Abstracts of the Technical Press

VoL. 8

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Conversion of Atomic Power.

In spite of all that has been written and said in recent months about the coming age of atomic power, particularly in the field of transportation, no tangible evidence has yet come to light which would indicate that, apart from jet propulsion, a new type of propulsion machinery has been developed or even thought of for the direct conversion of atomic energy into mechanical power. From what can be gathered from the information contained in the U.S. Government report on "Atomic Energy" (now also published by H.M. Stationery Office) a so-called "plutonium pile" will have to be employed as a heating element for the heating of air or gases or for the production of steam, etc. This pile was originally designed for the production of plutonium as an alternative to the uranium isotope U-235 for charging the atom bomb. The pile is a lattice-like structure which contains lumps of uranium embedded in graphite or some other suitable retarding material. In the course of the operation, atomic energy is released as heat, but even if it is assumed that the mechanical problem involved in the high-temperature operation of the pile may be solved with comparative ease, there still remains the most important drawback that the energy-releasing material uranium is extremely expensive and in very short supply. Furthermore, this uranium pile is self-wasting and in no sense the almost eternal source of power that has been so enthusiastically claimed in highly-coloured Press reports. Another disadvantage is the considerable danger involved in the operation of the pile because of its radio-active properties. It would therefore seem that, for the time being at least, technological considerations will prevent the use of the pile as a source of heat in connection with steam boilers and gas turbines, and that even if and when the technological problems are solved, the economic factors involved will remain to be dealt with. So far nothing has been published to indicate the consumption in power or latent power involved in the preparation of the energy-yielding isotope uranium 235, or, for that matter, of any other energy-radiating substance. Obviously, even if the development of greatly improved methods made it possible to produce from the heat equivalent of one pound of coal a quantity of radio-active material capable of yielding an identical heat equivalent, nothing would yet have been gained from the aspect of thermal economy, since the process would amount to no more than the conversion of one form of energy into another, this conversion having no more than "convenience value". Therefore, to make atomic power attractive from the aspect of fuel economy, it will be necessary to find some way by which radiant energy readily available in some natural form could be released by some kind of relay action.—*"The Shipping World", Vol. CXIII, No. 2,735, 14th November, 1945, p. 512.*

Critical Vibrations in Geared Turbines.

A paper entitled "Practical Aspects of Torsional Vibration in Marine Geared Turbine Propulsion Units", by S. C. Powell and W. V. Bassett, which was recently presented to the American Society of Naval Architects and Marine Engineers, dealt with what the authors described as the practical aspects of operation at critical speeds. Double-reduction gears of the articulated and nested types were the only forms of geared transmission considered, and the authors claimed that having determined the dynamically equivalent single-speed system, the moments of inertia and the flexible lengths would determine the resonant or critical frequencies and also the relative amplitudes and torques associated with the vibrations. Among the many disturbances noted which cause periodic torque fluctuations are non-uniform flow at the propeller, inaccuracy of gear-tooth contact and steam shock on the turbine blades, but experience has shown that in modern units only the propeller disturbances are of a magnitude and frequency capable of exciting annoying or deleterious vibrations. When torsional vibration occurs, the periodic oscillation of the turbine, gear and propeller masses, with associated twisting of the intervening shafting, produces vibratory inertia torques which become significant at critical speeds. The critical excitation for each critical speed is defined as the variation of propeller torque from the mean which will induce vibratory torque equal to the transmitted torque in the most susceptible gear mesh. Based upon the single-speed system—the mathematical details of which are set out in an appendix to the paper—the authors determined and tabulated the critical excitations of a large number of D.R. geared turbine drives for merchant ships. In a few of the examples chosen, vibration was apparent as evidenced by the characteristic knocking during operation, though in none of these cases did damage occur to the gears which could be ascribed to torsional vibration. However, as it would obviously be preferable to have no evidence of critical speeds whatever, it is suggested that this should be accomplished by an application of the simple and well-tried modifications to the design which are enumerated in the paper.—*"Shipbuilding and Shipping Record", Vol. LXVI, No. 16, 18th October, 1945, pp. 364-365.*

The Parsons Marine Steam Turbine Co., Ltd.

At the recent annual general meeting of the above-named company, the chairman, the Hon. G. L. Parsons, stated that throughout the war the works had been continuously employed to their full capacity on the construction of main propelling machinery for naval and mercantile ships, manufacture of mechanical gearing and the cutting of teeth in gear-wheels for other marine engineering firms, as well as for ships built in the U.S. and Canada. The machine shops had been extended just before the war, mainly to permit the installation of gear-cutting and pinion-hobbing machines in a shop in which the temperature could be controlled. The blade shop had been brought up to date, while the brass fitting shop and other departments were reorganised. The interior of the test house was re-arranged for the manufacture of welded steel gear-cases to Admiralty requirements, and the original test plant was now housed in a new building specially erected for the purpose of experimental and research work. The company's jetty, built in 1898, had been strengthened and lengthened, and the basin dredged to accommodate large ships for the installation of machinery. The sheer-legs had been replaced by a 30-ton electric travelling crane, while the original boiler equipment of the works, comprising two B. and W. boilers, had been replaced by a new boiler from the same makers, fitted with special coal-handling equipment. A suitable workshop and study were in course of preparation for the training of apprentices. A test station on land adjacent to the Turbinia Works, belonging to the company, was being built for the Parsons and Marine Engineering Turbine Research and Development Association, who proposed to utilise it for carrying out full-scale tests of high-pressure and high-temperature turbine installations up to the maximum, research work in connection with improvements and developments of steam and gas turbines, and transmission for marine propulsion.—*"The Engineer", Vol. CLXXX, No. 4,687, 9th November, 1945, p. 359.*

Turbine Casing Feet.

One of the most difficult problems which designers and builders of marine steam turbines had to deal with during the war years was the devastating effect on the latter of underwater explosions, or what were known as near-misses. In almost every case the damage caused by such explosions resulted in the breakage of the turbine casing feet. The designers of these supports had allowed for the actual and torsional weight to which they would be subjected, but not for what amounted in substance to the turbines being thrown in the air and then dropped back on their seatings, with disastrous effects. As a result of intensive research work, a form of seating was evolved which combined strength with resilience, and was designed in such a manner that the component parts could be renewed if damaged as the result of an explosion. The form of the supporting ribs and feet of the turbine casings was improved and thickened to make them strong enough in section to withstand any unexpected stress. The holding-down bolts were made much longer and, as well as being provided with spring and resilient washers, were designed to stretch under severe stress. These alterations in design were considerably facilitated by the introduction of fabricated outer turbine casings to take the place of the cast steel and iron formerly used for this purpose.—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,733, 8th November, 1945, p. 6.*

Recent Developments in Escher Wyss Steam Turbines.

The latest design of Escher Wyss impulse type steam turbine is characterised by large clearances, the elimination of dummy pistons, a relatively small number of expansion stages, the employment of a certain amount of reaction, increasing from the tips to the roots, for the blades of the last low-pressure stage, and improved separation of water in the L.P. stages, with better drainage arrangements. These improvements, together with improved blade shapes, have practically eliminated erosion, and no signs of the latter have been found in these new turbines even after they were run for periods of 20,000 to 30,000 hours. These developments have made it possible to operate turbines at steam pressures of up to 1,500lb./in.^{2} and temperatures exceeding 900° F. with a high vacuum and no intermediate reheating. The split casings now employed in all turbines made by the firm are designed with a gradual and uniform increase in the diameter of the stages between the H.P. and L.P. ends, thereby ensuring even stressing of the casing bolts. To provide for free expansion at high temperatures, the casing lugs are supported on bearing pedestals at the same height as the centre line of the shaft and are often made integral with the upper part of the casing. The body of the H.P. end bearing rests on special roller members which allow unobstructed axial expansion to take place. Carbon labyrinth gland packing with very small clearances permit the economical use of high steam pressures for turbines of relatively small powers with minimum leakage losses. In some cases packing of this type has been successfully used for the direct sealing of steam at a pressure of 1,500lb./in.^{2} and a temperature of 900° F. The patent bearing design which has now been adopted has two supporting surfaces separated by an annular drainage channel for oil, and has proved its merits at steam temperatures exceeding 900° F. For temperatures of 1,000° F. or more, the glands are protected by sealing steam at a lower temperature and a cooling device is arranged inside the turbine between the guide wheels and turbine casing, so as to ensure that the latter is only subjected to medium temperatures.—*F. Flatt, "Escher Wyss News: A Century of Turbines", Vol. XV/XVI, 1942/43, pp. 54-62.*

Astern Turbine Power.

Astern turbines are usually incorporated in both the H.P. and L.P. ahead turbine casings, and the astern rotor blading is generally of the impulse type. In some installations the total designed astern power can be varied to some extent by the operation of valves which control the number of nozzles in use. As a rule, up to about 50 per cent. of the total ahead power can be developed, when going astern. Owing to the form of the rotor and casing, it often happens that the astern wheels are not integral with the rotor but are shrunk on to the rotor spindle and securely keyed to hold them in position. Notwithstanding the care with which this work is carried out both in the design and machine-shop departments, cases occurred during the war years in which a sudden reversal of the propeller due to convoy formation, resulted in a complete stripping of the keys, thus depriving the ships in question of the ability to manœuvre astern. This circumstance brings to light that the assumed value of the torsional effort required to bring a geared turbine to rest when a ship is under way, together with the inertia of the gearing, is much greater than is generally assumed; also, that the astern turbine blading is, under certain conditions, capable of developing much more than the 50 per cent. of the total ahead power ascribed to it.—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,739, 15th November, 1945, p. 6.*

31,000-b.h.p. Passenger Liner Machinery.

The installation of the machinery in the 15,500-ton triple-screw Messageries Maritime passenger liner "La Marseillaise" (formerly "Maréchal Petain") will shortly commence. The French Sulzer Co. were able to proceed with the construction of the machinery at their Paris works during the war years with little interference by the Germans because such high-powered engines were not suitable for the hulls of the vessels being built under their programme of ship construction. The machinery is designed for an output of 31,000 b.h.p. at 141 r.p.m., to be maintained for a continuous period of 24 hours, and for a service output of 25,000 b.h.p. at 133 r.p.m. The corresponding ship's speeds are to be 22 knots and 20½ knots. The three main engines are s.a. two-stroke units of the Sulzer standard type, with a single scavenge pump driven off the crankshaft of each engine. The 11 cylinders have a diameter of 720 mm. and a piston stroke of 1,250 mm. The shop trials were carried out at outputs of 8,330 and 10,330 b.h.p., representing the normal and maximum power respectively. The fuel consumption was 0·355lb./b.h.p.-hr. at half load and 0·36lb./b.h.p.-hr. at full load, increasing to 0·38lb./b.h.p.-hr. at maximum load. The engines will exhaust through separate Sulzer La Mont forced-circulation exhaust-gas boilers, which are designed to generate all the steam needed for distilling up to 150 tons of fresh water per 24 hours when the ship is at sea. No information is available regarding the approximate date of completion of the ship, but it is thought that she will not be ready for service in 1946.—*"The Motor Ship", Vol. XXVI, No. 310, November, 1945, pp. 253-255.*

Reduction Gears for Geared Turbine Vessels.

The author gives a detailed and lavishly illustrated description of the double-reduction helical gearing installed in turbine vessels of various types recently completed by American shipyards. Among the items dealt with are: gear nomenclature; high-speed pinions and flexible couplings; low-speed pinions and flexible drives; main thrust bearings; motor-driven turning gear; checking the bearing clearances of gears; and lubricating arrangements for turbine-gear drives.—*F. V. Smith, Marine Engineering and Shipping Review", Vol. L, No. 10, October, 1945, pp. 137-143.*

Simple v. Costly Complicated Machinery.

