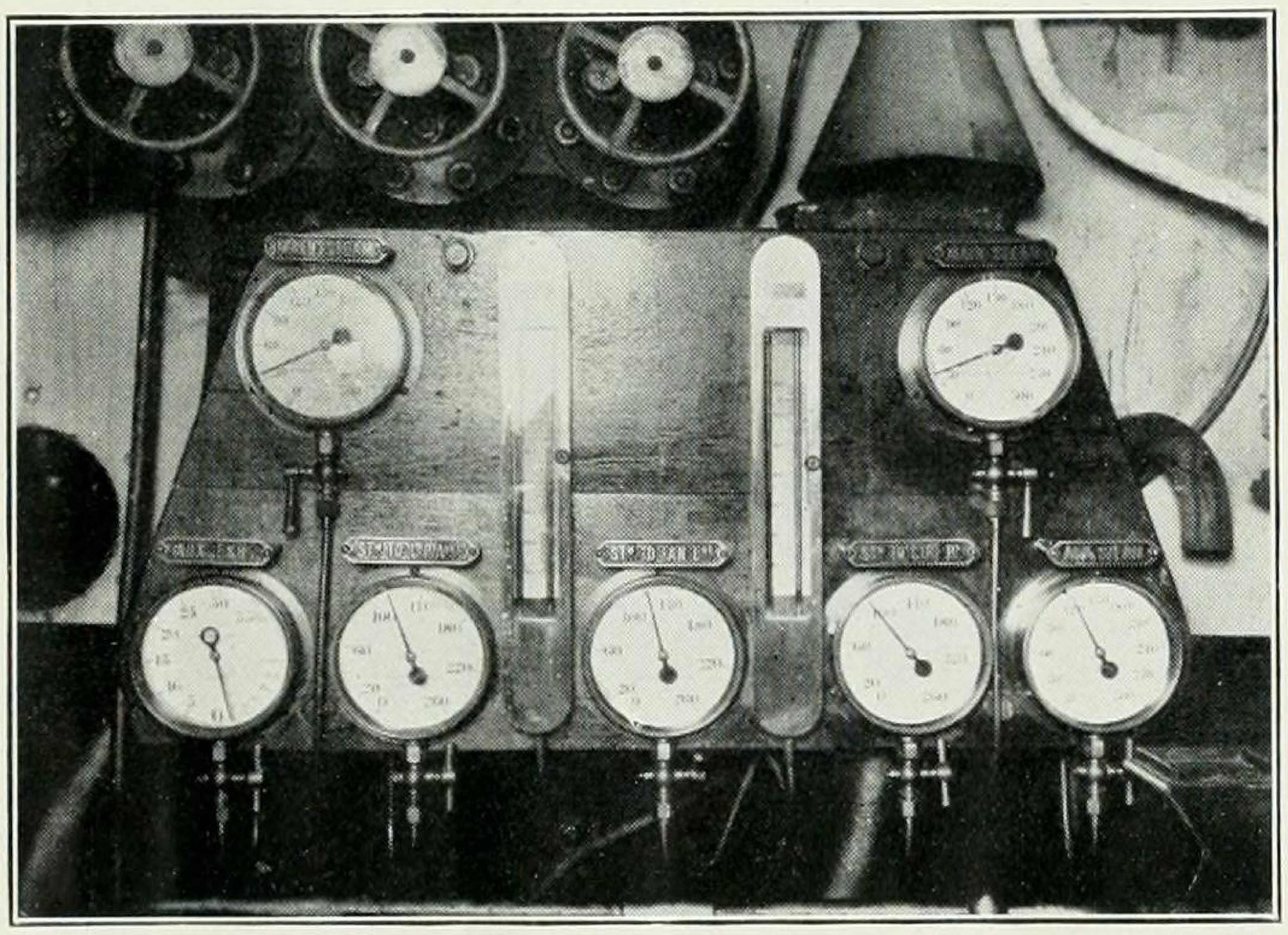
MODERN MACHINERY SPACES—III.

The Commonwealth and Dominion Refrigerated Liner "Port Hardy," built and engined by R. & W. Hawthorn, Leslie & Co. Limited, Newcastle-on-Tyne.

We are dealing this month with the main, auxiliary and refrigerating machinery of the Commonwealth and Dominion Liner *Port Hardy*. The vessel is a new one, and both hull and main propelling machinery have been constructed by R. & W. Hawthorn, Leslie & Co. Limited, Newcastle-on-Tyne; she has been designed for the Australian meat trade and left the Thames on her maiden voyage on March 6. The following are her leading particulars :—

Hull.	
Length b.p.	481·2 ft.
Breadth, moulded	62·3 ft.
Depth, moulded	33 ft.
Tonnage.	
Deadweight	11,300 tons.
Gross register tonnage	8,705 tons.
Net register tonnage	7,776 tons.
Engines.	
Number and type	Two sets triple-expansion reciprocating engines.
Horse-power	4,500 i.h.p.
Boilers.	
Number	Four.
Type	Scotch.
Fuel	Coal.
Draught	Howden forced.
Superheat, deg. Fahr.	200 deg.
Working pressure	200 lbs. per sq. in.



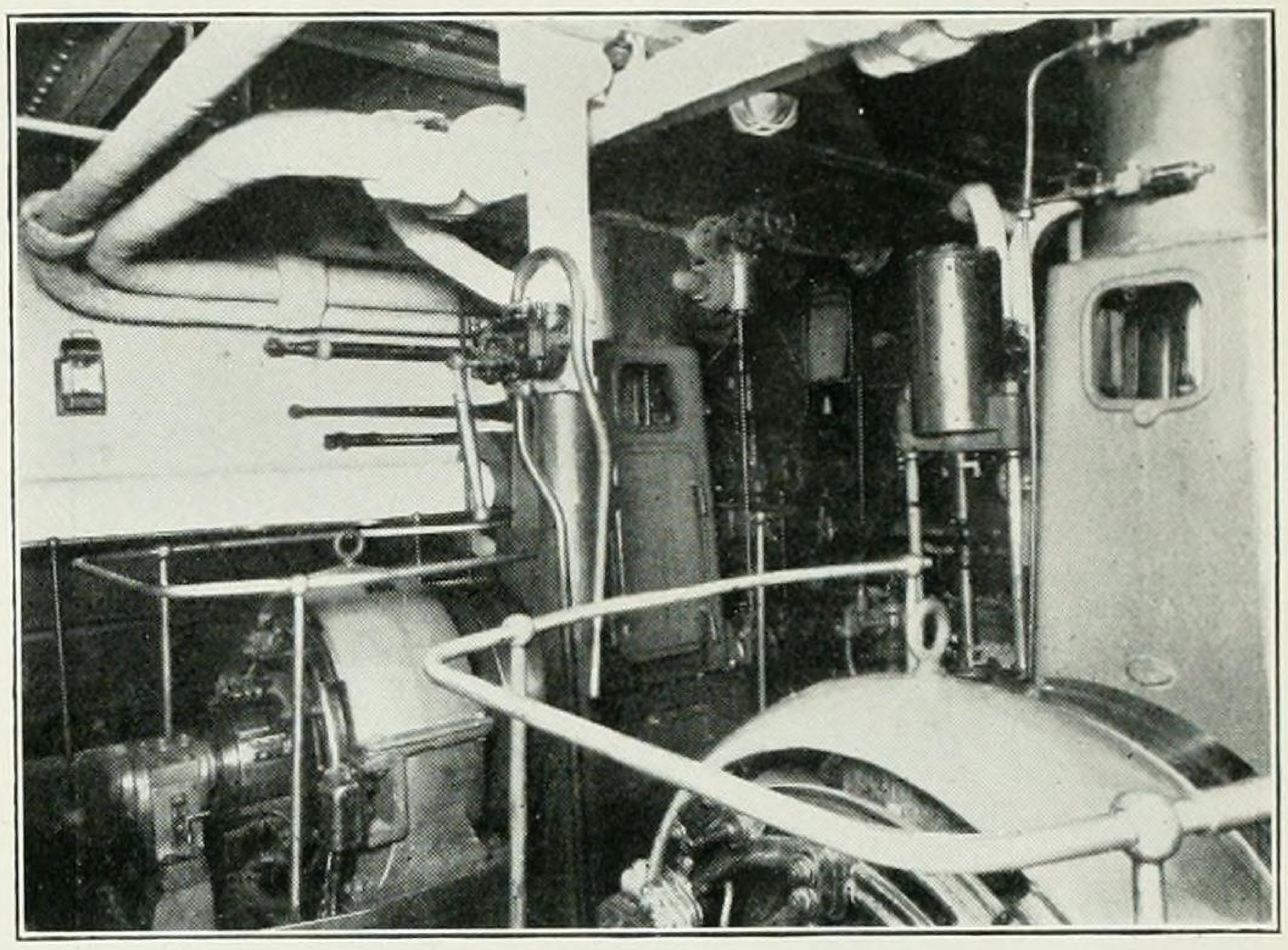
Photograph showing Gauges and Thermometers for registering Superheat.

General Particulars.

Constructed with a straight stem and cruiser stern, the vessel is of the three-deck shelter deck type. Five holds are arranged with large hatches and clear spaces suitable for cargo of a bulky nature, such as machinery and Colonial plant. The vessel has eight watertight bulkheads, 17 derricks of 7 to 10 tons, and one of 35 tons lifting capacity, and 15 steam winches are fitted for the ready handling of cargoes.

Nos. 1, 2 and 4 holds and main 'tween decks are insulated for the carriage of frozen meat, the refrigerating machinery being placed abaft the engine casing with the necessary insulated store rooms immediately underneath.

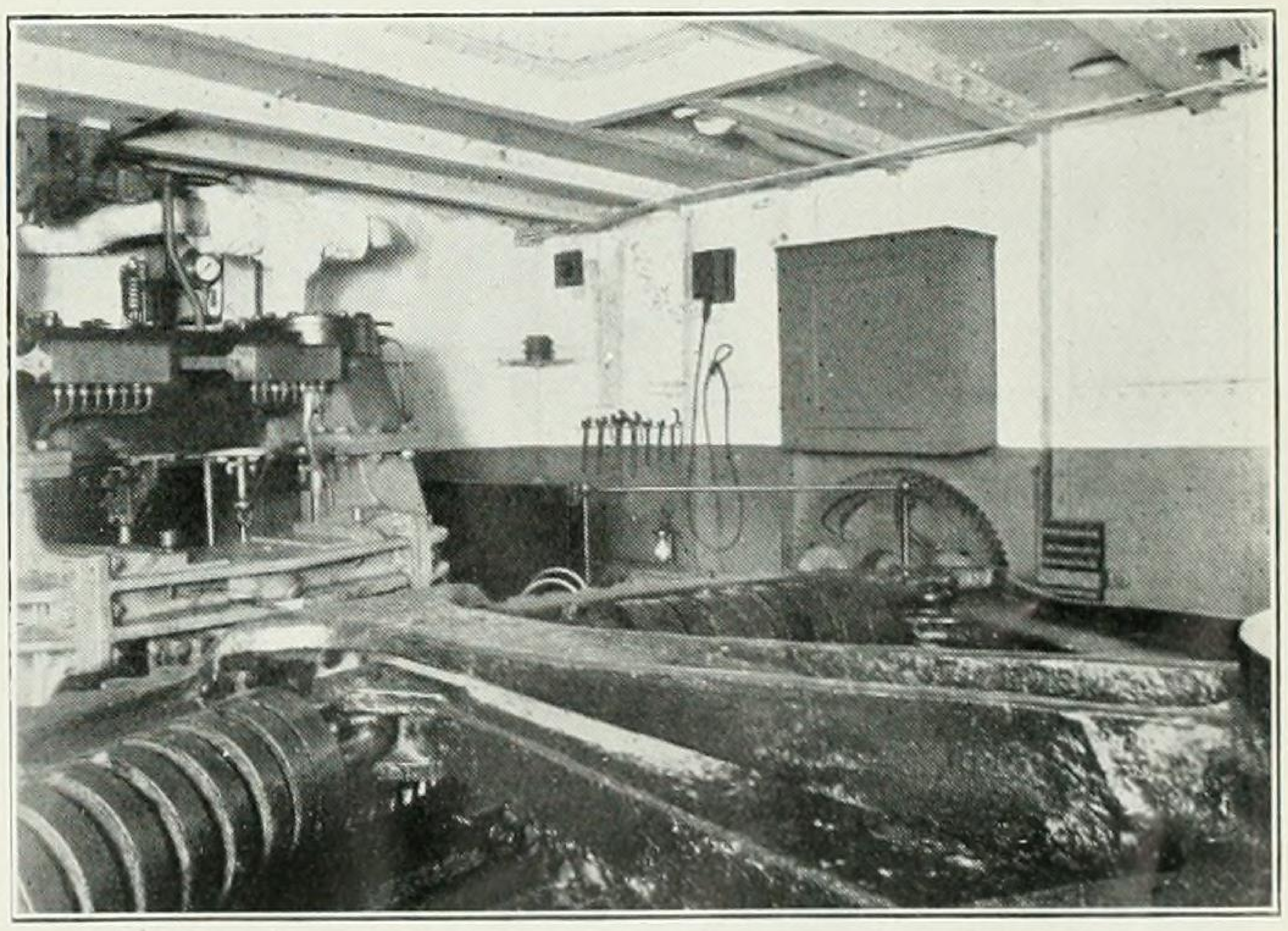
Accommodation is provided for first-class passengers in deckhouses on the shelter deck amidships, with large saloon, pantry and stores. There is also provisional accommodation for about 650 emigrants in the Shelter 'Tween Decks. Deckhouses are provided for entrances and lavatory accommodation.



