TWIN-SCREW MOTOR SHIP "MONTE PENEDO."

THE first German-built motor-driven ship, *Monte Penedo*, was given a special trial-trip from Hamburg to Cuxhaven and back on August 24th last, when a number of people interested in the subject were invited by the engine-builders to be present. This vessel has been built by the Howaldtswerke at Kiel, to the order of the Hamburg-Südamerikanische Dampschiffahrts Gesellschaft, and the propelling and other machinery has been manufactured and installed by Messrs. Sulzer Bros., of Winterthur, Switzerland.

The *Monte Penedo* is a vessel of 4,000 tons gross register, and 6,500 deadweight, and has a length of 350 feet, a beam of 50 feet, and a depth of 27 feet. The vessel, as she appears in the water, is illustrated in Figure I., while Figure II. illustrates the general arrangement of the cargo holds and the disposition of the machinery and oil-bunkers. Through the courtesy of Messrs. Sulzer Bros., we are enabled to give some interesting views of the engines, which consist of two sets of four-cylinder reversible two-cycle Diesel-Sulzer engines. This installation represents the first ocean-going two-stroke Diesel-system constructed. The cylinder diameter is 18·5 ins., and the stroke is 26·8 ins., and at 160 revolutions per minute each set develops 850 brake horse-power.

The general arrangement of the engines is illustrated in Figure III., which is a plan, and in Figure IV., which is a perspective view taken from the starting platform. The general construction of each cylinder and water casings is clearly shown in sectional elevation in Figure V., while Figure VI. is a similar view of the scavenging and air-compressing pumps, which are driven direct from a fifth crank at the forward end of the crank-shaft. Figure VII. represents a view of the upper part of the valve-gear of the main engines. The bed plates are cast in three parts and are of similar design to that of the ordinary marine steam engine. The cylinder covers are connected directly to the bed plates by steel columns, so that the explosive stresses are transmitted thereby directly to the bed plates, thus leaving the cylinder bodies free from axial tensile stresses and capable of expanding from the cover in a downward direction. This is very necessary for two-cycle engines where the scavenging takes place through openings in the cylinder walls. Besides these vertical steel columns cast-iron columns are provided to take the transverse stresses and to provide guide surfaces for the crosshead shoes. The crossheads are provided with single-type guide shoes working on plates bolted to the columns. The shoes are lined on their head and astern surfaces with white metal, the guide plates being adjustable and water-cooled. The engines are enclosed by planished steel-plate doors through which there is ample space for inspection and overhaul. Forced lubrication is provided for all working parts, the oil being cooled and filtered before being used a second time. A special pump is fitted for the cylinder lubrication, the oil passing to the pump through a sight-feed.

The working pistons are water-cooled, the water being led through telescopic pipes without any stuffing boxes, so as to enter the piston head in the form of a free jet; this arrangement is clearly shown in Fig. V.

The cranks are set at 90 deg., and the scavenging pump crank is set at an angle relative to the working cranks to give the best working results. The scavenging pumps are controlled by a piston valve driven from the crankshaft through a Stephenson's link motion. The compressor pumps are of the three-stage type for the supply of air at 955 lbs. per sq. in., used for injecting fuel and the starting and reversing operations. The first stage serves as the crosshead of the scavenging pump, and the remaining two stages are driven from the crosshead through a system of balance-levers. All three stages are water-cooled, and intermediate coolers are also provided, so that throughout the whole process of compression the air can be kept down to a suitable temperature, while automatic valves are provided, so that no special reversing gear is required.

The scavenging air enters the cylinders through two horizontal rows of openings in the cylinder walls; the lower row being controlled by the piston alone, while the upper row is controlled by the scavenging valves and is eventually covered by the piston. By means of this upper row, air to any desired quantity may be introduced into the cylinder after the piston has closed the ordinary scavenging openings. The exhaust openings are arranged on the opposite side, also in the cylinder walls. The exhaust gases enter a water-cooled exhaust pipe leading to a silencer, from which they escape freely into the atmosphere. This method of scavenging gives not only excellent results in working, but from the point of view of simplicity of design and safety is a decided advance on other existing methods, for should a scavenging valve fail it is impossible for a charge to escape into the exhaust pipe. The cylinder covers are very materially simplified, compared with the usual construction, and are free from the otherwise customary multiplicity of valves and gear, and, in consequence of this particular design, there are only the fuel and starting valves mounted on the covers. As a further result, the reversing gear is thereby much simplified and easier to operate.