The construction of the single-screw cargo-passenger steamer "Tasso" for the Hull-Scandinavia service of Ellerman's Wilson Line, by Swan, Hunter and Wigham Richardson, Ltd., indicates that there is still a considerable scope for this type of vessel in certain trades. The "Tasso" is 295ft. in o.a. length, with a moulded breadth of 40ft., a moulded depth of 25ft. 3in., and a total d.w. capacity of 2,080 tons on a 17-ft. draught. The three cargo holds and 'tween decks have a total bale capacity of about 132,700 cu. ft., and the vessel is equipped with comfortable accommodation for 12 passengers in five double- and two single-berthed staterooms. The propelling machinery consists of a triple-expansion engine with cylinders, 19½, 32 and 54in. in diameter and a stroke of 36in., which operates in conjunction with a Bauer-Wach exhaust turbine. The total power developed is 1,900 i.h.p. (or about 1,700 s.h.p.) at 110 r.p.m. Steam at a pressure of 210lb./in.^{2} and superheat temperature of 600° F. is supplied by two coal-fired Scotch boilers working with Howden's system of forced draught. With such machinery a fuel consumption of 1·0 to 1·05lb./i.h.p.-hr. of good quality coal is expected, or 1·12lb./s.h.p.-hr. The fuel costs of a similar motorship using Diesel oil at three times the present-day price of coal would, therefore, be about the same. The first cost of the Diesel propelling machinery would, however, be about 20 per cent. higher than that of the steam installation. A ship engaged in voyages between Hull and Scandinavia spends at least half her time in port, whereas 20 per cent. of extra capital charges is continuous. Moreover, on this service, 30 tons of coal should be enough even allowing for emergencies, so that the bunkers need not take up much space.—*W. O. Horsnaill, "Shipping", Vol. XXXIV, No. 400, November, 1945, pp. 30 and 32.*

Stub Boiler Tubes.

The process of expanding boiler tubes into drums or headers must inevitably involve some molecular distortion of the material, and in the case of high-pressure boilers this is liable to cause trouble at the expanded joints. The writer of an article dealing with this problem which appeared in a recent issue of one of our engineering periodicals draws attention to the fact that in several new boiler installations the expanding of the superheater and economiser tube ends has been eliminated, and in some cases no expanded joints whatever have been employed. The method adopted is to fit what are termed stub tubes into the boiler drum or header, these tubes being only from 4 to 8in. long and usually thicker than the normal boiler tube. They are welded into position and then heat-treated together with the drum or header itself. The stub ends are suitably prepared for welding and the actual tubes are then welded to the stub ends by the oxy-acetylene process. The weld is sufficiently remote from the drum or header to enable local heat treatment to be carried out without affecting the structure of the previously heat-treated main weld of the steel tube to the drum or header. It is claimed that this method has proved highly satisfactory in practice.—*"Shipbuilding and Shipping Record", Vol. LXVI, No. 20, 15th November, 1945, pp. 467-468.*

Furnace Dampers.

The dampers of the furnaces of marine boilers are liable to warp when subjected to wide variations of temperature, added to which they are apt to burn away when exposed to great heat. A new form of furnace damper developed by a well-known British firm of steel manufacturers is claimed to be free from these drawbacks, because it is built up to any desired shape or size from units of special heat-resisting steel in the form of plates or blocks each provided with joints of a special type so designed as to permit some movement of the individual members without producing any change of shape when the damper is subjected to repeated heating and cooling, thereby eliminating any fouling of the damper guides. The actual grade of steel employed depends on the conditions to which the damper will be subjected, but temperatures of up to 2,000° F. can, it is claimed, be safely withstood. In the case of a boiler installed at a large forging plant and having furnaces fired with pulverised coal, a damper of this improved type fitted 4½ years ago and continuously exposed to the choking effects of dust and sinter, and temperatures of close on 1,500° F., has cost nothing for repairs and is still in serviceable condition.—*"Shipbuilding and Shipping Record", Vol. LXVI, No. 17, 25th October, 1945, p. 387.*

The Operation of Watertube Boilers at Sea.

The paper deals firstly with the reasons why there has been such a great increase in the percentage of steam-driven merchant ships equipped with watertube boilers operating under the Red Ensign during the war years. The author outlines the fundamental rules to be followed in operating this class of boiler successfully in service, special stress being laid on the importance of keeping the tubes clean on both sides of the heating surface. This includes methods of keeping the feed and boiler water pure and properly conditioned. The maintenance of air preheaters and economisers is likewise considered. The concluding portion of the paper deals with the operation of firing equipment—particularly oil-firing gear—together with questions of furnace maintenance.—*Paper by Major W. Gregson, M.Sc.(Eng.), "Transactions of the Institute of Marine Engineers", Vol. LVII, No. 9, October, 1945, pp. 101-103.*

Mechanical Stokers.

In a paper entitled "Mechanical Firing of Marine Boilers" which was recently read at a meeting of the Cardiff Branch of the Institute of Fuel by Mr. E. K. Regan, the author stated that the earliest successful experiments with mechanical stokers afloat were carried out in 1884, when the s.s. "City of Nevada", trading between Glasgow and New York, was equipped with sprinkler-type stokers. This experiment was abandoned on account of the difficulty experienced in providing motive power for the stokers and fans, electrical power not then being available. Mechanical stokers subsequently installed in several other vessels proved satisfactory, but had to be removed due to labour opposition. In recent years, a Dutch Company operating a fleet of oil-burning ships in the East Indies, equipped the original B. & W. boilers of some of these vessels with retort-type stokers, and subsequently the well-known "Beaver" class of C.P.R. cargo liners were likewise fitted with mechanical stokers. These ships were unfortunately sunk during the recent war. Mechanical firing was also adopted by the G.W., Southern and L.M.S. Railway Companies in some of the cross-Channel steamers, and the B.I. passenger and cargo liners "Amra" and "Aska" of the Calcutta-Rangoon service, as well as two 6,500-s.h.p. 16½-knot Japanese steamships were similarly equipped. As the result of the satisfactory performance of the B.I. vessels, the Government of Australia have included a number of stoker-fired coal-burning vessels in their shipbuilding programme. These ships will, it is stated, have turbines of 3,500 s.h.p. to give them a speed of 15 knots, and their watertube boilers will be equipped with rotary-type stokers. Although the installation of mechanical stokers in conjunction with Scotch marine boilers presents a more complicated problem, Manchester Liners Ltd. were reported to be very satisfied with the performance of the sprinkler stokers fitted to the cylindrical boilers of four of their vessels. The latter are ships of about 8,500 tons d.w., having a speed of 13½-14 knots. Whereas the average efficiency of a hand-fired Scotch boiler without air heaters is only 65 to 70 per cent., an efficiency of 77 per cent. can be attained by the use of mechanical firing. A ship with hand-firing burning 30 tons of coal per day, would reduce this consumption to something just over 25 tons per day with mechanical firing, so that in the course of a year of 240 days at sea, a saving of 1,100 tons of coal would be effected. Apart from the increased boiler efficiency obtained by the use of mechanical firing, stokehold conditions are improved, steadiness of steaming is ensured and a reduction in boiler-room personnel can be effected. As regards coal requirements, the maximum size of coal that can be dealt with by mechanical stokers is about 2½in., and many of the existing mechanically-fired vessels have been equipped with a coal-breaker to reduce the size of the coal to suitable limits. On the other hand, ships sailing from home ports have used sized coal, or a slack or small coal. Generally speaking, a mechanical stoker can handle a variety of types of coal, although coal with definite caking characteristics is hardly suitable. War-time experience has provided some interesting examples of stoker flexibility; for instance, a ship fitted with retort stokers designed for Indian coal successfully burned Yorkshire, South African and Welsh coals. It is not suggested that all varieties of coals give equally satisfactory results, but it appears that mechanical stokers are more flexible than was supposed. What may be termed the semi-mechanical firing of boilers under forced-draught conditions can be achieved by the use of the rocker bar grate, which not only discharges ash through the grate, but also gives a considerable agitating and breaking-up effect to the fuel bed. Constant opening of the furnace doors is thus eliminated. Unfortunately, firemen have not taken kindly to this appliance, and what is really needed is some simplified system permitting this type of grate to be operated mechanically as required, according to the type and grade of fuel used. In conclusion, the author pointed out that the installation of mechanical stokers may not necessarily open the door to the use of low-grade fuels, despite the claims made to that effect in some quarters; it is obviously to the advantage of the country that coal should be burned as efficiently as possible in all circumstances.—*"Fairplay", Vol. CLXV, No. 3,261, 8th November, 1945, pp. 695-696.*

Feed-water Testing.

The author's war service included 15 months as an engineering instructor in a New York City Board of Education's stationary training ship for E.R. ratings of the U.S. Coast Guard. During that time he taught hundreds of men to test feed water for hardness, alkalinity and salinity, using both the U.S. Navy and the ordinary commercial methods. The simple equipment required for that purpose comprises a Pyrex glass cylinder to measure up to 58·3 c.c.; three dropper bottles for the reaction agents; a 250-c.c. Pyrex testing flask; three 10-c.c. burettes; and one 8-oz. shaking bottle for testing hardness. The U.S. Navy standard test for alkalinity involves the addition of three drops of phenolphthalin to 50 c.c. of feed water, which is thereby caused to turn pink or red. The further addition of nitric acid, a drop at a time from a burette, restores the natural colour of the water. The number of drops of nitric acid required for this purpose multiplied by two is equivalent to the percentage of normal alkalinity. The salinity test consists of the addition of three drops of potassium chromate to 50 c.c. of the feed water (the same sample can be used) and a further addition of silver nitrate from a burette until the water turns pink. The number of drops of silver nitrate added multiplied by two is equivalent to the chloride (salt) content in grains per U.S. gallon. The commercial test for alkalinity consists of measuring out 58·3 c.c. of the feed water into the Pyrex test flask and adding two drops of phenolphthalin, the water turning red or pink according to the degree of alkalinity. Sulphuric acid is then added from a burette until the water becomes clear again. The number of drops of acid needed for this purpose, expressed in grains per U.S. gallon, is termed the "P" reading. The addition of two drops of methyl orange to this same water causes it to turn to a straw colour, the same burette being used to add sulphuric acid solution to the mixture until it turns to a light pink or orange shade. The total number of drops of acid used is the total alkalinity of the feed water in grains per U.S. gallon. The chloride (salt) test requires the addition of five drops of chromate of potassium to the same sample of feed water, causing it to turn from pink to yellow, whereupon silver nitrate is dropped in from a burette until the mixture turns from yellow to a permanent brick colour. The number of drops of silver nitrate solution required for this purpose represents the salinity in terms of grains of sodium chloride per U.S. gallon in the sample. The hardness test requires 58·3 c.c. of feed water to be measured out into the shaker bottle, with the addition of five drops of standard soap solution, which should produce a lather when the bottle is shaken; if not, five more drops are added before shaking again and so on until a lather is obtained which will stand up for five minutes. The amount of soap solution taken from the burette to form a lather, less the hardness factor 0·5, is the hardness of the feed water in grains per U.S. gallon. The author remarks that the addition of a little soap powder to make the water alkaline for the alkalinity tests, and of a little salt for the salinity tests, facilitates demonstration. The U.S. Navy Boiler Compound for the treatment of feed water consists of 47 per cent. anhydrous disodium phosphate, 44 per cent. soda ash and 9 per cent. corn starch, but the composition of the numerous commercial boiler compounds on the American market, ostensibly "secret", varies considerably. Some of these preparations are reported to contain 90 per cent. of water.—*W. A. Teare, "The Marine Engineer", Vol. 68, No. 819, October, 1945, pp. 559-560.*

The First Marine Gas Turbine.

