supplies for Great Britain, for which there was the most urgent need. The British Government, he said, was very pleased with Canada's output of various types of ammunition and motor vehicles for military use. Those vehicles were now being turned out at the rate of 600 units per day. It was likely that new types of mechanised equipment for the Army would be soon made in Canada, while other war programmes which would be speeded up included the shipbuilding programme and the production both of artillery and aircraft. His visit to England with his officials had, he said, enabled them to gain an appreciation of the situation which could not have been gained in any other way. Particularly valuable information had been obtained with regard to the best use of machine tools.

Institution of Mechanical Engineers

LAST Friday, January 24th, was the occasion of the presentation by the Institution of Mechanical Engineers of the James Watt International Medal to Dr. Aurel Stodola, Hon. M.I. Mech. E., of Zurich, Switzerland. The actual meeting at the Institution was preceded by a luncheon at Grosvenor House, Park Lane, attended by the Council and its guests, among whom were included His Excellency the Swiss Minister, Monsieur Walter Thurnheer, the Hon. Vincent Massey, High Commissioner for Canada, and Mr. Ota Vojp sek representing the Czechoslovak Government in London. Dr. Stodola, it should be mentioned, was recommended for the award not only by technical societies in Switzerland, but also by similar societies in his birthplace, Czechoslovakia, and in Canada. Mr. Asa Binns, President of the Institution, welcomed the guests in a brief speech from the chair, and Monsieur Walter Thurnheer replied. At the meeting which followed at the Institution, Mr. Binns first announced the award, emphasising its international character and expressing regret that Dr. Stodola was unable to be present in person to receive it on account of age and infirmity. He then called upon Dr. Guy to present the Appreciation of Dr. Stodola, which we reprint on another page. The medal was then formally presented to Monsieur Thurnheer, who in reply promised to transmit it to Dr. Stodola in Switzerland. Mr. Stanier then proposed a vote of thanks to Monsieur Thurnheer for attending the meeting and undertaking the task of conveying the medal to Dr. Stodola. In seconding this vote, Lord Dudley Gordon pointed out the insignificant effect that war had upon the true progress of science and engineering. There followed a short interval before the ordinary business of the Institution was begun. The Thomas Lowe Gray Lecture by Dr. S. F. Dorey, entitled "Progress in Marine Engineering as Influenced by the Classification of Ships," was then presented by Mr. W. D. Heck, Dr. Dorey himself being unable to be present owing to indisposition. We begin to print an abstract from this lecture on another page of this issue. Major Gregson and Mr. Bruce Ball proposed and seconded a vote of thanks to the author, which was carried with acclamation.

A New Road Transport Scheme

AN important step to increase the efficiency of goods transport for war purposes was announced by the Ministry of Transport on Thursday, January 23rd The broad principles of the new scheme, which affects road transport, have been formulated in collaboration with the Road Haulage Consultative Committee. The Ministry of Transport will operate the scheme with the assistance of qualified men experienced in the industry, who will be invited to join the Ministry for that purpose. Under this scheme the Government will hire vehicles primarily to carry traffic on Government account. The running and maintenance of the vehicles will remain in the hands of the owners, but an official organisation is to be set up, staffed partly by Civil Servants and partly by experts taken from the industry to control traffic operation. By these means it will be possible to give ready priority to the rapid movement of Government goods and to ensure that full and continuous use is made of the carrying capacity of the vehicles. The Government has often found that existing methods are wasteful and this arrangement will enable a more efficient system to be established. Recent events, moreover, have shown it is desirable to be able to switch transport from one place to another to meet sudden demands with a minimum of delay, and in short the new scheme aims to give effect to priorities, to promote flexibility and to ensure expedition. The scheme has resulted from sixteen months' experience of the emergency organisation set up for road transport on the outbreak of hostilities and of the operation of the Meat Transport Pool. The emergency organisation will continue and will only be superseded in part by the new scheme. As a first step arrangements will be made by the Ministry of Transport with other Government Departments, such as the Ministries of Food and Supply, for carrying regular blocks of Government traffic. Any expansion thereafter will depend upon the measure of its success, though, whether it expands or not, it will have to enter the field of commercial haulage to a certain extent. Otherwise it would hardly be possible to make the fullest use of the carrying capacity of the hired vehicles. In so doing, the Ministry does not, however, intend to compete unfairly with the commercial haulier or to prejudice unfairly the post-war position of the goods-carrying industry. That point will be carefully watched in collaboration with the Road Haulage Committee. In connection with road transport, the Motor Agents' Association has brought to the notice of the Minister of Transport the inadequate provision which is being made for the maintenance and repair of motor vehicles used in civil transport. It proposes that a Director of Road Vehicle Maintenance and Repair should be appointed, whose function it would be to co-ordinate through a central and regional organisation all matters relating to the repair and maintenance of road transport coming under the ægis of the Ministry.

The Gretna Junction Accident

A COLLISION occurred at 6.9 p.m. on November 5th, 1940, at Gretna Junction, on the Carlisle and Glasgow L.M.S. main line. The 10.5 a.m. express passenger train, Euston to Perth, running at about 45 m.p.h., struck the tender and wagons of the 8.55 a.m. freight train, Shawfield to Carlisle, which was crossing the path of the express at the junction. The passenger engine was derailed and thrown on its side, and five leading coaches of the passenger train were derailed and badly damaged; the tender and fifteen wagons of the freight train, which had almost come to a stand, were also derailed and the wagons wrecked, blocking all lines and causing extensive damage to the permanent way. The driver of the express was killed and two passengers succumbed to their injuries later. In addition, forty-one passengers and the fireman of the express were injured. In his report on the accident, Colonel A. C. Trench states that there is a direct conflict of evidence between Signalman Dickson, of the Gretna Junction box, and Driver Stewart, of the goods train, and there appears to be no possibility of other confirmatory evidence to support either side. Colonel Trench says he cannot do more than offer an opinion based on the apparent probabilities. He considers that it is more likely that Signalman Dickson, anxious not to delay the express, may have changed the road in the face of the goods train, not realising that it was too close to be able to stop clear of the junction. The alternative explanation, which he considers to be less probable, is that Driver Stewart, expecting the signals to be pulled off as he approached, took no proper steps to control his train until he was too close to be able to stop at the outer home, and actually overran this signal by some 600 yards, after which he arranged immediately with his fireman and his guard that they should support his unusual story of the inner distant having been pulled off in his face.

Auxiliary Training in the Engineering Industry

A NEW leaflet (P.L.82), which has just been issued by the Ministry of Labour and National Service, gives particulars of a scheme for auxiliary training in employers' workshops for wartime work in the engineering industry. This type of training, it is pointed out, is additional to the training undertaken by employers for their own needs, and no trainee is subsequently placed in employment with the firm by which he or she is trained. The leaflet emphasises the advantages of training on the job. The courses, for which men, women, boys, and girls can generally be accepted from the age of sixteen upwards, do not last longer than eight weeks, and during that time the trainees work for the normal factory hours of the works in which they are trained. Allowances are paid by the Ministry during the period of training. A number of these courses, the leaflet states, are already in operation, but more recruits, both men and women, are urgently needed in order that existing courses may be filled and new courses started. Inquiries or applications for training should be made at any employment exchange, where copies of this and other training leaflets are available. These leaflets can also be obtained directly from the Ministry of Labour and National Service, Montague House, Whitehall, London, S.W.1.

Larger Timber Supplies

IN an announcement made at the end of last week, Major A. I. Harris, the Timber Controller, said that more timber had been secured for war purposes since France capitulated last summer than at any equivalent earlier period of the war. There was now, Major Harris stated, timber to be had for all essential purposes. Much of the deficiency caused by the loss of markets nearer home had been made up from Canada, with additions from the United States, Australia, Portugal, Brazil, and other parts of the world. In order to save the long sea voyage round the Pacific Coast from British Columbia supplies were now being brought by rail across North America. Major Harris estimated that already some 250,000 tons had been thus transhipped by the railways of Canada and the United States. It also happened, he said, that the expansion of home production had reached such a stage last summer that by August it already amounted to five times the peacetime production. On Tuesday last, replying to a question in the House of Lords on home timber supplies, Lord Portal, the Joint Parliamentary Secretary of the Ministry of Supply, said that the Ministry was directing all its efforts to reducing the imports of wood and increasing the use of home-grown timber. In the first year of the war imports were reduced by more than half of the ordinary programme; and in the present year it was proposed to reduce them by at least 33 per cent. on the first year, and it was hoped to achieve even more. Production of home-grown timber during the first year of the war was increased approximately four and a-half times; this year it was hoped to increase it seven times. It was only fair to say that at the beginning of the war the figure was not very large. One of the difficulties was to get the various Departments to take in their specifications hard wood from England rather than imported wood, and an Assistant Controller had been appointed specially to ensure that. This year he hoped that all pit props would be supplied from home-grown timber. The railway companies had recently agreed to make use of home-grown oak for sleepers and other purposes. He would welcome any suggestions for increasing the use of home-grown timber. Great help could be given if people would adjust their specifications to the hard woods of which there were goodly supplies in this country.

The Ross Dam, U.S.A.

No. I

THE Department of Lighting of the City of Seattle, Washington, placed in service during the first half of last year the initial stage of the Ross dam. Originally the structure was referred to as the Ruby dam, but the name was changed to do honour to the late James Delmarge Ross, Canadian born, who was, in fact, for long an inspiring leader in building up the city's municipally owned and operated electric generating plants.

Seattle began to equip itself in 1902 when the citizens of the community voted a bond issue to cover the building of a hydro-electric plant at Cedar Falls, 36 miles to the south and east of the municipality. The object was to bring about eventually Seattle's independence of the electric public utility that completely controlled the business of supplying electric current for lighting and power. In 1903 J. D. Ross joined the municipal organisation, and he remained nearly continuously in that service until his death on March 14th, 1939. It was Mr. Ross who conceived and successively planned for the development of the water power resources of a section of the Skagit River, where high heads were available, and the flow ample to make possible an ultimate development in three projected generating stations of an aggregate of 1,120,000 H.P.

The Cedar Falls plant on Cedar River—see accompanying map—has an installed capacity of 50,000 H.P., and that station began operation in October of 1904. Later, when still more current was needed, the city built a steam generating plant of 7500 kW in Seattle on the east shore of Lake Union, within the municipality, and this plant was finally increased in capacity to 30,000 kW in an effort to meet the continually growing demand for municipally developed electric energy.

Utilisation of the Skagit River as a source of power was first achieved with the construction of the Gorge plant, which began operating in September, 1924, with two 30,000-kW units. A third unit, rated at 33,000 kW, was added in 1929. Water for the Gorge plant is diverted by a rock-filled, timber-crib weir at a point upstream that affords an operating head of 270ft. The water is directed into a tunnel, 11,000ft. long and 20·5ft. inside diameter, driven through solid granite. From the lower end of the tunnel the water is carried by three steel-lined penstocks, 10ft. in diameter, to the three units in the power house. These machines were designed to operate at a head of 375ft., and they will do so when the timber-crib weir has been supplanted by a masonry dam that will assure a gross head of 385ft. This dam is to be built when the Ross dam attains its full height in the future. Contemporaneously, a second rock-driven tunnel, approximately 28ft. in finished diameter, will carry additional water to the Gorge plant, in which will then be installed two other units, each of 75,000 kW, and the aggregate output of the plant will then be 240,000 kW. The Gorge plant is situated on the Skagit River, 78 miles upstream from the mouth, and current generated there is transmitted to Seattle by a line 100 miles long.

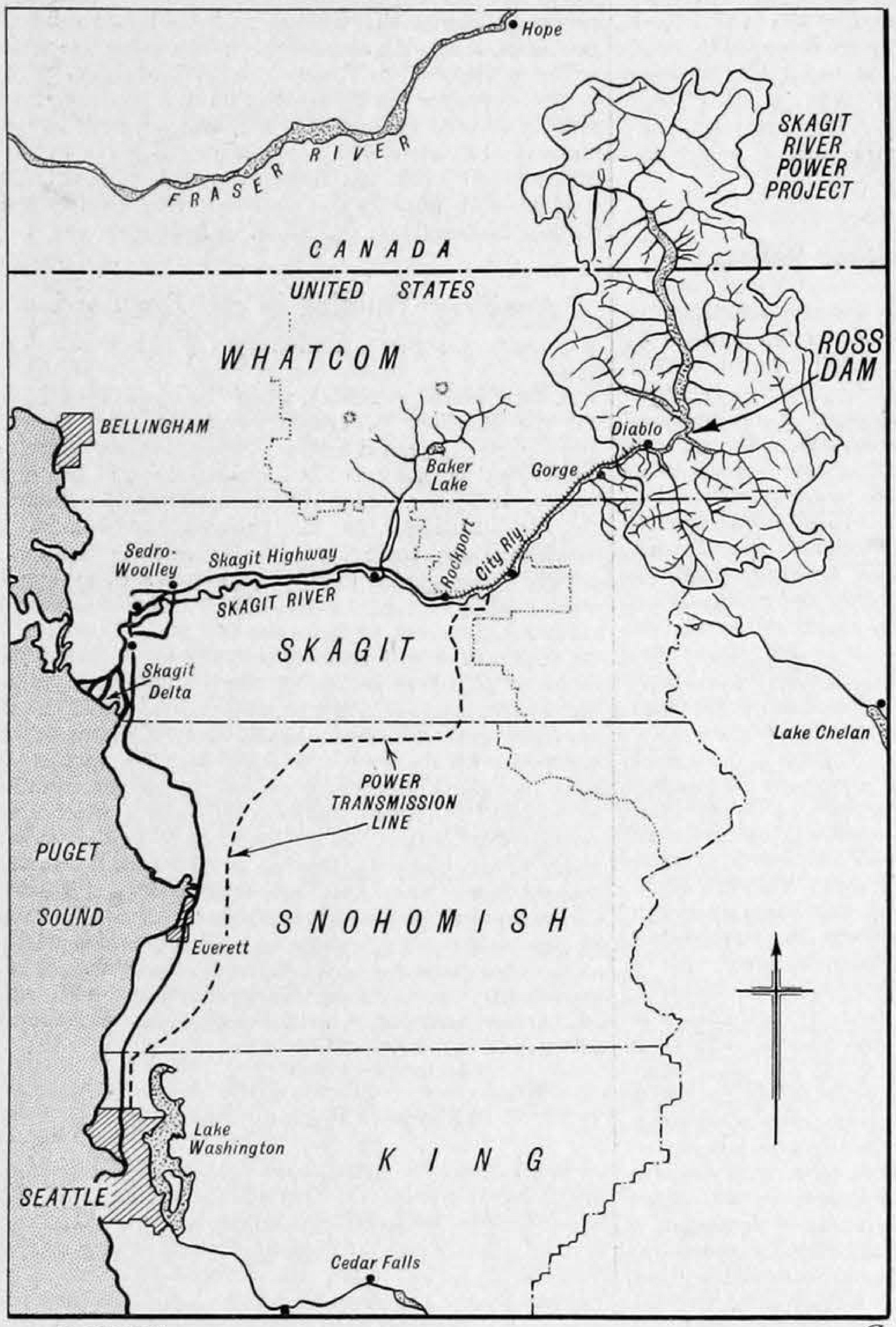


FIG. 1—MAP OF SEATTLE AND THE SKAGIT RIVER

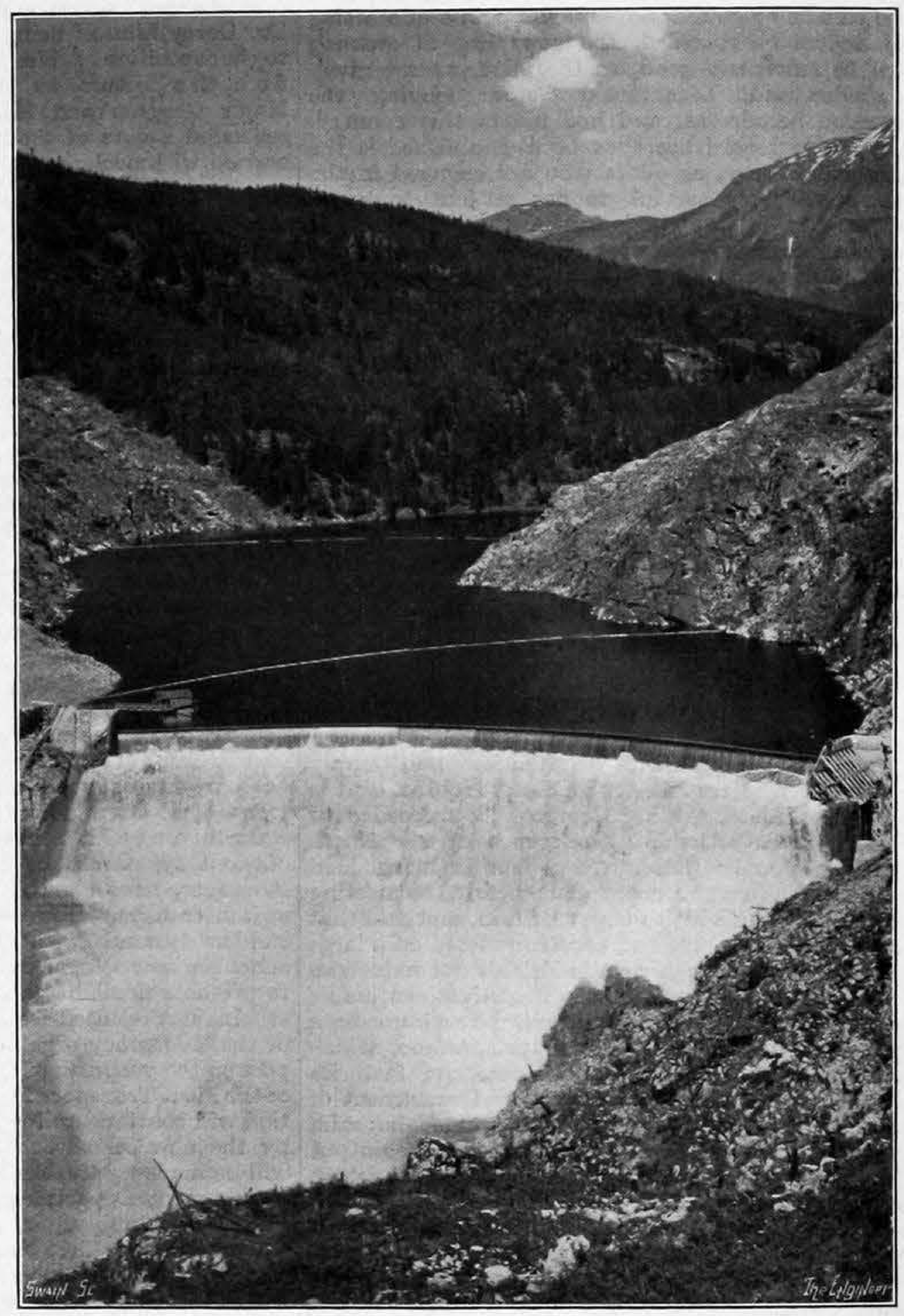


FIG. 2—FIRST STAGE OF ROSS DAM IN SERVICE

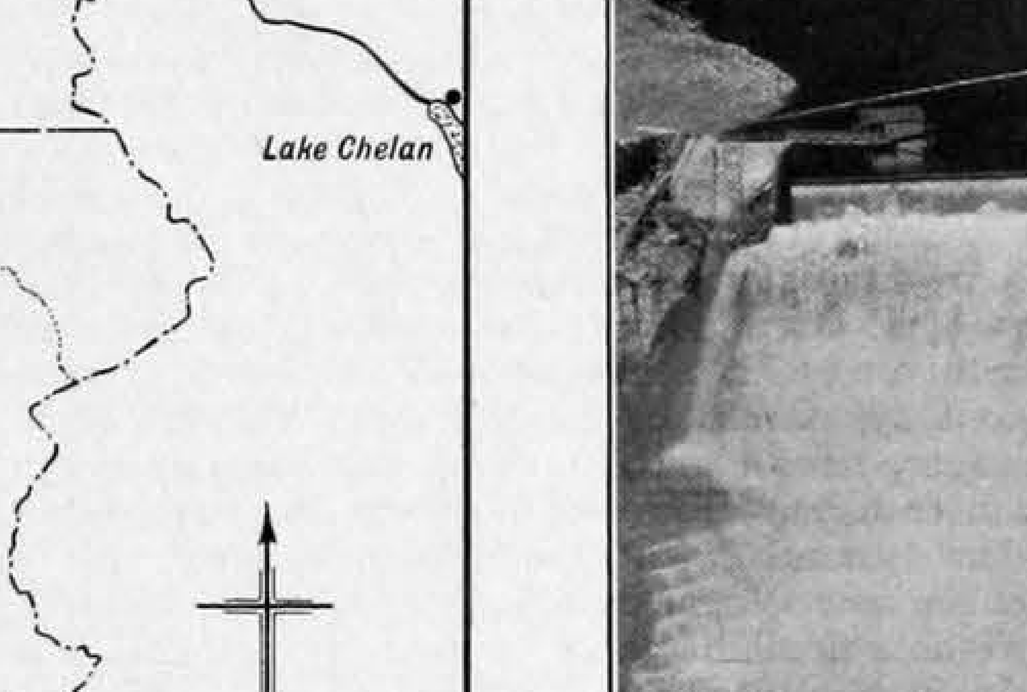


FIG. 3—STAGES IN ERECTION OF ROSS DAM

The next step in the city's programme of utilising the Skagit River was the building of the Diablo dam in Diablo Canyon, a high constant-angle arch concrete dam, which was finished in September, 1930. That structure is an immense wedge-shaped body of 350,000 cubic yards of concrete anchored within a narrow gorge flanked by precipitous walls of granite. The dam is 389ft. high and has a crest length of 1180ft. It furnishes operating water at an average head of 307ft. to the units in the power house established on Reflector Bar, below the dam. The power house was not built and equipped ready for service until November, 1937, at which time the two generating units, each of 66,700 kVA, began transmitting current to Seattle. Each unit is driven by a water wheel rated at 95,800 H.P., when working under a head of 325ft., and the units are therefore operating below their maximum designed rate. Water from the Diablo Lake flows first through a rock-driven tunnel, 19·5ft. in diameter and 2000ft. long, to a differential surge tank, and then descends through two steel penstocks, 15ft. in diameter and 500ft. long, to the two installed generating units. Current is transmitted over a double circuit 240,000-volt line, consisting of aluminium cables, reinforced with steel, that cover a distance of 121·8 miles to a substation in the heart of the industrial district of Seattle. The Diablo dam is 7·5 miles upstream from the Gorge plant, and Diablo Lake has a length of about 6 miles, and a storage capacity of 90,000 acre-feet, of which 60,000 acre-feet may be used to regulate the flow to either or to both the Diablo power house and the Gorge plant.

The key feature of the Skagit development is the Ross dam, which, when erected to its maximum projected height, will make it possible not only to operate the existing generating units in the Diablo power house and the Gorge plant at their full designed capacities, but will make it practicable and advantageous to increase the number of generating units in each of those hydro-electric stations. Also when the Ross dam reaches its third stage or ultimate maximum height of 653ft. above its base elevation of 1075ft., then a power house is to be erected immediately below the dam, and in it are to be installed four 90,000-kW vertical generating units, which will operate at an average head of 470ft., the water reaching the four units initially through two rock-driven tunnels, 24ft. in diameter and 600ft. long. There will be four 100,000-kVA transformer banks, which will step up the current to 240,000 volts for transmission to Seattle over two double-circuit transmission lines. The conductors will be of 795,000 circular mil aluminium cable, steel reinforced. The lines will have a length of 110 miles to the North substation.