Photograph showing Main Generators at Aft End of Machinery Space.

Main Propelling Machinery.

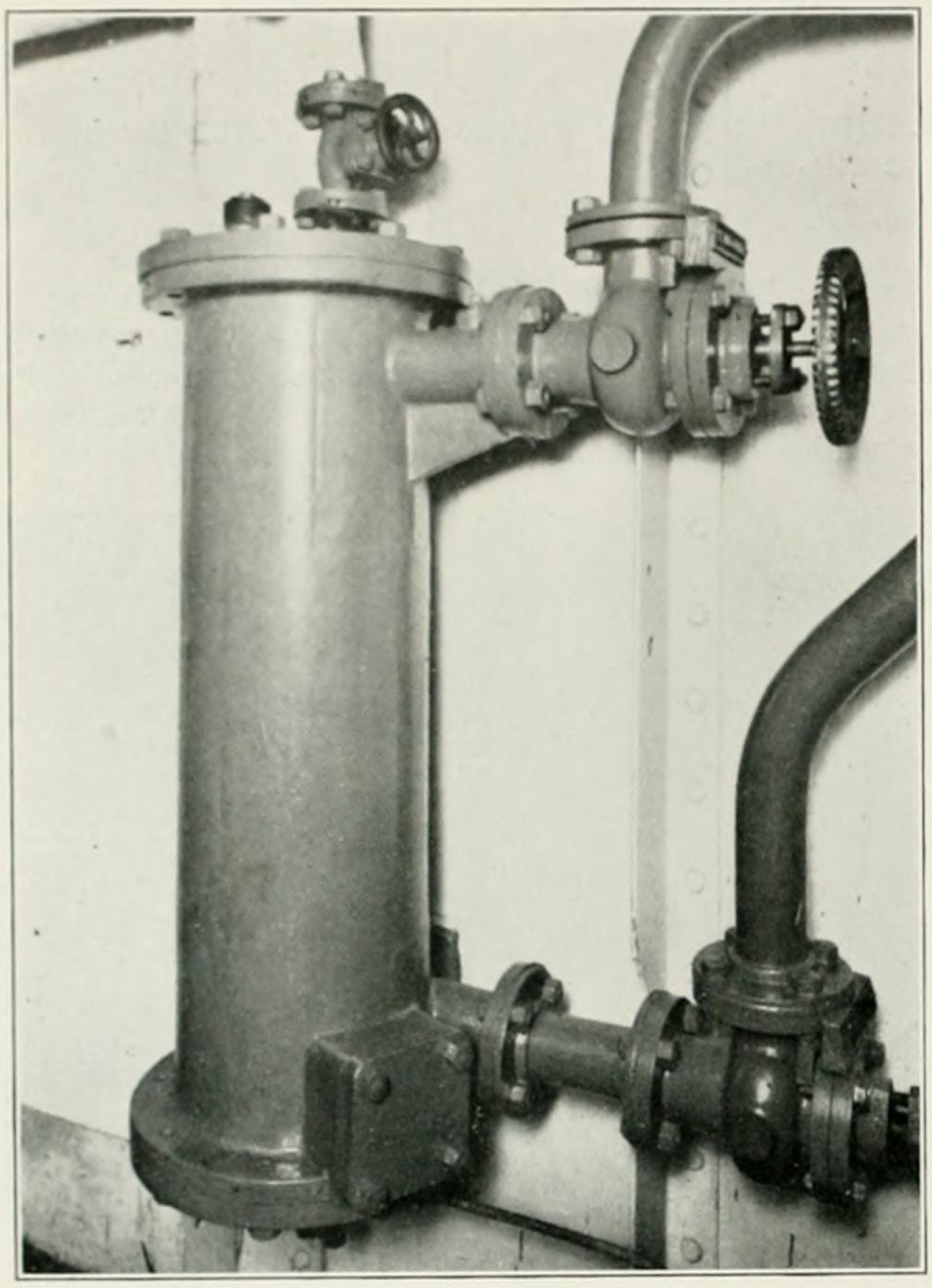
At a time when the geared turbine has had a run of popularity, and when the internal-combustion engine has made such rapid strides towards popularity, besides occupying the closest attention of all far-seeing engineers, it is of interest



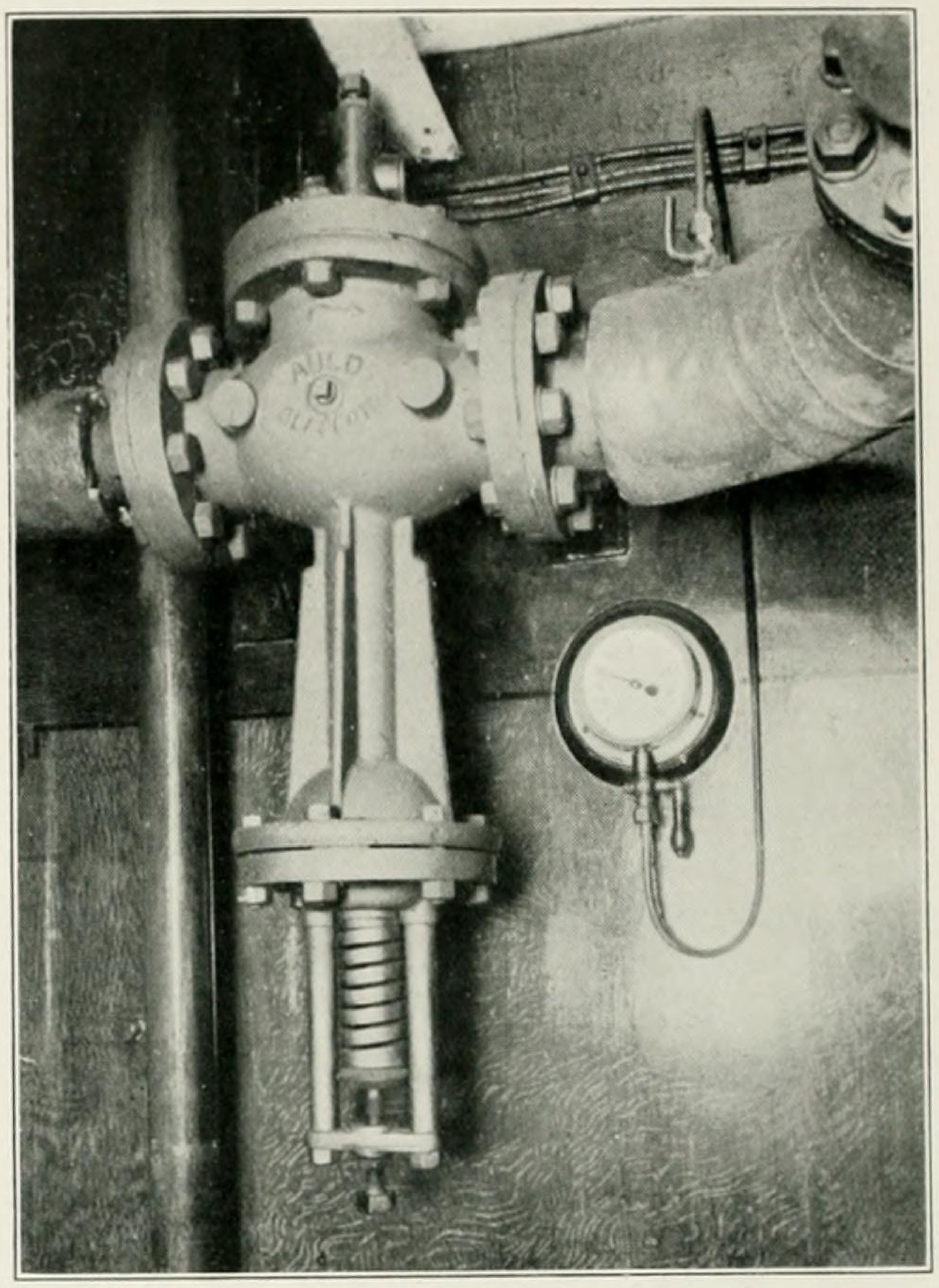
Steam Steering Engine, Tiller, and Spring Shock Absorbers.

to find a new vessel fitted with reciprocating engines. The reciprocating engine has given sterling satisfaction in the past and its present performances are known quantities, and owners who arrange for their tonnage to be propelled by such machinery can be sure of absolute reliability. Such evidently was the opinion of the owners of the *Port Hardy*, for the vessel is fitted with twin-screw triple-expansion machinery,