A demonstration was recently given before a large number of U.S. shipbuilders and engineers of a 2,500-b.h.p. gas turbine plant

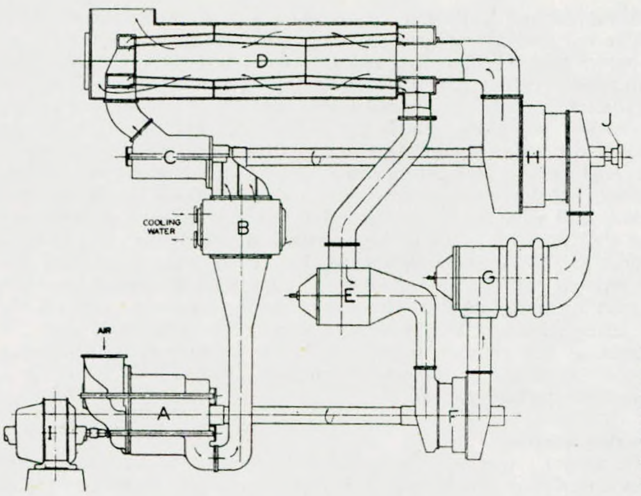


FIG. 3.—*Layout of the 2,500 h.p. turbine installation.*

A LOW PRESSURE COMPRESSOR
B INTERCOOLER
C HIGH PRESSURE COMPRESSOR
D REGENERATOR
E HIGH PRESSURE COMBUSTION CHAMBER
F HIGH PRESSURE TURBINE
G LOW PRESSURE COMBUSTION CHAMBER
H LOW PRESSURE TURBINE
I STARTING MOTOR
J OUTPUT SHAFT

built by the Elliott Co., Jeanette, Pa., for installation in a ship of the U.S. Navy. Two further turbines are under construction by the same firm, and with these, d.c. electric transmission will be employed, whilst a reversible v.p. propeller will be used with another set of turbines being built by the company for a cargo vessel of the Maritime Commission. The Elliott Co. built 1,300 Büchi exhaust-gas-driven turbo-chargers for 4-stroke Diesel engines during the war, and they are also makers, under licence, of Lysholm compressors; these two developments have given the firm the basis for the production of gas turbines. The Lysholm compressor is a positive displacement machine which, for each turn of the shaft, takes in and compresses a fixed volume of air independent of the back pressure imposed. Hence, over a very broad range the operating pressure can be independent of air quantity. This has the practical effect of allowing selection of a flow-pressure relationship exactly suited to the associated turbine. Consequently, a gas turbine plant employing such a compressor has a high degree of flexibility and part-load operation is very efficient. The demonstration plant consists of two turbines, two compressors with intercooling, two combustion chambers, and a regenerator. Fig. 2 shows the lay-out of this installation and Fig. 4 indicates the material used for the various component parts. The flow of gas in the unit begins at the L.P. compressor which takes in free air and compresses it to a pressure of 43lb./in.^{2} absolute and 300° F. The temperature of the air is lowered during its passage through the intercooler to the H.P. compressor, in which the pressure is raised to 96lb./in.^{2} abs. The air is then passed through the regenerator, where a portion of the heat in the exhaust gas is recovered before it enters the H.P. combustion chamber. Oil fuel is burned directly in the air stream of the H.P. combustion chamber, raising the temperature of the air to 1,230° F. at the inlet to the H.P. turbine, in which the heated air is expanded to 53lb./in.^{2} abs., sufficient power being developed by this process to drive the L.P. compressor. The air from the H.P. turbine exhaust is then reheated in the L.P. combustion chamber to raise its temperature to 1,207° F. before it is expanded in the L.P. turbine. The output of the L.P. turbine is 5,000 h.p., of which 2,500 h.p. is absorbed by the H.P. compressor drive, the remainder being the excess power available for driving the propeller. The air leaves the L.P. turbine at slightly above atmospheric pressure and passes into the regenerator, where it preheats the fresh compressed air from the H.P. compressor. The exhaust is discharged up the funnel to the atmosphere at a temperature of 400° F. The arrangement adopted in this installation of having the two compressors driven by separate turbines is not an essential feature of a gas turbine plant comprising two turbines and two compressors, but is considered desirable in this particular instance to meet the conditions under which the plant will be required to operate in service; these conditions call for a highly efficient part-load performance, which is attained in a gas turbine cycle by the provision of individual turbine drives for the compressors. The best efficiencies are obtained when the temperature of the compressed air is as high as possible before being put to work in the turbines, so that for maximum economy it is desirable to operate at reduced power by decreasing the supply of compressed air rather than by lowering the gas temperature. In this plant the components are arranged in such a manner as to allow the main power turbine to be operated at full temperature under all conditions of loading. Complete control of the plant is obtained by regulating the fuel flow to the turbine driving the L.P. compressor. As the amount of air which enters the system is controlled by this compressor, it is apparent that this one feature offers ease of control and, at the same time, ensures efficient operation of the main power turbine. The plant is started up by engaging the starting motor, lighting one burner and warming through, the time required for this purpose being slightly longer than with a steam turbine. From the time the fuel is first admitted to the combustion chamber, the process of warming through is merely one of inspection of the plant. The operator, having all the pressures and temperatures visibly indicated on the control panel, is able to regulate the rate of warming through by varying the position of the throttle lever. By the time the inlet temperature to the H.P. turbine has been slowly brought up to the point at which the starting motor can be stopped, the temperature in the L.P. turbine will also have gone up. The two by-pass valves are operated electrically by push-button control on the main panel, and at this stage these two units are energised in proper sequence, causing them to close and synchronize the plant. As these valves close, the speed of the L.P. turbine and H.P. compressor shaft rises from the 250 r.p.m. maintained throughout the warming-through period to about 900 r.p.m. The operator raises the starting-motor speed and increases the fuel combustion rate to compensate for the increased air flow. At just about this time the plant "floats" off the starting motor and is then able to develop useful power over and above that needed for running the compressors. The remaining burner in the H.P. combustion chamber is then ignited to increase the power developed, and a further increase in output is obtained by igniting the burner in the L.P. combustion chamber. With both burners in the H.P. chambers going at full rate and the L.P. chamber burner shut off, an output of 2,000 h.p. can be obtained, and for very light loads the unit can be run with only the one burner in the L.P. chamber in use. As soon as the starting motor is stopped, the power output obtained by regulating the controls becomes a function of the combustion rate and L.P. turbine speed. Changes in load level have little effect on the inlet temperatures to the turbines, any increase or reduction in power

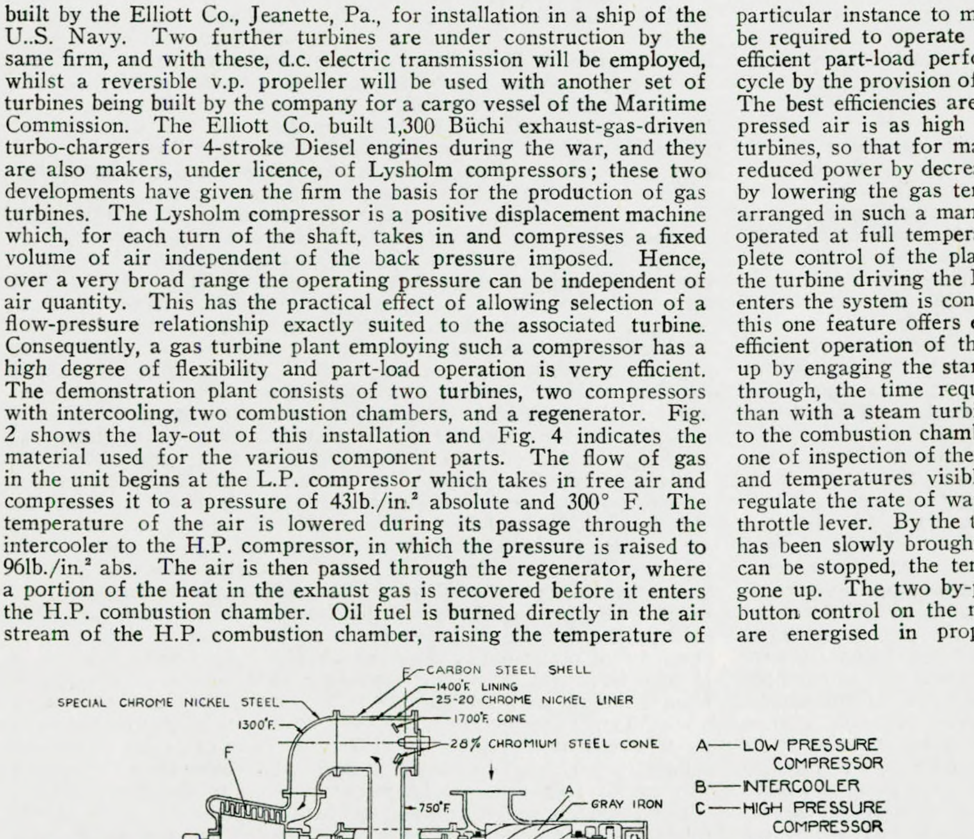


FIG. 4.—*Layout illustrating materials used in the various parts.*

output being obtained by varying the combustion rate. If the power is to be raised, the operator advances the throttle on all the burners until the inlet temperatures start to exceed the upper limits, producing an almost instantaneous effect on the entire unit. The excessive advance of the burner throttles gives a slight impetus to the system, the effects of which are cancelled out after a brief period of operation. The rise in temperature causes the speed to go up, thereby increasing the air flow, which tends in turn to reduce the temperature that brought about the original change of conditions. The momentary temperature variation is approximately 8·3 per cent. of the designed operating value. This small variation in temperature is of so short a duration that the actual heat level within the mass of the turbines remains practically unchanged and thus does not accelerate metal fatigue. The plant has an overall thermal efficiency of 29 per cent., but this could probably be raised to 31 per cent. by modification of details without any change of the basic conditions. The unit is designed to operate on high-grade oil, but the makers anticipate that the burning of lower-grade fuels and eventually Bunker C, will prove practicable. Some experience has already been gained in firing an experimental combustion chamber with No. 5 fuel oil, but the combustion was not quite so clear as with the lighter oil. The weight of the set amounts to 30lb./h.p. and it occupies a space of approximately 3½ cu. ft./h.p. It is expected that in the case of installations of higher power (up to 7,500 h.p.) it will be possible to reduce the size to 2 cu. ft./h.p. As regards production costs, gas turbines are not yet competitive with other types of prime mover, but they should ultimately cost less in sizes above 1,000 h.p. Two further units will be ready in six months. The full speed of the turbine is 2,750 r.p.m. and the idling speed 1,500 r.p.m.—*"The Motor Ship", Vol. XXVI, No. 309, October, 1945, pp. 218-222.*

The Aerodynamic Turbine Compared with Steam and Gas Turbines.

Unlike the steam turbine, the aerodynamic turbine operates with a pressure ratio between the first and last stages of about 4 instead of 700, so that no problems concerning the provision of small length blades at the inlet or large length blades at the outlet end of the turbine need arise. As compared with the open-circuit combustion gas turbine, the efficiency realised in the aerodynamic turbine is higher due to the increased density of the working medium employed in a closed circuit, making it possible to utilise a high degree of regeneration and intermediate cooling in an installation of relatively small dimensions. Whereas the maximum theoretical efficiency of a gas turbine is little more than 40 per cent., that of an aerodynamic turbine operating with the same initial gas temperature approaches 60 per cent. The maximum output of a single-shaft aerodynamic turbine working at a pressure of only 30 atmospheres (450lb./in.^{2}) and running at 3,000 r.p.m. is 100,000 kW., as against 12,000 kW. in the case of a comparable open-circuit gas turbine and 50,000 kW. in that of a steam turbine with cold cooling water. The use of pure air as a working medium in the aerodynamic turbine eliminates soiling of the blading and other internal working parts, and the higher density in the circuit permits the employment of smaller tubes in the heat exchangers, which can be made 16 times smaller than for an open-circuit gas turbine. The weight of the heat exchangers can actually be reduced to 2lb./kW. As the operation of an aerodynamic turbine is controlled by varying the circuit density of the working medium, the need for regulating valves, etc., on the unit itself is eliminated, together with the problems involved by the design of such fittings for operation at high temperatures and pressures. The specific fuel consumption at reduced loads increases to such a small extent as to make economical operation of an aerodynamic turbine at 10 per cent. load quite practicable, and as no pumps or other equipment for dealing with feed water and condensate are required and no provision for drainage or air extraction need be made, an aerodynamic turbine plant has fewer components than a steam turbine installation. The space required for a 15,000-s.h.p. marine aerodynamic turbine installation would be smaller than that needed for a Diesel-electric propulsion plant of equivalent power, as the whole power output could be obtained from a single unit instead of a number of engines, and as the fuel used would be boiler oil instead of Diesel fuel, there would also be a substantial saving in fuel costs.—*Dr. C. Keller, "Escher Wyss News: A Century of Turbines", Vol. XV/XVI, 1942/3, pp. 20-42.*

Coal Firing for Gas Turbines.

The possibility of employing coal as a fuel for combustion gas turbines is being considered in America, and emphasis is laid on the great economic advantages inherent in coal firing. These advantages are considered to be so great that it is said to be essential "to provide every incentive for developing coal-firing units with all available resources". In view of the abrasive action of fly ash and cinders contained in the flue gases of ordinary powdered-coal-burning plants, it is clear that any idea of applying orthodox pulverised-coal-firing methods to gas turbines must be ruled out. At the present time there are only two methods which hold promise of realisation, and these are now being investigated. In the one method, mechanical removal of the fly ash from the pulverised coal flame is aimed at by burning the coal dust in a combustion chamber of the Vortex type developed by the British Fuel Research Station, this combustion chamber being a combined cyclone type fly-ash eliminator. This device is now being investigated at John Hopkins University. The second proposed method involves the use of a "coal atomiser" representing a continuous explosion system in which crushed coal is subjected to the pressure of a gas such as air or steam. By allowing the coal to flow through a nozzle with the gas, the extremely sudden release of pressure causes the coal to shatter, thereby producing a pulverised product fine enough for direct firing. As the fuel supply to gas turbines must be made under pressure, this device appears to be particularly promising. It is now under investigation both at the Institute of Gas Technology and at John Hopkins University. In addition to this, the fundamental principles involved in the burning of coal under a pressure of about 60lb./in.^{2}, as required for gas turbine operation, are to be experimentally studied at the Battelle Memorial Institute. It is interesting to note that this ambitious research programme, from which the marine gas turbine builders expect to derive invaluable benefits, is financed by the Locomotive Development Committee with a view to adapting the gas turbine to coal-fired locomotives of up to 6,000-h.p.—*"The Shipping World", Vol. CXIII, No. 2,735, 14th November, 1945, pp. 511-512.*

Some Notes on Piston Rings.