The Ross dam is situated about 1·5 miles below the mouth of Ruby Creek and at the headwaters of the reservoir formed by Diablo dam. It is set in Skagit Canyon, where the normal course of the river narrows and is flanked by high granite walls. At its ultimate height, the Ross dam will bring into being a lake 30 miles long and from 1 to 3 miles wide, and will provide a storage capacity of 3,200,000 acre-feet. It is estimated that it will be able to hold an amount equal to the average flow of the river upstream of the dam for more than 500 days, and that it will permit the regulation of the stream flow, so that all of that flow may be utilised for the production of power. The gross operating head will be 505ft. The crest at the ultimate stage will be about 1650ft. in length and at a height of 653ft. above the lowest point of the basal keyway.

An accompanying diagram of the dam at its three stages of erection, Fig. 3, indicates the work recently finished up to El. 1365, as well as the concrete to be placed in raising the height of the structure to El. 1515 at the second stage, and El. 1728 for the final and climacteric stage. In the end the Skagit River project will make possible a development of 1,120,000 H.P.

While the primary purpose of the Department of Lighting of the City of Seattle has been utilisation of the Skagit River for power generation, still the aim has been to safeguard the region downstream in the Skagit Valley from the ravages of recurrent flood waters, due to heavy precipitation and the melting of the snows on the tributary watershed of the towering slopes of the Cascades Mountains. The lower Skagit Valley contains about 200 square miles of very rich farming land, built up of glacial silt in the form of a delta of fertile soil, hundreds of feet deep. In that valley, in Skagit County, more than 21 million dollars are invested in the dairy industry alone, and the district sends to market annually quite 20 million dollars worth of farm products. Protection of the region is therefore of great economic importance. At its final height, the Ross dam will create a basin capable of holding fully two-thirds of the waters of the greatest possible flood, that conclusion being based upon known records covering 136 years of flood periods on the Skagit River. All ordinary floods on the upper Skagit River would be arrested and rendered harmless by the Ross reservoir, and the basin would keep in check even an abnormally large flood until the crest of the flood in the lower river had passed onward.

FIG. 5—SUSPENSION BRIDGE AND CAR FERRY LANDING BELOW ROSS DAM

The contracts for the erection of a transmission line for construction purposes and for building the first stage of the Ross dam were let in August, 1937. The contract for the foundation step of the first stage of the dam was awarded to the General-Shea-Columbia Construction Company at a cost of 3,967,785 dollars. That figure covered a dam that then was to be reared to a height of but 225ft. Subsequently, the structure was increased 65ft. in height by raising the concrete body to El. 1365. All told, the City of Seattle has spent approximately 6,700,000 dollars as the dam now stands completed in its first stage. The outlay covered work that had to be done by the city in clearing the site and making it accessible. According to the estimates, raising the present structure 150ft. will entail the further expenditure of about 3,700,000 dollars, and the engineers of the Department of Lighting place the final cost of the dam, with the third stage finished in the neighbourhood of thirty-five million dollars.

Although the Ross dam is to be the dominating and the controlling feature of the Skagit development, the work that has been required in progressively harnessing the Skagit River has necessitated that the Gorge plant should be the first to be erected. The extreme ruggedness of the Gorge section of the river and the remoteness of the region made it necessary to start as near the bottom as possible and to use the facilities for each development as an aid in carrying forward the work at the next point of operations farther upstream.

The city of Seattle had to build a standard-gauge railway 21 miles long from an existing railhead to reach the site where the Gorge plant is reared. Again, it was necessary to extend the line 7·5 miles farther upstream to the scene of operations on the Diablo dam, and at that terminal to construct an inclined railway on a 68 per cent. gradient, 600ft. long, to connect the railway in the river valley with the high-level trackage above, which led to the main working base on the dam. Loaded cars were thus raised and the carriage used was handled by a 400 H.P. motor. All these transportation facilities have been utilised by the General-Shea-Columbia Construction Company, with some added facilities of its own, in doing the work on the Ross dam. A spur line was built to the shore at Lake Diablo, where a dock was constructed, that made it possible to transport by water materials and equipment to another landing, also on the right bank of the lake, about 1000ft downstream of the Ross dam site, Fig. 5. From that landing to the unloading point, at an elevation about 100ft.

FIG. 4—DIABLO DAM AND POWER-HOUSE

higher, freight cars loaded with bulk cement were pulled up the intervening ramp by a hoist. From the unloading station the bulk cement was raised by pneumatic pumping to the concrete mixing plant, with its floor elevation about 200ft. above the lake level. Freight cars and other materials were moved to and from the landings on the lake by steel barges, pulled by a tug, that were assembled just upstream of Diablo dam. The city of Seattle built a 26,000-volt transmission line from the Diablo power house to the site of the Ross dam, which is about 1½ miles below the point where Ruby Creek formerly met the Skagit River. About half a mile below the dam site the contractor reared and equipped a thoroughly comfortable camp for a working force of something like 315 men.

(To be continued)

Progress in Marine Engineering*

By S. F. DOREY, D.Sc., M.I. Mech. E.†

No. I

CLASSIFICATION OF SHIPS

FROM the earliest times, merchants wishing to transport their goods by sea must have sought to cover themselves against the attendant risks by adopting some form of insurance. It is known that the Phœnicians, Greeks and Romans all practised marine insurance. There is a direct reference to the subject in the Justinian Code of the early sixth century, in which the premium to be charged for "the perilous adventure of nautical insurance" was fixed at 12 per cent. The practice was further developed by the Italian republics of the Middle Ages and later by the Hanseatic League, which introduced marine insurance into England through its London colony, the Merchants of the Steelyard.

Origin of Lloyds.—It was not until the end of the seventeenth century, however, that the business of marine insurance and shipping intelligence was placed on a regular and organised basis. At that time an innkeeper named Edward Lloyd, of Tower Street, London, seeing that his establishment was frequented mainly by shipowners and underwriters, commenced to collect and circulate among his patrons regular shipping news. This proved so successful that in 1696 he published *Lloyd's News*, from which thirty years later sprang the world-famous *Lloyd's List*. It is also probable that the early patrons of Lloyd's Coffee House kept for their own guidance documents termed "ships lists," written by hand and containing particulars of vessels which underwriters were likely to have offered to them for insurance. These lists were the forerunners of the subsequent Registers of Shipping, and in principle differed little from those in use to-day. The earliest printed Register in existence is dated 1764–5–6. The information was of a complete nature comprising the former and present names of the vessels, those of the owners and masters, the home port and port of destination, the tonnage, the number of the crew and of the guns carried, the symbol of classification, and the year when last surveyed. Various symbols were adopted for the characters assigned to the different grades of vessels; thus the earliest notation was A, E, I, O, U, referring to the hull, while the attached letters G, M or B, meaning "good," "middling" or "bad," related to the equipment or outfit. Any alterations were originally made in pen and ink, but by 1775-6, at which time the familiar class A1 appeared, they were set up in type and posted weekly by hand, a practice which is peculiar to Lloyd's Register Book and which has been continued uninterruptedly down to the present day.

Lloyd's Register.—The early Register was known as the Underwriters' Green Book, but probably enjoyed some support from shipowners. In 1797, however, the basis of classification was altered in such a way as to make the character of a vessel entirely dependent on her age and place of build, irrespective of her intrinsic merit at the time of survey. Under this system also, Thames-built vessels were favoured at the expense of vessels built at other ports, with the result that shipbuilding enterprise outside the Thames was placed at a considerable disadvantage. Shipowners were dissatisfied at such an irrational system of classification and published a rival Register Book in 1799, which became commonly known as the Shipowners' Register, or Red Book. This quickly gained in popularity and public support, until in 1801 the Red Book contained particulars of even more vessels than that of its older rival. Age and place of build were used as a basis of classification also by the Committee of the Red Book, albeit to a less extent than in the Green Book. Further, under the rules of both societies, no amount of repairs could reinstate a vessel which through age had lapsed from the first, or A1, class; nor were there any rules for the construction and systematic survey of vessels, whilst the Surveyors were practically uncontrolled in their decisions. This lack of sound principles provoked in increasing degree the hostility of a large section of the shipping community, until in 1823 a series of protest meetings was held for the purpose of urging radical changes in the constitution and principles of the Registers. It was not until ten years later, however, that matters were brought to a head and a meeting was arranged between representatives of the two Registers with a view to conciliation. In consequence it was unanimously decided that the two societies should be amalgamated under the name of Lloyd's Register of British and Foreign Shipping, and in 1834 the new Register commenced its operations, its constitution and general policy being a great improvement on those of the parent societies.

Under the new constitution, merchants, shipowners, and underwriters were to have equal representation on the Committee, who were to have full powers to frame their own by-laws, not being inconsistent with the original rules and regulations under which the Society was established. The characters assigned were to be an indication of the real and intrinsic quality of vessels and were not, as previously, to depend on the place of build; further, such assignments of character were to be made, not by the Surveyors, but by the Committee itself after due consideration of the Surveyors' reports.

The original constitution of 1834 has remained fundamentally unaltered down to the present day, any changes since introduced having been mainly in the direction of securing the widest possible representation of shipping, shipbuilding, engineering and steel interests on the Committee and in extending the Society's activities to other countries.

MAIN PROPELLING MACHINERY

At the commencement of the Society's history in its reconstituted form, the regulations in respect of steamers were very brief and did not call for the survey of the machinery by the Society's Surveyors. The rules were based on the Government Regulations then in force and merely required that the machinery should be surveyed twice yearly by a competent master engineer, who was to sign a certificate describing the condition of the engines and boilers. If considered satisfactory, the vessel would be eligible for a notation of M.C. (Machinery Certified) in the Register Book. It should here be noted that the classification of hull and machinery was not at that time made interdependent, as is the case to-day.

In 1834 a typical installation in a steamer consisted of paddle wheels driven by side lever engines with a boiler supplying steam at a pressure of about 3½ lb. per square inch! The successful introduction of the screw propeller about 1837 gave an added impetus to steam propulsion and paved the way for various new types of engines, including the direct vertical marine engine. The boilers in use at that time were of the box type, which was weak in design, and this, in conjunction with poor workmanship and methods of manufacture, precluded the use of pressures above 25 lb. per square inch. At this time the heavy loss of life resulting from boiler explosions led the Committee to take steps to enforce more rigid compliance with the rules relating to the survey of machinery. Although it was not yet decided to appoint special engineer surveyors, a step in the right direction was made in the year 1869, when for the first time the engines and boilers were included as part of the vessel's equipment and the assignment of the figure "1" of the vessel's character was made conditional upon a satisfactory report from the Surveyors as to their safety and efficiency.

Appointment of Engineer Surveyors.—By the year 1873 the greatly increased number of steam vessels impelled the Committee seriously to consider the question of the survey of machinery, it being by then fully realised that the efficiency of the machinery and boilers was no less vital to the safety of a vessel than that of her hull and equipment. As a result, in the following year the first fully qualified engineer surveyor was appointed and other appointments quickly followed.

One of the first reforms recommended by the engineer surveyors was the prevention of accidental flooding resulting from a faulty arrangement of bilge pumping arrangements. There can be little doubt that many mysterious founderings prior to these improvements must be attributed to this cause.

A valuable result derived from the appointment of an engineering staff was that from their reports on the scantlings of the machinery and boilers of vessels classed with the Society the Committee were very soon in possession of information as to the practice of the principal marine engineers in the country, and were therefore early in a position to formulate rules for the strength and construction of boilers, which rapidly gained the confidence of manufacturers. The first rules to be issued aimed chiefly at a standard of strength and safety in the more important respects, but placed no restrictions upon the design and proportions of engines, thus affording free scope to the many new ideas in propulsive efficiency.

The services of the Society's engineer surveyors being keenly appreciated by owners, the Committee shortly after introduced the principle that the machinery of all new steam vessels to be classed with the Society should be constructed under the supervision of the engineer surveyors. Thus were the classification of hull and machinery made interdependent. The logical extension of this important step was the requirement issued in 1879 to the effect that periodical surveys of the machinery of vessels were also to be carried out by the engineer surveyors concurrently with those held on the hull and equipment, and that a special notation of M.S. (in red) should be introduced to indicate such inspections. Additionally, the boilers were to be subjected to annual survey after they were six years old.

Constructional Materials.—The introduction of steel made by the Siemens-Martin open-hearth process, about 1877, together with improved methods of manufacture, led to rapid developments in marine engineering in the next twenty years. Higher steam pressures were now possible and by 1890 the triple-expansion engine was in general use whilst in that year the quadruple-expansion engine was first applied to the propulsion of large vessels. About this time also the water-tube boiler was being developed, although mainly for naval purposes.

Following the satisfactory experience with steel for use in ships and boilers, greater attention was next given to forgings and castings. Prior to 1888 only large iron forgings were examined at the forge, others being inspected after delivery. At this date a system of inspection of all large forgings and castings during and after the process of manufacture was instituted, together with regulations for their quality, a change of system which proved of considerable benefit both to makers and purchasers. The regulations for the testing and inspection of steel material were revised, and these contained a list of the steel works recognised by the Committee for its manufacture. These regulations provided for a thorough supervision being maintained by the Society over the manufacture and testing procedure adopted at all steel works producing steel for use in classed vessels or machinery. At the same time, the Society published its first rules for the sizes of shafting. These were amended in 1900 in view of the increasing number of screw shaft failures, particularly in vessels engaged on Atlantic voyages in ballast.

Steam Turbines.—The year 1897 must be regarded as a milestone in the history of marine engineering, in that it witnessed the triumph of Parsons with his world-renowned "Turbinia" at the Spithead Naval Review, and from that time onward the Society was closely associated with the application of steam turbines to ship propulsion.

* From the Thirteenth Thomas Lowe Gray Lecture "Progress in Marine Engineering as Influenced by the Classification of Ships," delivered before the Institution of Mechanical Engineers, on January 24th.

† Chief Engineer Surveyor to Lloyd's Register of Shipping.

The beginning of the present century marked the extensive development of the use of the steam turbine in merchant ships, the classed yacht "Emerald," built in 1903, being the first turbine vessel to cross the Atlantic. In 1905 there were ten classed turbine vessels of a total tonnage of 16,000 gross tons in the Society's Register Book, and by 1908 this had increased to thirty ships of a total tonnage of 166,000, by which time it could be claimed that the steam turbine method of propulsion in merchant ships had passed the experimental stage. Low-pressure steam turbines in conjunction with reciprocating engines were also being introduced at this time.

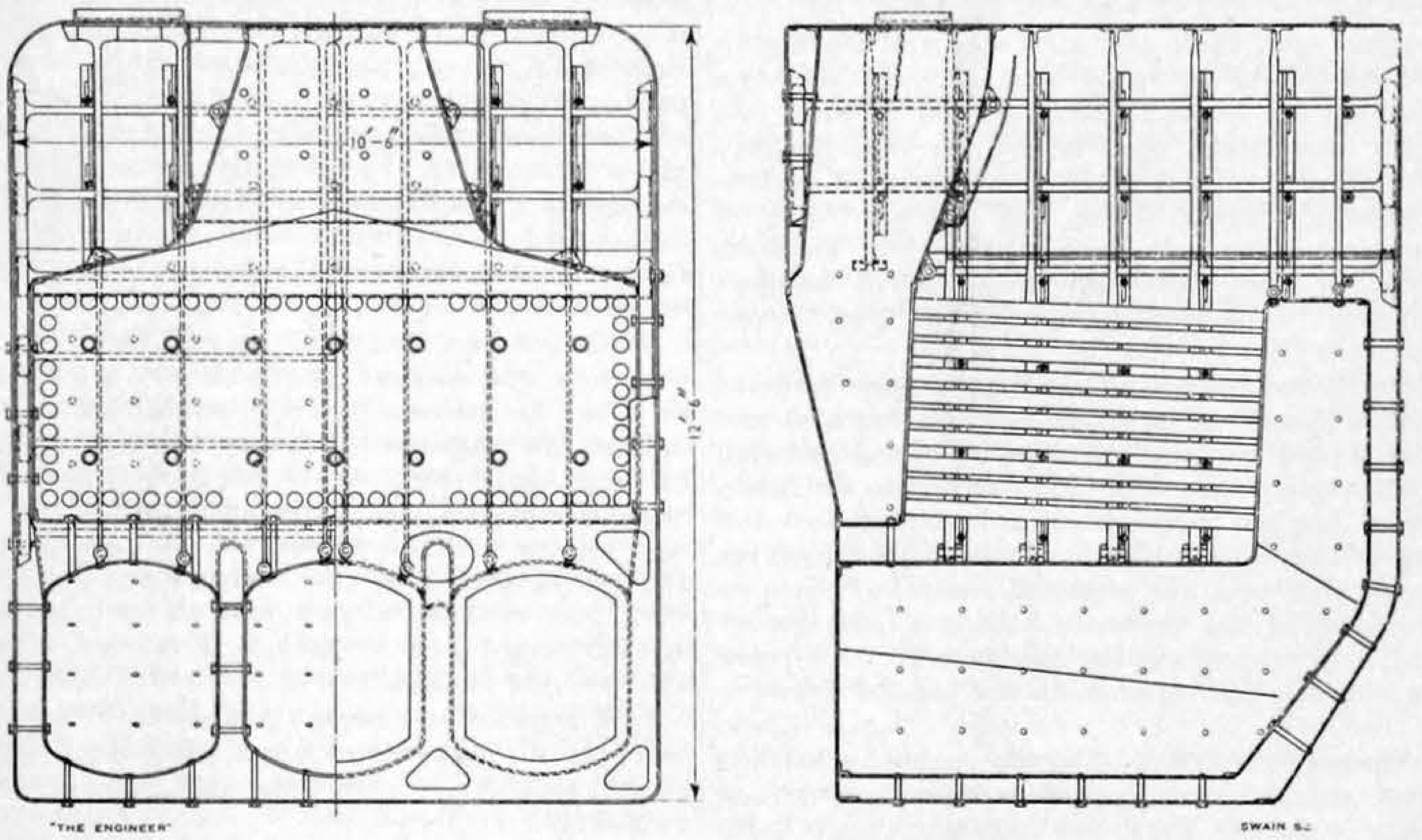


FIG. 1—ONE OF TWO BOILERS FOR OSCILLATING ENGINES OF 700 I.H.P. (1878)

Gas Engines.—In 1906 the subject of gas engines for marine propulsion was first brought under the notice of the Committee, and in 1910 the classed vessel "Holzapfel I," of 260 tons, was constructed and fitted with a suction gas engine using anthracite coal as fuel and developing 180 H.P. at 450 r.p.m. The engine, which was not reversible, was connected to the screw shaft through a Föttinger transformer, which not only reduced the revolutions to 120 per minute, but also made provision for reversing the direction of rotation of the propeller.

Petrol and Oil Engines.—Meanwhile increasing attention was being devoted to petrol and oil engines. By 1908 more than 2000 British and American yachts had been fitted with internal combustion engines, and the possibilities of the use of these engines for the motive power of ocean-going vessels became evident.

In the investigation and solution of the various problems which confronted the early designers and engine builders the Society was actively associated, and in particular Mr. Milton, the Society's chief engineer surveyor at that time, made a special study of the subject. The pooling of the available accumulated experience of many engine builders did much to advance the study of internal combustion engines, and enabled the Committee early to formulate rules for the shafting and for the construction of these engines.

Heavy Oil Engines.—The year 1912 witnessed the construction of the famous motorship "Selandia" and her sister vessel "Fionia" by Burmeister and Wain for the East Asiatic Company. The performance of these two vessels was so successful that the prejudice which had, until then, existed among the more conservative marine engineers was in large measure dispelled, and prominent British, Dutch and Swedish owners soon followed the courageous lead given by the Danes. Conversions from steam to oil engines were also successfully accomplished and by 1914, when the Society issued its first rules for the construction and survey of Diesel engines and their auxiliaries, there were twenty-seven classed vessels so fitted and twenty others building to class, in addition to thirty-six classed motorships fitted with heavy oil engines of other than Diesel type.

By this time also two-stroke cycle single-acting engines were being employed for ship propulsion, notably by Sulzer Brothers, of Winterthur. In 1914 Doxfords, of Sunderland, introduced a two-stroke cycle opposed-piston engine which was subjected to an interesting shop trial of 34½ days' duration. In the course of the trial the Society's surveyors continuously checked the data obtained and the results proved in every way satisfactory.

It was in the period after the war of 1914–18 that the Diesel engine may be said to have been developed in earnest. With the steadily increasing need for economy consequent upon falling freight rates and sharpened competition among the shipbuilding and seafaring nations of the world, it is not surprising that marine engineers quickly applied themselves to the task of perfecting a prime mover which held so much promise in the field of fuel economy.

About 1921, there was a marked increase in the horsepower per shaft of oil engines, and in the light of the experience gained since 1914 amendments were made to the Society's existing rules for the sizes of straight shafting for Diesel engines. The early rules for such shafts were based substantially on torque fluctuation coefficients comparable with those found in steam reciprocating practice, but the Society's wide experience had indicated that this was rather severe, in view of the much greater fly-wheel effect due to larger reciprocating and revolving masses in the engine itself. Accordingly, the rules were adjusted to allow for the greater torque-smoothing effect in the oil engine as compared with the steam reciprocator. At the same time, special rules were adapted for oil engines of other than Diesel type, with maximum cylinder pressures varying from 200 lb. to 550 lb. per square inch.

In 1930, as a result of the rapid advances in this type of engine and in the light of extended experience generally, the Society's rules were revised and brought up to date with the inclusion of rules for double-acting engines. As a basis for the rules governing the sizes of crankshafts, the maximum and mean indicated cylinder pressures, in conjunction with bore, stroke and span between main bearings, were adopted, and having regard to the complexity of the problem it may fairly be claimed that the rules in their present form have given general satisfaction under all normal conditions of working.

Further Developments in Steam-driven Propulsive Machinery.—In spite of the remarkable strides made in the development of the motorship since the end of the last war, continued progress also took place in other fields of marine engineering. Geared turbines, introduced to the merchant service about 1914, had increased to a remarkable extent by the end of 1918, and additional attention was being given to turbo-electric ship propulsion.

In 1928 proposals for the fitting on board of pulverised coal-burning equipment were specially considered and a number of these plants was installed in classed vessels. Unfortunately, the success hoped for this method of burning coal did not materialise, and most of the installations were removed after a short period of service. Other efforts shortly followed to increase the efficiency of steam reciprocating engines, with a view to reduction in coal consumption.

There has also been a resurrection of the earlier proposals adopted by Sir Charles Parsons in 1911 to deal efficiently with low-pressure steam by employing a low-pressure turbine in conjunction with steam reciprocating engines. The modern system employs the exhaust steam from the reciprocator to drive a turbine which is employed in one of the following four ways :—(*a*) Connected to main shafting by reduction gearing and hydraulic clutch—the Bauer-Wach system ; (*b*) to drive a directly coupled electric generator which supplies power to a motor mounted on the shaft, as in the system developed by the Metropolitan-Vickers Electrical Company ; (*c*) by driving a steam compressor drawing steam from the high-pressure cylinder exhaust and delivering it to the intermediate-pressure cylinder—the "Götaverken" system ; and (*d*) to drive an electric generator which supplies current to an electric heater through which the steam passes from the high-pressure to the intermediate-pressure cylinder—the "Lindholmen" system. To all these proposals the Committee of Lloyd's Register have given their consideration and approval.