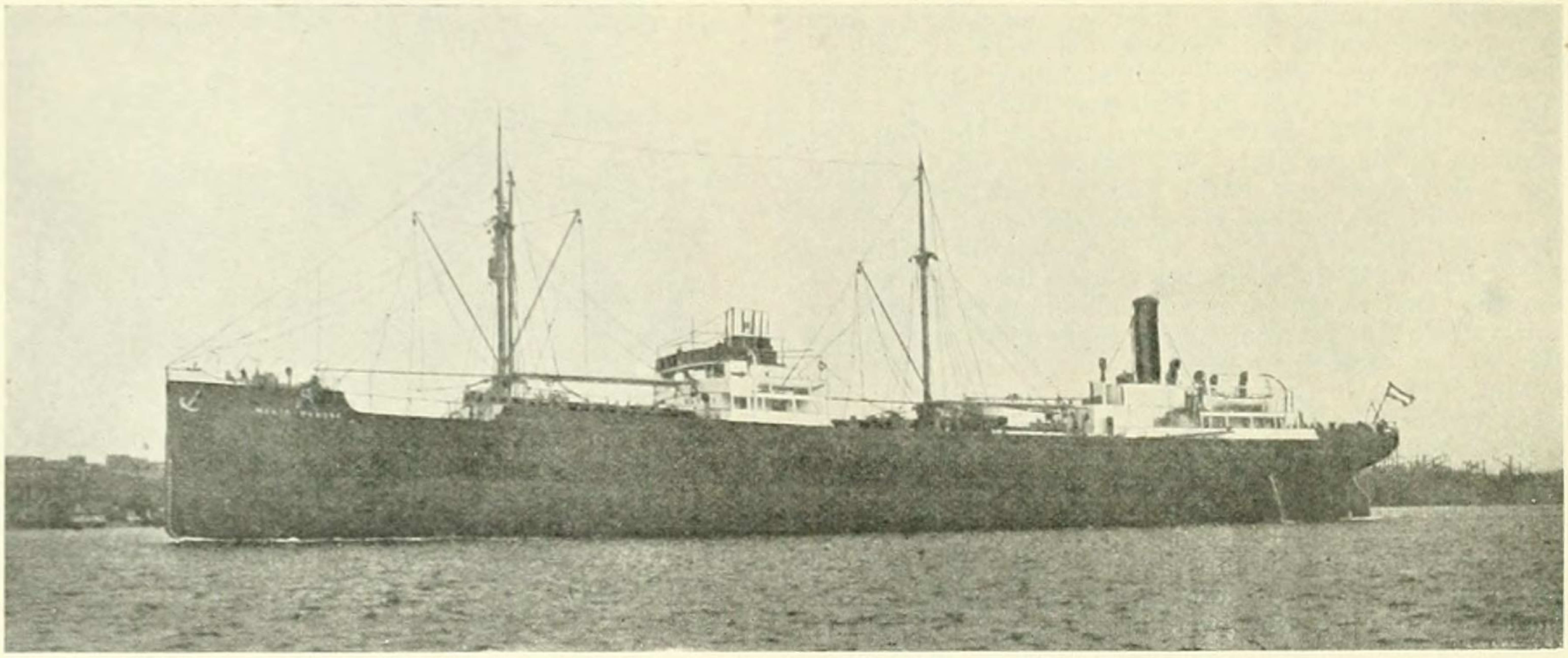

Fig. 1.—The Motor Ship *Monte Penedo*.