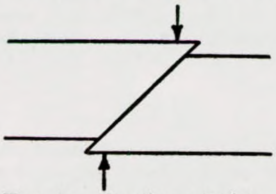


FIG. 1c.—*Butting of piston rings.*

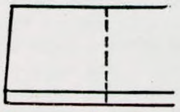


FIG. 1b.—*Proportions of scraping edge to total ring depth.*

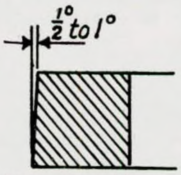


FIG. 1a.—*Tapering of piston ring faces.*

Although piston rings are perhaps the most important of all oil-engine components, they will work after a fashion with all kinds of imperfections—rounded edges, wall pressures from 2 to 80lb./in.^{2}, as tight as a disc valve or as leaky as a sieve, and of hard or soft material. Most other engine parts have to conform to a much closer specification. Some engine-builders of the present day accelerate the process of ring building by giving the ring face a taper of ½° to 1°, as shown in Fig. 1a. The wall pressure then theoretically starts at infinity, but the results appear to be satisfactory, no cases of ring seizure or rapid wear of cylinder liners having arisen from this cause. Cases of ring seizure have been known to occur, however, where the taper of the ring face has been increased to 1½°. Some interesting observations were made a short time ago on the critical wall pressure of a bevelled scraper ring on the C.I. piston of a two-stroke engine. Under normal conditions this engine was run at 500 r.p.m., the corresponding piston speed being 1,080ft./min. An engine of this type which had to work under conditions which involved running at 675 r.p.m. at fairly frequent intervals, however, gave trouble; there were numerous seizures, and proof of over-oiling. The liners were thereupon chrome hardened in an endeavour to eliminate the seizures, but the sole result was to transfer the seizing to the bevelled scraper ring, which had too narrow a scraping edge, more or less as shown in Fig. 1b. It was eventually found that the scraping edge could not safely be reduced below one-fifth of the ring face depth. If the normal wall pressure of a ring is 10 to 12lb./in.^{2}, and only one-fifth of the ring surface is used, the actual pressure becomes 50-60lb./in.^{2}. As the ring, in this instance, was a scraper ring, its edges were sharp. The only sure test for the butting of pressure rings is brightness at the points (Fig. 1c), but brightness at the butting surface can also occur with excessive butt clearance, and is then due to resonance instead of to butting. Generally speaking, butting is due to negligence. The top ring will butt with a closed ring clearance finer than 0·003in. per inch of diameter. Rings with rounded edges have frequently been tried and are still favoured by some makers, but such rings are far more prone to "blow past", producing accelerated wear and high oil consumption. Blow past and over-oiling always occur together, although over-oiling at high piston speeds—or even at speeds of 900 to 1,000ft./min.—may not be caused by faulty ring features, but by excessive viscosity of the oil. Cases of such over-oiling have been cured by merely reducing the viscosity of the oil to 55/60 sec.

Redwood at 200° F.—*"Gas and Oil Power", Vol. XL, No. 481, October, 1945, p. 338.*

Sulzer Oil Engine Developments.

Particulars have now reached this country of the most important developments in Diesel propelling machinery which have taken place at the works of Sulzer Bros., Winterthur, Switzerland. The normal non-supercharged large Sulzer marine 2-stroke engine has been more or less standardised, and as many parts as possible have been made interchangeable between different engine sizes. A supercharged opposed-piston 2-stroke engine for marine service has been on the test bed for some time. This engine has six horizontal cylinders 320 mm. in diameter with a double 400-mm. stroke. It is supercharged to 2 atm. abs., and with a b.m.e.p. of 156lb./in.^{2}, the unit develops 4,000 b.h.p. at 440 r.p.m., the two crankshafts being geared together for a propeller speed of 140 r.p.m. The fuel consumption is reported to be 0·351lb./b.h.p.-hr. The supercharging is effected by engine-driven piston-type pumps, whilst the exhaust-gas turbine is mechanically coupled to the main gear-wheel through a hydraulic coupling and is by-passed when reversing. The engine running unsupercharged astern develops about 65 per cent. of its ahead power. The complete unit is about as long as a double-acting engine of the same power and its width is about the same as that of a single-acting engine, but its height is much less than that of any other oil engine of equivalent power, being even lower than is probable with a high-speed geared installation. The total weight of the engine, including the gearing and thrust bearing, is only 40lb./b.h.p., although its design is very sturdy and robust. Other developments reported by Sulzer Bros. relate to improvements in the design of ultra-lightweight high-speed oil engines, free-piston power-gas units and gas turbines with combustion at constant pressure, including a gas turbine operating on a closed cycle and having a relatively high thermal efficiency. A complete marine gas turbine installation of about 7,000 s.h.p. constructed on this system is now nearing completion and will shortly be ready for shop trials.—*"The Motor Ship", Vol. XXVI, No. 310, November, 1945, p. 271.*

Diesel Propelling Engines.

In the course of his reply to the discussion which followed the presentation of Mr. C. C. Pounder's paper on the above subject at a meeting of the N.-E. Coast Institution of Engineers and Shipbuilders (for which he was awarded the Institution's Engineering Gold Medal), the author declared that although he had had the opportunity of examining many kinds of Diesel engine drive, he had not seen a geared drive which could be regarded as a sound commercial proposition. However, that did not mean that a sound scheme could not be devised. Among the vessels repaired at Belfast was a ship equipped with an 8,000-s.h.p. Diesel engine installation comprising four engines geared to a single shaft, with magnetic couplings between the engines and gearing. The gearing was cut by a firm of wide repute and the Diesel engines were also of reputable make. The installation had only been in service for two or three years at what one would have regarded as a reasonable rating, yet the entire set of gears had to be taken out of the ship and fully replaced; the engines had also to be de-rated. An experience of that kind could not be overlooked.—*"The Motor Ship", Vol. XXVI, No. 310, November, 1945, p. 283.*

Lubrication with Oil Mist.

Ordinary methods of lubrication are sometimes difficult to apply where high running speeds are involved, or where it is important to prevent grit from entering the bearings. To meet this situation, the Swedish S K F Company claim to have perfected a method of utilising a mixture of oil and air, instead of solid oil, which is made to pass through the bearings to be lubricated, and according to a recent report this system of lubrication has proved reliable and efficient in practice. The oil mist is produced in a special lubricator, in which compressed air vaporises the oil into an oil mist. The resulting mixture contains a large proportion of oil when it leaves the lubricator and is so constant in composition that it can be passed through long lengths of piping to the different points to be lubricated. In addition to obtaining efficient lubrication with a minimum quantity of oil, a certain excess pressure is produced in the bearings which prevents grit of all kinds from entering them. As an example of the advantage of this method of lubrication, its application to high-precision grinding machines is worth mentioning. Before its introduction, these machines had to be taken out of service after 300 to 400 working hours in order to renew the bearings, whilst the employment of oil-mist lubrication has allowed them to be run for about 7,000 hours with the same bearings, mainly owing to the elimination of the wear that used to be caused by the grinding dust. The consumption of lubricating oil was, at the same time, reduced by 90 per cent. as compared with the amount previously used when lubricating the bearings by the ordinary method.—*"The Power and Works Engineer", Vol. XL, No. 473, November, 1945, p. 266.*

Electrical Equipment of the "Queen Elizabeth".

The electrical installation of the 85,000-ton liner "Queen Elizabeth" resembles that of the "Queen Mary", but incorporates a number of improvements found desirable in the light of experience. With the exception of the turbo-driven feed pumps, all the auxiliaries in connection with the propelling machinery are electrically driven. The current for this purpose and also for the "hotel" services is supplied by four B.T.H. turbo-generators, each with a normal rating of 2,200 kW. at 225 volts, but with an overload capacity of 25 per cent. for two hours and 50 per cent. for five minutes. Under normal operating conditions, three sets are used, with the fourth in reserve. Each unit comprises a 12-stage turbine taking steam at a pressure of 390lb./in.^{2} and 730° F., and exhausting to its own condenser. The turbines drive the d.c. generators through reduction gearing, the normal running speed of the turbines being 4,500 r.p.m. and that of the generators 600 r.p.m. In addition to the main generators there are two 75-kW. Diesel-driven generators on one of the upper decks to provide light and power in case of emergency. The main generators supply current through four main feeder boards to 50 auxiliary switchboards which can be connected so as to form six ring mains which allow the P. and S. boards to be fed from either the port or starboard generator room. These auxiliary boards are so disposed that each W.T. compartment or fireproof section of the ship has its own board, thus avoiding as far as possible the piercing of bulkheads for the passage of cables from one section to another. About 4,000 miles of electric wiring have been built into the vessel. Six complete ring mains are connected to 60 feeder cables for the hotel services and 126 for the machinery services. About 30,000 electric lamps are fitted in the ship and approximately 650 electric motors ranging from ¼ to 250 h.p. and totalling about 20,000 h.p. The motor-driven deck machinery includes electric-hydraulic telemotor-controlled steering gear, an anchor windlass, gangway winches, a warping winch, capstans, boat hoists and six cargo winches incorporating a modified form of Ward-Leonard control. The 26 lifeboats can be lowered in a few seconds under the control of one man. In the main engine rooms, the condenser circulating pumps are driven by 250-h.p. motors, the main condensate extraction pumps by 55-h.p. motors and the forced-lubrication oil pumps for the main turbines by 33½-h.p. motors. The motor-driven oil-fuel pumps in the boiler rooms are equipped with dual field regulators to give a very fine speed control for the regulation of the oil-fuel pressure. The pump motors can be run at 375 speeds between the limits of 750 and 1,500 r.p.m. The 25-volt supply for the extensive low-tension system of the ship is furnished by motor-generators installed in duplicate supplemented by automatically-connected electric batteries for emergency use.—*"Electrical Review", Vol. CXXXVII, No. 3,547, 16th November, 1945, pp. 695-696.*

The All-welded Tanker "Phœnix".

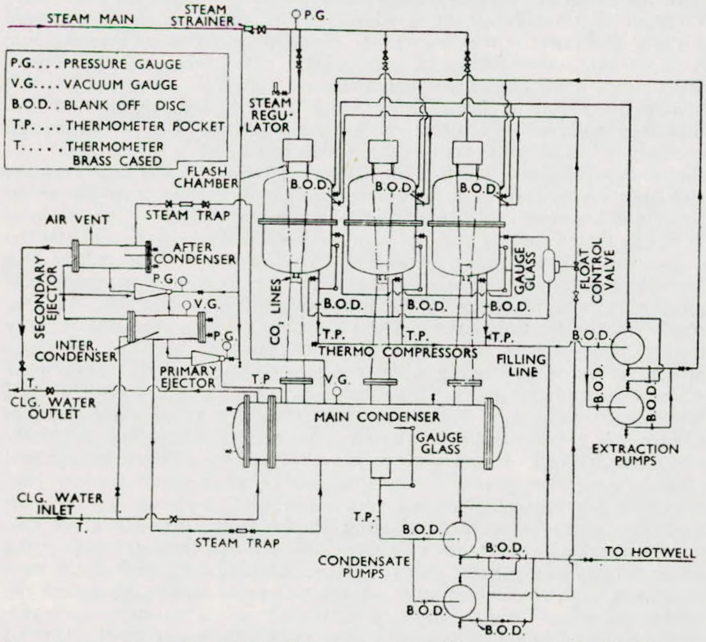
This paper, read at a meeting of the N.-E. Coast Institution of Engineers and Shipbuilders on the 16th November by Mr. W. A. Stewart, gives a brief account of the development, characteristics and design of the steam tanker "Phœnix", the largest capacity all-welded oil tanker ever constructed. She was built by Welding Shipyards Inc., at Norfolk, Virginia, where the firm have only one berth, about 600ft. long, and employ an average of 800 men. The ship is 541×80×40ft., and has a draught of 31ft. 4½in. at her full-load displacement of 29,270 tons. Her d.w. tonnage is 23,600 and the capacity of her 26 cargo oil tanks is 217,000 barrels. The propelling machinery consists of a set of H.P. and L.P. turbines driving a single propeller shaft through D.R. gearing and developing 13,200 s.h.p. at 105 r.p.m. of the propeller, corresponding to a speed of 17 knots. Steam at a pressure of 525lb./in.^{2} and superheat temperature of 750° F. is supplied by two oil-fired Foster Wheeler boilers. Large assemblies of 100 tons were prefabricated complete on the ground and lifted into position. Work proceeded from the E.R. bulkhead forward and aft simultaneously and the only welding that was done at the ship was the actual joining up of these assemblies.—*"Shipbuilding and Shipping Record", Vol. LXVI, No. 21, 22nd November, 1945, pp. 503-507.*

Replacement Programme of the P. & O. Group.