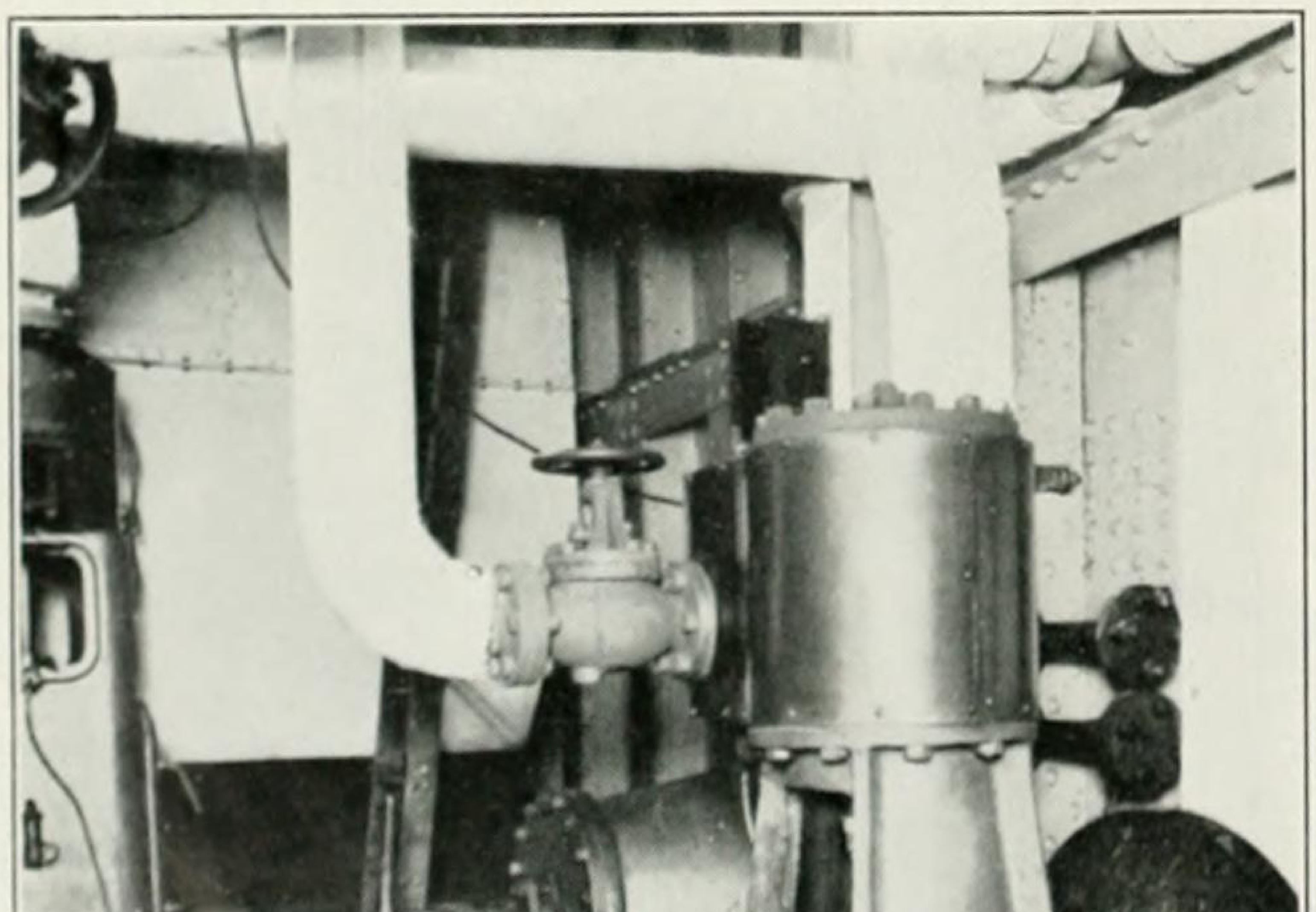
SOME VIEWS OF THE AUXILIARIES OF THE



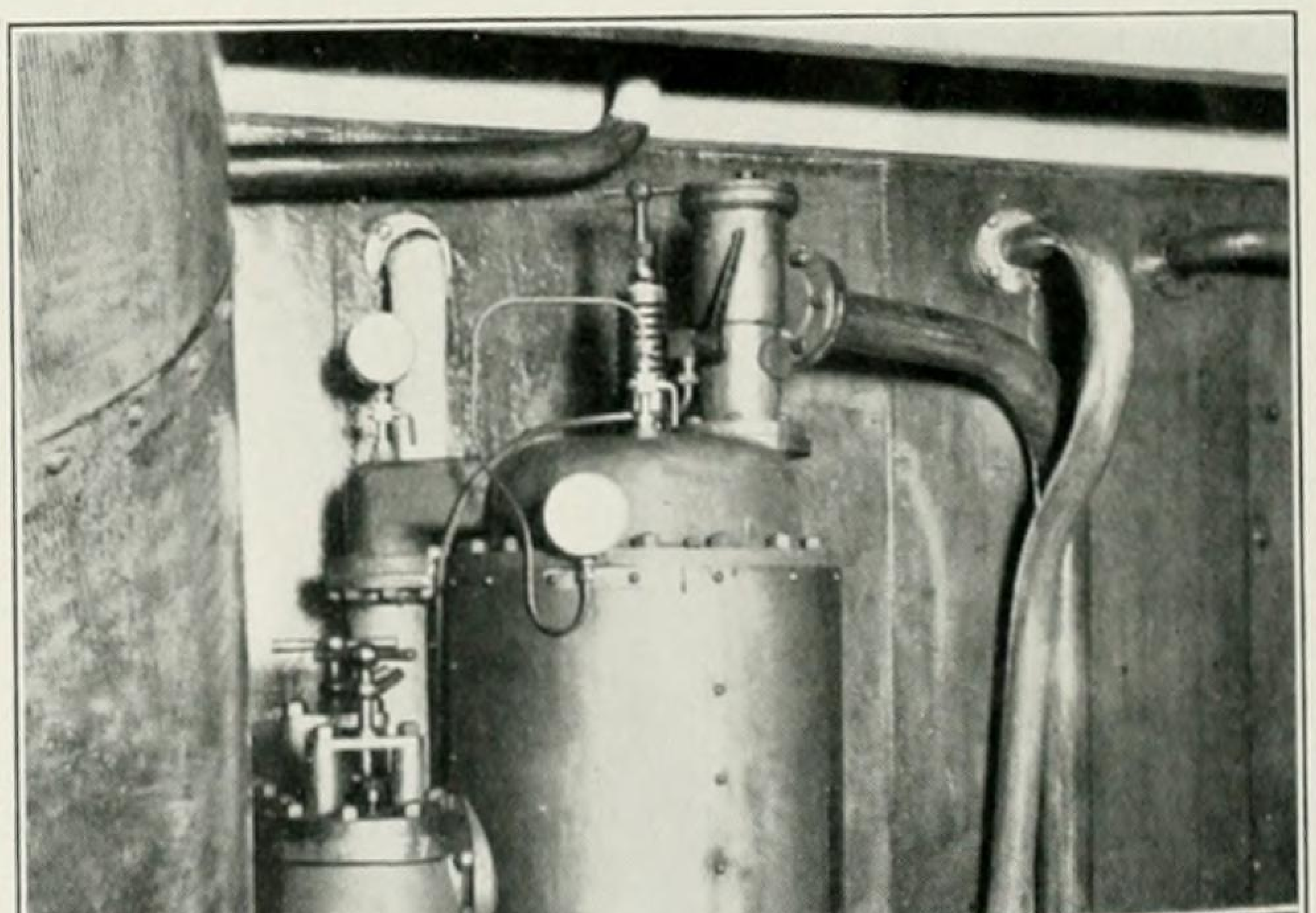
Heating Coil in Refrigerating Engine Room for "Thawing Out."



Auld Valve for Reducing Steam Pressure to Refrigerating Engines.

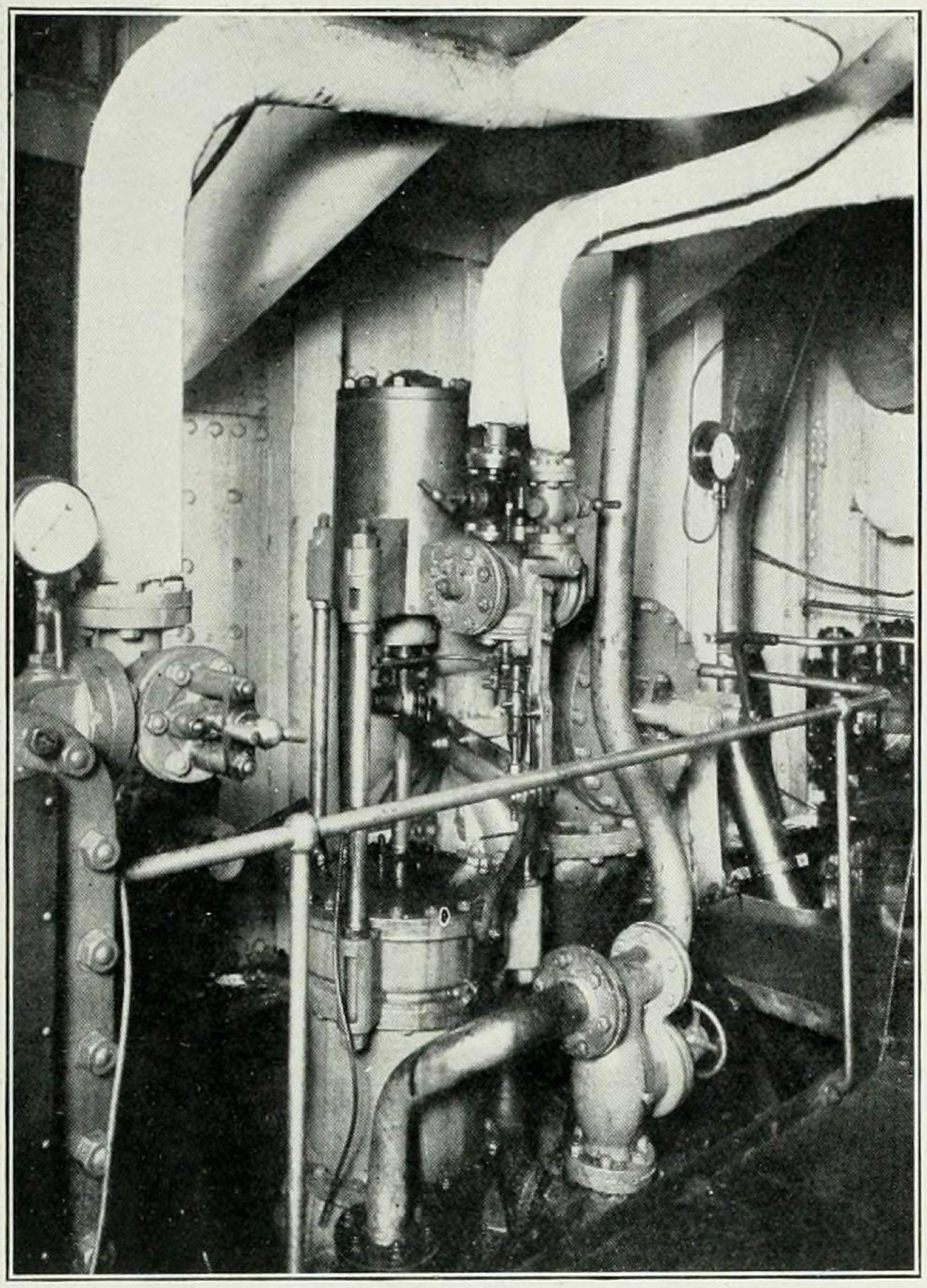


High-Speed Reciprocating Engine for Auxiliary Circulating Pump.

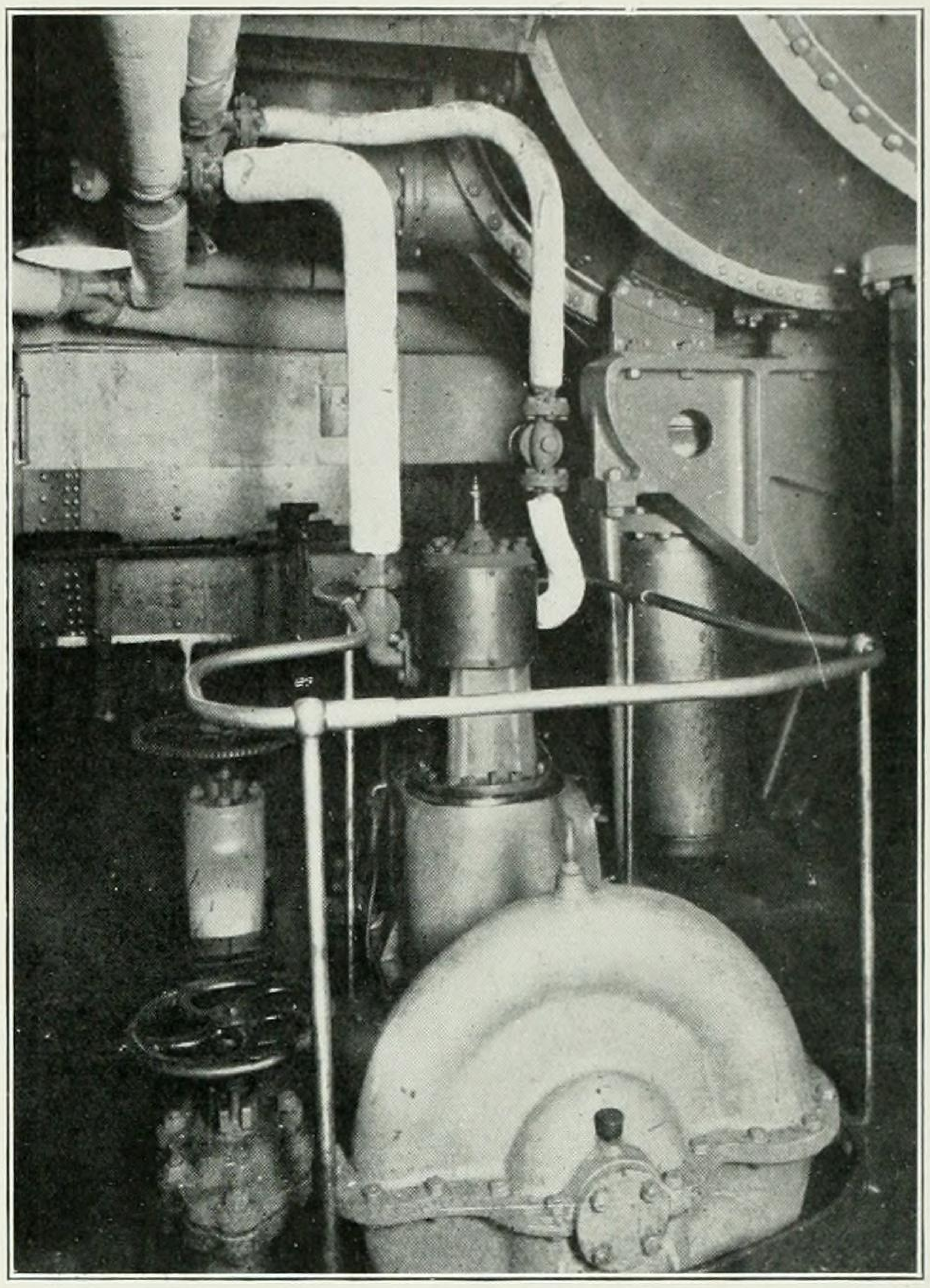


Weir's Direct Contact Feed-Water Heater.