The manœuvring gear consists of two mechanisms, each driven by a compressed air engine through a worm-drive. One engine serves to rotate the camshaft through the desired angle relative to the crankshaft, and to put over the scavenging pump excentric rods into the required position for ahead and astern running; the other serves to operate the fuel and starting air valve gear for starting up, running or stopping. Manœuvring may also be performed by hand, so that in the

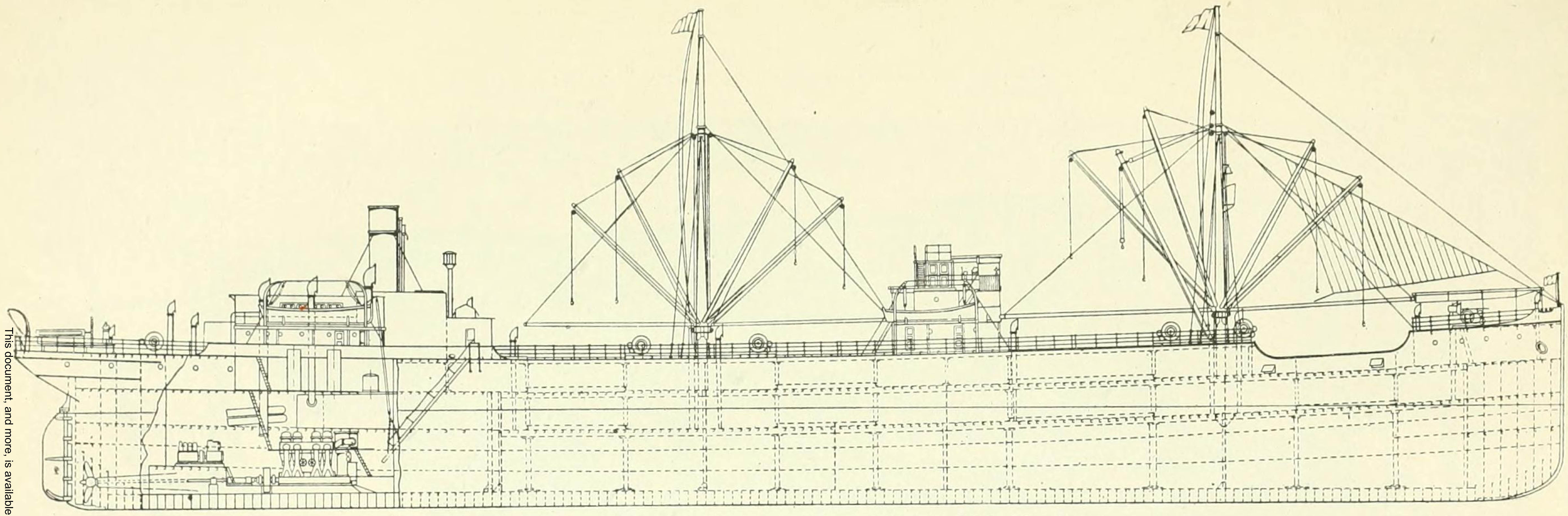

Fig. 2. General arrangement of Cargo Holds and Machinery.