Before the war the fleet operated by the P. & O. Group of companies, amounting to over 200 ships and more than 1,760,000 gross tons, was the largest of any shipowning group in the world. According to the latest reports, the six companies forming this group now have 35 ships of 337,350 gross tons under construction or on order, of which 16 will be Doxford-engined motorships, nine will be turbine-driven, seven will have reciprocating steam engines with Bauer-Wach exhaust-steam turbines and three will have triple-expansion engines with superheat. The new vessels building or on order for the P. & O. Company itself comprise a 29,000-ton 22-knot passenger liner for the Australian service; a similar vessel of 23,000 gross tons for the China service; four 17-knot refrigerated cargo liners with accommodation for 12 passengers and carrying about 10,750 tons d.w., for the China service (two being single-screw turbine-driven vessels and the other two twin-screw motorships); and the single-screw, turbine-driven, refrigerated cargo liner "Perim" of 10,000 tons d.w. and 15½ knots speed. The 17 vessels which make up the B.I.S.N. Co.'s building programme include a twin-screw 16-knot turbine-driven ship of 10,000 gross tons, to carry 240 saloon and 1,400 deck passengers; two twin-screw motorships, each of 8,900 tons gross, with accommodation for 90 saloon and 1,450 deck passengers; and two single-screw, 14-knot motorships of about 5,000 gross tons, carrying 50 saloon and 1,000 deck passengers. The remaining 12 vessels are single-screw cargo liners, without passenger accommodation, four of them being motorships. The Orient Line has a 29,000-ton turbine-driven passenger liner on order. The New Zealand Shipping Co. and Federal S.N. Co. have between them six twin-screw refrigerated-cargo motorships on order. They will be 17-knot vessels of some 11,000 gross tons with about 500,000 cu. ft. of refrigerated cargo space and 240,000 cu. ft. of general cargo space. The Federal S.N. Co. also has four 10,000-ton twin-screw refrigerated-cargo turbine vessels under construction, to be named "Devon", "Somerset", "Huntingdon" and "Cumberland". They will have D.R. geared turbines and high-pressure Foster Wheeler boilers designed to give them a service speed of 15½ knots, and will each have 400,000 cu. ft. of refrigerated space and 150,000 cu. ft. of general cargo space. The Strick Line, Ltd. has placed orders for the construction of two single-screw cargo steamships of about 7,000 gross tons driven by triple-expansion engines and exhaust turbines. These vessels, to be named "Nigaristan" and "Tabaristan", will be sister ships of the "Afghanistan", already built for the same owners.—*"The Shipping World", Vol. CXIII, No. 2,735, 14th November, 1945, pp. 517 and 519.*

Foster Wheeler Vacuum Refrigeration Plant.

The refrigerating equipment of the new Royal Mail Lines' motorship "Drina" (*see abstract on p. 94 of* TRANSACTIONS, *October, 1945*) comprises a Foster Wheeler vacuum plant which operates in conjunction with the main CO_2 plant. The vacuum refrigeration plant is used to cool the liquid CO_2 leaving the condensers of the compression machines from 85° to 38° F. This cooling is effected by passing the liquid CO_2 through coils in the flash chambers which are exhausted by thermo-compressors. The evaporation of water sprayed over the coils removes heat from them, and the vapour formed is compressed into the condenser by the thermo-compressors. Steam from the main-engine exhaust-gas boilers is used to operate the vacuum refrigeration plant, and the latter relieves the CO_2 machinery of approximately one-third of the total refrigerating load. This arrangement allows smaller electric motors to be employed for driving the CO_2 compressors, a further economy being achieved by the use of correspondingly lighter electric supply cables. The accompanying flow chart of the vacuum plant shows its system of operation. The installation is made up of three flash chambers, three thermo-compressors, a surface condenser and a two-stage steam-jet air pump. Two extraction and two condensate pumps are provided, one being a spare in each case. The cooling water for the condenser is supplied by the main refrigerator sea-water pump. The cooled water is withdrawn from the bottom of each flash chamber by the extraction pump and returns to the chamber through sprays, which distribute the water over the CO_2 coils. As heat passes from the liquid CO_2 through the coils to this water, about ½ per cent. of the water is flashed off as vapour, thereby cooling the remainder. The vapour is compressed by the thermo-compressors and is condensed together with the steam which actuates the thermo-compressors. The condensate is withdrawn from the condenser by one of the condensate pumps and (with the exception of the make-up water to the flash chamber) is returned to the hotwell. The make-up water from the condensate discharge is admitted to the flash chamber through float-controlled valves. The air and non-condensible gases are extracted by the steam-jet air pump. —*"The Motor Ship", Vol. XXVI, No. 310, November, 1945, p. 265.*



Flow chart of Foster Wheeler vacuum refrigeration plant of m.v. "Drina".

Insulating Cargo Spaces.

A recently published British patent covers an improved method of insulating refrigerated cargo spaces in ships, by which it is claimed that the necessity of drilling holes for securing bolts or studs, welding or other metal working, is eliminated. It is also claimed that this method of insulation prevents the ingress of heat from the ship's frames, etc.; that the hull structure and fittings covered by the insulation are readily accessible for examination; and that air ducts can be secured behind the insulating sheathing in a simple and inexpensive manner. The insulation is in the form of blocks of insulating material secured to the ship's frame members by brackets bolted to the latter. The blocks carry rails to which the sheathing plating is attached, means being provided on the inner faces of the rails for registering the plates. The securing brackets are formed with a gripping portion shaped to correspond with the bulb or flange of the frame member to which the brackets are to be secured, whilst the inner end of each bracket is made with a flat surface to take an insulating block. Fig. 1 is an elevation of such a bracket attached to a bulb-section frame member; Fig. 2 is a plan of Fig. 1; Figs. 3 and 4 are similar views of Figs. 1 and 2, showing a similar bracket fitted to a channel frame member; Fig. 5 is a cross section to a large scale of a form of securing rail; Fig. 6 is a partial elevation showing the application of such rails to the insulating blocks mounted on the brackets illustrated in Figs. 3 and 4; Fig. 7 is a partial section of Fig. 6; and Fig. 8 is a sectional elevation showing the method of dealing with an air duct. Referring to Figs. 1 and 2 (*1*) is the bulb angle to which the insulating covering is to be applied. The gripping portion consists of a plate (*2*) bent in the form of an angular J in plan, the tail portion of the J being adapted to pass over the inner face of the bulb, and a second right-angled plate (*3*) which abuts against the plane face of the web of the frame member (*1*), the bracket and insulating block (*10*) being held in place by a bolt and nut (*4, 5*) fitted in holes and recesses provided for the purpose. As shown in Figs. 3 and 4, if the brackets are to be fitted to channel frame members (*6*), the attachments to these are in the form of two bent plates (*7, 8*), which grip the flange (*6a*) of the

FIG 1

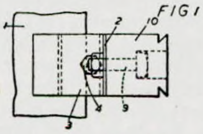


FIG.3

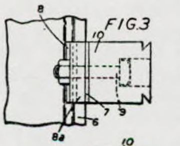


FIG 2

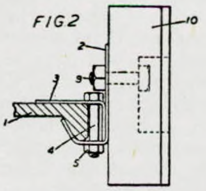


FIG.4

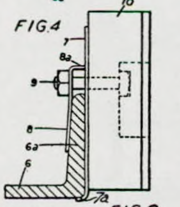


FIG.5

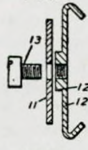


FIG.7

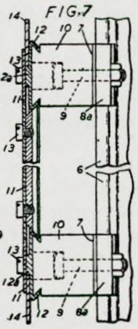


FIG 6

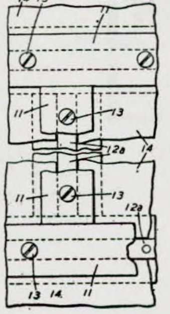
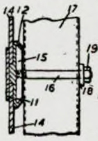


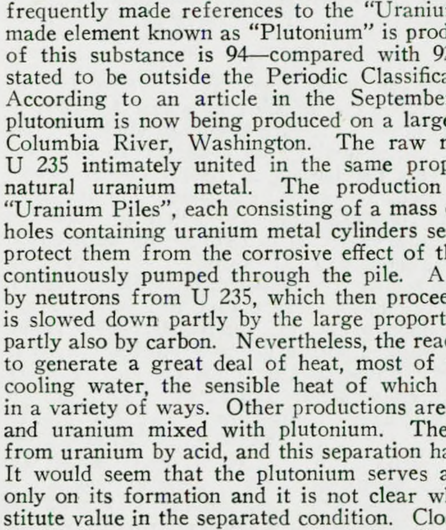
FIG 8



frame member and are drilled to take the securing bolt (9) of the bracket and insulating block, the head of the bolt being recessed in the latter. Referring to Fig. 5, the securing rails comprise a flat cover strip (*11*) and a back strip (*12*) of wide dove-tail section with a central ridge (*12a*) which serves as a register for the sheathing plates. The assembled rail section is attached in place by means of a screw (*13*). Referring to Figs. 6, 7 and 8, the brackets are first secured to the frame members in horizontal rows; the insulating blocks (*10*) are then mounted on the brackets—although they may have been fitted to these prior to the attachment of the brackets to the frame members, if desired—after which the securing rails (*11, 12*) are attached to the insulating blocks in the manner shown. The sheathing plates (*14*) are fitted in position with their lower edges inserted between the back and front strips (*12*) and (*11*) and resting on the ledge formed by the central ridge (*12a*). When the plates (*14*) are arranged in their correct positions, the front strip (*11*) is tightened up. The front rail strip of the second tier of insulating blocks is then loosely secured to the back in that tier and the procedure is repeated until the sheathing wall has been completed.—*"Modern Refrigeration", Vol. XLVIII, No. 572, November, 1945, p. 266.*

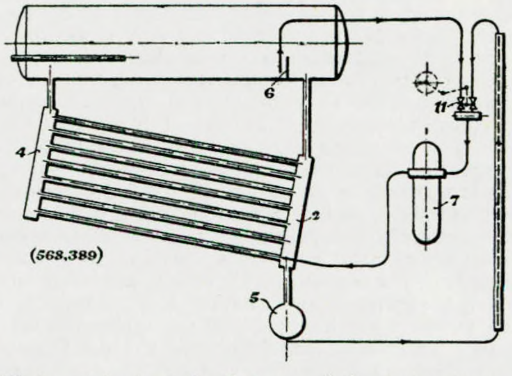
Atomic Energy.

Press articles dealing with the application of atomic energy have frequently made references to the "Uranium Pile", in which a man-made element known as "Plutonium" is produced. The atomic number of this substance is 94—compared with 92 for uranium—and it is stated to be outside the Periodic Classification of natural elements. According to an article in the September, 1945, issue of *Power,* plutonium is now being produced on a large scale at Hanford, on the Columbia River, Washington. The raw materials are U 238 with U 235 intimately united in the same proportions as they occur in natural uranium metal. The production units are several large "Uranium Piles", each consisting of a mass of graphite, provided with holes containing uranium metal cylinders sealed in aluminium cans to protect them from the corrosive effect of the cooling water which is continuously pumped through the pile. A chain reaction is started by neutrons from U 235, which then proceeds of its own accord, but is slowed down partly by the large proportion of U 238 present and partly also by carbon. Nevertheless, the reaction proceeds fast enough to generate a great deal of heat, most of which is absorbed by the cooling water, the sensible heat of which can obviously be utilised in a variety of ways. Other productions are hot air, radio-active rays, and uranium mixed with plutonium. The latter can be separated from uranium by acid, and this separation has to be made periodically. It would seem that the plutonium serves as a substitute for U 235 only on its formation and it is not clear whether it retains this substitute value in the separated condition. Close attention must be given to the design, size and control of the pile to ensure that the chain reaction shall proceed at an even rate. The actual size of the pile is apparently very considerable, as it is stated that its dimensions must be somewhat greater than are required for the chain reaction, which means "scores of tons of material". The accompanying diagrammatic representation of a section through such a pile taken from the *Power* article contains neither dimensions nor scale, but it conveys some idea of how the pile operates and of the kind of products it yields. The article summarises a few conclusions as follows: The release of atomic energy has been fully demonstrated; the energy thus released can be applied directly to produce hot water, or steam which can be converted by mechanical or electrical means into industrial use by conventional steam turbines or gas turbines.—*"The Power and Works Engineer", Vol. XL, No. 473, November, 1945, p. 266.*



Boiler-sludge Removal.