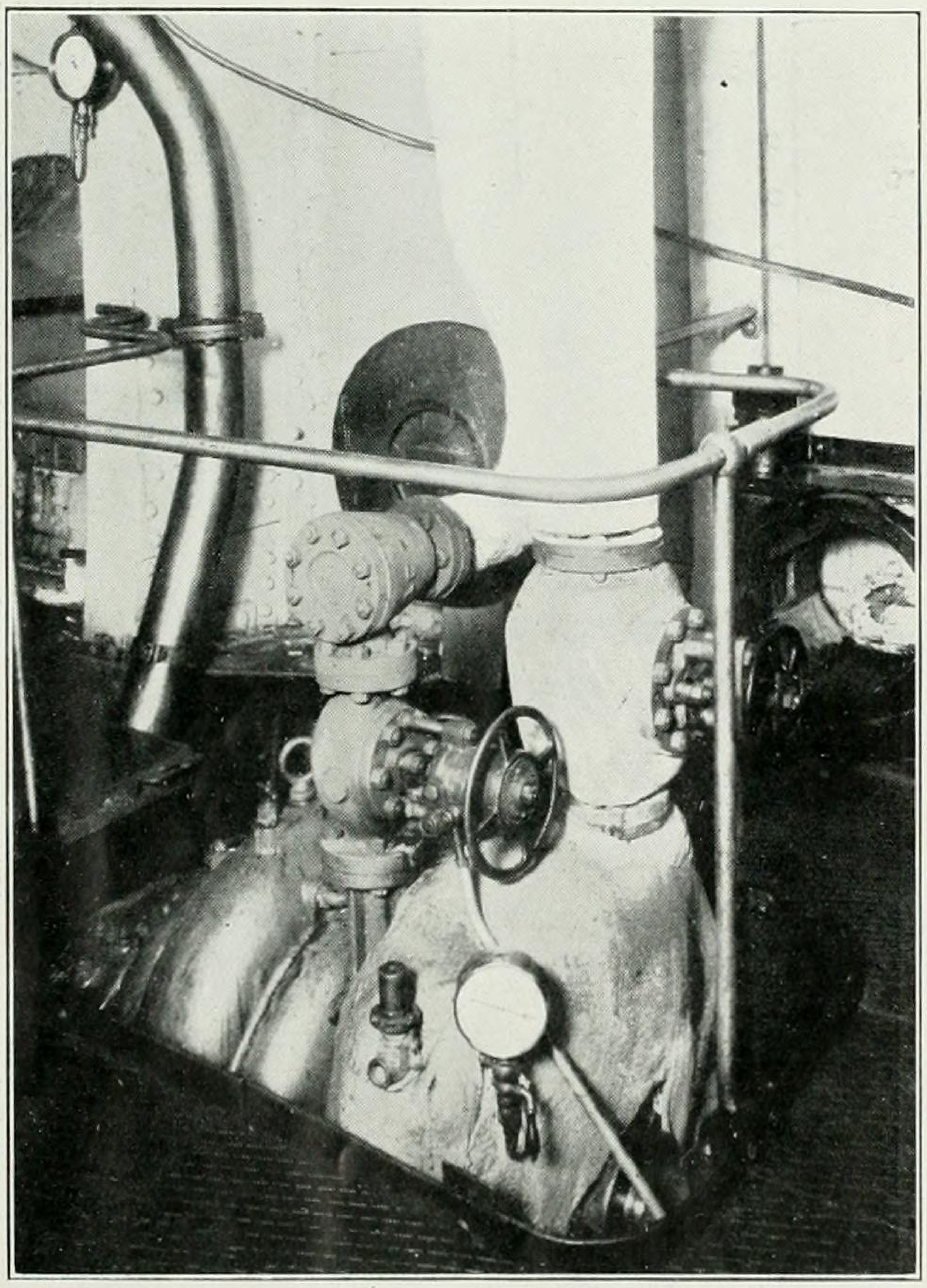
COMMONWEALTH AND DOMINION LINER "PORT HARDY."



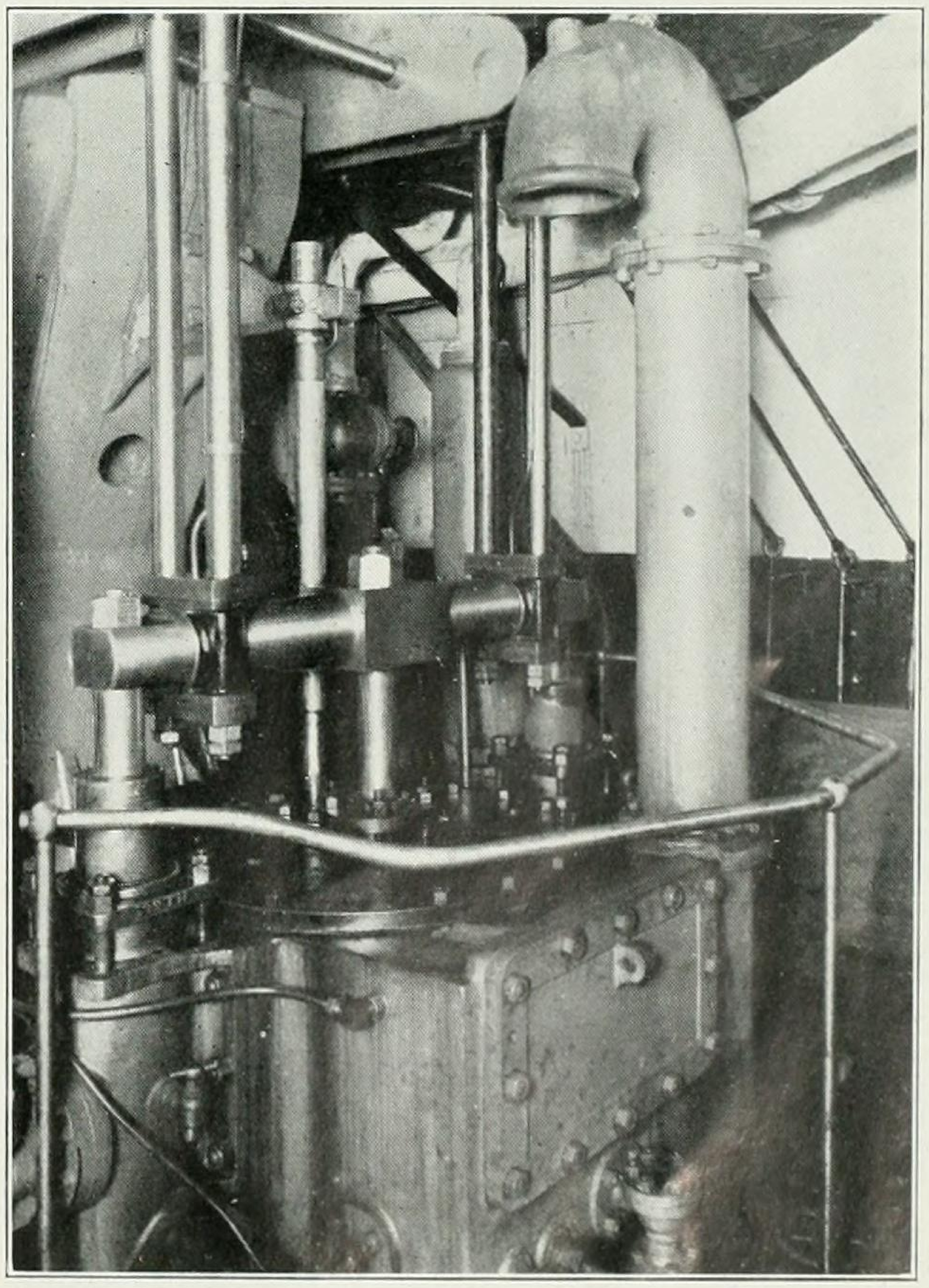
Auxiliary Feed Pump situated at Boiler-Room Bulkhead.



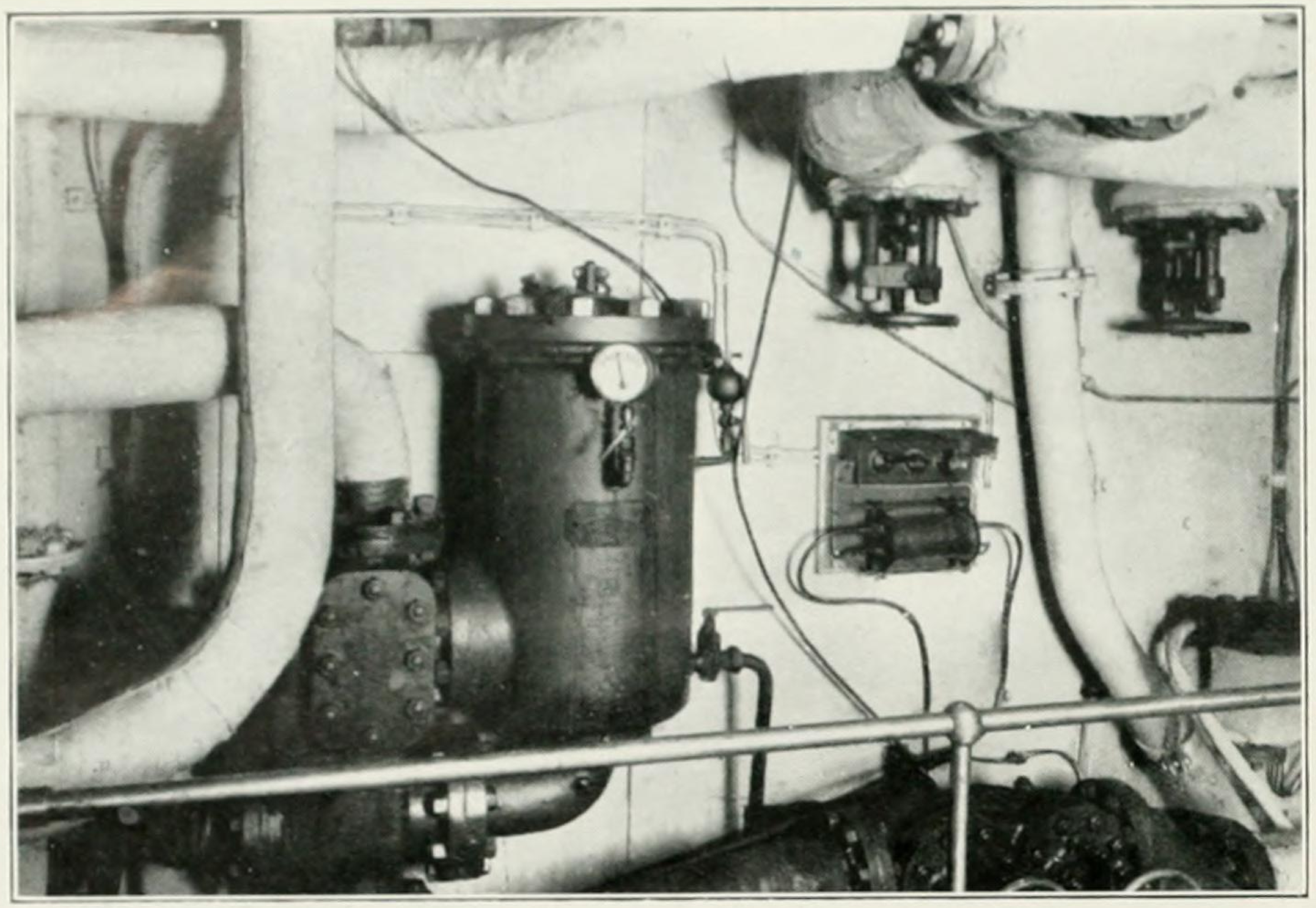
Auxiliary Circulating Pump on Port Side of Engine Room.



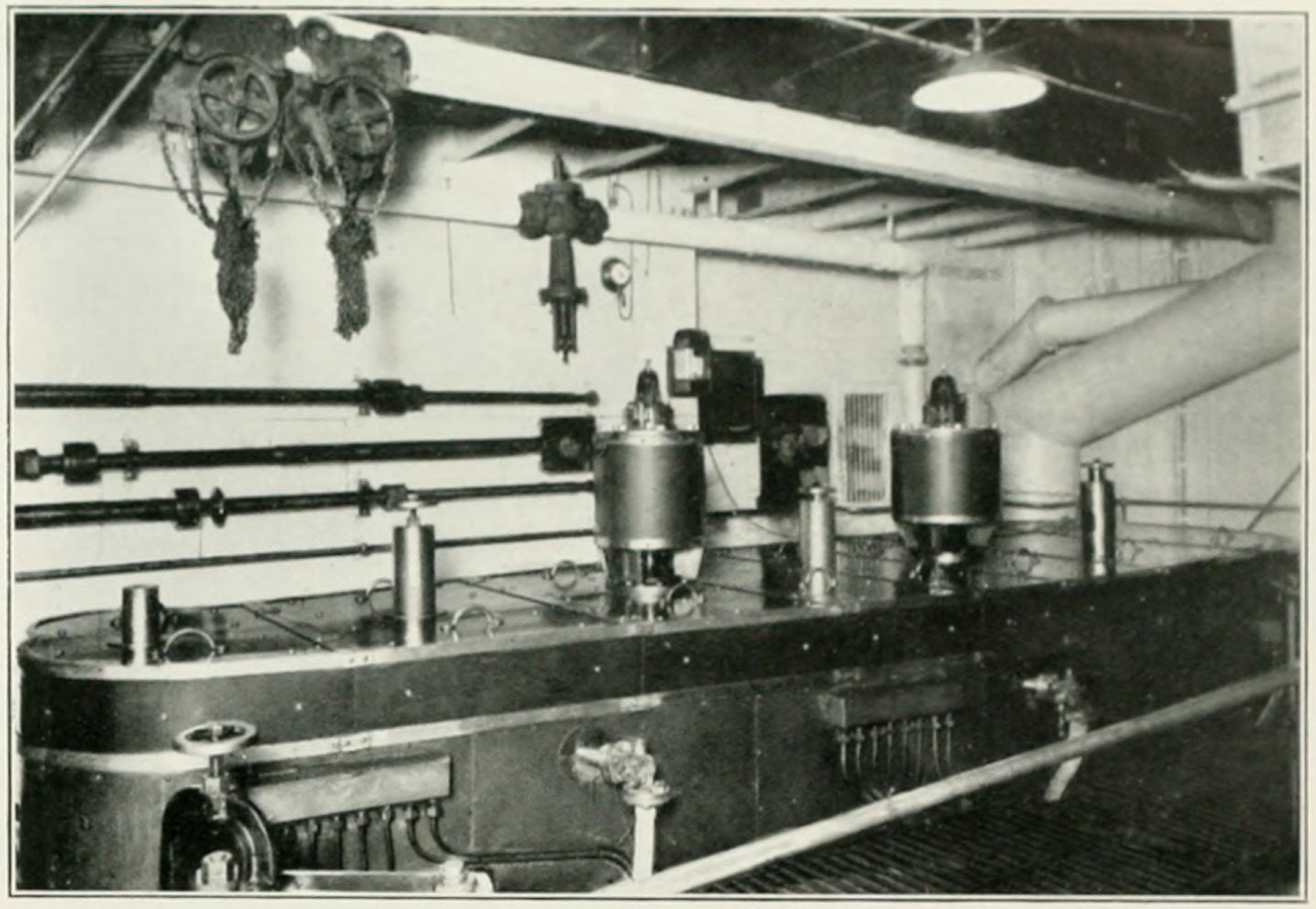
Main Turbo-driven Circulating Pump.