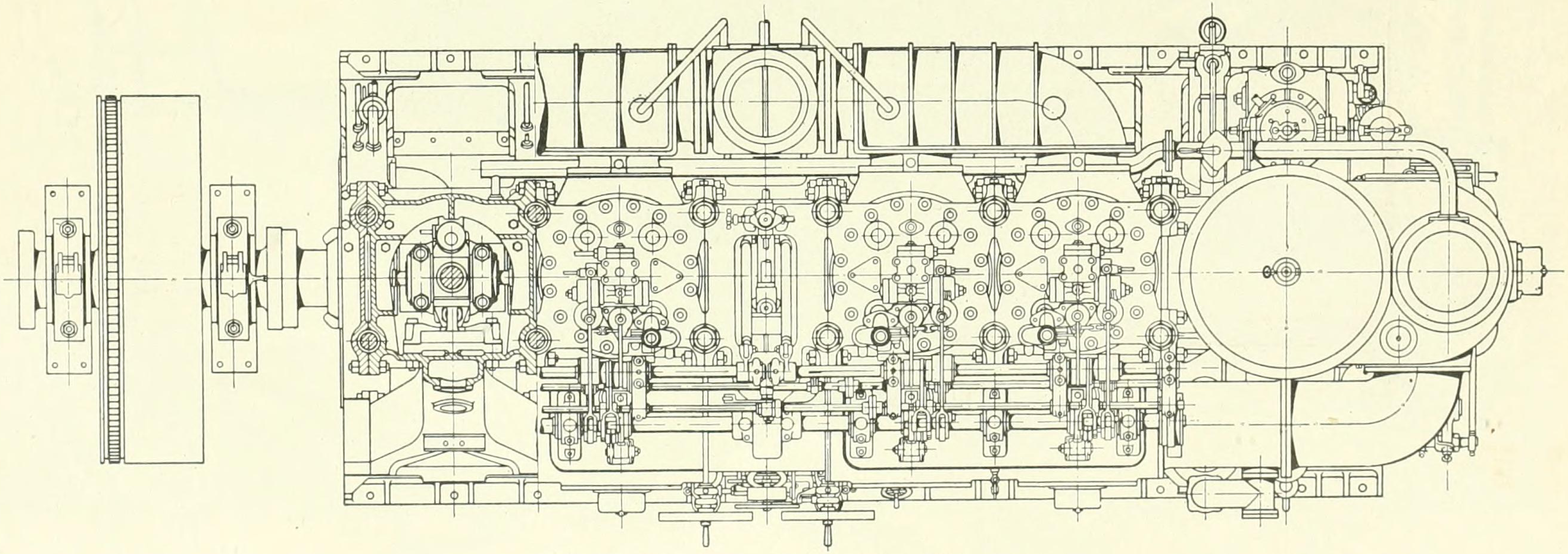

Fig. 3. Plan of general arrangement of Engines.