A new British patent covers an invention which aims at overcoming certain difficulties experienced in normal watertube boiler practice where the major part of the sludge precipitates in the top drum and, in passing downwards to the mud collector, has to pass the tubes opening into the header. Due to the high velocity of the water circulation there is a tendency for some of the sludge to be drawn into the tubes, from which it cannot be extracted by a circulation-type sludge remover. Referring to the accompanying diagram, the top drum of the boiler is connected with the water tubes by the back header (*2*) and the front header (*4*). A baffle (*6*) is fitted in the boiler drum to intercept the precipitated particles of sludge before they can reach the back header (*2*), although the conventional mud collector (*5*) is retained at the bottom of the latter to receive such particles as may get past the baffle (*6*). A circulation sludge remover (*7*) is provided to draw off the sludge accumulating in front of the baffle (*6*), the clear liquid from this sludge remover being returned to the back header at the inlet to one of the water tubes. The sludge remover also removes sludge from the mud collector (*5*), a two-way valve (*11*) being fitted to enable sludge to be withdrawn from the mud collector (*5*) or baffle (*6*) as required. This two-way valve can be controlled by a timing mechanism to effect the removal of sludge on a predetermined cycle.—*"Engineering", Vol. 160, No. 4,164, 2nd November, 1945, p. 364.*



Temperature and Tube Life.

An article in a recent issue of the *Copper Alloy Bulletin* of the Bridgeport Brass Company deals with the effect of temperature on the corrosion rate of ferrous and non-ferrous tubes. Although the rate of corrosion is generally increased by rising temperature, the effect of the latter may, in some cases, be to reduce corrosion. For example, with certain waters evaporation or an increase of temperature may cause the precipitation of various metals on the metal surface, this being frequently due to the decrease in solubility of some minerals in water with increase in temperature. In other words, when certain waters are heated, some minerals will deposit on the metal surfaces with which the water comes in contact. The most common scale found in heating coils consists essentially of calcium carbonate formed at elevated temperatures by the break-up of calcium bicarbonate. As the calcium carbonate that forms is much less soluble than the original calcium bicarbonate, it slowly precipitates, and over a period of time builds up a white, yellow, brown or grey coloured mineral scale on the metal surface. A common effect of this reaction is a considerable stifling of corrosion. Specimens of copper-base alloy tubes have been examined that were so well protected by carbonate or silicate scales ranging from 0·005 to 0·020in. in thickness that they had resisted corrosion for generations. Unfortunately, an excessively thick mineral scale on the inside of a heating coil or evaporator tube, etc., has a most deleterious effect on the heat transfer and may even cause tube failure due to rapid oxidation of the metal or actual burning. The formation of mineral scales is not confined to fresh water, but is met with in heat exchangers dealing with the evaporation of sea water as well as fresh water. Here evaporation leads to the concentration of mineral matter to a point where precipitation occurs, resulting in the formation of thick flint-like mineral scales on the heating coils. These deposits, which are usually grey to dark brown in colour, may form at rates as high as $\frac{1}{16}$in. per month or more, depending upon the size of coil and the amount of water being evaporated. Steam-heated copper coils are widely used for this purpose, and it is frequently necessary to de-scale them in service. If reduction in life of such coils occurs, this is due primarily to the mechanical or chemical means employed to remove the mineral scale. Sometimes severe local corrosion or pitting can rapidly perforate water-heater tubes on the water side because air bubbles separate from the water and cling to the metal surface at certain points, usually at scratches or sharp indentations, thus preventing the water from cooling these spots. The combination of high local temperatures, high concentration of corrosive agents separating where the bubble forms and the quantity of dissolved gas, accelerates corrosion at the point of bubble contact. Under such circumstances the rate of perforation of a heater tube increases considerably with an increase in tube-wall temperature. Deposits of foreign matter (rust, other types of scale, etc.) may also cause a local high temperature to develop under the deposit. Figs. 1a and 1b show the effects of gas bubbles and deposits in heat-exchanger tubes where the heat is moving from the outer to the inner surface of the tubes. Frequently both the bubbles of gas and deposits of foreign material will separate from the corrosive liquid, bringing about the condition shown in Fig. 1c. Corrosive cooling water passing through a metal tube with only a slightly corrosive hot liquid on the outside may fail prematurely. On the other hand, a tube of the same composition but with the hot liquid passing through the tube and the cooling water flowing around the outside will have a normal life. In this instance the rapidly flowing water prevents both the formation of bubbles of gas and the deposition of certain types of foreign material, as shown in Fig. 1d. In laboratory hot-wall tests, non-ferrous and ferrous tubes failed quite rapidly when exposed to 3 per cent. sodium chloride solutions. In service, such failures are sometimes met with on the liquid or water side of the tube. Water heaters with steam or flame on one side of the tube represent the type of equipment where pitting most commonly occurs because of the "hot-wall effect". A number of condenser tube alloys are available which are designed to resist dezincification, air impingement, pitting and general thinning. An example is Duronze IV (arsenical aluminium bronze), which has greatly increased the average tube life of ships' condensers. For conditions involving excessive impingement corrosion due to turbulence which cannot be corrected, 70-30 cupro-nickel has given very satisfactory results.—*"The Marine Engineer", Vol. 68, No. 820, November, 1945, pp. 623-624.*

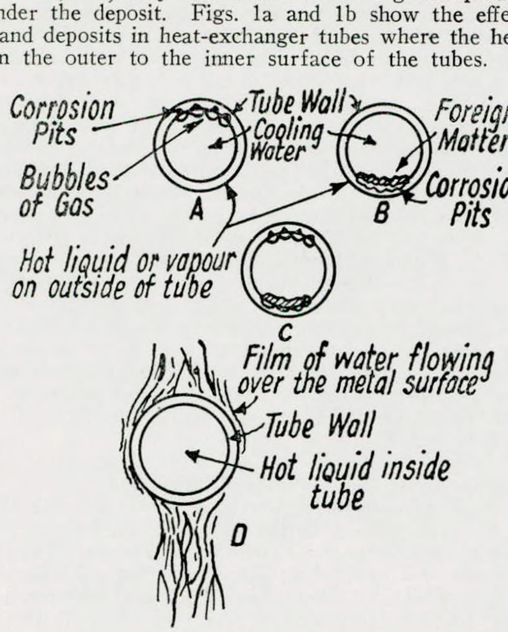


FIG. 1.

Unsuitability of Concrete Ships.

In a paper read at a meeting of the Institution of Naval Architects by Sir Amos L. Ayre, K.B.E. (late Director of Merchant Shipbuilding and Deputy Controller of Merchant Shipbuilding and Repairs at the Admiralty), the speaker referred to the many proposals made to him for the construction of concrete ships. The advocates of concrete ships appeared to be unaware of the fiasco which that method of building ships had proved in the last war, and claimed that a great advance in ferro-concrete technique had taken place since that time. Despite these claims, however, no real evidence could be produced to show that concrete hulls would effect a saving in steel per ton of deadweight or an improvement in the amount of deadweight relative to the displacement. One proposal was tried, and although great forbearance was shown in permitting a hull form helpful to the casting of concrete (regardless of resistance to propulsion considerations), the net result fell short of the claimed deadweight by some hundreds of tons and the general economics of the design showed no improvement on that attained during the previous war. Comparing the type with a steel ship of identical dimensions, it would have been necessary to construct about 15 ferro-concrete ships to provide the same d.w. capacity, driven at the same speed, as could be obtained with ten steel-built vessels. At that proportion, the total steel and iron content is about the same in both types in spite of the saving of steel in the hull structure alone when a comparison is made between one ship of each type. Fifty per cent. additional sets of propelling and auxiliary machinery, cargo-handling gear and other equipment would be required for the ferro-concrete ships, to say nothing of the operating disadvantages of the additional complements necessary to man the larger fleet. The decision not to put a large production programme of concrete ships in hand was, therefore, clearly justifiable.—*"Shipping", Vol. XXXIV, No. 400, November, 1945, p. 38.*

H.M.S. "Vanguard" Explosion.

The finding of the court of inquiry held at Dumbarton into the fatal explosion in H.M.S. "Vanguard" while in the fitting-out basin of John Brown & Co., Ltd., Clydebank, resulting in the death of three workmen, was to the effect that the cause of the accident could not be explained. Leakage of methane (marsh gas) was taking place through the ship's sea valves, which were watertight, but evidently not gastight. It was known that methane was generated in considerable quantities by the decomposition of organic matter at the bottom of the basin, and some of this gas was being trapped below the ship in the intakes of the sea valves, whence it penetrated into the interior of the ship. Although the leakage of the gas was very slow, it sufficed to build up an explosive concentration in a compartment where it was not free to diffuse. The available evidence pointed to the ignition of such an accumulation of methane. The order prohibiting smoking in the ship was sometimes disobeyed, but the explosion might equally well have been caused by a spark from a hammer or a hobnailed boot. The confined space in which the explosion occurred was ventilated by two fans, but no provision for exhausting the air from the compartment had been made. The gas was unlikely to manifest itself by smell.—*"Shipbuilding and Shipping Record", Vol. LXVI, No. 18, 1st November, 1945, p. 426.*

The Dutch Shipbuilding Position.

Reports from the Netherlands indicate that two of the country's 15 large shipyards were wrecked and ransacked by the Germans. The yards in question are those of the Rotterdam Dry Dock Co. and the Netherlands Shipbuilding Co., Amsterdam, but the latter has already been put in working order and is expected to begin construction shortly. The Schelde and the Wilton-Fijenoord yards are undamaged. Nine of these 15 shipyards are also makers of propelling machinery, able to produce B. and W., Werkspoor, Sulzer and M.A.N. Diesel engines. Apart from the shipbuilding firms, there are six large engineering works able to produce marine Diesel and steam engines. Among these are the Werkspoor works, Amsterdam, and the Stork Bros. works, Hengelo. In addition to these establishments, there are 30 smaller ones which can build coasters and small craft for inland service. A number of these yards are in a position to construct ships of up to 5,000 tons d.w. The Dutch yards are very eager to build ships for foreign owners, but no orders can be accepted without the approval of the Government on account of the pressing demands of the Dutch shipping industry. The country lost half its mercantile tonnage in the war, and a large proportion of the remaining half is obsolete, if not through age, on account of design, low speed and high fuel consumption. It is estimated that the replacement of lost and obsolete tonnage will involve new construction amounting to at least 1,750,000 gross tons.—*"The Motor Ship", Vol. XXVI, No. 310, November, 1945, p. 264.*

Modern German 16-knot Ships.