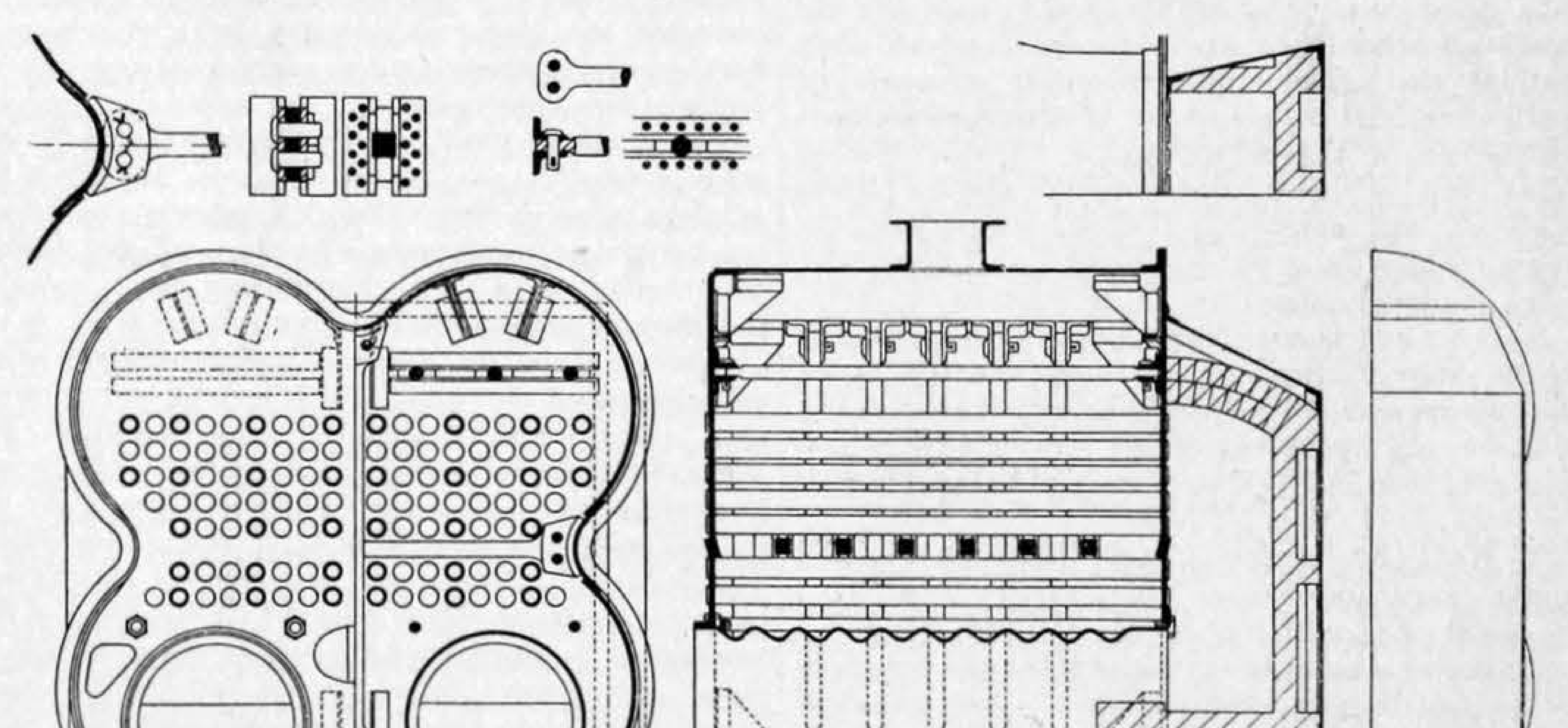


FIG. 2—R. S. BOYER'S PATENT BOILER

BOILERS

It was not until the appointment of engineer surveyors in 1874 that really serious attention was given to the condition of marine boilers. At this time, while wrought iron was almost exclusively used in marine boiler construction, Bessemer steel was used in a few instances for the shell plates and furnaces. In 1877 the Wallsend Slipway submitted a plan of the first marine boiler proposed to be made entirely of steel. Before giving approval special tests were carried out on the material, and were also applied in order to ascertain the actual strength of the flat plates stayed as proposed and of the riveted seams of the shell. A variety of tests on boilers also were specially carried out under the supervision of the Society's surveyors. Longitudinal seams were tested and greater bearing surfaces of the joints found to be necessary ; combustion chambers were constructed and hydraulically tested to prove the efficiency of the riveted seams ; the punching of rivet holes was demonstrated to be bad, and the beneficial effects of reamering punched holes and annealing plates were established. These tests, together with the accumulated experience of the behaviour of boilers in service and a wide knowledge of the practice of boilermakers throughout the country, enabled the Society in 1877 to formulate rules, on a sound basis, for the strength of cylindrical boilers. Two boiler designs approved about this period are shown in Figs. 1 and 2.

(To be continued)

Dr. Stodola and the James Watt International Medal

As recorded in a Journal note on the first page of this issue, the James Watt International Medal was handed last Friday, January 24th, to the Swiss Minister, Monsieur Thurnheer, for transmission to Dr. Aurel Stodola, of Zurich, at a special meeting of the Institution of Mechanical Engineers. In the course of the meeting the President, Mr. Asa Binns, called upon Dr. Guy to present the Appreciation of Dr. Stodola that we here reprint.

Professor Aurel Stodola, the Senior Honorary Member of this Institution, was born in 1859 in a small Slovakian village in the shadow of the Tatra Mountains. A brilliant scholar from his earliest days, he graduated with highest distinction at the Polytechnikum in Zurich. His practical training was obtained in the workshops of the Hungarian State Railways, followed at Berlin and Paris by further practical work and studies in technical, physiological, and economic subjects. After supervising the building of a leather belt factory for his father, he became a designer in the engineering department of Rustons, of Prague, who introduced the Corliss engine to Austria and enjoyed a considerable reputation as builders of the steam engine. With eight years of such practical work as a preparation, Stodola was in 1892 appointed Professor of Mechanical Engineering of the Swiss Polytechnikum at Zurich, where he has remained with such advantage to the land of his adoption that the eminent position occupied in engineering by so small a country as Switzerland, is due in no small measure to the skill and inspiration of his work and teaching.

Watt's vital improvement of the steam engine began with studies of the sources of loss in the engines of his day in the light of the scientific knowledge then available. Stodola, also endowed with great analytical ability and a capacity for sure and illuminating experiment, isolated and studied the losses and structural elements of steam turbines in the light of the accumulated knowledge of thermo-dynamics, of the flow of fluids and of heat, of elasticity and of stress analysis, and constructed a scientific basis for steam turbine design which directly and materially aided its development and improvement.

Watt gave the centrifugal governor to the steam engine. Stodola's earliest scientific work was concerned with problems of the stability of governing by means of the servo motor which in steam turbine practice was added to Watt's governor.

If Watt by inventing the indicator enabled engineers to understand and measure what went on inside the cylinders of his engines, Stodola's investigations and researches enabled the designers of his day to picture, understand, and calculate the operation of steam in the nozzles and blades which in the turbine replaced Watt's piston and cylinder. He demonstrated experimentally the fallacy of the belief that velocities of steam higher than that of sound were associated with prohibitive loss. He established the correct principles for the design of divergent nozzles, and the moving blades which co-operate with them and explored and explained the significance of steam shock.

Watt experimented on latent heat and the properties of steam, and discovered the importance of cylinder condensation. Stodola experimentally investigated Martin's suggestion that "under cooling" explains an anomaly of the expansion of steam in a turbine, and proved that with commercial steam condensation begins at expansion ratios much less than the "Wilson line."

Watt was the first to employ a slide rule in engineering calculations. Stodola employed many intricate mathematical processes in the solution of engineering problems and was the first to apply the Lanchester-Prantl theory to the flow of air in centrifugal compressors.

The strength of the slow-moving parts of Watt's engines was determined by the loads they trans mitted. In the fast-moving parts of the steam turbine such loads are small and the dimensions are controlled by stress arising from their own motion, or by their tendency to vibrate. In these new fields, Stodola, by his investigations and experiments on the critical speed of turbine shafts, of moving blades, and of loaded discs of practical form, and by his method of assessing stress in them, made straight the way of engineers engaged in developing turbines and high-speed machinery.

But Stodola's work has not been confined to the steam turbine. He has also followed and contributed to the development of the internal combustion engine. At an early date he introduced the gas entropy chart and the device of the kilogramme molecule in the solution of gas cycle problems. He produced analytical solutions to many of the problems arising in the theory and development of the gas turbine, and acted as consultant to Holzwarth for his development in that field.

Stodola's skill and integrity is such that the most eminent and competing manufacturers of many countries have not hesitated to seek his advice in their gravest and most intimate problems. Yet who, knowing Stodola, will not find a similarity in the characteristic modesty and meticulous caution in stating results which caused Watt, when soliciting the help of Dr. Small, to write: "Remember, also, I have no great experience and am not enterprising, seldom chusing to attempt things that are both great and new. I am not a man of regularity in business and have bad health. Take care not to give any better opinion of me than I deserve; it will hurt me in the end."

Watt set himself to learn German as a mental exercise, and so that he might read certain books of engineering interest. Stodola has added English to Slovak, German and French, that he may enjoy intercourse with us, study our scientific and technical work, and delight in the rich heritage of our literature. One pleasing memory is of an evening in a small hotel in Bohemia with Stodola expounding the subtlety and wit of Samuel Butler to some score of engineers of a dozen different countries.

Watt was tone deaf, for it is said that "he did not know one musical note from another"; yet as a boy he made a model "barrel organ," and in later life mastered the theory of music so that he might build pipe organs for Scotch churches. Stodola acquired considerable proficiency in playing such organs, and throughout his life found solace and refreshment in his beloved music. They are alike, too, in that the vast total of work covered in their long life is a triumph of intense mental activity over physical frailty.

In the name and memory of James Watt, we unite to do honour to Aurel Stodola, a great great engineer, a great teacher, and a great gentleman.

Letters to the Editor

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

WAR AIMS

SIR,—The thoughtful and inspiring article by Colonel Kitson Clark, and your Leader on it, both seemed to convey an invitation to others who have pondered the future of industry and the relations between those engaged in it to express their thoughts, perhaps as a contribution to the solution of urgent problems and to that further progress for which we are all hoping.

Like Colonel Kitson Clark, "I entered the workshop, sharing the full hours with the men, and so was admitted by them to the abrupt and kindly fellowship that we think is typical of our country."

Later I joined the ranks of managers, but have never attained the rank of ownership, and confess that I have never felt great ambition to do so. To this extent, my experience is incomplete. Like him, I have also watched with satisfaction "the growth of mutual understanding," although over a somewhat shorter period. I have also deplored the hampering of the outlook by those "vague [and, may I add, misleading ?] generalities, those irresponsible promises put forward by respected authorities," and regret, with him, the absence of definition and analysis.

I conceive that the object and purpose of all industry is the provision for all the people of all the necessities—material, moral, and spiritual—of a full and happy life. The motives of those who engage in it vary from the need to ensure the bare necessaries of life to the artistic love of craft and desire to achieve interest in particular phases, the seeking of individual gain and ambition.

I come now to the three proposals which he discusses.

(1) That the employees should share the profits.

What is profit ? Profit can be defined as the difference between cost and selling price; but to be correct this cost must be completely comprehensive, and include not only materials, labour, management, administration and taxes, but also provisions to cover losses by errors in every phase of activity and by changes in external conditions, as well as a fair and reasonable interest on the capital invested. Selling price must be taken to be the amount actually received by the concern for its product, after deducting costs of selling and distribution. Considered thus, how many industrial concerns can really be said to have made any profit over a period of, say, thirty years ? This is not, as it may seem, an attempt to baulk the issue, but an attempt to analyse and state the problem. If there is no profit but a loss, it inevitably falls upon the owner of the business, because materials, labour, taxes, &c., have been paid for before it is discovered, and the only fund from which it can be taken is the capital invested, and—if the mistakes which have caused it have been discovered and their lessons can be and have been assimilated—future profits.

It may be that selling prices have to be raised, even at the risk of reducing the markets, for, after all, the purchaser must pay the complete cost, and the cost can always be reduced, and without reducing wages. It may be noted that loss can be very often avoided by rigidly resisting the temptation to pay excessive dividends in good years, and by proper provisions for development and lean years, and the proper use of these reserves. I am aware that such reserves are falsely regarded as concealment of profits by some of the workers, and even trouble the consciences of some of those who make them, but this need not be. Here I would plead for a greater frankness and less secrecy in the matters of finance, cost, and reserves. As the result of experience, I am convinced that the best answer to the "vague generalities," &c., is the improvement of the education in such matters of the great body of those working and otherwise interested in industry. Such frankness will beget confidence, the necessity for reserves, even those for development, will be better realised, and the sting in the word profit will be neutralised.

I would replace the first proposal, then, by "There shall be no profits." If, after all, errors on the safe side result in profits, the best way of using them is in the development of the concern. Thereby the investor is insured against loss, the workers get better conditions and more security, and the purchaser can buy more cheaply, products being more widely available.

(2) That the employees shall take part in the management.

The quality of industrial management has undoubtedly improved during the past thirty years, partly as the result of the more conscious study of the art, as the result of the devising and spreading use of what may be called aids to management, and perhaps as the spread and raising of the standard of education and consequently of the broadening of outlook of all those concerned.

On the other hand, the changes and the progress that have been made have increased the difficulty and complexity of management, and have made a higher standard necessary. He would be a bold man, and almost certainly mistaken, who would say that it is easier to manage successfully an industrial undertaking to-day than it was, say, thirty years ago, or that this success is more generally achieved. One would rather say that to-day those responsible for management and direction need, not only all the aids, scientific or otherwise, but also all the active help they can get. The carrying out of the somewhat idealistic practices suggested under the discussion of proposal (1) will increase and not diminish what may be called their technical difficulties.

How can the workers help ? In the first place, it will be conceded that every waged or salaried employee has a right to a voice in the fixing of his and his fellows' conditions of service. This is also one of the functions of management. Secondly, if every employee, of whatever rank, has a truly co-operative attitude of mind, and in most cases, I am convinced, this simply means if he knows and realises both his own interests and his own duty, he can and will make helpful and constructive suggestions or criticisms, either with regard to his own or to a wider sphere, and those suggestions made in his own sphere are based on sure knowledge possessed by few others and are almost invariably valuable.

I do not think it matters greatly whether or not the workers are given representatives on management committees or boards, because what they most need is not power but knowledge ; knowledge that their help is both needed and wanted and welcomed when it is given. However, the appointment of a representative would be a visible sign of this attitude, and would therefore increase the workers' goodwill and confidence, and emphasise to them their sense of responsibility and duty.

So I would write the second proposal : " All workers shall co-operate in management."

(3) There should be no employer other than the State.

If we had all reached the spiritual and moral state epitomised in Bellamy's "Looking Backward," it would not greatly matter whether the present system or the proposed one was in vogue. But, alas, we are all still ordinary human beings, with all the weaknesses and proneness to err of our species. To make such a change, now or in the near future, would be to sacrifice much of the progress which has been made, without gaining anything in return. It would remove the local or concentrated effect of many of the motives and incentives which actuate most of us now, and would not immediately put anything in their place. Would frustrate or dissipate some of our higher impulses, and smooth out our individualities as no modern industries with their standardisation, mass production, or subdivision of tasks can or do. For a long, long time it would stop progress. May Heaven forbid it !

No. There are many and serious evils in our present system, and they can and must be cured. My opinion is that the best way to cure them is to separate, diagnose, define, and analyse them, specifically and individually, and when these processes are complete, the cures will almost certainly be obvious.

Whatever may be thought of this effort, I sincerely hope that Colonel Kitson Clark's article and yours may succeed in broadening and intensifying interest in these urgent problems, and result in some kind of concrete action. H. T. HILDAGE.

Eyam, Derbyshire, January 23rd.

TOWN'S GAS FUEL FOR PETROL ENGINES

SIR,—I entered this arena as a "free lance," because Mr. Chamberlain's mixture ratio of 4·1 to 1 upset hitherto generally accepted figures by 100 per cent., and so far the correspondence has failed to extract either from Mr. Chamberlain or other authority any full answer or definite expression of opinion for either side of the question, though it has been sought to draw many red herrings across the trail. Mr. Jones' letter in your current number still avoids the issue. It, however, with your permission, calls for specific answers to his criticisms, especially as his final paragraph directly contradicts the wording of his earlier letter, and debate becomes impossible if the ground is thus changed.

First, I contend that theoretical mixtures have no useful bearing on the actual ratio of gas to air required when running the engine. Some faddist of the future may claim to discover that argon as a constituent of air has been neglected, and that as a result theoretically more or less gas is required. If he does, it will not alter the gas consumption or the fuel bill by one cubic foot or one penny, so why worry with it ?

Secondly, I did not overlook the volumetric efficiency of the engine in the test quoted, though not knowing what factor to allow I alluded to the reduction of air by attenuation and conceded that it would tend to result in a higher gas ratio than the calculated 1 to 8·6 based on swept volume without such allowance. Moreover, I intentionally, and rather generously, I think, deliberately neglected the compression space of 333 cubic inches, as with late exhaust valve closing and early air valve opening it is possible partially to scavenge this space by the inertia of the exhaust gas column, especially with a long exhaust pipe. Any such air trapped when the exhaust valve shuts is available for combustion, and would further weaken the mixture.

Finally, Mr. Jones corrects me for assuming that his own result of 5·7 to 1 air to gas was obtained when working at maximum power, and now states that it was obtained when the engine was tuned for maximum "economy." I presume that this means maximum efficiency.

I must therefore refer Mr. Jones to his own letter of December 9th, ult., from which the following is an extract :—

"In the case of a series of experiments on a National high-compression gas engine, tests were made from full load to no load with quality governing (that is, throttling on gas only), and the mixture strength *at full load* was found to be 5·7 air to 1 of gas, and at no load 11·88 of air to 1 of gas, and while the optimum consumption was obtained at full load, the no-load consumption was 44 per cent. of the full-load consumption." The italics are mine.

If "full load" does not mean full power, what does it mean ?

When so many cars and other petrol engines are being turned over to gas fuel, it does seem to me of some importance to settle this controversy, and I suggest that it would be worth while to take an ordinary car engine and with the minimum of alteration to it arrange for accurately metering both the gas and air, and thus ascertain whether Mr. Chamberlain's ratio or the 8-to-1 ratio is the more correct. I am quite ready to bow in submission, hand in hand with the shade of Sir Dugald Clerk, if I am wrong. INQUIRER.

January 19th.

PROPAGANDA BY BOASTING

SIR,—Would Captain Edgar Smith not be on safer ground in championing the French as outstanding pioneers, lacking perhaps the dogged application which often requires still more inventive power.

It would be easy to fill an issue with the names of German pioneers. I think it would be still more easy to do so in the cause of Britain, but, as the Editor implies, it would serve little purpose. The question is, I suppose, the extent, if any, to which German reputation is based on propaganda other than fair advertising.

May I briefly refer to the history of the type of field glass "developed by Abbe and Zeiss." The prismatic glass was first invented by Professors Barr and Stroud. They submitted a patent specification covering many combinations of prisms, of which they preferred the Porro type. From the examiner's reply they realised they had been anticipated by Porro. The application was therefore abandoned. Some months later Messrs. Zeiss patented their prismatic binocular on the basis of the interocular distance hinge arrangement in its application to a prism binocular. The Porro system they used was already anticipated ; the hinge arrangement was not novel—it had been described by Father Cherubin. The combination was novel, and the patent a valuable one.

Their great rival, Mr. Goerz, avoided the Zeiss patent during its lifetime by using a rack and pinion interocular gear. He produced, I believe, larger quantities than Zeiss.

Ottmar Mergenthaler is cited as the German inventor of the Linotype. The editorial view of invention appears to be emphasised by the official statement of the company, which reads as follows :— "The first Linotype was the product of twenty years of patient co-operation of a small group of pioneers, who employed a watchmaker, Ottmar Mergenthaler." Apportionment of credit in a controversial way is always difficult, and indeed better left alone.

With Captain Smith's dislike of self-praise at the expense of others, everyone must be in complete sympathy. Some of us in industry have, however, been forced to realise that propaganda by boasting is regarded in Germany as a legitimate commercial weapon of importance, encouraged and assisted by the Government as a policy which has benefited many of their industries. The same weapon was used as a preparatory war measure to provide in the countries to be conquered a Fifth Column holding the backdoor key for admission of the enemy. We all know the methods of their Ministry of Propaganda, of which, I think, they were the first and true inventors. JAMES WEIR FRENCH.

Glasgow, W.3, January 24th.

American Engineering News

Care of Oil-electric Locomotives

With the rapidly increasing use of oil-electric locomotives on American railways, mainly for yard and shunting work, but also for general passenger and freight service, the mechanical departments have had to design and provide special facilities for running repairs and servicing at the running sheds. In 1935 the Atchison, Topeka and Santa Fe Railroad introduced a locomotive having four twelve-cylinder "V" type two-cycle oil engines of 900 H.P. each and two four-cycle engines of 90 H.P. for the auxiliaries. It also put in service a shunting locomotive with a 600 H.P. oil engine. This railway has now seventeen high-speed oil-electric passenger engines, with a maximum speed of 118 m.p.h. and forty shunting engines. The electric transmission is a main limiting factor for continuous operation on heavy gradients, owing to the necessity for dissipating the thermal losses from the traction motors and generators, as well as dissipating the heat generated by the oil engines. This second factor is a difficulty on account of the space limits, axle load limits and power required to drive adequate cooling apparatus. A special shop has been built at Chicago for handling the repair work on oil-electric locomotives, the equipment of which includes a crank-throw grinding machine for the oil engine shafts. Maintenance costs average 8½d. per locomotive mile for oil engine locomotives, as compared with 9½d. for steam locomotives. In train service a repair man rides on the locomotive and makes a complete log report, including all repairs and inspections required on the trip. He inspects the locomotive before departure, giving ample time to ensure proper performance of any work required. He also reports on mileage and service of such parts as cylinder heads and liners, pistons, traction motors, axles and wheels. Another specially trained man inspects the oil-electric shunting engines on the entire system, checking their operation and maintenance. The latest oil-electric locomotive on this road is a goods locomotive having four oil engines of 1350 H.P. each.

American Airport Activities

Planning and construction of airports—both civil and military—is one of the leading activities in the United States and is likely to increase and continue for some years. Both the Army and Navy Departments of the Federal Government are busy with the expansion of their aviation facilities, including the construction of new airports and the enlargement of existing airports. Civil airports have been on the increase for some time, as commercial and private aviation grows and every city and town desires to be on or connected to the main airways. As most of these enterprises come to the Federal Government for financial aid, the Government exercises some control over them and limits its aid to those which are of potential value as adjuncts to the military airport system. To assist in reducing these municipal and other private airports to some uniformity in design and standardised requirements, the Civil Aeronautical Authority has been created. The progress of private aviation is shown by the increasing manufacture of light aeroplanes, which has risen rapidly to an output of 3000 in 1939 and a probable output of 5000 for the year 1940. Commercial aviation is also increasing rapidly, as a competitor of railway and motor coach travel. The programme for the expansion of civil airport facilities covers a period of six years and a net of some 4500 airports adaptable to military purposes if required, the total cost being put at some £120,000,000. There would then be approximately 500 civil airports of the major class, 1600 of the medium-sized class and 2500 of the smaller class. Those for municipalities will be planned by the cities, but in co-operation with Government authority, the cities to provide land and buildings, whilst Government forces carry out the earthworks, paving, marking and lighting. Thus airports are destined to represent an important feature in the construction industry.

SYNTHETIC PETROL.—A new iron catalyst has been developed recently in the laboratory of Dr. Kita, of the Kyoto Imperial University. It is claimed to be quite as efficient as the German cobalt catalyst in the production of synthetic petrol by the Fischer-Tropsch and allied processes. The catalyst has now been successfully tried out on a small scale by a number of different investigators. The next step is the erection of a large pilot plant at a cost of 180,000 yen (donated by the Hokkaido Artificial Petroleum Company), and which is to be built near Kyoto University. If the pilot plant results are satisfactory the Government and other large petroleum companies in the country are to adopt the new catalyst.

The Engineer

JANUARY 31, 1941

VOL. CLXXI No. 4438

Contents

POST-WAR PROBLEMS

IT appears from an article printed in the January number of *Mechanical Engineering* that American engineers are beginning now to give thought to the industrial, social, and commercial problems that will certainly arise as soon as peace is re-established. Even if America succeeds in remaining to the end a non-belligerent, she will not escape the difficulties that will beset countries impoverished and disorganised by war, though she may find herself in a better position to cope with them. But this, at least, has to be remembered. Urgent as her isolationists may be that she shall keep out of the European War, there is no possibility that she can keep out of the European peace. Repercussion on her industries and trade will be unavoidable. Her financial commitments in Europe are on a vast scale. Those commitments will be affected not only by the terms of the peace, but, to a far greater degree probably, by political and sociological changes that are certain to take place in every one of the countries involved in the war. Aware of this fact, it is not surprising that she is beginning already to give thought to the problems that will face engineers and the engineering industries when the time comes to rebuild a world shattered by warfare and resolved to erect upon the ruins a new and better edifice than that which has fallen.