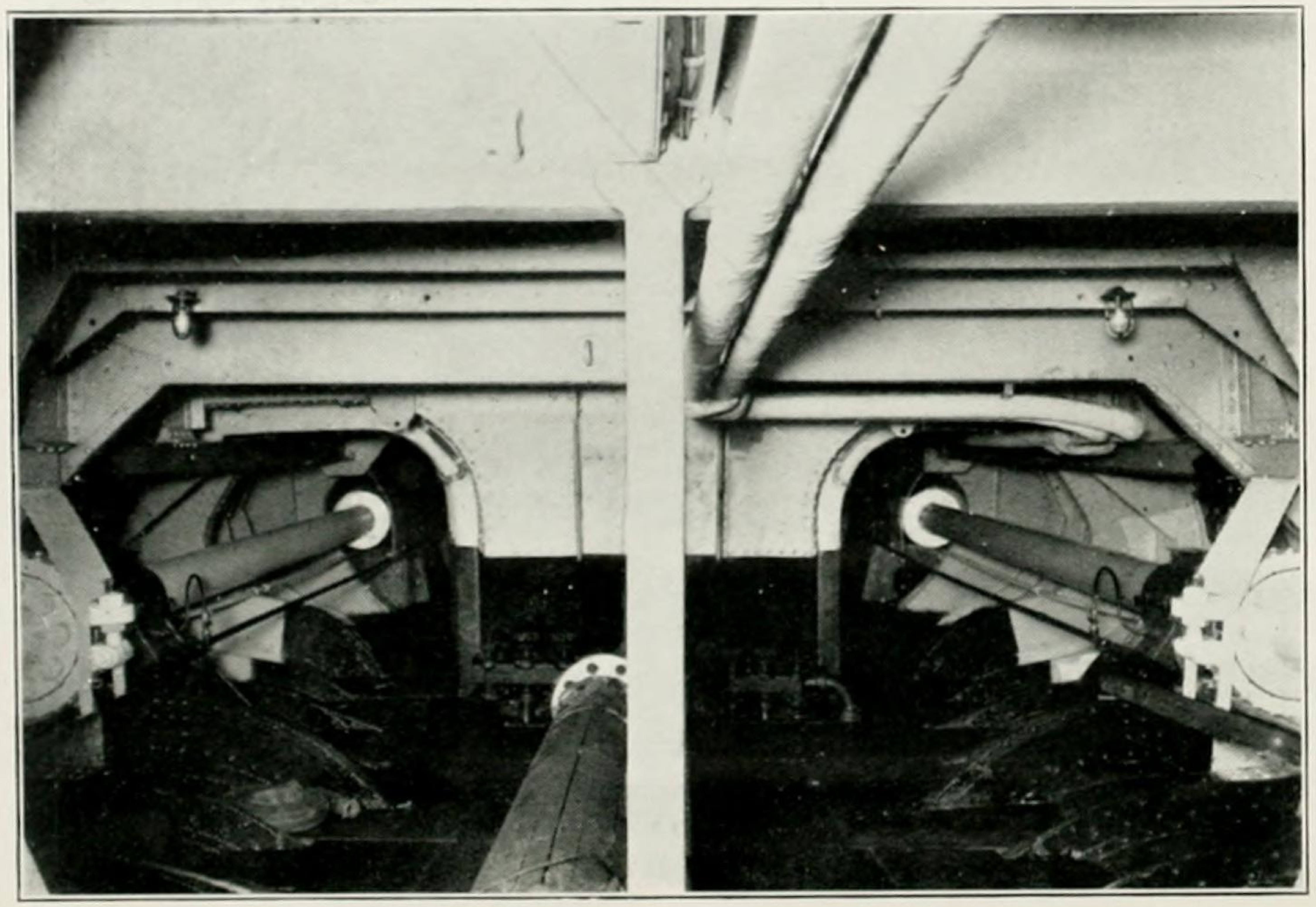
Main Air Pump, showing Beam-Drive from Main Engines.



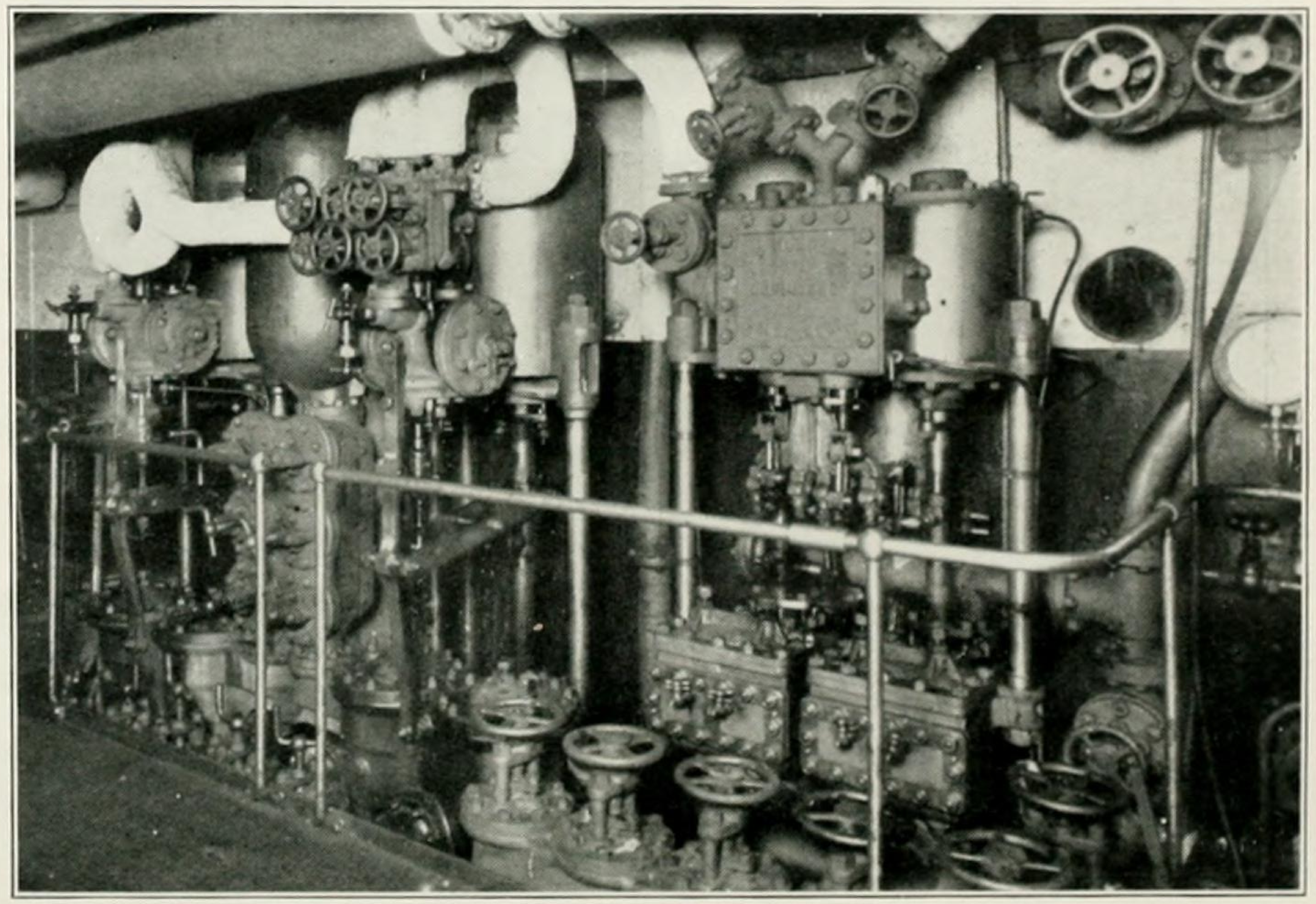
Edmiston Feed Filter and Cumberland Electrolytic System on Boiler-Room Bulkhead.



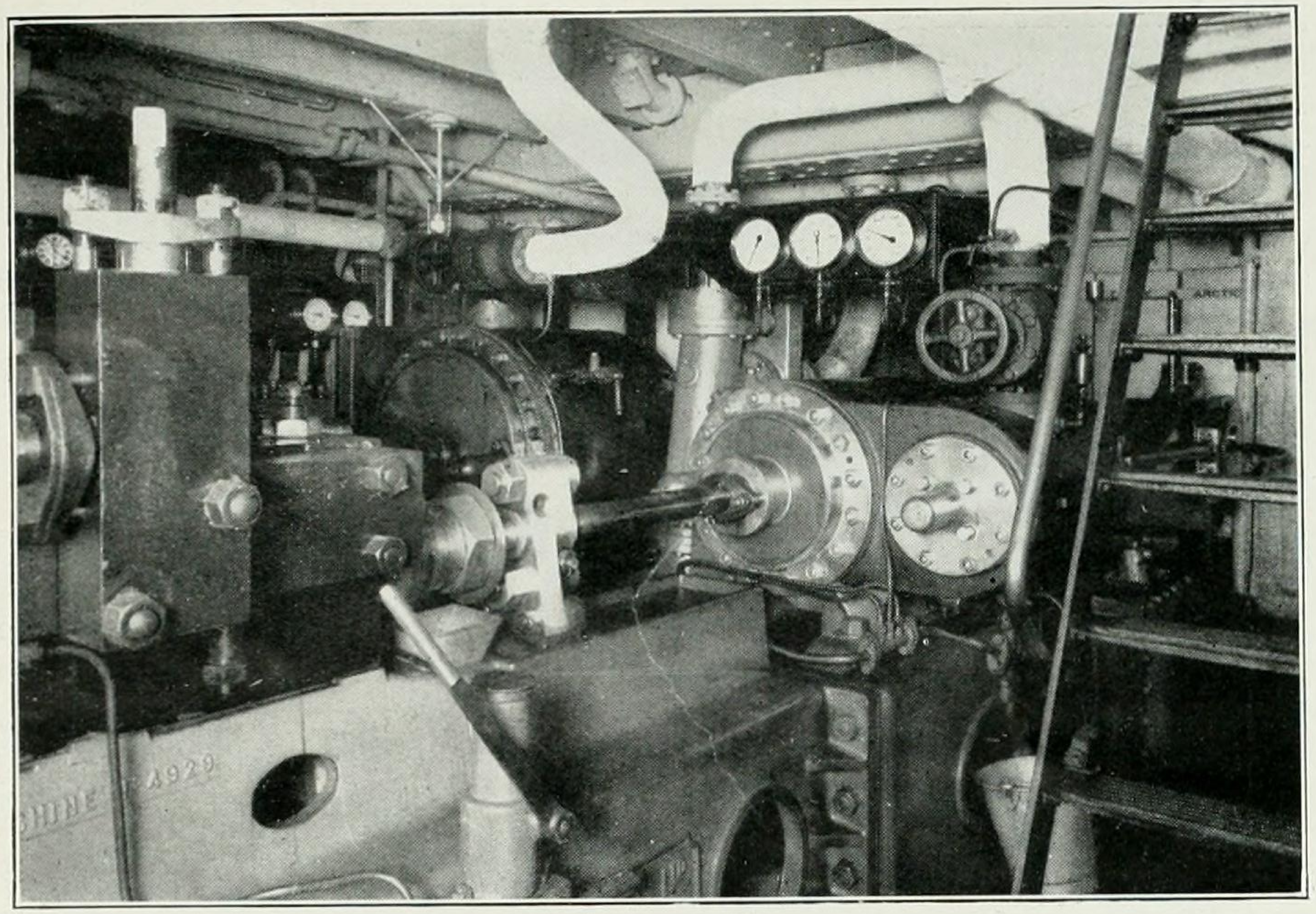
Photograph showing the Cylinder Tops of the Starboard Engine. Door to Engineers' Workshop in Background.