The cargo-passenger motorship "Empire Dee", 7,838 gross tons, now on her second voyage under the management of Wm. Thompson & Co., was formerly the "Neidenfels" of the Hansa Line. She was the last of eight similar vessels built for the company's service to India and was actually on her maiden voyage when the war broke out, although she contrived to get back to Germany, where she was later employed as a troop transport. The ship is the only one of her class now left afloat. The hull is of unusually heavy construction, the light displacement of the vessel being 5,885 tons for a cargo d.w. capacity of 10,375 tons. The total bale capacity of the five cargo holds, 'tween deck, poop and bridge deck spaces is 616,682 cu. ft., including refrigerated cargo space. The "Liberty" ships, which can carry about the same amount of cargo, have a light displacement of only about 3,500 tons. The "Empire Dee's" cargo-handling equipment comprises 21 motor-driven cargo winches. Excellent accommodation for 12 passengers is arranged on the forward boat deck, while the living quarters provided for the ship's officers and crew are unusually spacious and well equipped. The propelling machinery consists of two double-acting 6-cylr. M.A.N. two-stroke engines each designed to develop 3,800 b.h.p. at 210 r.p.m. and driving the single propeller shaft at 86 r.p.m. through Vulcan clutches and reduction gear. The service speed of the ship is 16 knots fully loaded and her fuel oil capacity of 1,383 tons gives her a cruising radius of fully

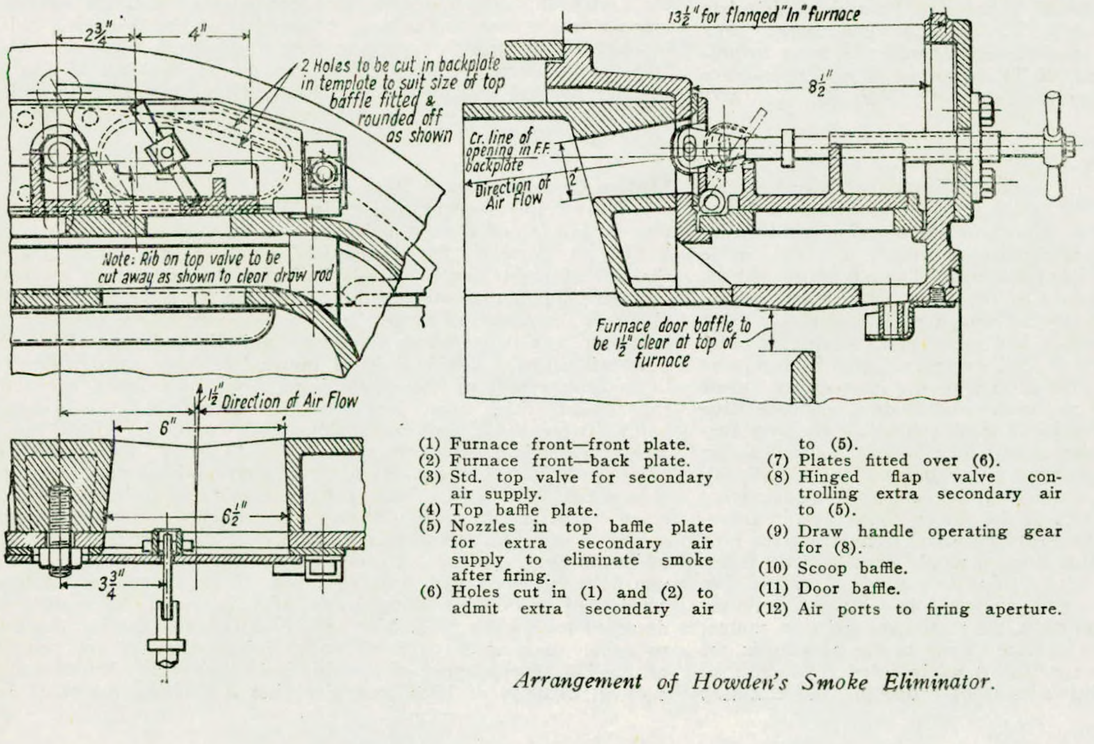
15,000 sea miles. The daily fuel consumption at full speed is stated to be 30 tons for all purposes. Electric current at 220 volts is supplied by three 150-kW. d.c. generators, each directly driven at 440/462 r.p.m. by a 7-cylr. four-stroke M.A.N. engine. Two of these engines also drive a compressor through a clutch. All the E.R. and deck auxiliaries are motor driven, no steam being used in the ship. The steering gear is all-electric and the wheelhouse control consists of two press buttons, no steering wheel being fitted.—*"The Motor Ship", Vol. XXVI, No. 310, November, 1945, pp. 256-264.*

Ships for the Netherlands East Indies.

By the end of this year 24 small motor tankers originally ordered by the British Government for service in the Dutch East Indies under war conditions, will be completed by three American shipyards for the Government of the Netherlands East Indies. The hulls of these tankers are all 230ft. in length b.p. with a beam of 39ft. and a draught of 13ft. 5½in. at a displacement of 2,560 tons. They are designed to carry 12,000 barrels of oil (1,600-1,800 tons). There is a small dry cargo hold forward, abaft which is the forward pump room. Five pairs of cargo oil tanks are provided, with a continuous centre-line bulkhead, and eight transverse bulkheads. The No. 5 tanks are separated from the after (main) pump room by a cofferdam. Mechanical ventilation is provided for all the living accommodation and working spaces, fan rooms being arranged above the midship and poop deck-houses. Three types of four-stroke Diesel engines of 850 b.h.p. are being installed for the propulsion of these tankers, *viz.,* Enterprise, Busch-Sulzer and Nordberg engines, all developing their rated power at 300 r.p.m. and all pressure-charged on the Büchi system. The Enterprise engines have six cylinders 16in. in diameter with a piston stroke of 20in.; the Busch-Sulzer engines have eight cylinders 13in. in diameter with a piston stroke of 20in.; and the Nordberg engines have six cylinders with a diameter of 16in. and a piston stroke of 22in. Each tanker will be equipped with two 150-kW. oil-engined dynamos which will supply the current for the motor-driven cargo oil pumps. The two main pumps, each of 170 tons/hr. capacity, are driven by 60-h.p. motors in the main engine room by shafts which pass through the bulkhead separating the latter from the after pump room. There are also two auxiliary cargo oil tanks with motors driving them in the same manner. It is stated that the lowest quotation for these tankers, exclusive of machinery, was about $589,000 (£147,500) per hull.—*"The Motor Ship", Vol. XXVI, No. 310, November, 1945, p. 277.*

Howden's Smoke Eliminator.

An outstanding contribution to the war effort by Jas. Howden & Co., Ltd., was the production of smoke-prevention apparatus for the boilers of coal-burning steamships running in convoy. The device, as shown in the accompanying sectional drawings, was fitted to Howden's standard furnace front, and consists mainly of two nozzles (*5*) through the top baffle plate controlled by a flap valve (*8*) worked by draw-handle and push-rod gear (*9*) which extends through the front plate of the furnace front. The door baffle was slightly modified and an air scoop was provided to direct additional secondary air to the top of the fire. Immediately after firing, the main nozzles are opened, considerably increasing the supply of secondary air, and thereby providing an effective means of eliminating smoke. The secondary-air supply above the firegrate is regulated by a slide valve (*3*), the air being admitted to the furnace through small holes in the top baffle (*4*) and corresponding side baffles. The admission of the extra air is controlled by observation of the smoke detectors fitted in the uptakes. With coal having a high volatile content it may also be necessary to reduce the supply of primary air by partial closing of the ashpit doors while the nozzles are in use, but special care must be taken to prevent overheating of the firebars as the result of such action. Although the smoke eliminators were sometimes misused by allowing them to pass too much secondary air into the furnace, thereby reducing the CO_2 and the efficiency, these devices proved most effective in reducing smoke.—*"The Marine Engineer", Vol. 68, No. 820, November, 1945, p. 588.*



(1) Furnace front—front plate.
(2) Furnace front—back plate.
(3) Std. top valve for secondary air supply.
(4) Top baffle plate.
(5) Nozzles in top baffle plate for extra secondary air supply to eliminate smoke after firing.
(6) Holes cut in (1) and (2) to admit extra secondary air to (5).
(7) Plates fitted over (6).
(8) Hinged flap valve controlling extra secondary air to (5).
(9) Draw handle operating gear for (8).
(10) Scoop baffle.
(11) Door baffle.
(12) Air ports to firing aperture.

Arrangement of Howden's Smoke Eliminator.

French Shipbuilding Orders in Great Britain.

Over 100,000 gross tons of merchant vessels for French owners are due to be completed by British shipyards in the course of next year. Among these ships are: I.—Cargo Vessels.—Two 7,500-ton steamships with D.R. geared turbines and two oil-fired watertube boilers, with a speed of 13 knots and daily fuel consumption of 24 tons building by Wm. Gray & Co., West Hartlepool; two identical vessels building by J. Readhead & Sons, South Shields; and a 7,000-ton motorship building by Bartran & Sons, Sunderland. II.—Passenger and Cargo Vessels.—Two 8,000-ton ships building by Swan-Hunter & Wigham Richardson, on the Tyne. III.—Colliers.—Two of 5,040 and two of 3,550 gross tons building by Smith's Dock Co., Stockton and South Bank; and one of 1,970 gross tons building by the Grangemouth Dockyard Co. IV.—Fishing Craft.—Six 300-ton steam trawlers building by Cook, Welton & Gemmell, Beverley; six identical trawlers building by J. Lewis & Co., Aberdeen; and one ocean-going trawler of 1,300 gross tons building by Hall, Russell & Co., Aberdeen. In addition to the vessels enumerated above, it is understood that orders for eight more have just been placed. These ships, two 5,000-ton passenger and cargo vessels, three cargo motorships of 5,400 tons d.w. and three turbine-driven cargo-passenger ships of 2,750 gross tons.—*"Journal de la Marine Marchande", Vol. 27, No. 1,349, 25th October, 1945, p. 1,023.*

Rudders of Ships Built in the U.S.A.

In a letter to the Editor, the writer points out that the type of rudder fitted to most of the ships built in America during the war, including the entire series of Liberty ships, is a slight modification of a design developed by his firm, the Balanced Reaction Rudder Co., Ltd. The idea of having a balanced rudder, curved in opposite directions above and below the axis of the propeller, is essentially a British invention, the design adopted for the Liberty ships differing only in a few constructional details from the standard British design which was being fitted to many vessels before the war. During the war the construction of such rudders was temporarily suspended in this country in favour of a simpler type of rudder suitable for prefabrication by non-shipbuilding firms. The writer claims that the reaction type of rudder is by far the most efficient form of streamline rudder for single-screw vessels, and that U.S. experience with hundreds of ships confirms this claim.—*J. Tutin, "The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,733, 8th November, 1945, p. 8.*

Büchi Overhung Rotor Turbine and Diffuser.

A recently published British patent secured by A. Büchi, of Winterthur, covers an improved design of overhung exhaust-gas turbine discharging through a diffuser. Referring to the accompanying sectional diagram (Fig. 1), the rotor (*1*) is provided with flat blades (*17*) and discharges the gas into the diffuser (*22*) at a lower pressure than that maintained at the exit of the latter. The blades are integral with the body of the rotor and have oblique surfaces, while their bases are curved so as to divert the interblade passages from a radial into an axial direction. The gas leaves the discharge edges (*20*) at a lower pressure and higher velocity than is registered at the outer end of the diffuser. The latter is formed as a rectilinear cone with an internal taper guide (*24*), which prevents the gas velocity from vanishing abruptly. For cooling the rotor there are blades (*28*) at the back through which air is admitted from a casing (*9*) via a passage (*30*). A seal (*33*) prevents the escape of gas from the back of the rotor. Four supply pipes (*10, 11, 12, 13*) form an arrangement of convolutions so that the outer diameter of the casing is reduced to a minimum. —*"The Oil Engine", Vol. XIII, No. 151, November, 1945, p. 192.*

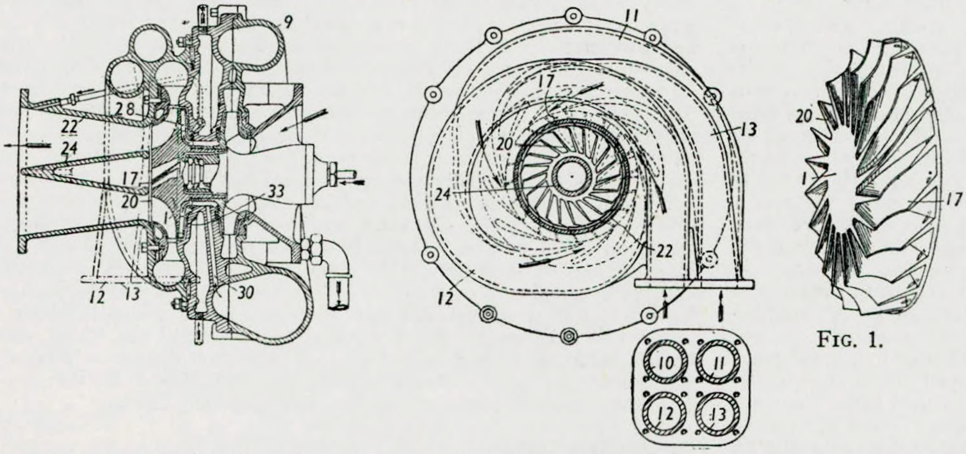
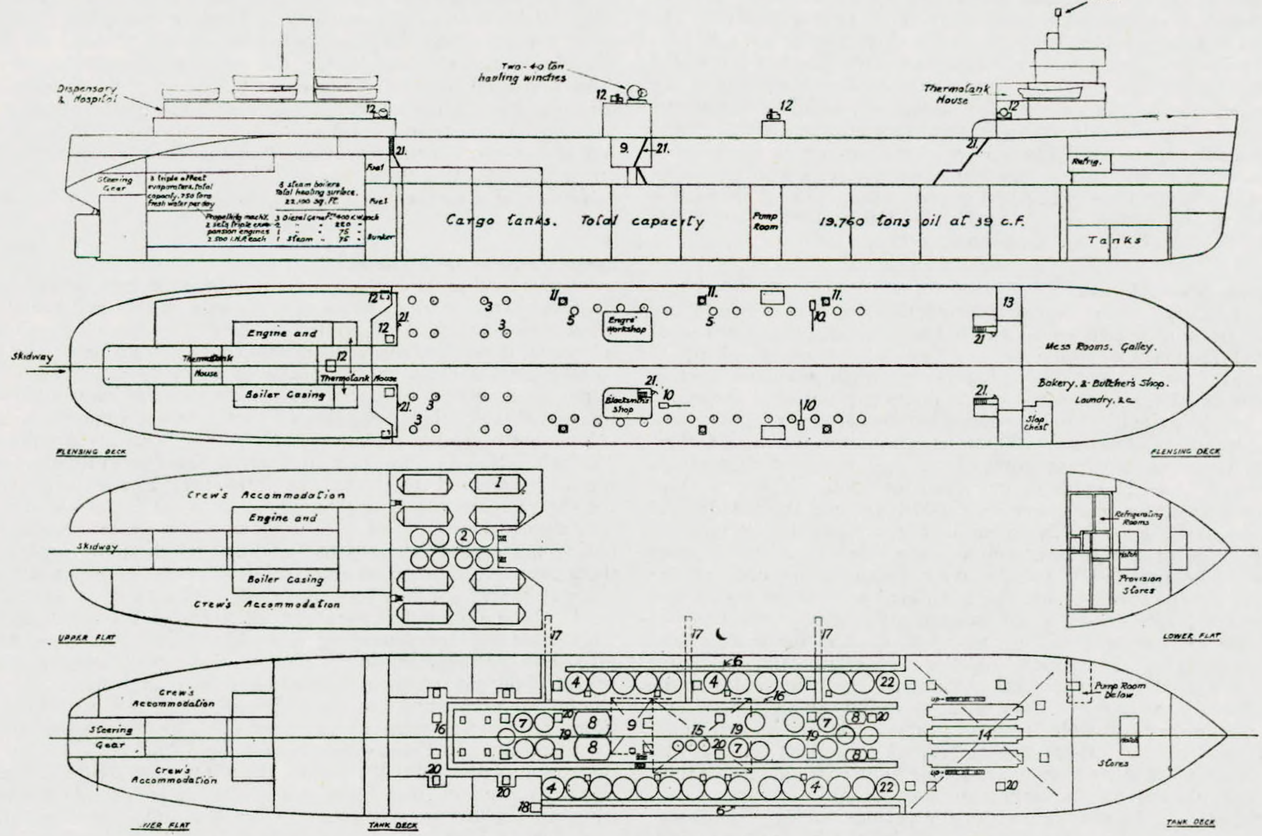