The American spokesman was Mr. W. L. Batt, a Past-President of the A.S.M.E., and the occasion was the annual dinner of the Society, held in New York a few weeks ago. Mr. Batt passed in review the changes which are taking place in American industry under the pressure of military necessity. We are now engaged, he said, on a programme which would have more profound effects on America than the Four Years War, and would more deeply affect her "relationships to a world whose make-up we cannot even clearly imagine." Then, after touching upon the disadvantages of high import duties, for "foreign trade must work both ways," he outlined "the vital problems that this war and our national defence problem are creating for us." He placed first Industrial Problems—what to do with excess manufacturing capacity; then came Labour Problems—where to find jobs for the men trained for the production of wartime products; Political, Financial, and Monetary Problems followed, amongst the first of these three being "Who is to Own and Operate the Plants that the Government is Building or Paying for in one form or another?" All these, and many more, he said, will present "staggering difficulties." There are, he concluded, "dark days ahead unless we look realistically at what is happening around us." Then he passed on to make a concrete proposal. Let us quote a few of his sentences: "Therefore it seems to me essential that we immediately create a small group of the ablest men in the country who would be charged with studying these long-range problems and working out solutions in advance. They ought to be set off in a corner by themselves, instructed to forget all about the immediate problems of procuring war material, except as far as it affects the future national economy. They should set to work now on the preparation of an industrial demobilisation plan. . . . That might involve the discovery and development of new processes and new products for civilian consumption that could be manufactured on the same machines that now are turning out, or preparing to turn out, products that are useless in times of peace; plans for the absorption of our newly trained labour in peaceful pursuits; the fundamental policies of a foreign trade policy in a world that will be vastly different from that with which we have ever dealt before. This group would need inventors and research scientists, trade experts and fiscal experts, men of practical knowledge and great vision. They should devote their entire time to the formulation of the best plans that could be evolved for the utilisation of our entire resources for the improvement of our standard of living, for the protection of our national economy from the repercussions not of war but of peace, for the conversion of the processes of economic waste to the processes of economic usefulness."

Whilst we fear that Mr. Batt's plan is based on a plane unattainably high, we welcome his discourse for the support it gives to a plea several times expressed in these columns that engineers should begin now to think about the problems that they will have to face as soon as the war comes to an end. We have no doubt that many engineering firms, with the experience of the last war and the Armistice still corroding their vitals, are asking themselves how they are to re-establish their businesses and to what new and good use they can put the equipment that they have installed to meet the needs of the day. But we are convinced that concerted action is needed. Not for a moment do we suggest that the individual enterprise of manufacturers should be curtailed or restricted. Upon it we shall have to rely in the future, as in the past. But we see the ever-shortening shadows of changes which will affect the whole of the engineering industry, and we hold that engineers by corporate action should endeavour so to guide those changes that they may have as few ill effects and as many good effects as the wit of sensible men can win out of them. We are glad to see signs, small at present, of a movement in this direction. It would be premature at this stage to say more. We are happy to know that partly as the result of our efforts, engineers are beginning to think of these things, and we trust that before long we may be at liberty to make announcements of definite steps. Profoundly necessary as it is that engineers should allow nothing to deflect their energies from the pursuit of victory, it is almost as important that they should not find themselves unprepared for peace.

The One Best Way

THERE was, not so many years ago, a group of enthusiasts who preached that every human action ought to be performed in "the one best way." The expert, it was argued, whether golfer or machine operator or anything between, owed his superiority to the perfection of his bodily movements, and anyone who would imitate them faithfully might acquire an equal degree of eminence. To facilitate the acquisition of the desired skill, the movements of acknowledged masters were recorded by motion-study photographs, and analysed for the benefit of those who might wish to emulate their performances. We are not aware of any noticeable improvements in the standards of either work or play that can be attributed to the cult of the "one best way." Indeed, the apostles of the creed would have preached with more conviction had they shown themselves capable of carrying out the actions of everyday life in an identical manner —writing, for example, in a facsimile script and eating a meal without waste of energy in superfluous motions. In spite, however, of the exaggerated importance it attaches to movements as compared with the workings of the brain that directs them, the theory of the one best way contains, nevertheless, a certain amount of truth. The drill sergeant, when inculcating methods of handling a rifle "by numbers," has no doubt about it. The skilled mechanic, when demonstrating to an apprentice how a hammer and chisel should be used, also shows his belief in the principle. Both would claim support from the proverb that there is a right way and a wrong way to do everything. But the proverb takes into account only two alternatives, and says nothing about the almost infinite number of other methods, most of which could not be classified as either right or wrong without reference to the circumstances of each case.

To hundreds of firms up and down the country who are now undertaking work of a kind new to them, the question of the one best way, in so far as manufacturing methods are concerned, is one of very great importance. The articles to be made are unfamiliar, and very often the machining involved has little or no resemblance to anything customary in the works. Even such an apparently simple thing as an H.E. shell can present a multitude of problems to a firm whose normal products are of an ordinary peacetime nature. Starting with the forging, what number of operations are required to produce the finished shell, and in what order can they best be performed? By what sort of devices can the work best be held for turning, boring, shaping the nose to form, and other processes? How long should each operation take, or—more practically—how many machines must be allotted to each operation for a given weekly output? These are typical of the questions for which answers have to be found before any firm can start quantity production. Even the best all-round mechanics, without previous experience of the work, are unlikely to hit upon the best way of performing each and every operation at the outset. Advice as to manufacturing methods is, of course, generally obtainable from technical members of the staff of the Ministry for whom the products are destined, or from some main contractor for whom the work is being carried out. But, however fortunate the firm may be in getting advice, the latter will mostly be verbal, scrappy, and frequently contradictory. Time will be needed to get the programme of operations decided on, more time to discover such defects as will almost certainly exist, and still more time to remedy them. Finally, the firm will arrive at what it considers a satisfactory output from the machines and operating staff engaged, and production will then proceed normally. But even when stable production conditions are attained, there will always remain the question whether the output is as high as it should be for the number of machines and personnel employed. This can best be judged by making comparisons with the performances of other firms engaged upon the same work. Information of this kind is not kept secret in wartime, and those who have reason to be proud of their output are only too willing to share their experience with others working with less efficiency. For this, however, it is necessary that the firms with an output below what is possible should realise that their production figures are capable of improvement, and this is by no means always the case. During the last war, in order to provide a basis for the allocation of labour to plants where it would be most efficiently employed, an immense amount of data relating to productivity was collected, and much of this should be available to-day. The weekly output divided by the number of persons directly or indirectly engaged in production of any particular article was found to vary remarkably between different works, and this wide discrepancy in efficiency was frequently attributable to the variety of the methods employed. That a similar state of affairs exists to-day there can be little doubt. Broadly speaking, it may be stated that for any firm with the normal equipment of machine tools there is one best way of making any article required in quantities. It is, moreover, a fair assumption that the firm with the greatest output per man or per machine has, at any rate approximately, discovered this way, and no greater assistance could be given to amateurs in the same field than to furnish them with full and detailed particulars of the best existing practice. Generalities are of no use. Every operation should be taken in order and described clearly, together with the nature of the tools employed. Accuracy and fulness of detail are essential. The method of holding the work should be stated, and drawings, fully dimensioned, given of any kind of special chuck, fixture, or jig which would not normally be part of the machine equipment. Cutting speeds and feeds would, of course, be mentioned, and the hourly or daily output of work which should be attained.

The schedule of operations, drawn up in this way, would represent actual practice confirmed by experience, and would therefore be free from any suspicion of "theory." It would not necessarily be compiled exclusively from the practices of one firm, for others might excel in particular machining operations. If prepared by a competent production engineer, it would be of immense value in expediting the output of the particular munition concerned, putting inexperienced firms straight on the right path by giving them the benefit of the experience of others. It is not suggested that the Ministry should exercise the slightest compulsion upon firms to make them use the methods or operations described, and the encouragement of still better ways should not be withheld. The position would be that the firms would have before them a programme of operations which, if followed, would enable them to obtain with certainty a given output. If they preferred to employ other methods or different operations they would be perfectly at liberty to do so, but they could reasonably be held responsible for any failure to attain the output predicted by the programme. The procedure indicated might not be the "one best way," but it would surely be somewhere near it.

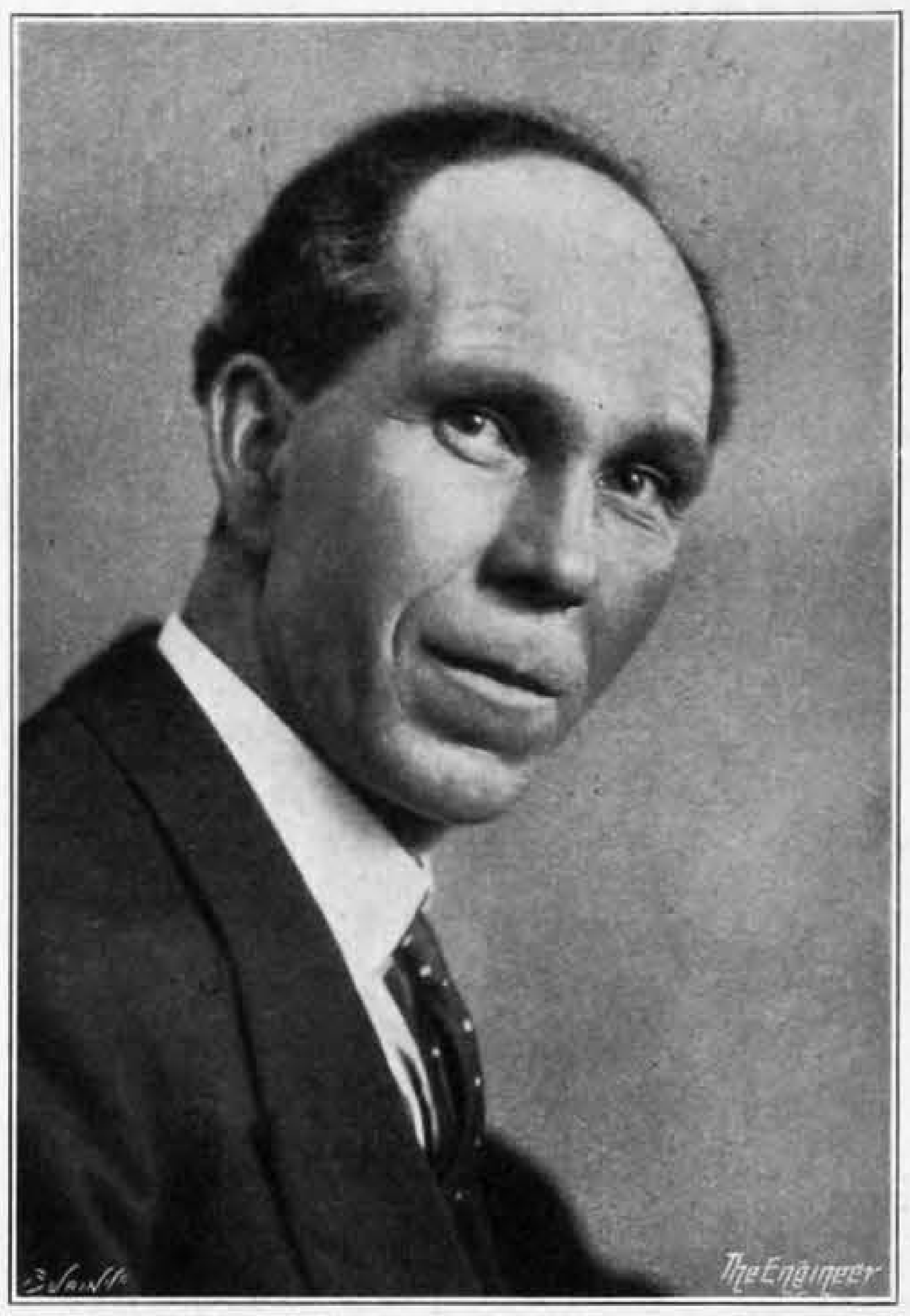
Obituary

BERNARD PARKER HAIGH

VERY sincere sorrow will be felt in engineering circles throughout the country at the news of the death on January 18th of Dr. B. P. Haigh, Professor of Applied Mechanics at the Royal Naval College, Greenwich. Professor Haigh had been in poor health for two or three years past, but he bore his illness cheerfully and seemed to be making headway against it. Doubtlessly, however, the complaint—diabetes—from which he suffered reacted on his general strength and laid him open to the consequences of the attack of pneumonia from which he died.

Bernard Parker Haigh was born in July, 1884, and was the son of William Rylance Haigh, an Edinburgh engineer. His general education was obtained at Allen Glen's School, Glasgow, and during the years 1901 to 1904 he studied engineering at Glasgow University, where he took his B.Sc. degree with high distinction. From 1904 to 1913 he practised as a mechanical and electrical engineer at home and abroad, and during the war of 1914–1918 he was attached to the Admiralty's Paravane Department as consulting designer in connection with the production of gear for protecting ships against mines and for attacking submarines. In 1921 he succeeded Sir James Henderson—like himself a graduate of Glasgow University—as Professor of Applied Mechanics at Greenwich.

It may perhaps be explained that at the Royal Naval College the professorship of Applied Mechanics corresponds with what is usually called elsewhere that of Mechanical Engineering and, incidentally, covers as well the instruction of young naval officers of the executive branch in certain electrical, hydraulic, and aeronautical subjects. The College does not, as it is frequently misunderstood to do, seek to train engineer officers. The Royal Naval Engineering College is situated at Keyham, Devonport. The Naval College at Greenwich is a distinct establishment which undertakes the training of young executive officers who have already had some sea experience in the scientific aspects of their work and affords them opportunities for specialising in the navigation, torpedo, gunnery, and other sections of their profession. Although it does not train them as engineers, instruction in engineering principles under the guise of applied mechanics naturally forms an important portion of its work.



PROFESSOR BERNARD PARKER HAIGH

In his professorial capacity at Greenwich Haigh undoubtedly found himself in congenial surroundings. He was a born experimentalist, and in the fully equipped laboratories of the College he found ready to his hand the means for carrying out many notable investigations. These investigations had naturally to have some bearing on naval subjects; but with the Navy as now established it was not difficult to provide the required evidence of a naval connection in almost any subject in which Haigh was interested. For example, he made a prolonged study of the strength of wire ropes and the causes of their failure in service, paying particular attention to their interstrand corrosion and lubrication. This investigation was amply justified from the naval point of view from its bearing on the satisfactory behaviour of the ropes used for towing paravanes.

Anything to do with the strength of metals, particularly their strength under repeated and alternating stresses, seemed to have an especial attraction for Haigh. He devised an ingenious fatigue-testing machine, now well known and largely used, which applies to the specimen a pull produced by an alternating magnetic flux acting on a laminated iron armature. More recently he produced a machine for determining the fatigue strength of wires in which the loading was applied by the simple expedient of rotating the wire when deformed curvilinearly. Welding and the strength of welds provided him with another subject of great interest and an outlet for his genius as an experimenter. He was, too, one of the first to study the phenomenon of corrosion fatigue.

It was not, however, only on the practical, or experimental, side of applied mechanics that Haigh excelled and established a name for himself. On the mathematical, or theoretical, side he made some notable contributions to the science. His strain energy theory of failure under compound stresses is an alternative to the maximum principal stress theory usually associated with Rankine's name, the St. Venant maximum principal strain theory, and Guest's maximum shear stress theory. Haigh's theory has not yet been completely verified experimentally, but it has an attractive logical basis and possesses a thermo-dynamic analogy. The foundation of his theory is that if a body can be brought to a particular condition by different methods then the work done in causing it to pass from the initial state to the final is independent of the method employed in effecting the change. We need not here follow out the development of this fundamental idea. We can, however, say of it that its conception and development illustrate the broad, orderly lines along which Haigh's mind invariably worked. Among other theoretical subjects with which he was engaged were static and dynamic balancing and the torsional oscillation of shafts.

Haigh's abilities found many outlets, some of an unexpected kind. Some ten years or so ago he threw himself enthusiastically into the arrangements for the naval pageant which was staged so successfully in the grounds of the College. Perforce the "stage" had to be turned to face the Thames instead of having the river as its natural background. It was Haigh who, by a simple yet ingenious adaptation of the "magic lantern," solved the difficulty. The "Golden Hind" could not be shown actually sailing up the Thames—it might accidentally have been accompanied by an embarrassing train of unromantic tugs and barges—but Haigh was able to provide a good substitute by projecting an image of the little ship on to a suitable background and causing it to move across the screen, increasing in size as it approached. It was Haigh, too, who designed the staging for the seats of the audience, a vast temporary structure filling one of the College quadrangles and composed of a framework of tubular scaffolding. At an early rehearsal there was an awkward moment when all the spectators rose simultaneously to their feet on the first roll of drums marking the beginning of "God Save the King." The stand swayed uncomfortably, but Haigh had faith in his calculations and his design. In his quiet, but decisive manner, he issued instructions that the preliminary roll of the drums was in future to be omitted so that the audience would receive no warning of the National Anthem and would rise to their feet otherwise than simultaneously.

We do not recall that Haigh ever wrote a text-book, but he was a voluminous author of papers for the learned societies. It is doubtful, indeed, whether there is a single important engineering or similar institution or association in this country to the "Proceedings" of which he did not contribute at least one paper. He was a frequent and welcome contributor, too, to the discussions on papers by other authors, his remarks being invariably distinguished by the clarity of their expression. We recall an occasion at the Institution of Mechanical Engineers. A very abstruse, but important, point had arisen in the course of a discussion. Few of those present, quite obviously, were able to understand it until the President asked Haigh, who was present among the audience, if he would volunteer to explain it. He immediately responded and without showing signs of hesitation or desiring time to prepare his remarks, proceeded with the aid of a few simple diagrams on the blackboard and some well-chosen words to convey within the space of two or three minutes a clear understanding of the point to the majority of those present.

Haigh was trained at Glasgow University under Professor Archibald Barr, a fact which, in all probability, accounts in considerable measure for the manner in which he combined in rare unison the practical and theoretical sides of his profession. He not only studied under Barr, but began his career as a lecturer under him when round about 1912 he was appointed as one of Barr's assistants. In 1915 his old University awarded him a well-merited D.Sc. degree for a thesis dealing with his favourite subject, the fatigue of metals. He was a member of the Institutions of Civil and Mechanical Engineers, and an associate and a Member of Council of the Institution of Naval Architects.

We may well admire Haigh for his scientific attainments. Those of us, however, who had the privilege of knowing him as a friend will remember him best for the lovable simplicity and modesty of his character. He was always athirst for the acquisition of fresh knowledge of any kind and from any source. One incident, trifling in itself, will serve to illustrate this characteristic and also the charm which his manner exercised on those with whom he came into contact. A young student was dining one evening round a table at which Haigh was present. The conversation turned on greenhouses and why the sun's rays kept them warm long after the outside temperature had fallen. The young man, with considerable daring, ventured to suggest that the phenomenon of diathermy might account for the observed facts. With an obviously genuine desire for information, Haigh turned to him and asked him what diathermy was. On being given the explanation, Haigh took the idea up and speedily developed it to its scientific conclusion, but in such a way as to make the student feel that it was he and not the Professor who had solved the details of the problem. The young man subsequently expressed his regret that Haigh was not his Professor. We who were also present caught an insight into his success as a lecturer and exponent of scientific subjects.

PROFESSOR MILES WALKER

DR. MILES WALKER, who died after an operation on January 22nd, will be missed by the electrical profession as much for his originality as for his undoubted talent. He was born at Carlisle some seventy-three years ago and very nearly failed to be an engineer. Bowing to the wishes of his parents, he read for the Law, passed his final with honours, and for a few years practised in London. But a small inheritance came to him, his partner died, and he cut adrift from a profession for which he did not care. In 1894 he went to Finsbury as a student of Silvanus Thompson. From there he went to Cambridge, St. John's, where he gained some distinction and attracted the attention of J. E. Ewing, his professor. At the time the Westinghouse Company of America wanted a number of young English engineers to study its methods in its own works. Ewing was asked to nominate them and Miles Walker was selected as one of forty. He spent three and a-half years in Pittsburg and then returned as designer of A.C. machinery to the British Westinghouse Company, which is now the Metropolitan-Vickers Electrical Company, Ltd., of Trafford Park, Manchester. There he remained till 1912, when he accepted the Chair of Electrical Engineering in the Faculty of Technology of Manchester University. For twenty years he occupied that position, and on his retirement in 1932 was made Professor Emeritus. Up to the time of his death he acted as consulting designer to the Metropolitan-Vickers and other makers of heavy electrical machinery. He developed, but did not originate, the cylindrical field magnet for turbo-generators, invented a self-regulating alternator and an electric harmonic analyser and patented many improvements in electrical machinery and equipment. His publications were numerous, both as books and papers. His best-known works are "The Specification and Design of Dynamo Electrical Machinery" and "The Diagnosing of Troubles in Dynamo Electric Machinery," but he was the author also of a more popular book, "What Everybody Ought to Know About Electricity." He was elected a Fellow of the Royal Society in 1931.

JOHN HENRY SILLEY

BY the death of John Henry Silley, which took place at Port Navis, Cornwall, on Friday last, January 24th, the shipbuilding and ship-repairing industry of South England has lost one of its outstanding figures of the last half century. John Silley was born at Chepstow in Monmouthshire in 1872, and after leaving school was apprenticed to the engineering firm of Edward Finch and Co., of Chepstow. On completing his training in 1892 he came to London and went to sea in a steamer of the Star Line, belonging to J. P. Cory and Co. His progress with the company was rapid, and in the course of a few years he attained the position of chief engineer. Before reaching the age of thirty he left the sea for a shore position and started in business on his own account. His wide knowledge of practical engineering problems and his sea experience stood him in good stead, his business prospered, and at a later date was merged with that of R. and H. Green, Ltd., a firm with one of the oldest shipbuilding records in the country.

The new firm was styled R. and H. Green and Silley, Weir, Ltd., and specialised in, and is still carrying out, a very large amount of repair work on the Thames for the leading shipowning companies. John Silley became its chairman and managing director and assumed personal direction of the work of the company. Between 1914 and 1918 he was closely identified with the late Mr. Allan Hughes in developing the port of Falmouth as a centre for ship repairing. He joined the firm of Cox and Co. (Engineers), Ltd., as a director, and was also a director of the Falmouth Docks and Engineering Company, Ltd. These businesses have expanded under his guidance, and in recent years he divided his time between the management of his firms in London and in Falmouth and his home in Epping. John Silley was always keen to follow up new developments in shipbuilding and engineering, and we recall his early sponsoring of the Buell system of powdered fuel burning in marine boilers and his more recent interest in the Kort nozzle principle for the propulsion of tugs and smaller craft.

Alongside his many business activities he took a keen interest in the scientific side of his profession, and was a valued member of the Institution of Naval Architects, the North-East Coast Institution of Engineers and Shipbuilders, and the

JOHN HENRY SILLEY

Institute of Marine Engineers. In 1901 he was awarded the Denny Gold Medal for a paper he presented to the Institute on the treatment of boilers working under forced and induced draught. During his term of office as President of the Institute of Marine Engineers, he founded the Guild of Benevolence.

Apart from his talents as an administrator and an engineer, John Silley always took a personal interest in everything pertaining to the welfare and happiness of the men with whom he was called upon to work. He it was who inspired and made possible the present building of the Y.M.C.A. Red Triangle Club at Plaistow, which has cost something over £100,000. At Falmouth he laid out a model village for the workers at the docks, while in London he was responsible for the building of flats and bungalows near to the works in which retired workpeople and their wives could live at low cost. That scheme was also carried out at Falmouth. Mr. Silley was a Liveryman of the Worshipful Company of Shipwrights, and a Fellow of the Royal Society of Arts. He will be remembered by a wide circle of friends not only for his engineering knowledge and his successful business career, but also for his interest in the social welfare of those whom he employed.