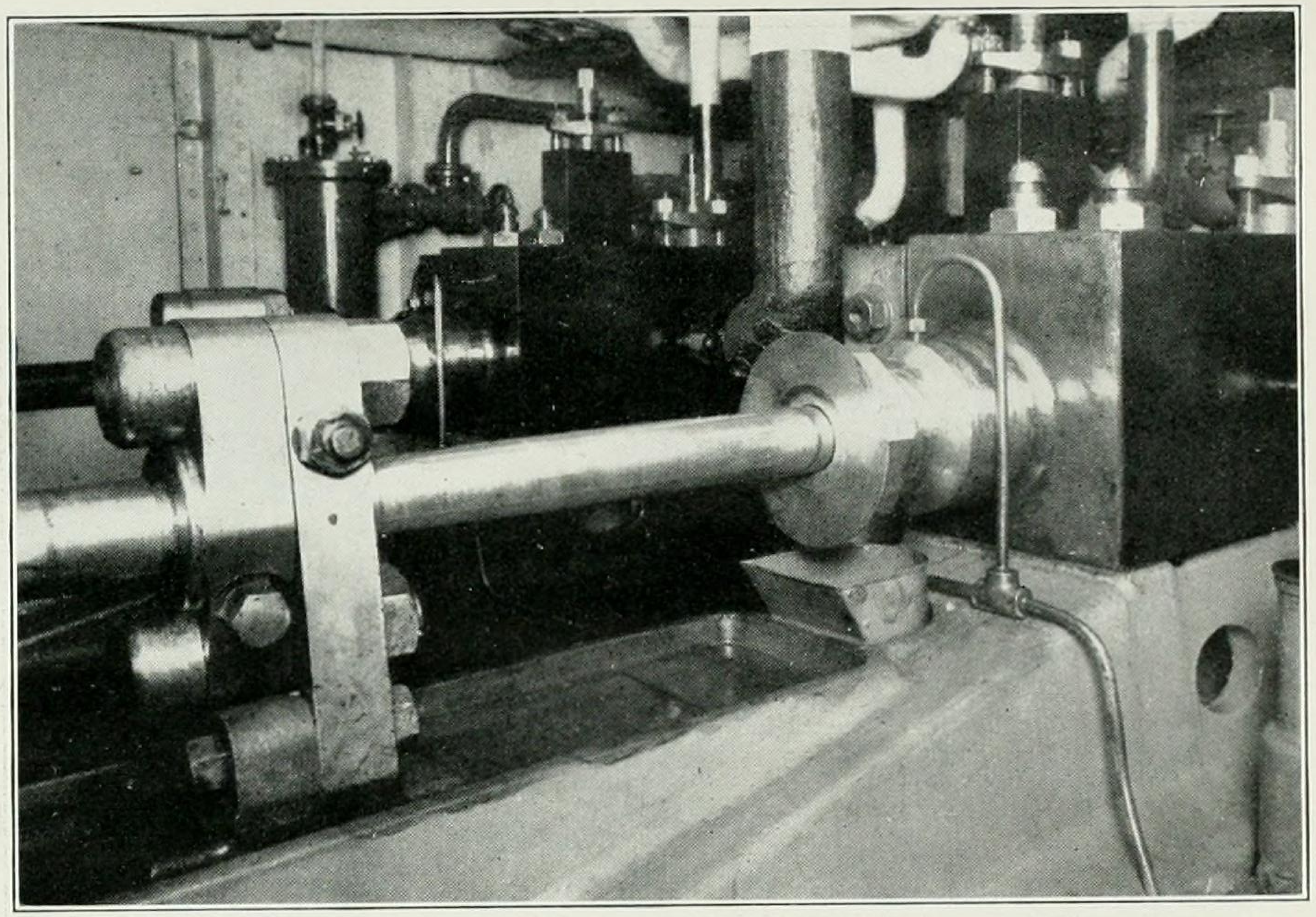
View of Flat at Aft End of Shaft Tunnels, showing Spare Tail Shaft.



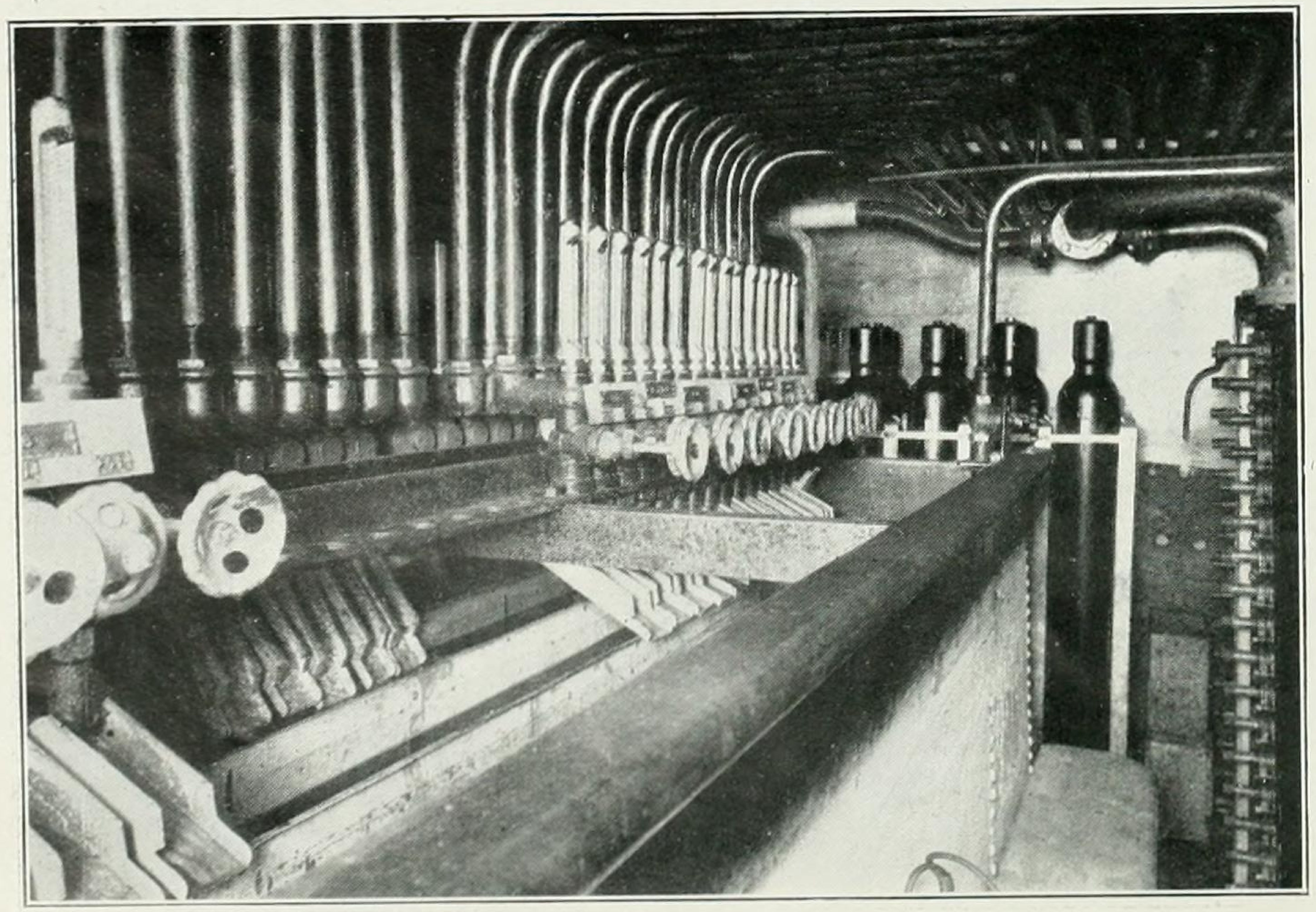
Main Feed Pumps at Boiler-Room Bulkhead.



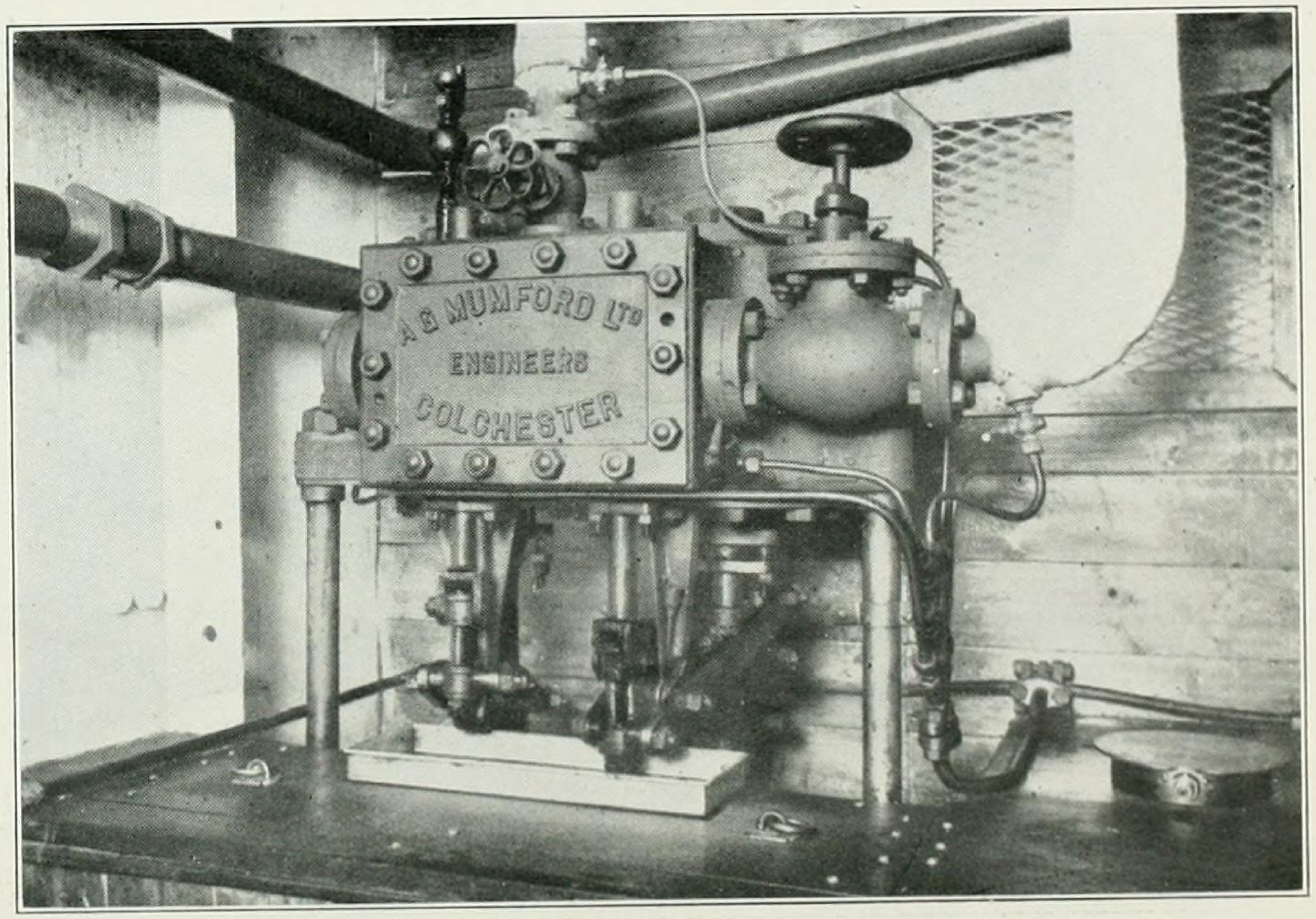
View of one of the CO_2 Machines, showing Steam Cylinders and Gauges.



Main Compressor of one of the two CO_2 Machines.

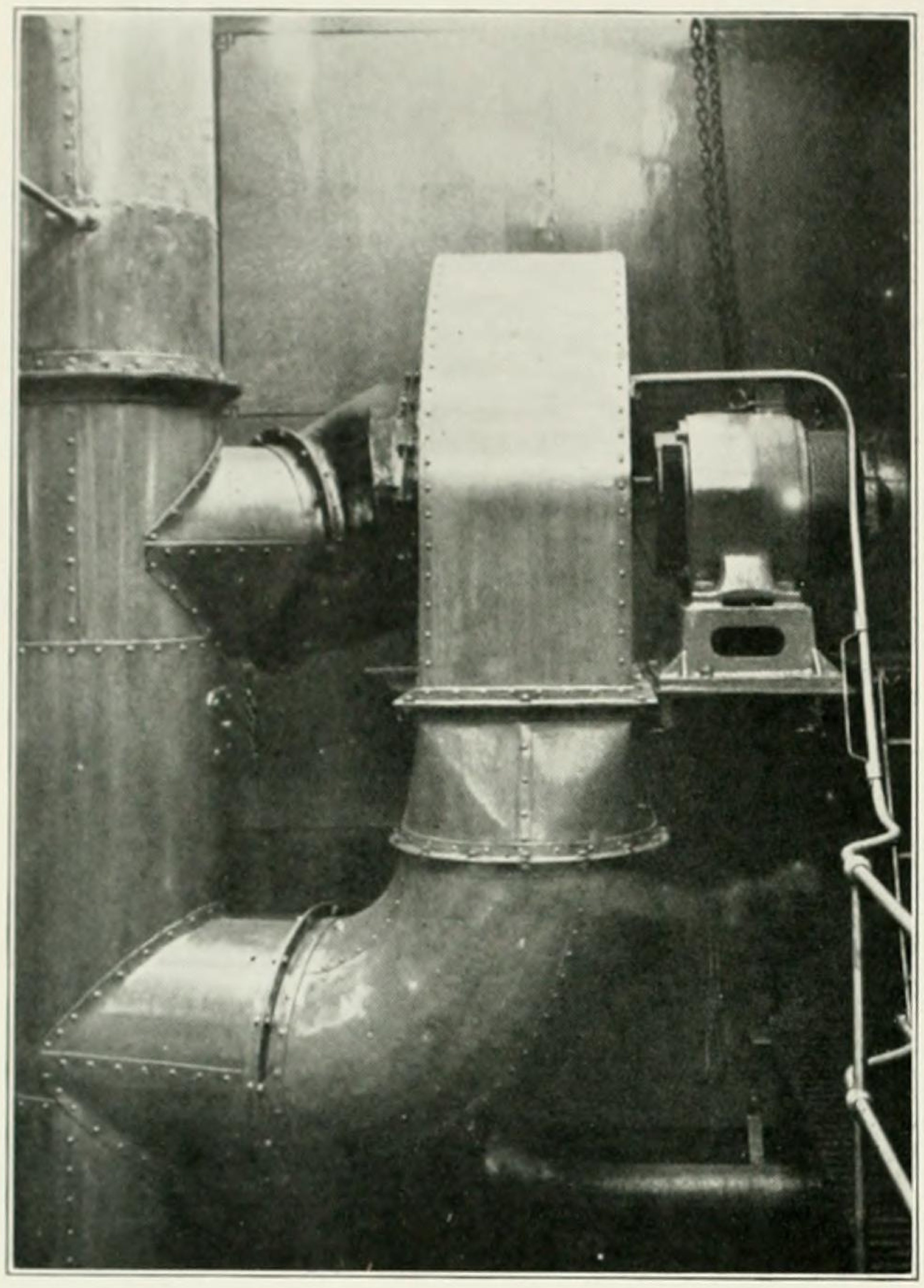


Brine Distribution Tank, showing Valve Controls for Pipe Nests.