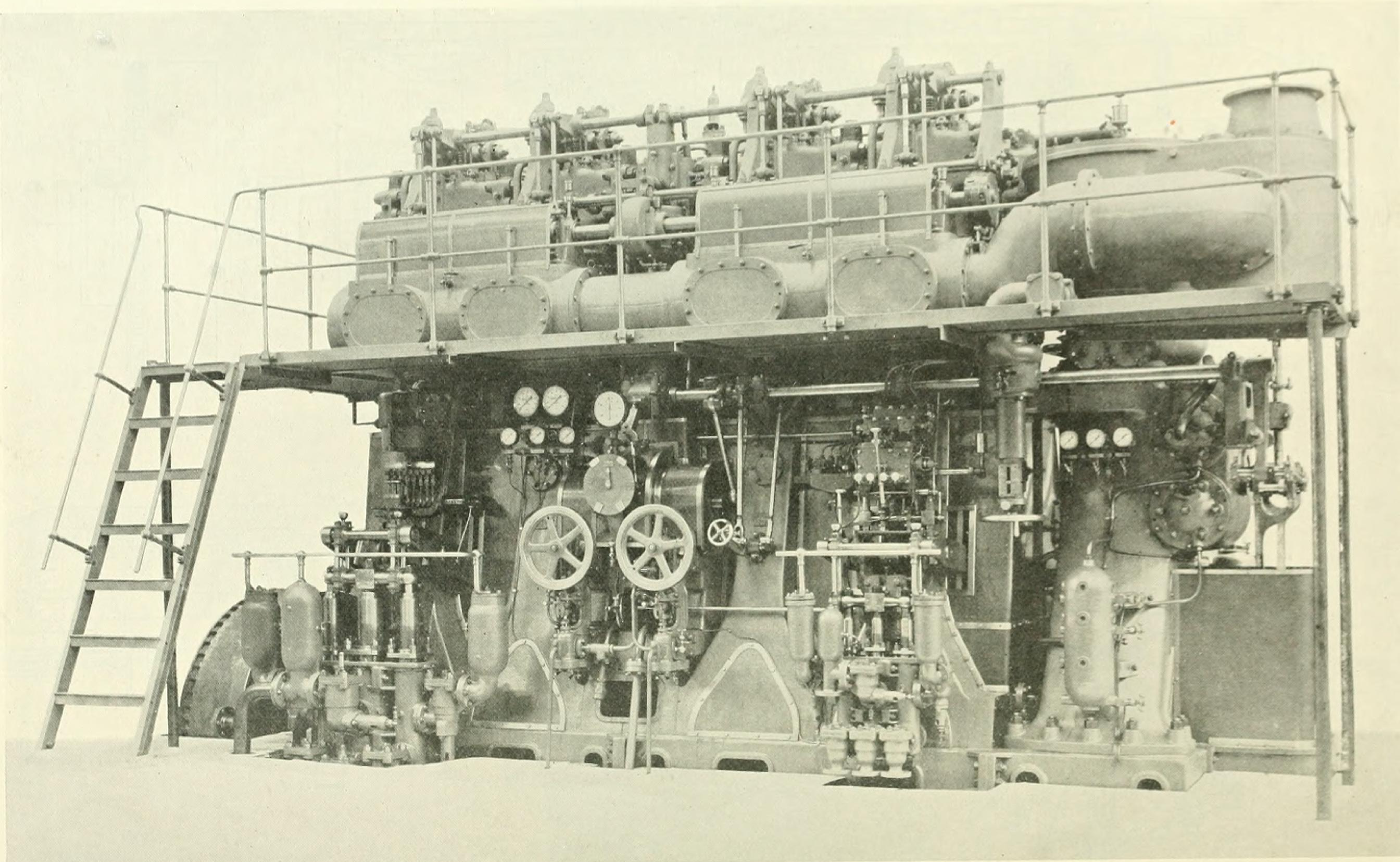

Fig. 4. View of Main Engines from starting platform.

event of the manœuvring engines failing through any cause, no time need be lost in carrying out the orders. As may be seen from Fig. IV., these manœuvring engines are placed centrally on the front of the main engines, and so near to one another that if need be one engineer can manœuvre both main engines. A governor is fitted which, on the slightest increase above the maximum speed, operates directly on the fuel pump.

The pumps for the various services are driven by means of balance-levers from the crossheads of both No. 1 and No. 4 engines, and are constructed of the ordinary design. They