MR. G. E. GITTINS

WE regret to have to report the death of Mr. G. E. Gittins, B.Sc. (Lond.), M.I.E.E., on January 16th, 1941. Mr. Gittins was born at Tunstall, Staffordshire, in 1871, and received his early training at the Wedgewood Institute, Hanley, afterwards proceeding to Chester College. He was a lecturer in electrical engineering at Blackburn Technical College from 1899 until 1903, when he became head of the electrical engineering department of the Harris Institute, Preston, which post he held until 1917. Whilst at Preston and during the war of 1914–18, he undertook voluntary work with the Southport and Preston electricity departments. In 1917 Mr. Gittins joined the British Westinghouse Electrical and Manufacturing Company (now Metropolitan-Vickers Electrical Company, Ltd.), taking up a position in the switchgear engineering department, at the same time lecturing at the Manchester College of Technology. In 1923 he was appointed sales manager of the transformer department, which position he held until the time of his death. He was keenly interested in mining work, and was a very active member of the Association of Mining Electrical Engineers, being President of the North-Western Branch in 1927–28.

Sixty Years Ago

SUBSIDENCES AT BLACKHEATH

FOLLOWING an abnormally heavy fall of rain on the night of April 11th–12th, 1878, a subsidence occurred on Blackheath, not far from the main entrance to Greenwich Park. A hole eight or nine yards in circumference and about 20ft. deep suddenly appeared in the ground. The Metropolitan Board of Works duly filled it in, and little more was thought about it. Early in November, 1880, however, a second subsidence occurred within 600 yards of the first, while on the 19th of that month a third appeared. The Astronomer-Royal, Sir George Airey, expressed some concern for the safety of the Royal Observatory, and received the permission of the Board to explore the subsidences. Eventually the work of exploration was taken over by a newly formed body, the Lewisham and Blackheath Scientific Association, of which Dr. H. E. Armstrong was President. This body—it still flourishes, we believe—collected such information as it could and in our issue of February 4th, 1881, we published an article giving the results at which it had so far arrived. There are many stories still current in the neighbourhood of mysterious underground passages beneath Blackheath. One is said to run down from Vanbrugh Castle to the banks of the Thames, while others are believed to connect with the famous caves at Chislehurst, some 5 or 6 miles away. A number of the local inhabitants, including some members of the Scientific Association, were fully persuaded that the subsidences were in some way or another connected with these underground passages. It would appear, however, that they were really of no very romantic origin. A careful examination of the third subsidence showed it to be a substantially round hole a little over 7ft. in diameter, with almost vertical sides extending to a depth of about 20ft., beyond which the diameter increased in an inverted bell-mouth form. At the foot of the hole there was a heap of fallen earth which was found to tally in composition layer by layer with the strata of the surrounding ground at and just below the surface. The ground consisted of beds of sand, sandy clay, and pebbles overlying a chalk formation. Informed opinion came to the conclusion that underground carbonated water had gradually dissolved away the chalk, leaving a cavity into which the superincumbent layers eventually fell.

BOOKS RECEIVED

Mechanical World Year Book, 1941. London: Emmott and Co., Ltd., 28, Bedford Street, Strand, W.C.2. Price 2s. net.

Plastics in Industry. By "Plastes." London: Chapman and Hall, Ltd., 11, Henrietta Street, W.C.2. Price 12s. 6d. net.

The Practice of Arc Welding. By W. Heigh. London: Sir Isaac Pitman and Sons, Ltd., Parker Street, Kingsway, W.C.2. Price 5s. net.

Classical and Modern Physics. By Harvey E. White. London: Chapman and Hall, Ltd., 11, Henrietta Street, W.C.2. Price 21s. net.

Railway Signalling and Communications. London: The St. Margaret's Technical Press, Ltd., 33, Tothill Street, Westminster, S.W.1. Price 7s. net.

The Geometry of Sheet Metal Work. By A. Dickson. London: Sir Isaac Pitman and Sons, Ltd., Parker Street, Kingsway, W.C.2. Price 12s. 6d. net.

Works Boiler Plant. By F. J. Mathews. London: Hutchinson's Scientific and Technical Publications, Paternoster House, Paternoster Row, E.C.4. Price 10s. 6d.

Physical Science in Art and Industry. By E. G. Richardson. London: English Universities Press, Ltd., Little Paul's House, Warwick Square, E.C.4. Price 15s. net.

Engineering Economics. By T. H. Burnham and G. O. Hoskins. Fifth edition. London: Sir Isaac Pitman and Sons, Ltd., Parker Street, Kingsway, W.C.2. Price 10s. 6d. net.

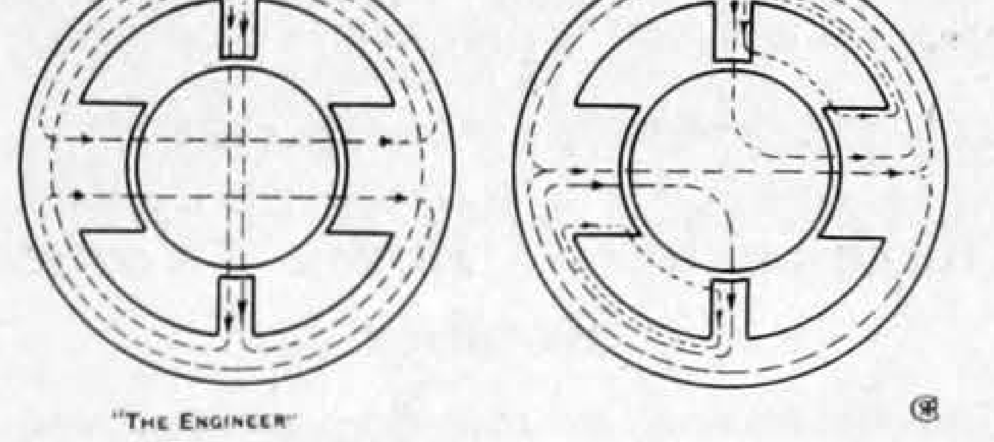
The Analysis of Minerals and Ores of the Rarer Elements. By W. R. Schoeller and A. R. Powell. London: Charles Griffin and Co., Ltd., 42, Drury Lane, W.C.2. Price 18s. net.

Flux Distribution and Armature Reaction in D.C. Interpole Machines

By ROBERT POHL, D.Eng., D.Sc.

THE interpole flux passes through the strengthened tip of the neighbouring main pole of opposite polarity, and is therefore linked not with all the armature A T (ampere turns) per pole, but only with those lying in the neutral zone. These act as back A T and form the first component of interpole armature reaction. The second component results from cross magnetisation of the main pole by the remaining armature A T beneath them. Each main pole and each interpole of like polarity as its advanced part have to supply for the gap and teeth under the strengthened pole tip of the neighbouring main pole A T equal to these cross-magnetising armature A T. The two components of interpole armature reaction together equal the total armature A T per pole. The path distortion of the main lines of force, as distinct from their density, reaches its maximum for the line passing through the pole axis, whereas the path of the lines passing the pole tips is not much affected by cross magnetisation.

The apparently so simple question how to picture the flux distribution in D.C. interpole machines and to treat the armature reaction phenomena does not appear to have found a final answer yet. In connection with the introduction of interpoles, many years ago, the writer suggested that they should be looked upon as parts of the adjacent main poles of like polarity moved into the neutral axis. That conception makes the interpole flux join the main flux, its circuit closing through the main pole of opposite polarity. It considers a resultant flux picture. Other writers preferred to develop the theory by the superposition method which pictures the interpole flux as independent of the main flux, crossing it at right angles (Fig. 1). Even some modern textbooks retain this treatment of interpole problems.



FIGS. 1 AND 2

Apart from the objection that it does not supply a resultant streamline picture, it is misleading, because it creates the impression as if, say, in a bipolar machine, the taking away of one interpole seriously affects the flux of the remaining one, that the number of interpoles should therefore always be equal to the number of main poles. Yet it is well known that the interpoles are practically independent of each other. Numerous D.C. machines are working quite satisfactorily with half as many interpoles as main poles.

On the other hand, the diagram (Fig. 2) proposed by the writer at the time* is also not free from objection. Here the useful interpole flux is shown to enter the main pole of opposite polarity in the centre of its pole arc. This presentation was chosen to make the interpole flux appear to be linked with the full armature A T per pole, $A\,T_{a\text{-}p\text{-}p}$. These, as is well known, represent the armature reaction for the interpole, and must be counteracted by equal and opposite A T to which the purely magnetising A T for the interpole have to be added. If it is true, however, that the interpole flux joins the main flux, it can only enter the main pole of opposite polarity at its tip and not at its centre, and if thus shown the question at once arises—why should we, to meet armature reaction, require the full $A\,T_{a\text{-}p\text{-}p}$, since the flux is only linked with a part of them, namely, those which lie in the neutral zone?

Is there some saturation effect? We see there is a need for a simple presentation supplying a resultant flux picture and disposing of this apparent contradiction.

Let us first of all develop a correct line of force picture of a loaded D.C. machine without interpoles. Only through a quantitative knowledge of the magnetic stream, *i.e.*, of the paths followed by the lines of force, are we enabled to determine their concentration in any part of the magnetic circuit, to calculate the influence of, and limitations due to, saturation, and recognise where and why M M F is being absorbed. The modification produced by interpoles will then be easily understood.

The two considerations on which a line of force picture has to be based may be briefly restated:

(1) For any bundle of lines, or tube of force, "Ohm's law of the magnetic circuit" holds good. The flux is equal to the ratio of the total M M F of the tube circuit in question to its total reluctance. The M M F is that due to all A T linked with the circuit. The law also applies to any part of the circuit lying between two magnetic equipotential planes. The flux equals their magnetic P D divided by the reluctance of the path between them.

(2) The flow follows the law of least reluctance.

An excited pole system and armature on no load may have the undistorted flux shown in Fig. 3. The gap induction, $B_{g\,nol}$, is uniform. Let us divide the flux into six equal parts or tubes,

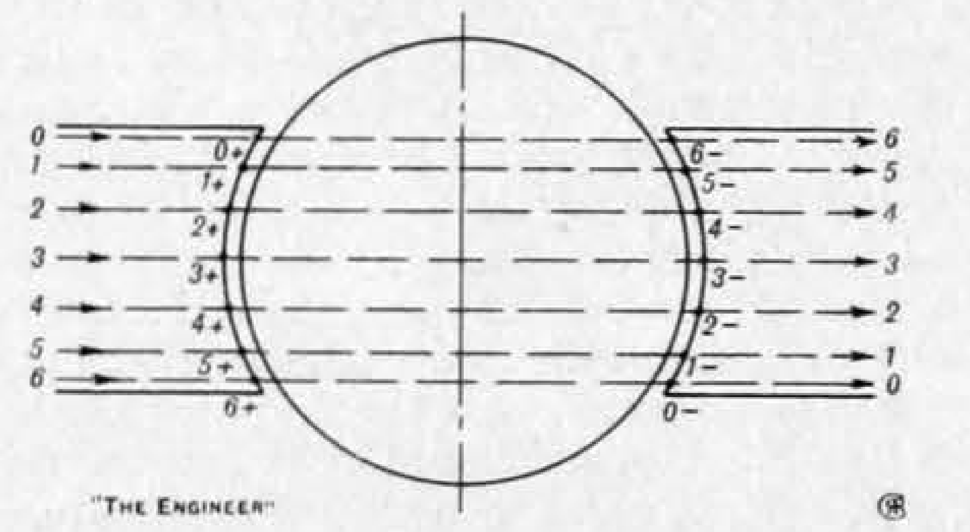


FIG. 3

separated by the seven lines of force 0–6, 1–5, . . . 6–0, which pass the pole arcs respectively at the points 0+ to 6+, and 6− to 0−.

For clearness sake let us at first ignore all stray lines in the neutral zone by considering the reluctance of the latter as infinite compared with that of the gap and teeth, and let us treat the armature core as of negligible reluctance in comparison with the gap and teeth. The A T of each field coil, less those absorbed in the pole and yoke, are then entirely used up in the gap and teeth under the respective pole. We call them $A\,T_{g\text{-}a\text{-}t}$. Each pole face is an equipotential plane, also the armature core beneath the teeth. $A\,T_{g\text{-}a\text{-}t}$ supplies the magnetic P D between them.

If, now, the armature is made to carry current, how exactly will the paths of these seven lines of force be affected? We know that the armature A T, $A\,T_a$, magnetise at right angles to the field A T. Their distribution around the armature circumference between $+A\,T_{a\text{-}p\text{-}p}$ and $-A\,T_{a\text{-}p\text{-}p}$ is linear, as shown in the well-known diagram, Fig. 4, which also contains the summation of $A\,T_a$ and $A\,T_{g\text{-}a\text{-}t}$ plotted over the armature circumference, the new M M F between our two equipotential planes, and the resultant B_g over the pole arc α for unsaturated teeth. The neutral zone υ, by preliminary assumption, is free from lines.

B_g is a straight line and may be expressed by:

$$B_g = B_{g\,min} + \frac{B_{g\,max} - B_{g\,min}}{\alpha} \cdot x$$

with

$$B_{g\,mean} = B_{g\,nol}$$

where x is the distance of the point under consideration from the pole tip, 0+, or 0−, respectively. The new position of the points in which our seven lines of force penetrate the two pole arcs is now quickly found. A simple graphical method is as follows:—

The sum of all lines we pass in travelling along a pole arc from tip 0 to a point at x, Φ_x, is the integral of the $B_g = f(x)$ curve. At no load, when B_g is constant, Φ_x is a straight line, and equal increments of Φ_x correspond to equal increments of x, Fig. 5. On load, for unsaturated teeth, we get

$$\Phi_x = \int_0^x B_g\,d\,x = B_{g\,min}\,x + \frac{B_{g\,max} - B_{g\,min}}{\alpha}\,\frac{x^2}{2}$$

This is the full-line curve in Fig. 5. Our six equal increments of flux on the Φ axis now cut off very unequal increments of x, again marked 0 to 6 along the abscissa. If we now join the respective

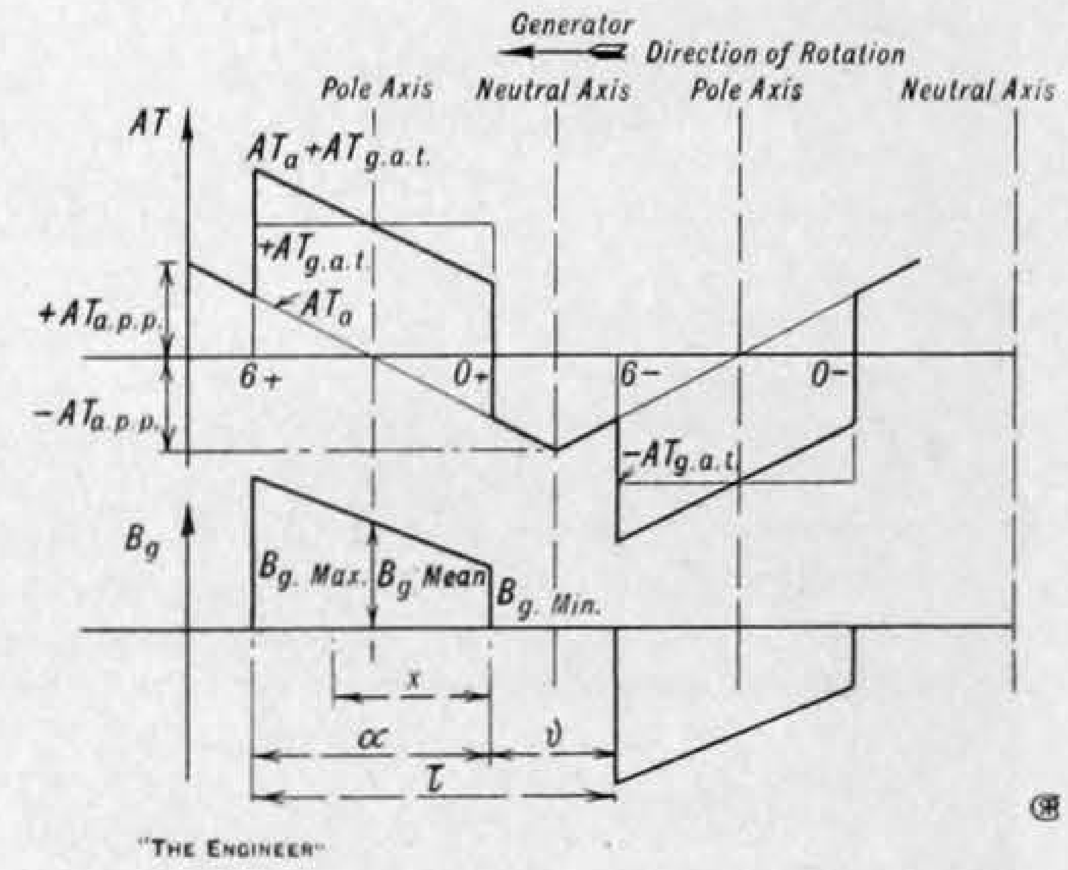


FIG. 4

points marked 0+ to 6+ and 0− to 6− on the two pole arcs, we derive the correct flux picture for load (Fig. 6). This picture is interesting. Going downward from the top line 0+−6−, which has remained horizontal, we find that the lines crossing the armature get more and more inclined, down to the line of symmetry 3+−3−, which is steepest and passes through the armature centre. They then flatten out again, finishing with the bottom line 6+−0−, which again has remained horizontal. Needless to say, as soon as the lines

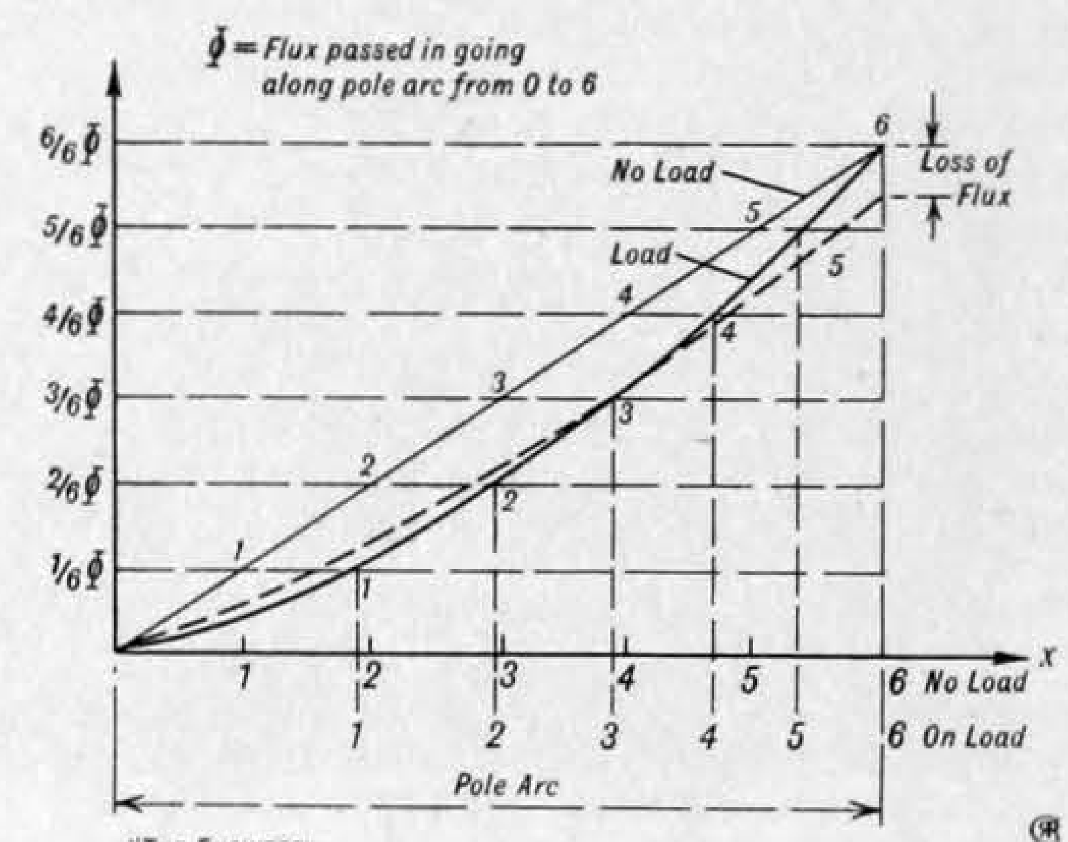


FIG. 5

of force have entered the pole, they spread uniformly over the available section accordng to the law of least reluctance. This flux picture, derived from the resultant A T diagram, conforms to "Ohm's law of the magnetic circuit," applied to the complete circuit of any tube of force. Take, for example, line 3+−3−. Linked with it, in addition to the two field coils are the armature A T lying in the horizontal belt between 3+ and 3−. The belt has the horizontal pole axis as its centre

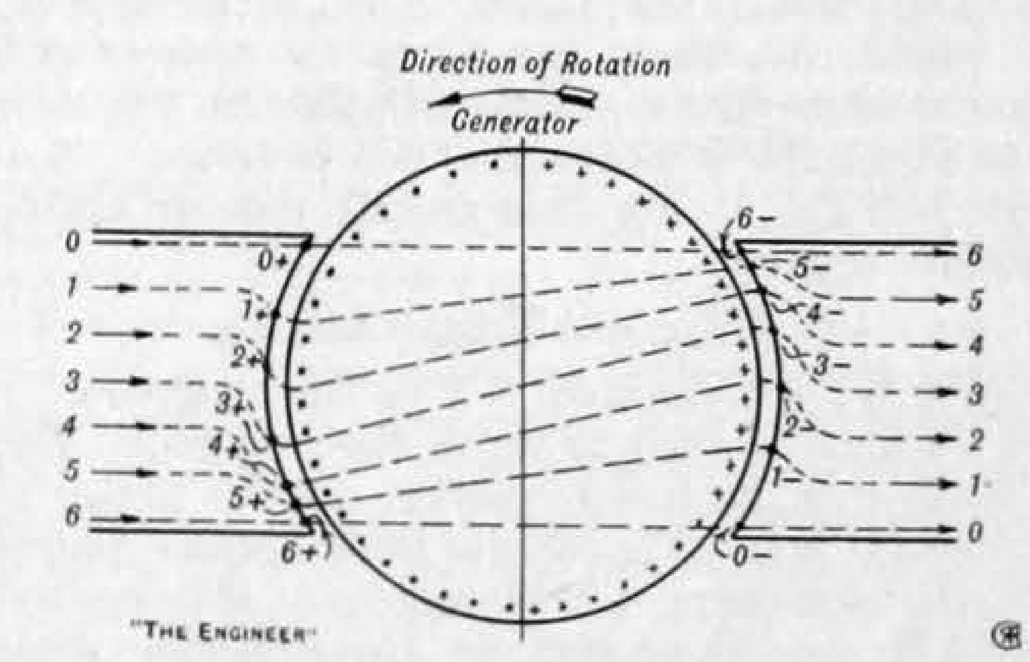


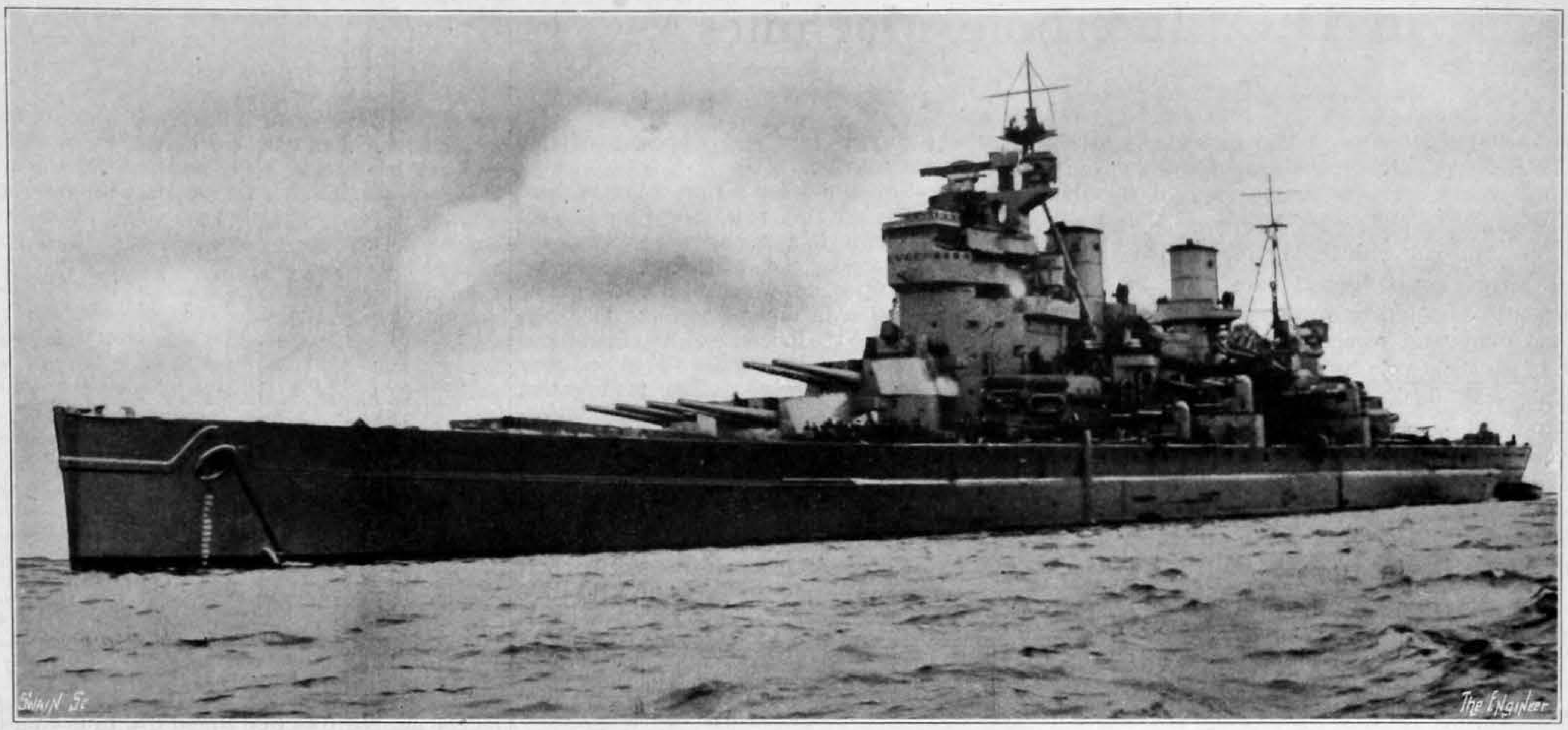
FIG. 6

line. These armature A T represent additive M M F. Those between the pole axis and 3+ are just absorbed by the increased reluctance due to the higher gap density at 3+, compared with B_g mean for no load; likewise, those between the pole axis and 3− are absorbed by the increased density at 3−.