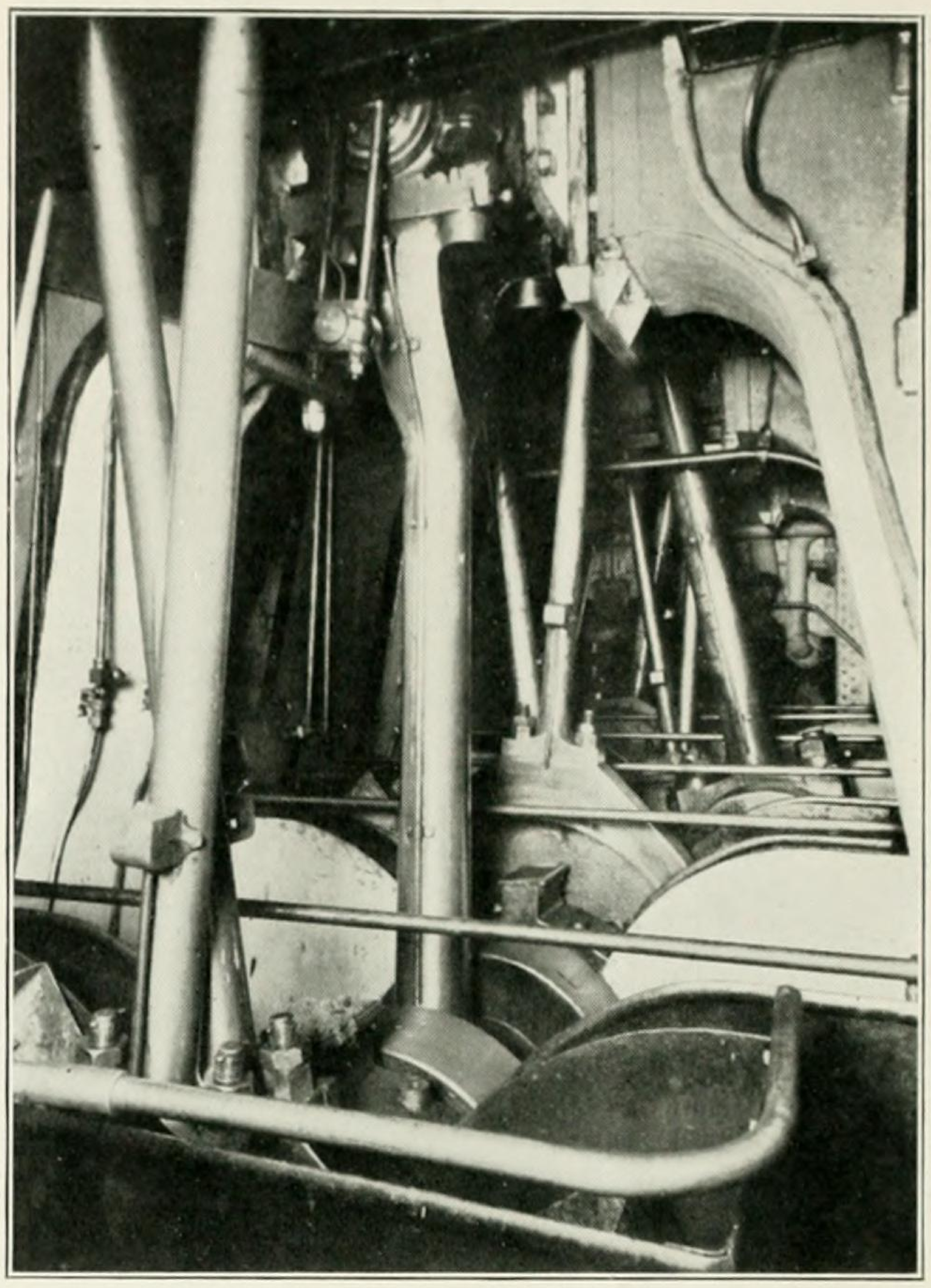


One of the Brine Circulating Pumps.

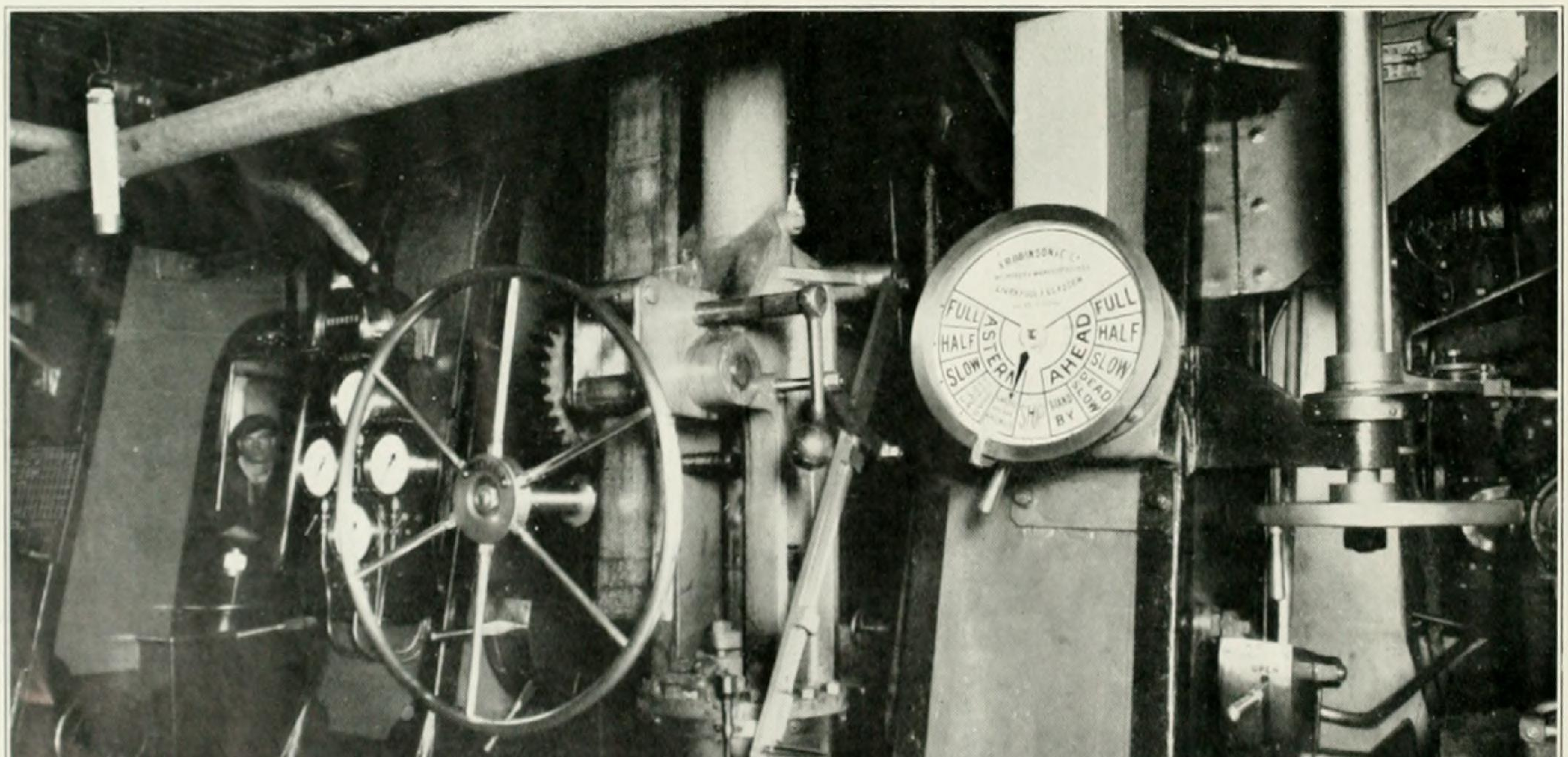
MACHINERY OF THE "PORT HARDY."



Fan and Motor for Engine Room Ventilation.



View looking along Port Crank Pit, taken from Forward.



Control Platform for Port Engine, showing Telegraph and Reversing Handle.

engine having cylinders 22½, 38 and 63½ by 48 in. stroke, designed to run at 85 r.p.m. and developing 4,500 i.h.p.: the thrust blocks are of the Michell type, and these are forced lubricated from pumps driven off the main engine.

The main condensers, which are of the uniflux type are carried on the outboard side of the main engine and have each 2,500 sq. ft. exposed area. The air pumps for supplying the necessary vacuum are driven by levers of the main engines and the main circulating pump is turbo-driven. A stand-by circulating pump, situated on the starboard side of the ship, as a glance at the general out-lay of machinery will show, is driven by one of two high-speed enclosed crankpit reciprocating engines.

Propellers.

The propellers are of the built type, each having four loose manganese-bronze blades bolted to a cast-iron boss which has a diameter of 4 ft. 1 in.

The following are the diameters of the various sections of the propeller shafts, which are of Siemen's-Martin ingot steel :—

Crankshaft	13⅝ in. diam.
Thrust shaft	13½ in. ,,
Intermediate shaft	12⅝ in. ,,
Tail shaft	14⅝ in. ,,

We illustrate on page 132 the flat at the aft end of the shaft tunnels, showing the spare tail shaft and value distribution boxes to aft tanks. The arrangement of the main and auxiliary machinery seems to be quite commodious, and there is plenty of space for access to the manœuvring controls ; the starboard starting position we reproduce elsewhere, and this photograph shows also one of the main telegraphs which is a product of Robinson & Co. Limited, Liverpool ; the revolution counter, which will be noticed in the background, is of the Harding's improved pattern.

The length of the engine room is 30 ft. 10½ in. and that of the thrust recess 19 ft. A point of interest arises in the method of ventilating the engine room. The motor, which we show elsewhere, drives a fan which can either supply air or exhaust it from the engine room through the vent "legs," as will be seen, and any one "leg" can be cut off if necessary by means of louvres. The motor is a shunt wound direct-current motor, developing 4½ h.p. at 460 r.p.m., giving 42 amps. at 100 volts. It is supplied by the Sunderland Forge Company.

Boiler Room.

The boiler room is 45 ft. 1½ in. in length ; steam is supplied by four boilers of the horizontal multitubular Scotch type, working at a steam pressure of 200 lbs., with superheaters of the Schmidt type fitted to give 200 degrees superheat. Howden's system of forced draught is fitted to the boilers.

Each boiler is fitted with four Morison type furnaces of 3 ft. 7 in. diam. The funnel has an internal diameter of 9 ft. 9 in. and a height above the centre line of boilers of 88 ft. 5½ in.

The feed-water arrangements consist of a Weir's direct-contact feed-water heater fitted with the usual float, which we illustrate elsewhere, one main and two auxiliary feed pumps of reciprocating type, which we mention later, and an Edmiston feed filter of the type supplied by the Glasgow Patents Limited. The Cumberland electrolytic system is fitted for the determination of salinity of the feed water ; this and the Edmiston feed filter we illustrate on page 132.

Auxiliary Machinery.

We give in the next column a complete list of auxiliary machinery which should prove of great interest, since it gives a very comprehensive idea of the types of machinery fitted and their sizes.

TABLE OF AUXILIARY MACHINERY.