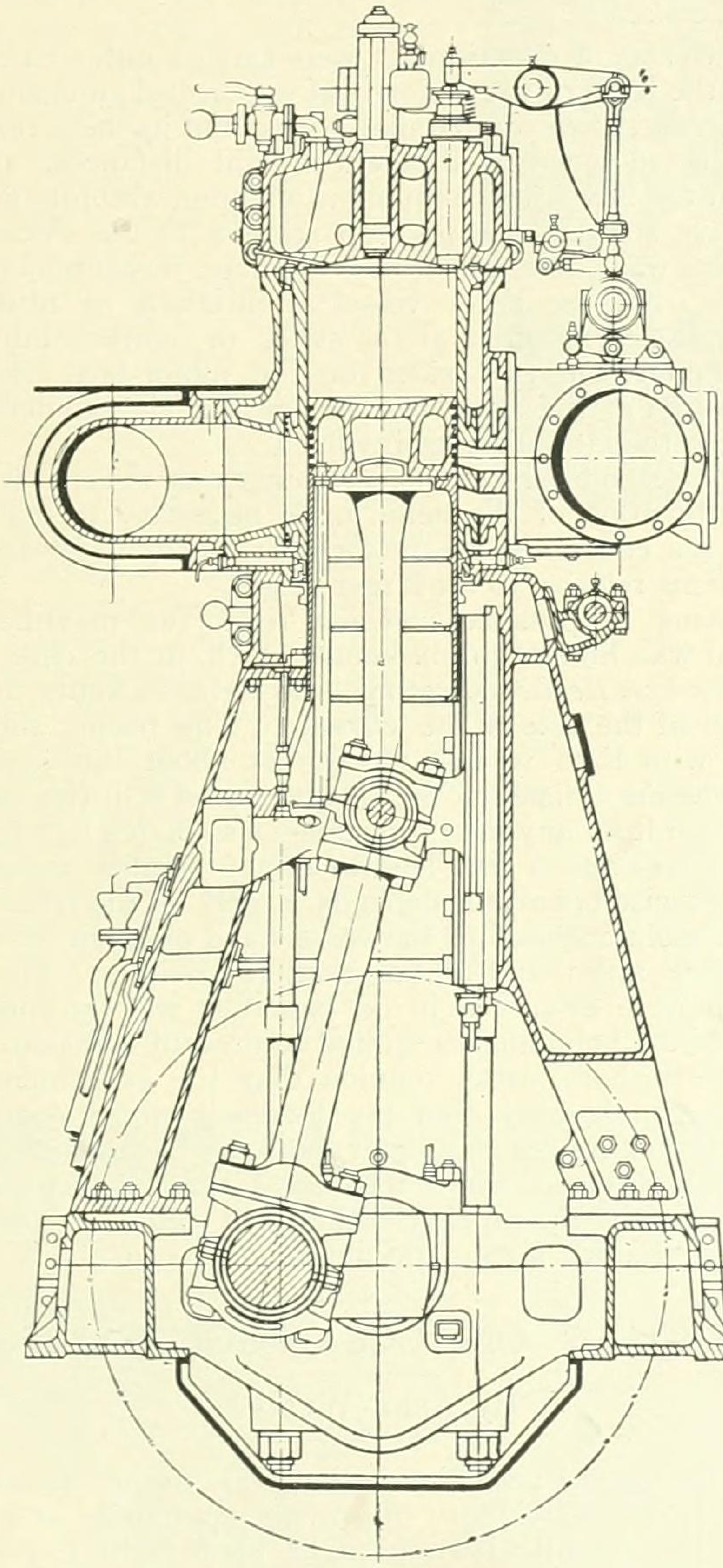

Fig. 5.
Showing construction of each Cylinder and Water Casings.

supply cooling water for the working cylinders, pistons, compressor-cylinders and intermediate coolers, etc., and are utilized also for sanitary and bilge purposes. The sanitary and bilge pumps were designed to be driven off the main engines at the special request of the ship owners, and in consequence, the main engines, as seen in Fig IV., appear somewhat more complicated than they really are. A compressed air turning engine is mounted at the back of each main engine and gears with teeth machined on the periphery of the flywheel, which weighs 8 tons.

The auxiliary machinery consists of two three-cylinder single-acting Sulzer-Diesel motors of 8·07 in. diameter by 8·66 in. stroke, working on the four-stroke principle. Both are of 50 B.H.P. at their normal revolutions of 425 per minute. One motor is coupled direct to a dynamo, which serves for lighting the ship; the other drives a compressor for use in case of emergency or failure of the ordinary air supply, particularly for use when entering or leaving a port, canal or in similar circumstances when large quantities of air are required for manœuvring. The weight of the dynamo and its motor is 7 tons. These two auxiliary sets are shown in Fig. 8, the electric lighting set being on the left-hand side and the compressing set on the right-hand side.

The engine frame is built in two parts and of box form, strengthened internally by columns. The engines are enclosed by light planished steel plates easily dismountable for inspection or overhaul. On the cylinder heads the fuel,