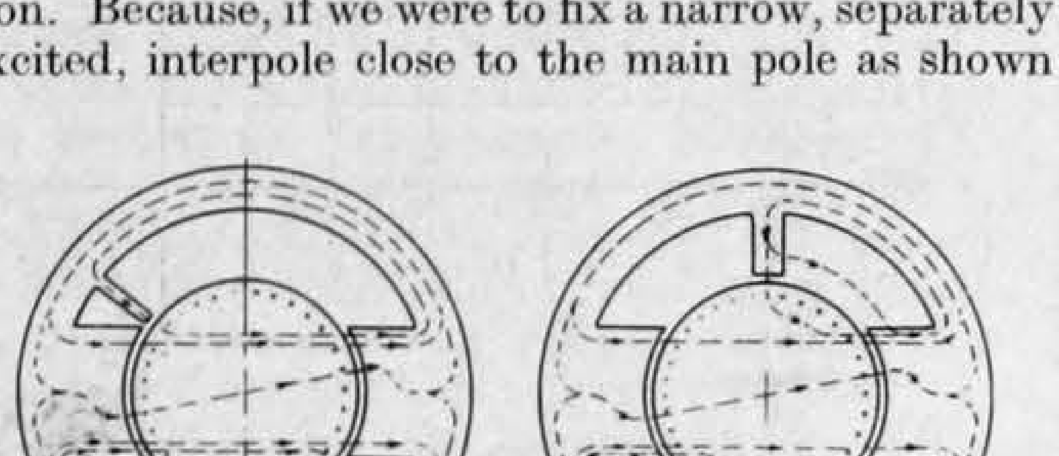
The answer to our interpole problem follows from the appearance of the two border lines

* *E.T.Z.*, 1905, page 786.

H.M. BATTLESHIP "KING GEORGE V"



$0+-6-$ and $6+-0-$. It is these which an interpole flux would join. They have remained horizontal; therefore no armature A T are linked with them. So the field A T alone must cover their total reluctance. Yet they pass through the reduced gap density $B_{g\ min}$ under the weakened pole tip and then through the increased gap density under the strengthened one. The decreased absorption of A T on the one side is just balanced by an increased absorption on the other. Clearly, what a field coil saves in A T under its own weakened pole tip it supplies to the opposite pole, there to overcome the increase of reluctance under the strengthened pole tip. The amount of A T thus transferred equals the armature A T under the pole—$A\,T_{a\text{-}u\text{-}p\text{-}}$—, *i.e.*, those lying in the belt between pole axis and pole tip. This is the clue to the understanding of our interpole question. Because, if we were to fix a narrow, separately excited, interpole close to the main pole as shown



FIGS. 7 AND 8

in Fig. 7, and let its flux, not linked with any armature A T, travel along with theline $0+-6-$, the A T of its coil would not only have to overcome the reluctance of its own yoke and pole, gap and teeth, for which $A\,T_{magn}$ are needed, but would also have to supply the excess A T required under the strengthened pole tip $6-$ over those which the negative field coil provides. That excess is $A\,T_{a\text{-}u\text{-}p\text{-}}$. For such an interpole we should therefore require

$$A\,T_{i\text{-}p\text{-}} = A\,T_{magn} + A\,T_{a\text{-}u\text{-}p\text{-}}$$

where $A\,T_{i\text{-}p\text{-}}$ are the total A T on the interpole.

If we now proceed to move the interpole along the yoke into its usual position, in the centre of the neutral zone (Fig. 8), its lines become linked with the armature A T situated in the neutral zone $A\,T_{a\text{-}i\text{-}n\text{-}}$. These act in the opposing sense and have to be balanced by additional A T on the interpole. Hence we now get

$$A\,T_{i\text{-}p\text{-}} = A\,T_{magn} + A\,T_{a\text{-}u\text{-}p\text{-}} + A\,T_{a\text{-}i\text{-}n\text{-}}$$

The two latter items add up to $A\,T_{a\text{-}p\text{-}p\text{-}}$. It is perhaps preferable, however, to leave this equation as it stands, as a reminder of the different physical effects of $A\,T_{a\text{-}u\text{-}p\text{-}}$ and $A\,T_{a\text{-}i\text{-}n\text{-}}$.

It only remains to indicate the modifications arising from saturation in the teeth and from the straying of lines through the neutral zone. Neither will make any essential difference. Saturation results in the Φ_x curve in Fig. 5 being bent up a little under the weakened and down under the strengthened pole tip as indicated by the dotted line. It reveals a total loss of flux due to this "cross-magnetisation effect." The altered subdivision into equal flux increments and the slight resultant shifting of the points 1 to 6 along the pole faces require no further comment. Lines entering the armature in the neutral zones may be shown in flux picture (Fig. 6) by plotting the curve (Fig. 5) over the total pole pitch and using smaller increments in the neutral zone. At any point in the latter where an interpole line passes the armature surface for the strengthened pole tip the interpole has to supply first the additional A T for overcoming the increased reluctance of the passage, and secondly, the armature A T with which the line in question remains interlinked. These two parts always add up to $A\,T_{a\text{-}p\text{-}p\text{-}}$.

It is thus explained why the A T required for an interpole are exactly as if its flux linked the full $A\,T_{a\text{-}p\text{-}p\text{-}}$, although it manifestly does not do so.

The two border lines $0+-6-$ and $6+-0-$ of Fig. 6 are now no longer strictly horizontal, but their distortion through armature reactionre mains small as compared with the centre line $3+-3-$. As we are not concerned with the study of the commutat on field we may retain Fig. 8 as a diagrammatic representation of the total flux. It is drawn to indicate the different inclination of the main lines of force, and the horizontal border lines are to suggest by inference that the main coils as well as the interpole coils supply ampere turns for the gap and teeth under the strengthened pole tip of opposite polarity.

Incidentally, it shows that, assuming equal axial length of both main and interpoles, there is practically no direct leakage between main poles, also a considerable, easily calculable, difference of flux in the yoke to the right and the left of each interpole.

H.M.S. "King George V"

THE photograph of a British battleship, the "King George V," which is reproduced above, was released a few days ago, after she had carried Lord Halifax to the United States.

"King George V" is the first of a class of five ships; the others are "Duke of York," "Jellicoe," "Prince of Wales" and "Beatty." She was laid down on January 1st, 1937, at the Vickers-Armstrong works on the Tyne and not so very long ago slipped silently away one dark night. According to "Jane," her shaft horsepower is 152,000, and it is believed that she will make no less than 30 knots, a great speed for a ship of 35,000 tons displacement. She carries ten 14in. guns. They are arranged, as our engraving shows, in two quadruple turrets and in one two-gun turret, firing over the forward four-gun turret. She has also a secondary armament of sixteen 5·25in. guns and, of course, a large A.A. armament. She is propelled by Parsons geared turbines on four shafts.

It has been stated officially that she is particularly well protected against aircraft attack, which no doubt means a heavy armoured deck. Her side armour is also of great strength, with a water-line thickness of 16in. Indeed, it is said that nearly two-fifths of her weight is accounted for by armour.

As three of her sister ships were laid down at about the same time—all in the first part of 1937—it is not improbable that they also are at sea. The "Prince of Wales" was built by Cammell Laird, the "Duke of York" (ex "Anson") at Clydebank, the "Beatty" by Fairfields, and the "Jellicoe" by Swan Hunter.

These are the first British battleships to be constructed since 1927, and it is interesting to compare them with their immediate predecessors, "Nelson" and "Rodney," of 33,950 and 33,900 tons respectively, with three triple turrets, all forward, and 16in. guns. Their speed is 23 knots, as against the 30 knots of the new ships. They have twin screws driven by turbines of 45,000 total horse-power.

It is indeed a fortunate coincide e that these magnificent ships, the finest in the world in their class, were designed for completion at this time.

The Blackburn "Botha" Torpedo Bomber

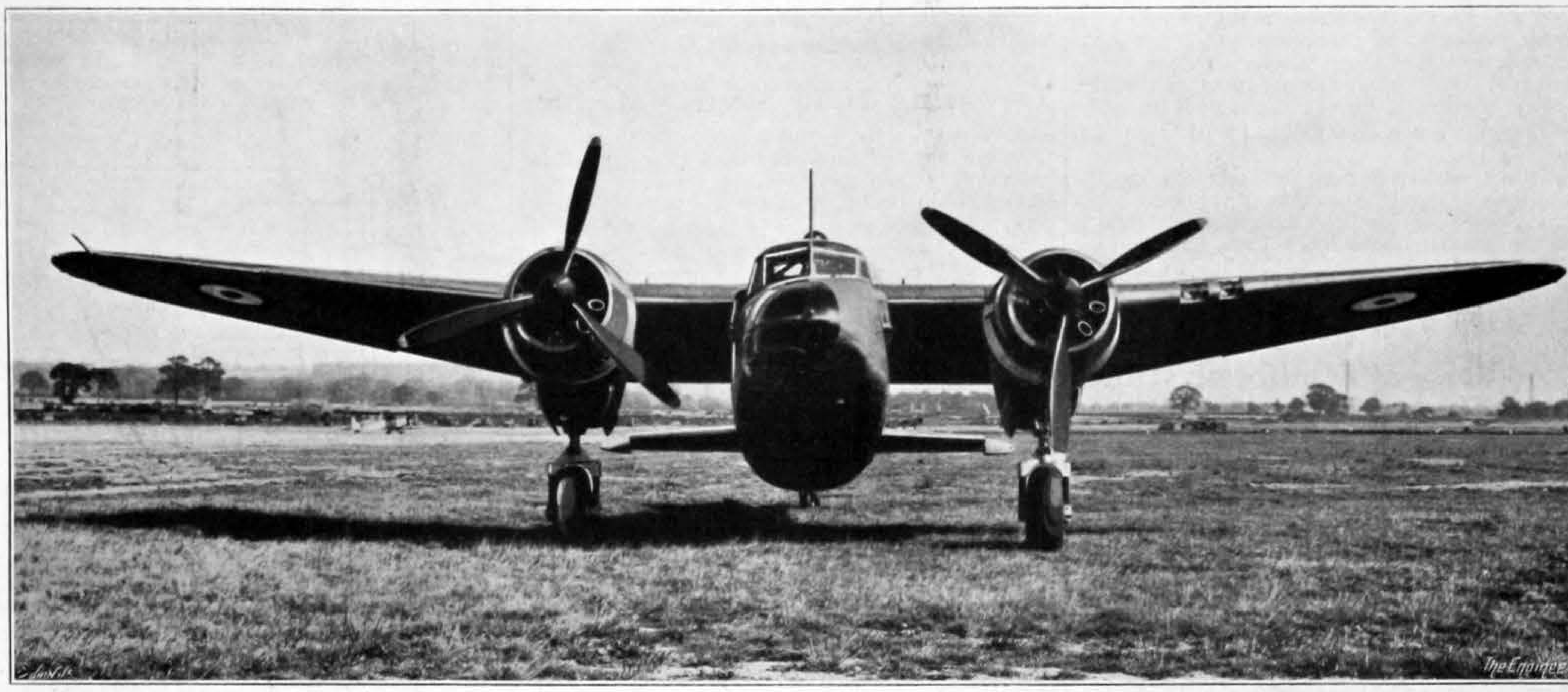
WE illustrate on the opposite page the Blackburn "Botha" I, a general-purpose twin-engined torpedo bomber. The engines are Bristol "Perseus," Mark XA, sleeve-valve radials, carried in nacelles formed below the main plane. The machine is of all-metal construction—with the exception of fabric covering on some of the control surfaces—and carries a crew of four. A gun turret is mounted on the upper side of the fuselage behind the main plane, giving a wide field of fire.

The fuselage is a monocoque structure, flush riveted throughout. An enclosed cabin houses the crew, consisting of pilot, navigator/bomb aimer, wireless operator, and gunner. A gangway extends along the starboard side of the cabin, permitting intercommunication between forward and rear positions. Access to the cabin and pilot's seat is obtained through a large entrance door on the starboard side. The pilot's seat is situated to the port side of the forward end of the cabin, the bomb aimer's prone position being to the starboard side.

The main plane is composed of three principal sections, the centre section, which carries the engine nacelles, and the two outer sections. The centre section is parallel in plan, while the outer sections taper considerably towards the tips, which are rounded. The outer portions of the plane have a pronounced dihedral angle. Balanced ailerons extend along a portion of the trailing edges of the outer sections, and flaps along the trailing edges of the centre section. The flaps are hydraulically operated, and may be used to improve take-off and to limit landing speed. The centre plane carries the two engine mountings and the undercarriage units, and also houses the main fuel and oil tanks.

Both the fin and the tail plane are unbraced cantilevers of stressed skin metal construction. The rudder and elevators are of metal construction, but are fabric covered. The tail plane is placed to the rear of the vertical fin and the leading edges of the plane sweep back slightly towards the tips, the trailing

THE BLACKBURN "BOTHA" TORPEDO BOMBER



edges of the elevators forming a straight line. The leading edge of the vertical fin slopes to the rear, while the trailing edge of the rudder is vertical. The tips of the tail plane and rudder are well rounded, and the rudder and elevators are balanced by a combination of inset hinge and horn balance. Trimming tabs are fitted.

The landing gear consists of separate retractable oleo-pneumatic legs carried beneath the engine nacelles and retracting into them. When the wheels are raised hydraulically, mechanically operated doors close beneath the legs and give a smooth undersurface to the nacelles. Retraction is effected by hydraulic rams and hydraulically operated brakes are fitted to the landing wheels. The tail wheel is mounted on an oleo-pneumatic shock absorber strut, the wheel having castor action with friction dampers.

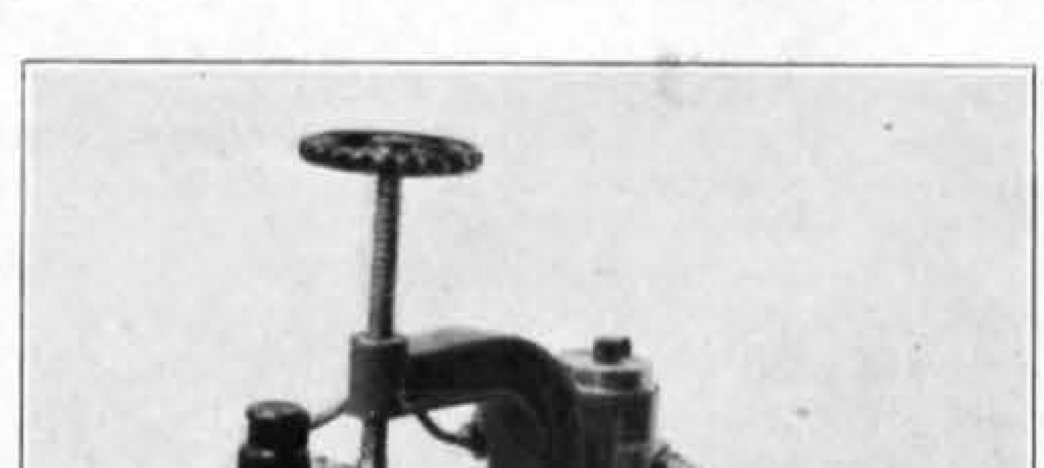
The two radial engines are provided with leading edge exhaust collector rings and are enclosed in deep chord fairings with controllable cooling gills. Three-bladed, constant-speed, controllable-pitch airscrews are fitted. The rear portions of the engine nacelles, which are detachable, are mounted below the centre plane, and house the retractable undercarriage units.

A power-operated multi-gun turret is situated on the fuselage to the rear of the main plane trailing edge. Access to it is gained from the rear of the cabin. The equipment of the "Botha" for marine work includes a collapsible dinghy, with inflation bottle, markers, floats, &c., in addition to a complete set of wireless and electrical gear. This aircraft has a span of 59ft., a length overall of 51ft. 1½in., and a height overall of 14ft. 7½in.

CANADIAN NICKEL.—The output of nickel in Canada last year was the greatest in the history of the industry, amounting to well over 100,000 tons. Nickel is an important war material, and 90 per cent. of the world's entire output is produced in the Dominion.

Joining and Repairing Cables

THE half-tone engraving which accompanies this article illustrates a vulcaniser for joining and repairing cables with single or multiple cores, made by Harvey Frost and Co., Ltd., of Bishop's Stortford. The



VULCANISER FOR CABLE JOINTING

process used is said to be based on the same principles as those employed in the manufacture of the cable. The platens of the vulcaniser illustrated measure 8¾in. by 6in., and have a daylight gap of 2in. They are heated by two Chromalox electric elements placed within the platens, each platen being independent and insulated from the cast frame by means of uralite. Heat is controlled by a sensitive thermostatic switch operating in a vacuum chamber placed in the solid metal in intimate contact with the vulcanising materials. A temperature indicator is fitted, showing at a glance when the vulcaniser is at the correct point for vulcanisation. The time switch illustrated is supplied as an extra. Moulds can be arranged, as necessary, to deal with cables of different types and sizes, and the question of moulds is usually one for special consideration. It is desirable to switch on the electric current about 20 min. before the actual vulcanising operation is commenced. This model is applicable to all cables up to 1¼in., and to the making of two-way junctions as well as straight joins. The vulcaniser is supplied with a complete outfit, consisting of an initial supply of materials, one tube of vulcanising solution, one pair of special pliers, one special rasp, one pair of special scissors, one knife, and one tin of French chalk.

In operation the fault in the cable is first cut out and the cores are joined by an approved method, either soldering or otherwise. The cable is so dealt with that the ends of the sheath are approximately 2in. apart, the wire or cores being exposed for a distance of about ¾in. The next step is to insulate the cores by wrapping the insulating material supplied in a special way which ensures efficiency. The ends of the cable are then roughened and coated with H F Saflux, which is allowed to dry for a few minutes. The whole join is next covered by two lozenge-shaped pieces of compound, supplied ready moulded, and applied one on each side of the repair. The edges of these covering pieces are then sealed by squeezing with the pliers and after slight trimming the repair is ready for vulcanisation. Vulcanisation is carried out by inserting the repair between the two halves of the vulcanising mould, placing in position in the vulcaniser, tightening the thumb screws and applying heat. After a period of approximately

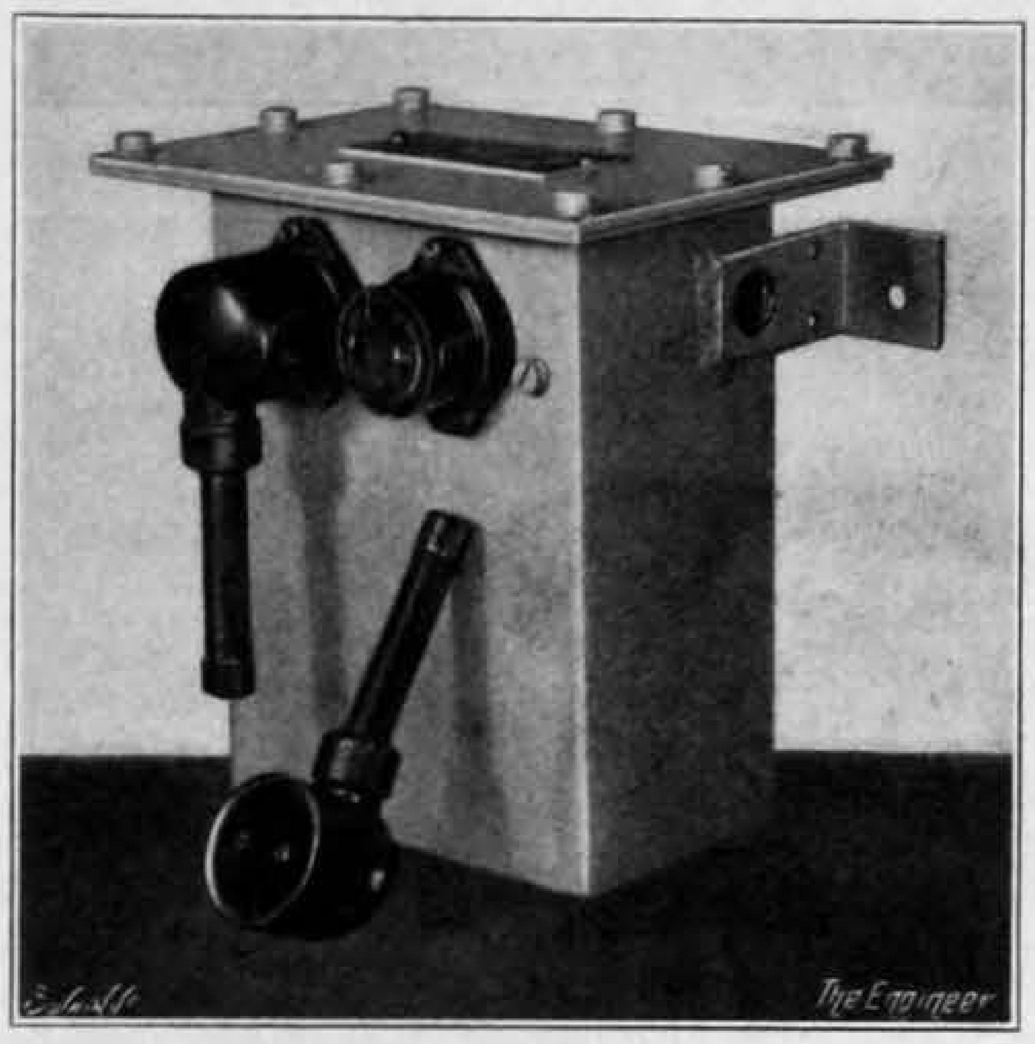
15 min. the mould is removed from the vulcaniser, the two halves are separated and the job is complete. Any slight spew at the edge of the repair may be trimmed off with scissors. The finished repair is claimed to be as strong as the main part of the cable, perfectly insulated, and permanent.