Auxiliary.	No.	Maker.	Size.
Main auxiliary pump	1	Paul	16 in. reciprocating.
Main auxiliary pump	1	Weir	16 in. (turbine).
Main air pump	2	O.M.E.	23 in. diam. by 24 in. stroke.
Main feed pump	2	Weir	10 by 13½ by 21 in.
Auxiliary feed pump	1	Mumford	6 by 9 by 10 in.
Feed pump	2	O.M.E.	6 in. diam. by 24 in. stroke.
Bilge	2	O.M.E.	6 in. diam. by 24 in. stroke.
Forced lubricating pump	1	Weir	8 by 9 by 18 in.
Auxiliary air pump	1	Weir	15 by 9 by 12 in.
Auxiliary circulating pump	1	Paul	8-in reciprocating.
Ballast	1	Mumford	8 by 10 by 10 in.
F. and bilge	1	Mumford	7 by 8 by 8 in.
Distiller and W. deck	1	Mumford	7 by 8 by 8. in.
Emergency b.p.	1	Lamont	6-in. suction motor, driven 9 by 8 in. stroke.
F.W. pump	2	Mumford	5 by 5 by 8 in.
Sanitary	1	—	6 by 7 by 8 in.
Evaporator	1	Weir	80 tons.
Fan and engine	1	Howden	90 in. fan.
Lubricating oil pump	1	O.M.E.	2½ in. diam. by 8 in. stroke.
Sanitary pump	1	O.M.E.	6 in. diam. by 12 in. stroke.

The following auxiliaries are driven off the main engine :—

Two main air pumps	23 in. diam. by 24 in. stroke.
Two feed pumps	6 in. diam. by 24 in. stroke.
Two lubricating oil pumps	2½ in. diam. by 8 in. stroke.
Two bilge pumps	6 in. diam. by 24 in. stroke.
One Sanitary Pump	6 in. diam. by 12 in. stroke.

The main circulating arrangements have been mentioned already ; the main turbo-driven circulating pump is of the Weir 16-in type, and the auxiliary circulating pump is of the centrifugal type, driven by a high-speed reciprocating engine supplied by Matthew, Paul & Co., Dumbarton.

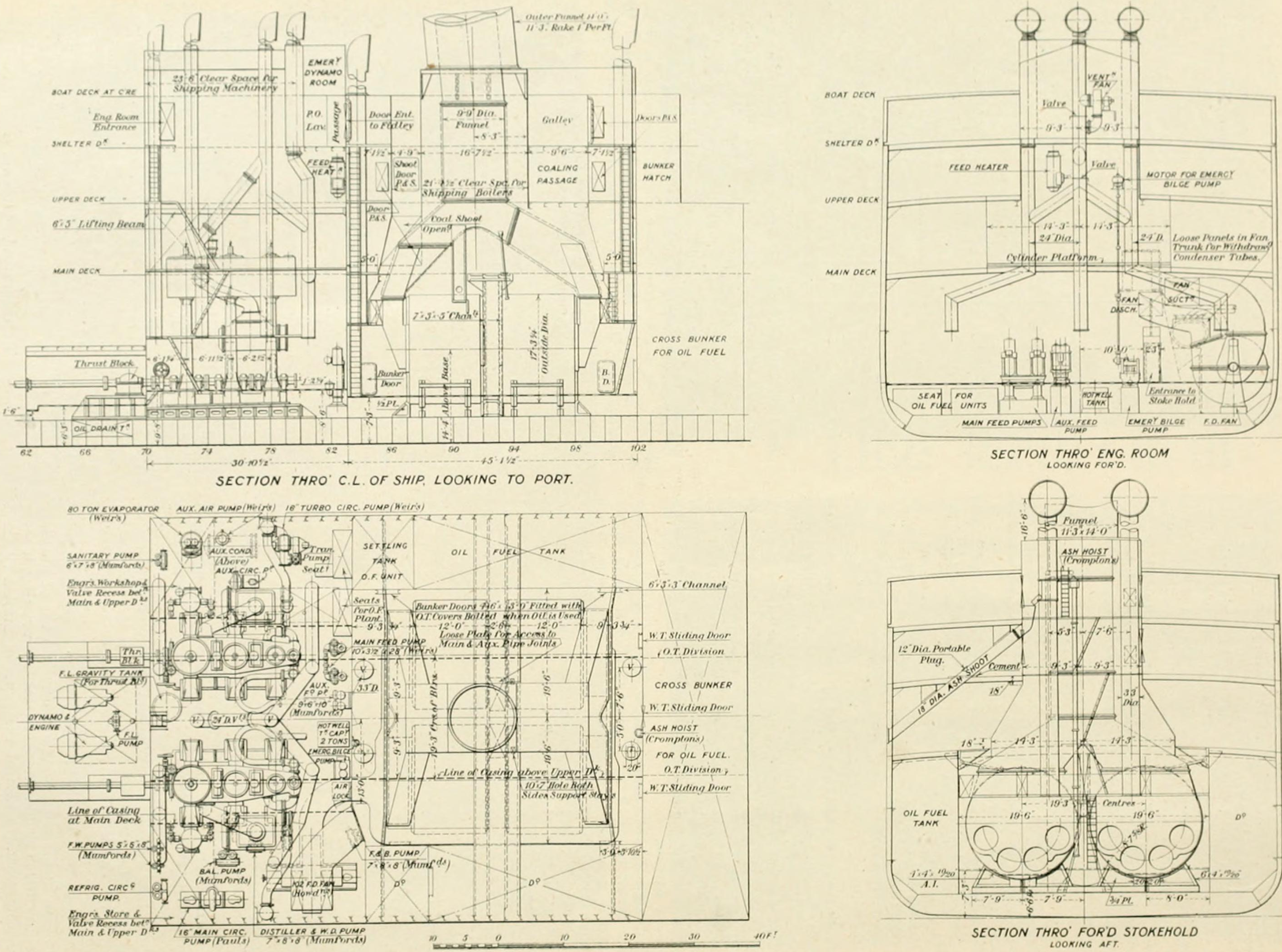
The auxiliary condenser is of the ordinary type ; its circulating pumps, which we illustrate elsewhere, is supplied by the makers of the auxiliary main circulating pump, and the air pump for the auxiliary condenser is a Weir monotype pump. The auxiliary feed pumps are supplied by Mumford's, of Colchester, and the main feed pump is one of Weir's type. For particulars of the remaining auxiliary machinery the reader is referred to the appended table. On page 129 we illustrate an observation board on which are fixed various steam gauges which are of the type manufactured by Dewrance & Co., London, and also thermometers, which are of the special type made by the Scientific Instrument Company, Newcastle-on-Tyne. The Auld patent reducing valve, illustrated on page 130, is fitted for the purpose of reducing the steam pressure to the 120 lbs. per square inch required in the refrigerating engines. The pressure guage, shown on the right of the value, is of the Bourdon type.

Generators, &c.

The generators are arranged as shown in the plan, and we also illustrate them elsewhere. There are two units, each consisting of a generator giving 260 amps. at 100 volts and running at 275 r.p.m. The generator is direct-coupled to a Howden high-speed forced-lubrication reciprocating engine. The pump situated between the two generators is an auxiliary forced-lubrication pump for the Michell thrust blocks. The steering engine, situated on a level with the crew space aft, and well protected from heavy weather, is of the steam-driven type, manufactured by Hastie & Co. Limited, and is controlled from the bridge by a Mactaggart-Scott telemotor gear.

Refrigerating Machinery.

The refrigerating machinery is of the CO_2 type. There are



The Commonwealth and Dominion Liner "Port Hardy." General Arrangement of Machinery Space Sections through Engine Room and Boiler Room.

two distinct units, and we illustrate two views of one of them elsewhere; each engine takes steam at 120 lbs. per sq. in., runs at 70 r.p.m., and is coupled up to a 5½-in. compressor.

The system of freezing is that of the actual distribution of brine through nests of pipes arranged in the holds in the usual manner, arrangements being made whereby warm or cold brine can be circulated, according to the nature of the cargo. We illustrate one of the brine tanks, and the photographs show the controls for pipe distribution, *i.e.*, for shutting off a given number of coils, and also a distribution box, the valves on one side controlling the warm brine for chilling purposes, and those on the other side the cold brine for freezing purposes; spare CO_2 bottles will be noticed on the bulkheads. There are three brine distribution (see photograph) pumps which are of the direct-acting type, supplied by Mumford's Limited, Colchester, and working at 14 double strokes per minute. On the bulkhead leading to the engine room is situated the steam coil for thawing out, and this we illustrate elsewhere. The insulating material is granulated cork, and the insulation of the holds has been carried out by Gregson's Limited, London.

SOME NOTES ON THE LONGITUDINAL ADJUSTMENT OF TURBINES.

The longitudinal adjustment of a turbine is arranged for by means of the thrust block. Thrust collars are turned on the shaft just as in the case of ordinary reciprocating engines, but the thrust block, in turbine machinery, is fitted outside the forward end of each turbine casing. Also, this adjusting block is in halves in such a way that the lower half takes the ahead thrust and the upper half the astern thrust, being also capable of separate adjustment. It is of steel, and is grooved out to receive brass rings, the edge of the groove being then well caulked into the ring. Through the rings, excepting the end ones, holes are drilled and gutter ways cut from these to the edges; this is to allow a good circulation of oil, and, as the end rings are not drilled, this prevents the oil escaping too easily. The rings in the bottom half bear against the forward faces of the collars on the shaft, and those in the top half against the after faces of the shaft collars, when in the normal or working position, the rings all being bedded on to the shaft collars, to ensure that each is doing its work. When the rotor dummy has the requisite clearance, the bottom half of the block is brought hard up against the forward side of the shaft collars, and in a space at one or both ends of the block, brass liners are fitted, the effect of which is to prevent the shaft working forward. The top half is then put on, and by means of screw gear is brought forward so that the rings bear against the after-side of the thrust collar. It is then set aft until there is a clearance of from 4 to 6 thousandths between rings in top half of brush and collars of shaft for lubrication purposes, being then secured in this position. The bolt holes in the thrust block are oval, being larger than the bolts to allow for the foregoing. In practice, it is found that the wear on the thrust block is nil, the propeller thrust being balanced by the pressure of the steam acting on the vanes in the opposite direction. It will be seen from the foregoing description that the top half of the block may be moved by the screw gearing attached, but in the case of the bottom half, it can only be moved forward or aft by decreasing or increasing the thickness of the liners fitted. To adjust the dummy clearance: this is obviously the longitudinal adjustment of the turbine. By means of the dogs and gear provided, bring the rotor up until dummy rings and grooves are in actual contact; now note clearance at finger plate in this position; and then screw back rotor until clearance at finger plate is increased by, perhaps, 30 thousandths. The liners of thickness requisite to bring the lower half and thrust rings up against the forward faces of shaft collars can then be fitted in place and the lower half will then be locked in position. The upper or astern position of the thrust is dealt with thus: Ease back nuts of collar studs and work adjusting screw till rings and collars are in actual contact by cover moving forward. Now tighten cover stud nuts and screw back adjusting stud till "feelers" between it and the turbine casing show the necessary clearance for oil, say, six thousandths. Then ease back cover nuts and tap on top half till this clearance becomes nil; then screw cover bolts down hard. Thus there is an oil clearance of about six thousandths, the dummy clearance being, as explained, 30 thousandths. This operation of adjusting clearance should always be done with the turbine thoroughly hot, and as this clearance is a most important detail in the economy and efficiency of the turbine, it must always be very closely and carefully observed.

TEMPERATURE AND THE STRENGTH OF MATERIALS—*Continued from page 126.*

figure. The method of "colonizing" was only fully described in the *Marine Engineer* in July last year. This treatment consists of heating metals in retorts in a reducing atmosphere with a mixture containing finely divided aluminium, and so thoroughly infuses aluminium into the exposed portions dealt with that a homogenous aluminium alloy is formed for a certain depth, ranging as required for surface treatment to the permeation of the entire mass. This method is primarily a protection against burning, and "colonized" metal will sucessfully withstand temperatures up to 1,800° Fahr. without deterioration. This figure, as has been shown, is far above any of the recorded best results quoted, and will, of course, prove even more efficacious below this limit. From the point of view of erosion, there is much less to fear than there is in the effect of temperature on strength as far as turbine discs are concerned. Holzwarth, it should be noted, in the various gas turbines he has built, contented himself with comparatively low blade speeds—about 540 ft. per second, so that his disc stresses were fairly well covered by the use of electro-steel, but the low blade speed meant a low impinging velocity of gas, and hence a weak mixture, so that the potential efficiency of his machine suffered accordingly. Before the internal-combustion turbine can encroach—if it ever does—on the field of the large marine oil engine, much more work requires to be done on rotor material. That we have an alloy to-day that will stand 1,000°-1,200° Fahr. is not sufficient. The time factor has an important influence on the question of reliability, in the case of alloys the tendency has often been for the constituent elements to separate out under the combined effect of heat and the duration of its application. It must not be forgotten, however, that blade speeds and steam temperatures are in daily use to-day which only ten years ago were very far from realisation. Just as they came into being to supply a demand, so it seems certain that, with application to the subject, much higher speeds at much higher temperatures will be rendered equally possible by improvements in material in the direction of superior heat-resisting qualities.