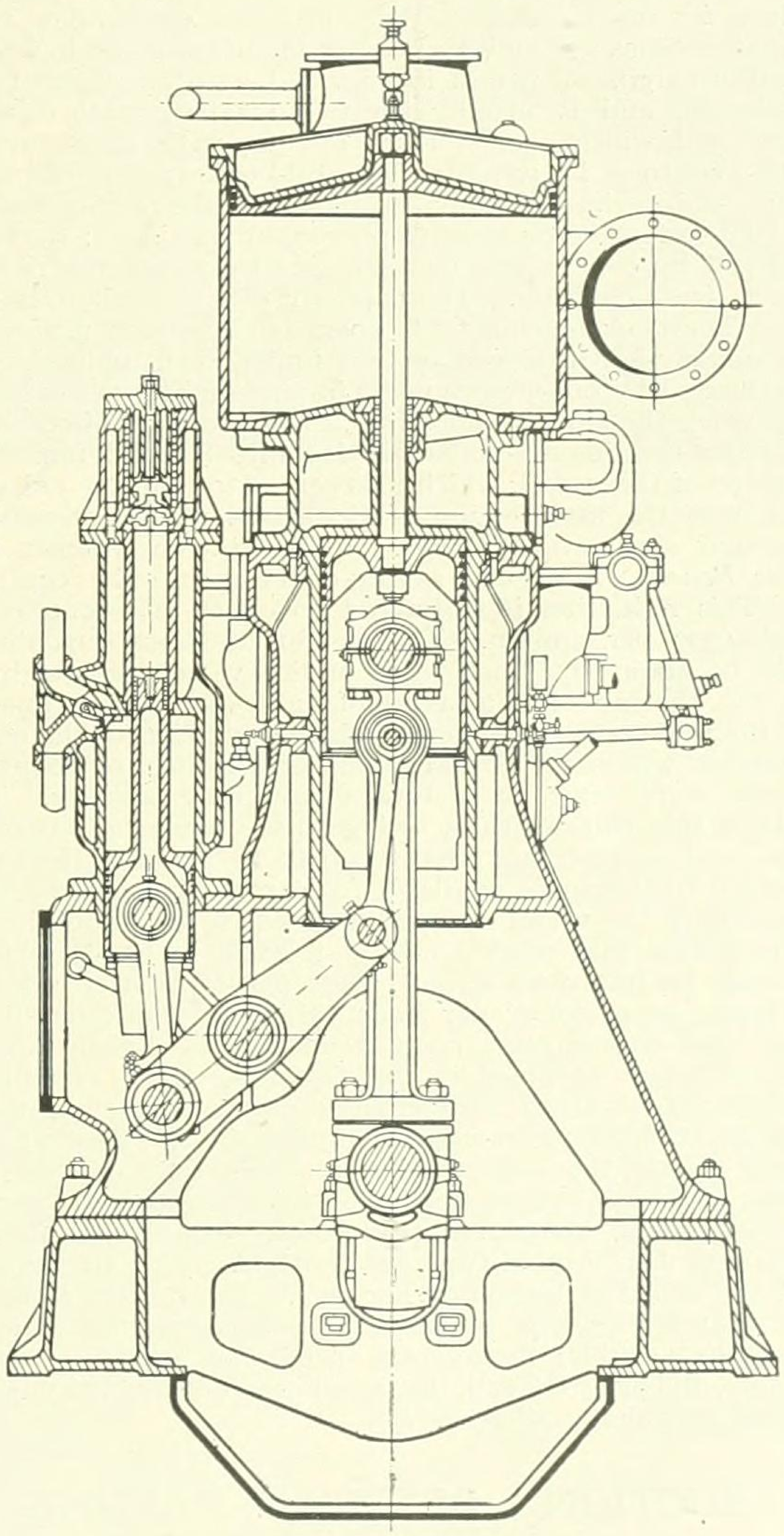

Fig. 6.
Showing construction of Scavenging and Air Compressing Pumps.

starting, admission and exhaust valves are mounted and are operated through vertical rods by cams mounted on a horizontal shaft enclosed in the engine frame. This cam-shaft is driven from the crankshaft through spur gearing. The valves and valve gear are similar to the usual stationary four-cycle motor design, and the fuel pump is driven direct by the crankshaft. An adjustable governor is fitted which works on the well-known principle of controlling the amount of lift of the suction valves of the fuel pump. An oil pump for cylinder lubrication is cast in one with the fuel pump, the drive being common to both. Forced lubrication is provided for all the bearings and the gudgeon pins by a pump placed inside the engine frame and which draws the oil through a filter. The oil level can be read off on a conveniently placed gauge. On the forward end of the engines a semi-rotary wing pump, which is coupled to the crankshaft, supplies water for cylinder and compressor cooling.

The nett weight of each main engine is 55 tons, or with all pipes, air flasks, exhaust, silencer, etc., 77 tons; the air compressor and motor weigh 6 tons, or a total of 160 tons.

The fuel consumption of each engine was proved on a forty-eight hours' run at normal working to be ·46 lb. per B.H.P. per hour, but as the pumps for the various ship purposes are driven off the main engines, the actual consumption of the latter alone is much lower.