Some particulars of the vulcaniser are given in the following details :—Voltage range, 100–110, 200–220, 230–250 ; maximum current demand, 0·25 kW ; overall measurements, 10in. by 9in. by 10in.; weight, 27 lb.

A portable model vulcaniser is also made by the firm. It has overall dimensions of 10in. by 8½in. by 6in., and is packed in a metal container. Heat is applied by means of solid fuel tablets, and the time taken for completing a repair is 15 min.

Low-Voltage Transformers for A.R.P. Shelters

A MEANS of providing protection against electric shock in A.R.P. shelters is that of installing low-voltage transformers which give a low-voltage supply. Such a transformer made by Reyrolle and Co., Ltd., is illustrated in the accompanying engraving. It has a primary winding with tappings for 200/210, 220/230, and 240/250 volts, and can therefore be connected up



LOW-VOLTAGE TRANSFORMER

to any supply within the range of 200 to 250 volts. From the secondary winding, which can be for 12 or 25 volts, the lighting is supplied through permanent wiring in conduit or through T.R.S. cable from plug points on the transformer casing. The plugs, which may be either fused or not fused, cannot be inserted into sockets on the mains supply. To eliminate the possibility of shock to the user, an earthed metal shield is fitted between the primary and secondary windings. This shield ensures that in the event of a breakdown on the supply side, the low-voltage winding remains unaffected.

The transformers are oil cooled and double wound.

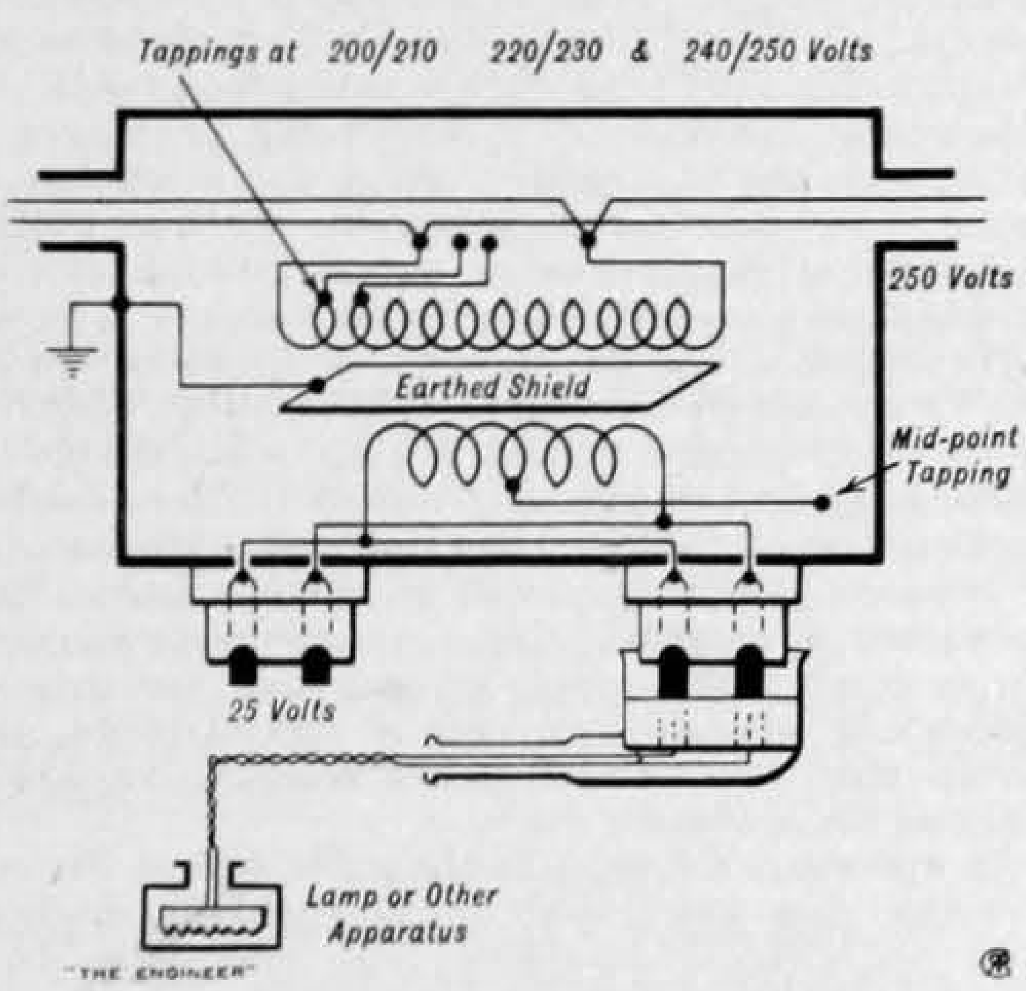
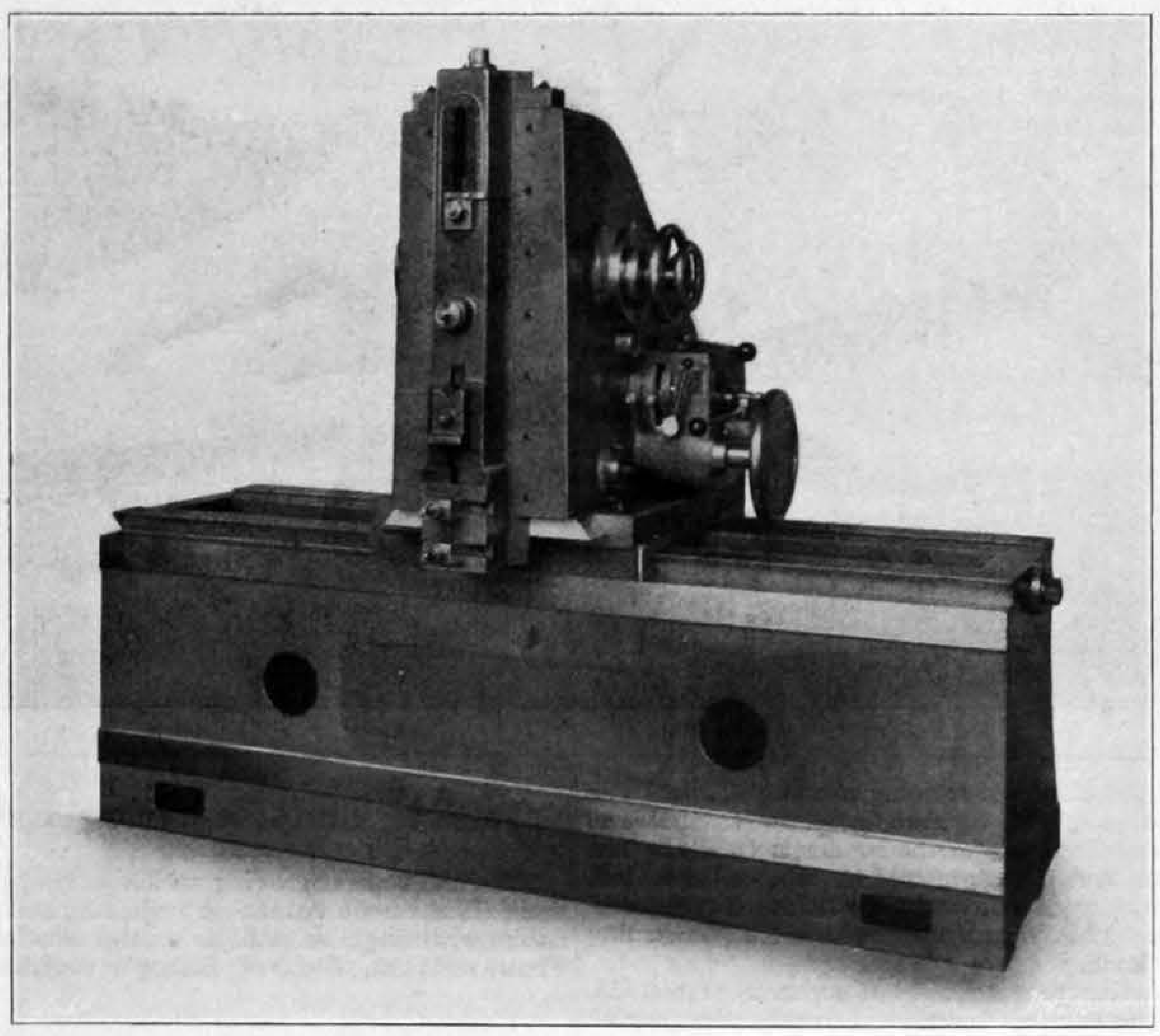


DIAGRAM OF CONNECTIONS

The windings, which are insulated between layers, are wound on bobbins fitted round a laminated soft iron core, and the whole is enclosed in a rustproof welded steel tank, which has external fixing lugs for mounting on a wall. The supply cable can be led in through conduit to either side of the tank, or, alternatively, may be taken right through with tee-off connections to the transformer, as shown in the diagram of connections. The low-voltage outlet is by means of two special outlet plugs and sockets on the front of the tank. They are punched with keys and slots, so arranged that a plug cannot be inserted into any but a corresponding low-voltage socket. The sizes of these transformers most useful for A.R.P. service would be 50 VA and 150 VA. They are, however, made in sizes up to 750 VA for portable electric tools and other industrial applications, and also, as to the 50 VA unit, in portable form.

Traversing Head Slotting Machine

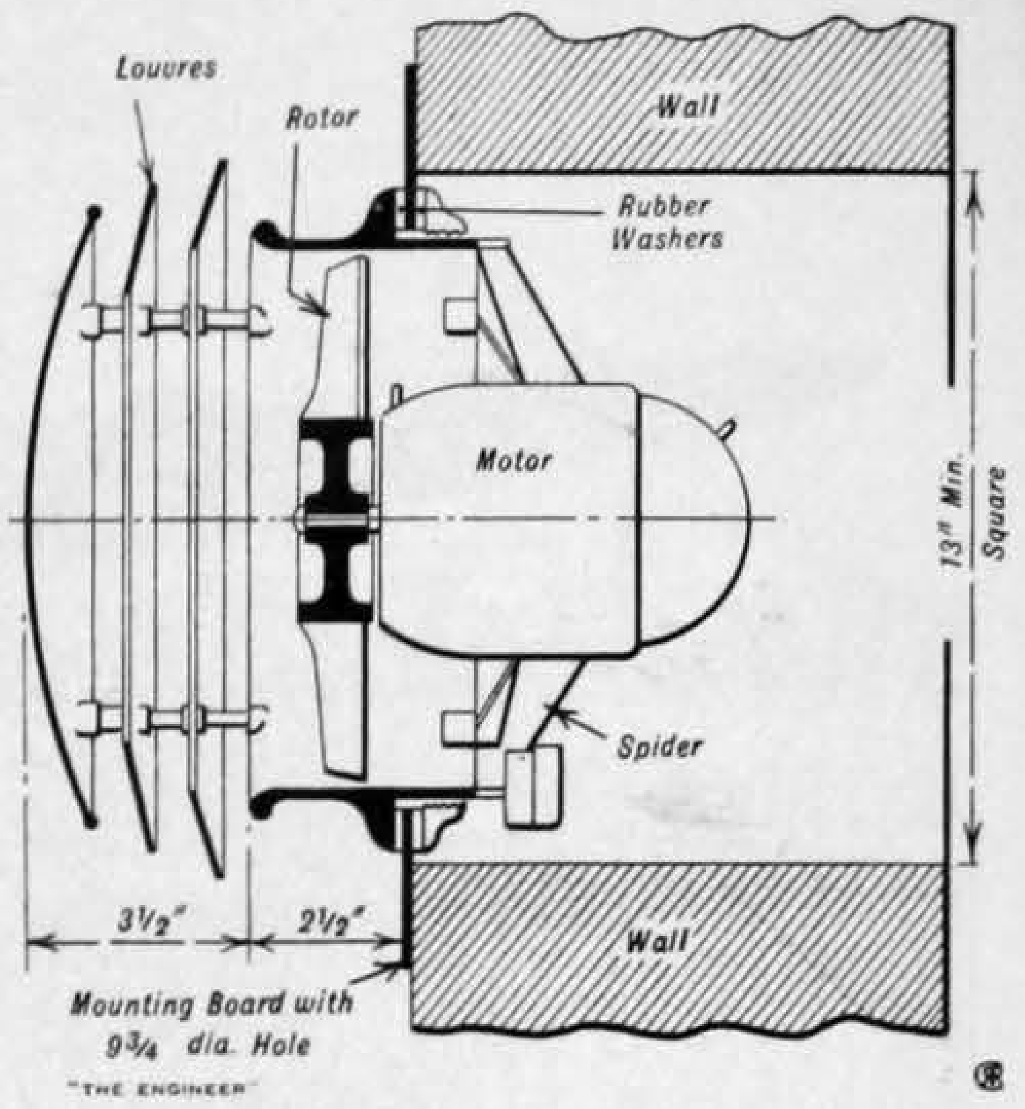
A NEW type of traversing head slotting machine has recently been developed by Ormerod Shapers, Ltd., Hebden Bridge, Yorks. It is illustrated herewith. The tool is primarily designed for use on bunched plate work, and, being self-contained, is portable. It consists of a sturdily proportioned base, well ribbed internally, and having side slideways to carry the headstock. Machined facings on the front of the bed enable work to be set up quickly and accurately. The headstock, which is driven by a flange-mounted motor developing 4 H.P., has a built-in gear-box, giving a range of three speeds of 28, 38, and 56 strokes per minute to the ram, which has an adjustable stroke of up to 8in. Vertical adjustment to the ram is also provided. The reciprocating motion of the ram is obtained from a large driving wheel and closed end type link motion. The length of stroke is adjustable whilst the machine is in motion or at rest. Four rates of reversible power feed are provided to traverse the headstock along the bed. The length of traverse is 5ft. 3in., on a standard bed which is 7ft. 3in. in length. A safety device is fitted to prevent damage through over-feeding. In addition to the power feeds, fine adjustment by hand is obtainable through a large-diameter hand wheel. Rapid power traverse for quick setting is also provided, and is so arranged that it operates in the reverse direction to the power feed. The headstock is also fitted with in-and-out traverse of 12in. A steel insert is dove-tailed into the ram head to carry steel planer type tool holders. A serrated tool stop is also supplied to take the end thrust of the tool. Pump lubrication to all gears and shafts is provided by means of a positively driven pump fitted with a filter and a visible indicator. The controls of the machine are conveniently grouped, enabling the operator to have them at his finger tips in his normal working position. The working floor space required for the machine is 7ft. 6in. by 5ft. 3in., and the approximate weight is 65 cwt., including the electrical equipment.



TRAVERSING HEAD SLOTTING MACHINE

Ventilator for Air Raid Shelters

AN accompanying engraving illustrates the arrangement of a fan unit suitable for the ventilation of air raid shelters, made by Vent-Axia, Ltd., of 9, Victoria Street, London, S.W.1. The drawing shows how the unit is fixed to a board which is fastened to the outer face of a wall. Rubber washers insulate the fan from the wall. The unit consists of a small electric motor driving a fan and mounted in a lightproof bakelite casing. Louvres prevent leakage of light. Two sizes of unit are available, the "Nine" and the "Six" respectively. The first named and larger unit delivers 20,000 cubic feet per hour, and has a current consumption of 35 watts. A single such unit is suitable for a shelter accommodating fifty people, providing 400 cubic feet per hour per shelterer. For larger shelters more than one unit can be installed. The smaller "Six" provides 8000 cubic feet of air per hour, and has a current consumption of 25 watts. It is more particularly useful for small shelters, such as are made for family use. Both units are claimed

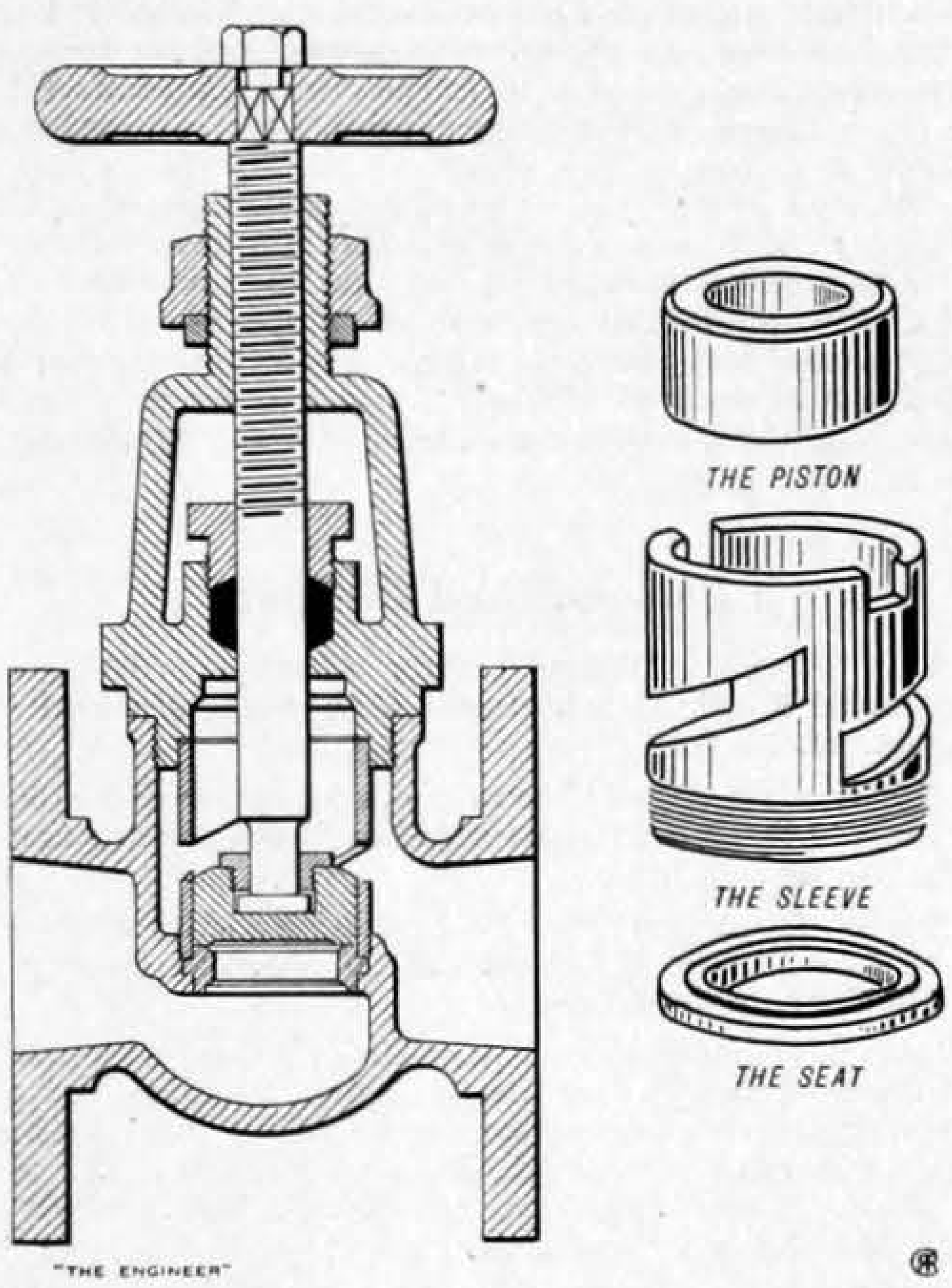


VENTILATING FAN UNIT

to be silent in operation. They are weatherproof and designed for continuous operation, and they can be supplied either for intake or extraction. They cannot be used for gas filtration. We need not refer to methods of fixing the units, since the precise arrangement depends on the particular design of the shelter concerned. It is obvious, however, that space must be provided for inflow of air if an extractor is fitted, and *vice versâ*. The following details give some particulars regarding the fixing of the ventilators :—Size of hole in wall, minimum : "Nine," 13in.; "Six," 10in. Diameter of hole in fixing board : "Nine," 9¾in.; "Six," 6¾in. Thickness of fixing board, maximum : "Nine," ½in.; "Six," ⅜in.

Seat-in-Sleeve Valve

ONE of the more frequent causes of valve breakdown is wearing of the seat by steam whilst the valve is in a slightly open position. This result can usually be attributed to the necessity for working valves in the "cracked" position when very fine regulation is required. The valve is only just open to allow the passage of small quantities of steam. Apart from stoppages for disc renewals and regrinding of seats, there are also maintenance costs continually involved. A valve specially designed to eliminate wire drawing of this kind is the improved type Arkon seat-in-sleeve valve made by Walker, Crosweller and Co., Ltd., of Cheltenham. In this valve, details of which are shown in the drawing, the stainless steel seat is protected by a sleeve in which the valve clack moves. Ports are cut in the sleeve so that no steam passes until the valve clack clears the ports. The clack is then well clear of the seat, and all wear due to the sudden rush of steam is taken by the sleeve. No matter how worn the ports in the sleeve become, the valve, it is claimed, will shut tight when screwed down on the seat. Thus, with the Arkon valve only just open, it is possible to get very fine regulation, whilst not subjecting the seat to the damaging effects of "wire drawing." The seat is reversible and all



ARRANGEMENT OF SEAT-IN-SLEEVE VALVE

internal parts renewable. Two types are manufactured :—"B" for saturated steam up to 150 lb. pressure, and "D" for superheated steam up to 650 deg. Fah. and 300 lb. pressure. They are available in all the usual pipe sizes with screwed or flanged connections.

BRITISH STANDARDS INSTITUTION

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria Street, London, S.W.1. The price of each specification is 2s. 3d. post free, unless otherwise stated.

WAR EMERGENCY BRITISH STANDARDS FOR NAVAL BRASS DIE CASTINGS AND BRASS GRAVITY DIE CASTINGS

Nos. 920 and 932. Apart from the specification which has existed for special brass castings, B.S. 208, there have so far been no British Standards for Brass Castings such as are commonly used in engineering. The need for such specifications is particularly apparent at the present time, when it has been necessary to use castings for purposes for which they were not previously adopted. The British Standards Institution, at the request of certain Government Departments, has now issued two emergency standards, one for naval brass die castings and the other for brass gravity die castings. Both standards are similar in form and provide for the chemical composition of the ingots from which the castings are made and the mechanical properties obtainable from the castings. For the naval brass casting a tensile strength of 20 tons per square inch with an elongation of not less than 20 per cent. is specified. For ordinary die casting a tensile strength of 18 tons per square inch with an elongation of not less than 25 per cent. is specified.

FLAMEPROOF ENCLOSURE OF ELECTRICAL APPARATUS

No. 229. The first issue of this specification, published in 1926, comprised a general definition of the term "flameproof enclosure," a general outline of the tests to establish the quality of flameproofness and a suggested form of certificate to be issued by the testing authority. A first revision was published in 1929, which included a few small changes only. No attempt, up to that time, had been made to provide detailed directions for the design and construction of flameproof enclosures. In this new edition the definition of the term "flameproof enclosure" remains substantially unaltered, but the specification has been considerably enlarged to include a detailed prescription for those features of design and construction which are considered to be essential to secure mechanical strength and reliability in service. The specification at present covers apparatus for use in coal mines only and amplifies the requirements of the Mines Department Testing Memorandum No. 4. It is intended to prescribe, in due course, corresponding data for flameproof apparatus for use in other industries.