FIG. 1.

The Whaling Factory Ship "Southern Venturer".

The steam whaling factory ship "Southern Venturer", which recently completed her trials and sailed for the South Atlantic, was built by the Furness Shipbuilding Co., Ltd., for Chr. Salvesen and Co., Leith, in a remarkably short space of time; her keel was only laid on 28th June, 1944, she was launched on 10th June, 1945, and is already in service. The ship is 535ft. b.p., with a breadth of 74ft. and a moulded depth of 35ft., has a gross tonnage of 14,066 and carries over 20,000 tons of cargo on a mean loaded draught of 34ft. 6in. The propelling machinery consists of two sets of triple-expansion engines with cylinders of 24½in., 39in. and 70in. in diameter, with a stroke of 48in. and a total output of 5,000 i.h.p. Steam is supplied by eight oil-fired Scotch boilers. All the auxiliaries are motor driven, electric current being supplied by seven generators, of which one is a 75-kW. steam-driven unit, whilst the remainder, comprising one of 75 kW., two of 220 kW. and three of 400 kW., are driven by Diesel engines. There are 36 main cargo oil tanks with a total capacity of about 20,000 tons. One 25-ton and nine 10-ton derricks are provided for handling whale carcasses, etc. The meat processing plant has a capacity of 25 tons/hr., whilst the rack conveyors can handle 50-80 tons/hr. in 1-cwt. and 1½-cwt. bags. The ship should be able to deal with 24 blue whales every 24 hours—or with 1,200 per season. Excellent accommodation is provided for the crew of 108 officers and men, 160 factory workers



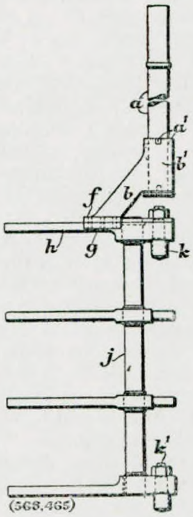
General arrangement drawings of the steam whaling factory ship "Southern Venturer".

Key: 1.—Eight rotary digestors; 2.—eight separators; 3.—filling hatches; 4.—25 pressure boilers; 5.—filling hatches; 6.—grax conveyor; 7.—oil receiving tanks; 8.—"Coastguard" separator; 9.—separator room with 9 purifiers; 10.—bone saw; 11.—capstans; 12.—winches; 13.—laboratory; 14.—meat treatment plant; 15.—liver oil plant; 16.—sack conveyor; 17.—bag elevators and conveyors; 18.—rotary strainer for glue water; 19.—whale oil pumping station. 20.—hatches to cargo tanks; 21.—factory entrance; 22.—trichlorethylene tanks.

and 134 members of the attendant whale-catchers' crews. The accompanying drawings show the general arrangement of the vessel.—*"The Syren", Vol. CXCVII, No. 2,568, 14th November, 1945, p. 227.*

Ship's Rudder Frame.

A recently published British patent covers an improved form of fabricated rudder frame which is claimed to be particularly suitable for merchant ships and tankers. Referring to the accompanying sketch, the rudder stock is in two parts, an upper forged-steel shaft (*a*) and a lower cast-steel member (*b*), the latter having a boss (b^1) which is shrunk on to the lower end of the shaft (*a*). A collar prevents the rudder from lifting and four equally spaced radial keys (a^1) cut from another solid collar forged on the shaft engage recesses in the top of the boss (b^1), thereby further ensuring a rigid connection between the two parts of the rudder head. The member (*b*) projects aft from its boss (b^1) and is formed with a coupling flange (*f*) of approximately rectangular section, which is bolted to a correspondingly-shaped flange (*g*) on the top rudder arm (*h*). The coupling flanges (*f*) and (*g*) are extended forward to take the top spigot of the main piece (*j*) of the rudder frame, and the top pintle (*k*). The spigot and the pintle (*k*) relieve the coupling bolts of all shearing stress and facilitate rapid assembly of the shaft (*a*) and the main piece (*j*). In accordance with standard practice, the main piece (*j*) is provided at intervals with collars for the top rudder arm (*h*), two intermediate rudder arms, and a bottom rudder arm of cast or forged steel, the arms being shrunk on to the collars. The bottom arm is also extended forward and is drilled to provide a bearing for the bottom pintle (k^1) in alignment with the top pintle (*k*) and the shaft (*a*). The rudder plating is attached to the arms in the usual manner. It is claimed that this design of weldless fabricated rudder shows a considerable saving in steel as compared with rudders of conventional forms. All the rudder parts can be easily handled and machined independently at the same time, thus effecting a substantial saving in the time required for production. The construction is adaptable to any size of single- or double-plate rudder.—*"Engineering", Vol. 160, No. 4,165, 9th November, 1945, p. 388.*



Express Cargo Motor Liners.

Post-war cargo liners under construction in British yards are mainly vessels with speeds of 15 to 16 knots, although a number of refrigerated motorships which are to have a service speed of 17 knots are also on order. The advantages which may, on certain routes, be claimed for high-speed cargo liners are not only economic, but also psychological. The Swedish shipowners who have now ordered a series of 20-knot, 9,000-ton cargo motor liners for their service to Australia, have for some years past operated motorships with speeds of up to 16 knots or more on this route. The new ships are to have twin-screw machinery of 15,000 b.h.p. and their daily fuel consumption at 20 knots fully laden is expected to be 60 tons, or practically twice as much as a similar vessel operating at 16 knots would use. The fuel bill is usually from 15 to 25 per cent. of the total annual expenditure, so that the additional percentage outlay per annum for the faster vessel is not exceptionally high, since many of the other charges are only slightly modified, even if the interest and depreciation charges in respect of the propelling and auxiliary machinery are doubled. The total amount of fuel required for the 12,000-13,000-mile voyage to Australia is round about 1,500 tons, which is not an unreasonable quantity for a 9,000-ton motorship to carry; in point of fact, there are vessels of this class with a fuel capacity of over 2,000 tons in their double bottoms and deep tanks. It is not unlikely that an increasing number of 20-knot cargo liners will be built during the next few years for various trades. The faster the ship the greater the advantage gained by the oil engine: first, because with the considerably higher fuel consumption of the steamship the saving in the annual expenditure with the motorship is greater, and secondly, since even the most efficient oil-burning steamship requires 50 per cent. more fuel than the motorship, there is a big saving in the weight of fuel carried with the latter. In other words, the oil-burning steamship must, throughout its whole life, transport a considerably larger amount of non-paying load.—*"The Motor Ship", Vol. XXVI, No. 310, November, 1945, p. 250.*

War Work on the North-East Coast.

The N.-E. Coast area war production in shipbuilding, engineering and armaments included a number of capital ships, aircraft carriers, cruisers and other vessels for the Royal Navy, in addition to large numbers of small craft of special designs. Among the types which were originated or, to a large extent, developed in that area, were cargo liners, fast tankers, merchant aircraft carriers, frigates and corvettes. The N.-E. Coast also set the pace in the application of geared turbines and watertube boilers to cargo liners and fast tankers. During the war period from September 3rd, 1939, to August 31st, 1945, N.-E. Coast shipyards constructed altogether 548 merchant vessels of various types, with a total tonnage of 3,100,630 gross tons. These ships included 26 passenger and cargo liners, 17 refrigerated-cargo liners and partially refrigerated cargo tramps, 84 oil tankers, 282 cargo tramps, 32 colliers and 30 coastal tankers and coasters. Of the above vessels, 371 were equipped with reciprocating steam engines of 755,430 service i.h.p.; 20 ships were fitted with geared turbines of 147,800 s.h.p.; and 157 vessels were equipped with heavy-oil engines developing a total of 410,324 b.h.p. Of the merchant ships built on the N.-E. Coast, 258 were coal-burning steamships, 264 were oil-fired steamships or motor vessels, and 26 were steamships with boilers arranged to burn either coal or oil.—*Presidential Address by Sir Summers Hunter delivered before the N.-E. Coast Institution of Engineers and Shipbuilders on the 19th October, 1945.*

German Ship Design.

The design of the German merchant vessels which are now being surrendered to the British authorities and placed under the management of British shipping companies for operation, is being examined very carefully, particularly where the ships concerned have been completed since the outbreak of war. The general opinion is that British designers have little, if anything, to learn from the Germans, who have made less progress since the outbreak of war than we have. Some of the material used in their ships is of a low-grade quality which British surveyors would be unlikely to pass, but that was probably the result of the Nazi policy of giving priority to munitions. The living accommodation for the crew is admittedly very roomy, light and well ventilated, excellently laid out for convenience and comfort, but furnished and fitted with even greater austerity than has been necessary in British ships during the war. Most of the deck and engine-room fittings are considered to be inferior, although many are interesting and ingenious..—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,739, 15th November, 1945, p. 6.*

Large Castings in Sections.

Considerable difficulty has frequently been experienced in the delivery of large steel castings to shipyards in this country due to the limitations in respect of width and height imposed by rail and road transport, these difficulties being especially applicable to the stem and stern frames and the rudder frame castings of large liners and warships. One method of overcoming this problem, which has proved highly successful in the U.S., consists of casting these items in sections and subsequently joining them together by the Thermit welding process. Thermit, which is a mixture of finely divided metallic aluminium and specially prepared iron oxide, has now been in use for several years for the rapid repair of broken stem and stern frames *in situ*, but has not hitherto been applied to new work. The process consists of preparing the various sections to be joined by chipping them, anchoring them securely in their correct relative positions to ensure accurate alignment, and pouring wax into the joints to form a pattern for the weld. Moulding boxes are then built round the latter and packed with moulding sand, pouring and vent holes being provided in the usual way. Preheating in the vicinity of the weld and the preparation of the Thermit mixture is the next step, and when the required amount of preheating has been effected, the Thermit powder is fired. Chemical reaction takes place 20 seconds after firing, the temperature of the mixture in the crucible then being 5,400° F. The hot metal is thereupon poured into the mould, the aluminium oxide in the mixture being given off in smoke and slag, while the iron oxide forms a metal equal in texture to cast steel. After the weld has been allowed to cool for 10-12 hours, the moulding boxes are removed, the gates burned off and the weld cleaned up. The welded sections, now forming a single casting, can then be removed for machining and boring.—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,745, 22nd November, 1945, p. 6.*