By reference to Figure II., it will be seen that the ship is of the twin-deck type, and is provided with a double bottom over her whole length, so that the space enclosed may be utilized for water-ballast; there are four cargo-holes with deck stanchions suitably spaced for facilitating the handling of bulky cargo. The hull is provided with six water-tight bulk-heads, and is fitted with two masts furnished with booms and winches capable of dealing with goods up to thirty-five tons in weight. The oil-bunkers are disposed athwart-ships, immediately in front of the engine-room; special provision being made to prevent any leakage; they are protected by coffer-dams on each side to reduce the risk of damage from collision. The capacity of the bunkers is 700 tons. The deck machinery is operated by steam generated in a donkey-boiler placed on the upper deck and adapted to be heated by oil burners when in port and by the exhaust gases when the ship is under way. The products of combustion from the donkey-boiler are led into a small funnel at the stern of the vessel, which also serves to take the exhaust gases from the main engines. Compared with a steamship of similar size, which would require sixteen firemen the *Monte Penedo* will effect a saving of ten men, only requiring six. This reduction is estimated to effect an economy of about £700 per annum. The weight of steam machinery would be about 400 tons, while in this vessel the weight is only 160, thus effecting a saving of 240 tons. It is estimated that the reduction in bunker weight, in addition to the other economies, will effect a total saving of 900 tons, or about an increase of 15 per cent. of total deadweight capacity. The result of this will be, that, owing to the saving of space in engine and boiler-room, from 8,000 to 10,000 cubic feet can be added to the space available for cargo. During the trial at Hamburg the vessel attained a speed of 10½ knots, but it is anticipated that when a change is made in her propellers this may be improved upon. The consumption of ·46 lbs. per brake horse-power per hour, which is about one-third of the coal consumption on a steamship, is slightly higher than the result obtained in the *Selandia*, which, it will be remembered, is fitted with engines of the four-cycle type, although it must be remembered that in the case of the *Monte Penedo* the consumption includes that due to the driving of the air compressor for oil injection and air storage for starting and manœuvring purposes. The *Monte Penedo* started on her first voyage to South America on August 31st, and called at Lisbon on her way. The reports received state that her passage so far has been carried on without the slightest hitch; the average speed was between 10 and 11 knots, and after the call, the vessel proceeded on her voyage without any delay whatever.

"SUCTION" BETWEEN PASSING VESSELS.*

By PROFESSOR A. H. GIBSON, D.Sc., and J. HANNAY THOMPSON, M.Sc., M.Inst.C.E.

IN view of the general lack of experimental data as to the magnitude of the mutual forces involved in the cases of interaction between two vessels moving in parallel paths in close proximity, and as to their effective range of action, the authors decided to carry out a series of experiments to investigate these points on boats of sufficiently large size to enable the results to be applied with some confidence to seagoing vessels. The vessels used were the steam-yacht *Princess Louise* and a motor boat. Each is propelled by a single screw, and their details are as follow:—

Vessel	Length between perpendiculars.		Beam		Draught	Displacement.	Rudder Area
	Ft.	In.	Ft.	In.			
Princess Louise	88	6	13	0	6ft. forward 7ft. aft	—	—
Motor-boat ..	29	6	6	9	2 ft. 3 in.	—	100 sq. in.

Two sets of experiments were carried out. In the first the helm of the motor-boat was lashed amidships, with the vessels on parallel paths, and its behaviour was noted when at different lateral distances, and when the boats were moving at different absolute and relative speeds. Its position relative to the *Princess Louise* was determined by angular measurements taken from the latter vessel at intervals of fifteen seconds. Pressures at a series of corresponding points on the two sides of the motor-boat were measured at the same instants, with a view to determining the lateral forces involved.

The second series of experiments was devoted to a determination of the helm angle necessary to maintain the course of the motor-boat when in different positions relative to the larger vessel.

Owing to possible collision risks the maximum speed was limited to six knots, which, in the case of the *Princess Louise*, corresponds to eighteen knots in a vessel of the size of the *Olympic*. The results show that with both vessels moving at about this speed with helms amidships, the smaller vessel is drawn into collision from any lateral distance less than a hundred feet (three and a half lengths of the smaller vessel). The precise behaviour depends largely on the relative and absolute speeds of the vessels and on their initial distance apart and initial relative position. These points were discussed in the paper, as was the question of the helm angle required to prevent collision.

The authors are of opinion that the experiments prove conclusively that the forces involved during interaction are much greater than has been generally realized hitherto, while they have been particularly impressed by the rapidity with which collision usually follows the first sign of any interaction.

* Read at the Dundee Meetings, September, 1912, of the British Association for the Advancement of Science.

LIFEBOATS ON OCEAN-GOING-SHIPS.*

By AXEL WELIN.

THE urgent necessity for revising present regulations referring to life-saving appliances at sea has recently been brought home with terrible force to the public mind. Anticipating the ultimate results of the international deliberations at present in progress, the United States Government have already stipulated that every ocean-going passenger steamer must provide sufficient boat-accommodation for every soul on board.

To the lay mind such a rule must appear perfectly reasonable, seeing that no objection on the ground of expense can be permissible in a matter of this nature. But it must be borne in mind that the mere fact of

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