CANADIAN NYLON.—The first Canadian plant for the manufacture of nylon is under erection by Canadian Industries, Ltd., at Kingston, Ontario. The plant will cost about 1,500,000 dollars, and is expected to be ready for starting up in August this year. The nylon polymer required will, at first, be imported from the United States.

Markets, Notes and News

The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quantities are f.o.b. steamer

The Purchase of Brass Ingots

The Non-ferrous Metals Control has announced that it is prepared to buy brass ingots of a defined analysis at £35 per ton f.o.r., makers' works. This offer is made in order to create a market for the disposal of heavy brass and other forms of lower grade brass scrap, and the analysis of the brass ingots has been drawn up accordingly. The copper content is allowed to vary from 62 to 65 per cent., and reasonable latitude is given for tin, lead, iron, and other elements. Full details of the scheme are as follows :—Composition : The ingots must be of good commercial quality and comply with the following analysis :—Copper, 62·0 to 65·0 per cent.; tin, 0·75 to 1·5 per cent.; lead, 3·5 per cent. max.; iron, 0·5 per cent. max.; nickel, 0·5 per cent. max.; aluminium, 0·01 per cent. max.; total of all other elements except zinc, 0·5 per cent. max.; zinc, balance. The ingots must be guaranteed to comply with the above composition and an analysis must be supplied with each lot. For lots of over 5 tons, one analysis will be required for each separate 5 tons or part thereof. Weight : The weight of each ingot must be not less than 14 lb. or more than 28 lb. Marking : The makers' name or trade mark and a batch or melt number must be stamped or cast on to each ingot. After acceptance for purchase by the Control, the manufacturer will be required to stamp each ingot with the letters "N.C.B." Inspection : Before purchasing, the Control reserves the right to inspect and sample all ingots offered and to refuse to purchase any that do not comply with the requirements of the above specification. Delivery : Within three months of the date of contract. Payment : Net cash payment will be made when ingots accepted for purchase are placed at the disposal of the Non-ferrous Metals Control, together with the required analysis. Inquiries should be addressed to the Joint Controllers, Non-ferrous Metals, Grand Hotel, Rugby.

The Pig Iron Market

Considering the war conditions, the position of the pig iron market is satisfactory. Now and again there may be a stringency in certain descriptions, but this is quickly overcome, and the Control contrives to keep all industries employed upon war work supplied with the necessary materials. The iron ore position a little while ago was rather tight, but imports were arranged upon a liberal scale, and the situation was rectified. At the moment there is some tightness in the hematite iron department, and imports are being continued at a substantial rate, whilst at the same time consumers are encouraged to make use of other pig irons wherever possible. The demand for foundry iron is increasing, and the improvement in the position of the light castings foundries continues, with the result that there are heavier demands upon the makers of high phosphoric iron. On the North-East Coast the production of Cleveland foundry iron is small and irregular, and consumers there are obtaining their supplies from Northamptonshire and Derbyshire. Under the Control arrangements, however, users do not have to pay more for their pig iron, in spite of the fact that there is a longer rail freight than if they were supplied by local producers. In the Midlands a noticeable feature of the position is the heavy demand for special irons from the engineering trades engaged upon armament and munitions work. These irons are also required in considerable tonnages by machine tool makers. Imports of ores suitable for the production of low phosphoric iron are being distributed by the Control in sufficient quantity to enable the production of this description to be expanded. The output of pig iron on the North-West Coast and in Scotland is on a heavy scale. The light castings foundries, although better employed than they were, are still rather slack. They are obtaining their supplies of foundry iron from the Midlands, and these seem adequate to meet their needs. The home production of basic iron also should be sufficient to satisfy the steel trade, as it has been greatly developed since the war began, and imports have helped the position.

Scotland and the North

Great activity prevails at the steel works in Scotland. For the first fortnight of the New Year there was some falling off in production as a result of the necessary repairs to plant, but these have been practically completed, and it is anticipated that the big outputs obtained at the close of 1940 will be exceeded shortly. A large proportion of the steel production is for work arising from the war, and in cases where it does not go into direct use for this purpose it is the result of the indirect demand. Here and there some stringency is noticeable in supplies, as in the case of plates, which are in heavy request from the shipyards which have large programmes of naval and mercantile work in hand. In addition, the tank makers are actively employed, and are taking good tonnages, as are the boilermakers. The locomotive engineers also are busy, and lately have received orders from the home railways for sixty-two locomotives and tenders. There has been an increase in the demand for structural steel, and many of the constructional engineers, who are less busy than in the early part of last year, have now secured sufficient orders to keep them well employed for the greater part of 1941. The demand for joists, however, is principally for the lighter sizes. At the same time, large quantities of the smaller sections are passing into consumption, and the re-rollers are hard pressed to keep pace with the demand. The wrought iron works, which for the most part are now fully occupied, are experiencing an active request for high grade bars and strip, whilst the lower quality bars are being taken up in good quantities by the bolt and nut makers. The sheet mills have been busy for months, and there has been no relaxation in the pressure which consumers exercise to obtain supplies. Black and galvanised sheets are in strong demand, and the output is going chiefly into work on Government account. In the Lancashire market a large business is passing in structural steel, and the demand for this description of manufactured steel looks like increasing. The boiler and tank makers are taking up large quantities of plates, but the makers of the latter are inclined to quote rather long delivery dates.

The North-East Coast and Yorkshire

The demand for all classes of steel shows a tendency to increase, and in the case of those descriptions required for munitions, consumers' needs are on a definitely larger scale than even a few weeks ago. As a result, production at the works on the North-East Coast is being pressed to the limit, and it is anticipated that outputs will exceed even the high levels attained in the latter months of 1940. It is not anticipated that conditions will change much during the current year, and it is probable that the Control will exercise a rigid supervision upon the consumption of all kinds of steel. The production of semi-finished steel is well maintained, but it has to be supplemented by considerable imports, and these are arriving with regularity. Most of the billets used by the re-rollers for some weeks past have been of American origin, and it is understood that arrangements have been made for maintaining these supplies. All descriptions of finished steel materials are being sought after, and the demand for plates is particularly heavy. The shipyards on the North-East Coast are fully employed, and have a programme of work in hand which will last them for many months. Probably, the present pressure of work at the shipyards will continue for the duration of the war. There is some slackness in the demand for structural steel, owing to many of the constructional engineers having completed big contracts ; but fresh work has been given out recently, and some of these firms are busier than they have been for some time, whilst others are expecting to obtain new business. There is still some stringency in the supply of plates, owing to the excessive demand, but big orders have been placed in the United States and supplies from that country should be sufficient with the home production to place the consuming industries in a satisfactory position. Great activity characterises the Yorkshire steel works. The demand for special steels in particular has expanded during recent months, and is taxing the resources of the works. These steels are largely required by the munition manufacturers, and the orders have a high priority. The forges and rolling mills in the Sheffield district have been actively engaged for a long time, and their production is being well maintained. One of the busiest sections of the British steel trade is the manufacture of small tools for the engineering establishments. There is a big output of crucible steel, and this form of manufacture is likely to expand in the not distant future.

Copper and Tin

There has been no material change in the copper position, and whilst in this country there is no shortage and the war industries are getting ample supplies, in the United States the situation has become more stringent. Prices, however, have not been altered, and the domestic quotation remains at 12c., but this is largely because the Government has intimated that it does not desire the quotation to rise. For export the price stands at 10·25c. to 10·50c. f.a.s. Consumers are apparently becoming somewhat nervous as to the future, and representations have been made to the authorities. It is reported that it has been decided by the American Government to arrange the import of South American copper free of duty, and ordinary consumers wish it to be made clear that they will be permitted to participate in the use of these imports. It would seem that they fear that the imported copper will be used for Government work and that the stringency in the market may affect their supplies. Export licences have now to be obtained for the shipment of copper overseas from the United States. It is reported that there is some hold-up in the issue of the licences, due probably to the difficulties attendant upon operating a new Government Department. . . . Whilst the tin market in London has been moderately active, prices have moved to the extent of only a few shillings. American Government Departments have placed fairly big orders, some direct in the East and others which were filled from stocks in the United States. Ordinary consumer buying in America is apathetic, and there seems to be plenty of tin available. In Great Britain the situation is comfortable, but export licences are granted sparingly. Some tin, however, has been shipped, and the stocks have been reduced, with the result that the contango has shown a tendency to narrow.

Lead and Spelter

Whilst there is a big consumption of lead in Great Britain supplies are adequate to meet the position of the war industries, which find no difficulty in getting the metal they require. The situation in the market is easier than in the case of other non-ferrous metals, but consumers who are not engaged upon essential work do not always find it easy to obtain supplies. At the same time it is probable that this class of user finds the lead position easier than in the case of copper or spelter. The cable and battery makers are amongst the largest consumers of the metal and take up good tonnages. . . . Large quantities of spelter are being consumed, and there does not appear to be much surplus for purposes other than those arising from the war. In fact, the spelter position seems to be tight in most countries. Probably Germany is the best off for this metal, owing to the productive plant of which she has obtained possession by overrunning other countries. No concern, however, is felt in Great Britain regarding future supplies, since the arrangement entered into at the beginning of the war with Empire countries should ensure ample supplies for the period of hostilities. In the United States the position remains stringent, and is likely to become worse when the full weight of the rearmament requirements is felt. Japanese efforts to buy spelter in the United States, even at enhanced prices, do not appear to have been successful, and there are no reports of any important business having been arranged.

Notes and Memoranda

Rail and Road

HIGHGATE STATION.—The deep-level station at Highgate, underneath Highgate Station, L.N.E.R., was opened for traffic on January 19th. The tube platforms have been used for weeks past as an air raid shelter.

NORTHERN IRELAND ROAD TRANSPORT.—The accounts of the Northern Ireland Road Transport Board for the year ended September 30th last have recently been issued and show an operating profit of £67,473.

A ROAD MAGNET.—There may be something in the old story of American automobile monkeys after all, for now comes a report that a " road magnet " on wheels, designed to rid the State highways of nails, bolts, and other objects which cause tyre blow-outs and automobile accidents, has been invented by a Missouri engineer.

MONTREAL LOCOMOTIVE WORKS.—An extension to the plant of the Montreal Locomotive Works—controlled by the American Locomotive Company—has been started. The plans provide for a new building, 800ft. by 400ft. There are reports that the company has received orders for tanks and gun carriages, to be made in Montreal.

LIGHTING A BRIDGE.—Storey Bridge, which spans the Brisbane River, Queensland, Australia, has a main span of 924ft. and with its approaches a total length of 4575ft. It is the largest bridge in Queensland. Both span and approaches have recently been installed with sodium lamps, 85 W for the roadway and 60 W for the footpaths, all accommodated in refractor plate lanterns. This combination of lamp and lantern has resulted in a high degree of visibility, freedom from glare and economy in operating expense.

AGRICULTURE AND TRACTION.—The Ministry of Agriculture has made extensive preparations for the spring ploughing. Tractors and implements are coming from British manufacturers and from abroad in greater quantities than ever before. In the next three months it is expected that over 4000 tractors will be imported. In the same period we shall produce at home between 4000 and 5000 tractors. Last year, in the whole twelve months, we imported 6000 tractors and produced 17,000 of our own. Nearly 7000 binders arrived from overseas in 1940. Some of these latest extra tractors and implements will go to increase the reserves held by County War Committees to meet emergencies.

Air and Water

SUBMARINE LOSS.—The Board of Admiralty regrets to announce that H.M. submarine " Triton " is overdue and must be considered lost.

TEESSIDE PROBLEMS.—Sir John Maxwell, Northern Regional Transport Commissioner, has decided to form a committee to inquire into transport problems with special reference to the Teesside industrial area.

SHIPPING LOSSES.—Mercantile losses by enemy action for the week ended January 20th were five British ships, amounting to 34,772 tons, and six allied ships, amounting to 23,440 tons, making a total tonnage of 58,212.

METAL IN AEROPLANES.—In an article in *Foreign Affairs*, Mr. P. W. Bidwell estimates that an all-metal aeroplane, weighing 8300 lb., contains 5120 lb. of aluminium, 1680 lb. of iron and steel, 360 lb. of copper, from 60 lb. to 70 lb. each of nickel, chromium, molybdenum, magnesium, and tin, as well as small quantities of lead and zinc.

ROUMANIAN OIL OUTPUT.—Mr. H. G. Austin, formerly factory representative in Roumania of the Oil Well Supply Company, Ltd., who recently addressed members of the Fuel Luncheon Club in London, said that Roumanian oil production in 1939 had declined 30 per cent. from its 1936 peak. Production figures in metric tons had fallen from 8,700,000 in 1936 to 6½ millions in 1939, and the figures for 1940 would show a further drop of 500,000 tons.

SOUTH AFRICAN AIR SERVICES.—Weekly air services between Johannesburg and Cape Town, Cape Town and Loanda in Angola, and Germiston and Entebbe in Uganda have been inaugurated by the South African Railway Administration. The *Railway Gazette* states that the new American-built Lockheed " Lodestar " passenger aeroplanes are being used for the new services, which run on fast schedules arranged in accordance with the results achieved in test flights. Both services will start from Germiston.

ALUMINIUM SCRAP FOR AIRCRAFT.—The salvaging of aluminium scrap from destroyed aeroplanes was the subject of an authoritative statement by Mr. H. F. James, a director of Northern Aluminium Company, Ltd. It was printed in the current issue of *Steel Metal Industries*, and *inter alia* emphasises the changed conditions that must be observed in these times. After the outbreak of war the use of aluminium was severely curtailed, and it became obvious that all good quality scrap should be segregated and used again in melts of composition similar to that of the original sheet, rod, or other material from which it was produced. Utilised in that way its intrinsic value would be approximately equivalent to that of alloys of similar constitution produced from virgin materials. The percentage of such secondary material that could be added to melts was limited only by the supplies of segregated scrap available, and not, as had been the case hitherto, by the quantity of impurities allowed to mix with the scrap.

AN ANNUAL REVIEW OF SHIPPING.—Despite the war and the restrictions of the Censors, *The Journal of Commerce*, Liverpool, has been able to produce an excellent " Annual Review of Shipping and Allied Subjects." It opens with an Introductory Survey by the Editor, in which all the events connected with shipping during the past year are clearly chronicled and reviewed. Amongst many interesting comments we note that the Editor expresses doubts about convoys. " From the purely shipping point of view," he says, " there is nothing in their favour, and it may be that there will be less to be said for them from the aspect of safety in the near future." A number of special articles follow this Introduction. In one, Sir Philip Haldin, President of the Chamber of Shipping, speaks strongly of the refusal of the Ministry of Shipping to allow shipowners to purchase ships, and sees in that a possible danger that the Government may contemplate the folly of nationalising shipping. Mr. Lawrence Holt contributes an article on a high literary plane, which exalts the pride of vocation and sense of duty in the seamen of Britain. Passing over many other good articles, we must mention an article by A. C. Hardy, in which the question of submarine design, propulsion and limitations are ably discussed. Altogether this Annual Review, which makes quite a thick volume, is something for the producers to be proud of.

Miscellanea

A KELVIN LECTURE.—The Institution of Electrical Engineers hopes to arrange for the Kelvin Lecture by Dr. S. Chapman, F.R.S., to be delivered on May 8th, immediately following the annual general meeting, which is to be held on that day at 2.30 p.m. Dr. Chapman will deal with the subject of " Electrical Works by Helios, or the Sun and the Ionosphere."

INSTITUTION OF CHEMICAL ENGINEERS.—The Institution will hold its annual meeting in London on April 4th. Mr. C. S. Garland has been nominated by the Council as President, in succession to Mr. F. Heron Rogers. The Institution has recognised satisfactory completion of the undergraduate courses in chemical engineering at the Imperial College of Science and Technology, South Kensington, and at University College, London, as carrying exemption from the associate membership examination.

GLASS AS AN INSULATION MEDIUM.—Spun glass as a material for insulation has its place alongside mica and asbestos, but for many purposes it is useless untreated; it requires to be combined with a suitable varnish. Recent research has developed varnishes and other impregnating material suited to conditions of high heat and humidity. High temperatures have been reached in glass-insulated coils under laboratory conditions, and useful data have been obtained on impregnants. The resources of the varnish makers should now lead to the production of impregnants for use in daily practice.

A CLOSE MEASUREMENT.—A New York company making scientific apparatus has produced an instrument with which dissolved oxygen in boiler feed water can be measured to one part in 400 millions. The instrument is based on the thermal conductivity principle, and embodies four platinum spirals forming four arms of a Wheatstone bridge. Two spirals are exposed to the sample gas and two are permanently sealed with saturated hydrogen. The deflection of the instrument is proportional to the concentration of dissolved oxygen in the sample water passing through the scrubbing tower.

ARMS AND THE AREA BOARDS.—The work of the Area Boards in developing war production has been surveyed by Mr. Harold Macmillan, Parliamentary Secretary to the Ministry of Supply. The Government wants the Boards to anticipate every kind of problem which may arise as a result of enemy action and affect war production. Problems created recently by air raid damage have led to a clearer understanding of the functions on which Area Boards can usefully concentrate. Mr. Macmillan hopes to discuss the problems that come to light as the results of the survey with the Board in each area.

MICA PRODUCTION.—A recent note in these columns on the production of mica in Tanganyika may now be supplemented by a report on the mica industry of Canada which experienced marked expansion last year. Producers' sales were double those of the preceding year, and the value increased by over 80 per cent. The Canadian mica output is almost wholly of the phlogopite or amber variety, and is particularly valuable for uses where high resistance is required in the electrical industry. The deposits now being worked are situated mainly in Eastern Ontario and the adjacent section of Quebec. There is a small production of moscovite or white mica.

WORKSHOP BLACK-OUT.—In a paper on " Industrial Lighting in Wartime," read at a recent meeting of the Illuminating Engineering Society, Mr. H. C. Weston discussed among other things the effect of blacking out every window. The almost complete deprivation of daylight which that involved had the effect of placing the day shift on the same level as the night shift, although when the artificial lighting was adequate no evidence had been found that the effect was prejudicial. Natural daylight, however, was always to be preferred, and if removable shutters were installed so that the ratio of unobscured window to floor area was about 1 to 8, much work could be done without artificial light. In many modern workshops the ratio of window to floor area was 1 to 3, so that only a proportion of the windows needed to be shuttered.

A CANADIAN COKING PROCESS.—A coke which can be produced rapidly in comparatively small quantity, if necessary, and of a quality particularly suitable for use in processes where coke is chemically reacted with other elements, as in the manufacture of calcium carbide, silicon carbide, or in the production of phosphorus, is the subject of a Canadian patent which is to be worked by Shawinigan Chemicals, Ltd. According to the *Chemical Trade Journal* the invention rests on the discovery that, by controlling and judiciously applying the air through the grate and the bed of the coal, the volatile matter is attacked in preference to the fixed carbon. This is an unexpected result, since it is the usual experience that bituminous coal burned with insufficient air results in a mixture of ash and unburnt coal containing more or less volatile matter. The coke produced is as strong as most types of by-product coke. It has been demonstrated that coal running 35 to 40 per cent. volatile matter can be utilised to produce a strong coke with very little breeze, an operation that has not been practicable in the ordinary retort.

CUTTING QUARTZ CRYSTALS.—In the course of a paper on " The Application and Use of Quartz Crystals in Telecommunications," read before the Institution of Electrical Engineers, Mr. C. F. Booth drew attention to the need for better saws. Several of the available saws for cutting quartz crystals possessed the " long-life " property, but they failed to give the desired cutting accuracy. The solution appeared to lie in the use of a hard steel disc, to give stiffness, with a softer deposited rim containing the diamond charge. The effective cutting rate could be accelerated by the use of precision gauged saws capable of producing three or even four slices. Improved universal fixtures might enable the raw crystals to be cut into slices with the minimum amount of preparatory cutting. Improvement of the parallelism of the plates from the cutting machine and of their closeness to the final dimensions would reduce the duration of the lapping process.

Personal and Business

THE FRANCOIS CEMENTATION COMPANY, Ltd., has appointed Mr. F. G. Atherton to take charge of its mining department.

MR. R. J. HALL has been appointed by the Minister of Transport to be a nominee member of the Mersey Docks and Harbour Board.

DR. W. H. HATFIELD, of Thomas Firth and John Brown, Ltd., has become President of the Sheffield Society of Engineers and Metallurgists.

MR. P. PRITCHARD, of the Birmingham Aluminium Castings Company, has been elected President of the Birmingham, Wolverhampton and Stafford District Engineering Employers' Association, and Major E. O. Yates, of Thos. Smith and Sons, of Saltley, Ltd., has been appointed Deputy President.

THE LATE MR. T. U. HILL.—We regret to have to record the death at his home at Westerham, Kent, of Mr. T. U. Hill, who until he retired in 1935 occupied the position of the London manager of the Carborundum Company, Ltd., Trafford Park, Manchester. Mr. Hill joined the company in 1907, and took a leading part in the rapid growth of the abrasive industry in this country.

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 Monday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

Bradford Engineering Society

Monday, Feb. 10th.—Technical College, Bradford. " Some Common Types of Water Supplies and their Influences in Steam Plant," W. F. Gerrard and T. Millican. 7.15 p.m.

Fuel Luncheon Club

Thursday, Feb. 6th.—Connaught Rooms, Great Queen Street, Kingsway, W.C.2. Luncheon. " The War Damage Bill and its Relation to the Fuel Industries," Captain H. F. C. Crookshank. 12.40 for 1.10 p.m.

Illuminating Engineering Society

Tuesday, Feb. 11th.—E.L.M.A. Lighting Service Bureau, 2, Savoy Hill, W.C.2. " The Recognition of Coloured Light Signals," J. G. Holmes. 2.30 p.m.

Institute of Fuel

Wednesday, Feb. 12th.—Connaught Rooms, Great Queen Street, Kingsway, W.C.2. " Some Notes on a Post-war National Fuel Policy with suggestions for a Practical Plan," J. D. Troup. 2.15 p.m.

Institute of Petroleum

Wednesday, Feb. 5th.—Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1. " Extreme Pressure Addition Agents," E. A. Evans and J. S. Elliott. 2.15 p.m.

Institution of Electrical Engineers

Monday, Feb. 10th.—N.E. CENTRE: Neville Hall, Westgate Road, Newcastle-upon-Tyne. " Electricity in Paper-making," W. G. Mason and S. A. G. Emms. 6.15 p.m.

Institution of Engineers and Shipbuilders in Scotland

Tuesday, Feb. 11th.—39, Elmbank Crescent, Glasgow, C.2. " Experiments in Rough Water with a Single-screw Ship Model," J. L. Kent and R. S. Cutland. 6.30 p.m.

Institution of Mechanical Engineers

Monday, Feb. 3rd.—N.E. BRANCH: Mining Institute, Neville Hall, Newcastle-upon-Tyne. " Progress in Marine Engineering as Influenced by the Classification of Ships," S. F. Dorey. 6 p.m.

Newcomen Society

Wednesday, Feb. 12th.—Institution of Civil Engineers, Great George Street, Westminster, S.W.1. " Early Application of Engineering to the Warming of Buildings," A. F. Dufton; " History of the Hydraulic Extrusion Process for Metals," C. E. Pearson. 2.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders

To-day, Jan. 31st.—Mining Institute, Newcastle-upon-Tyne. " Effect of Some External Factors on the Performance of Single-screw Ships," A. Kari. 6 p.m.

North of England Institute of Mining and Mechanical Engineers

Friday, Feb. 14th.—Royal Station Hotel, Neville Street, Newcastle-upon-Tyne. Dinner. 7 for 7.30 p.m.

Royal Institution of Great Britain

Tuesday, Feb. 11th.—21, Albemarle Street, W.1. " Explosives," G. I. Finch. 2.30 p.m.

Royal Society of Arts

Wednesday, Feb. 5th.—John Adam Street, Adelphi, W.C.2. " Design and the Paper Manufacturer," E. W. Goodale. 1.45 p.m.

Wednesday, Feb. 19th.—John Adam Street, Adelphi, W.C.2. " Methods of Paper Manufacture," J. Grant. 1.45 p.m.