THE TURBINES OF THE "CARMANIA."

The triple-screw turbine-driven steamship "Carmania," of the Cunard Line, which has recently completed its maiden voyage to New York, is a sister ship to the "Caronia," and identical with her in everything outside of the engine room. As we described the "Caronia" fully in our issue of March 11, 1905, when we gave illustrations of the passenger accommodation of the vessel, it will be sufficient for our present purpose to recapitulate briefly the leading dimensions and capacity of the new turbine liner.

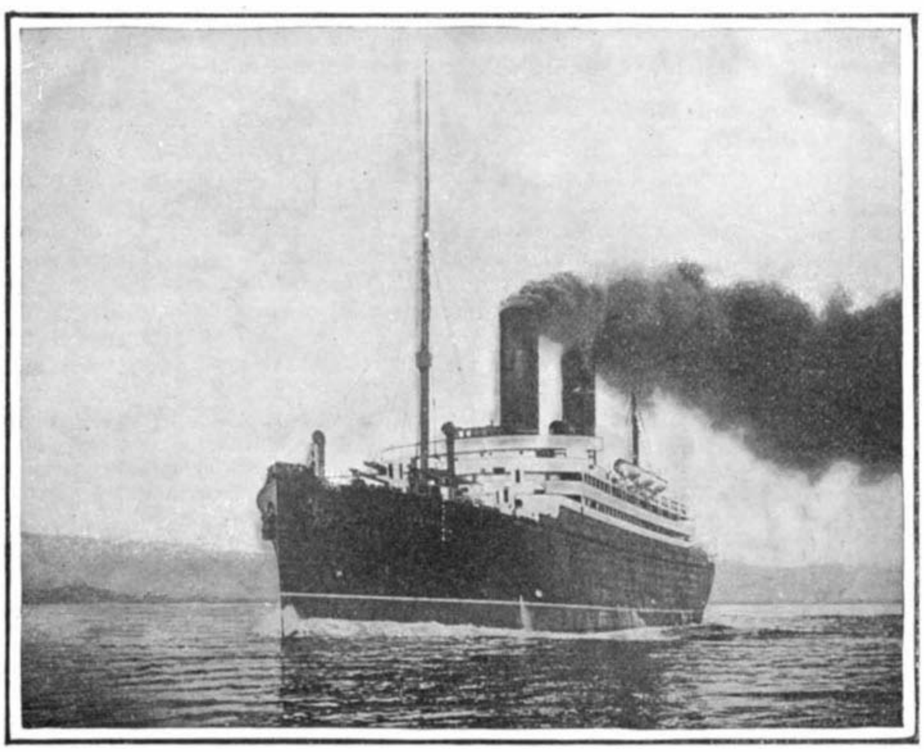
The "Carmania," like the "Caronia," was built on the Clyde by Messrs. John Brown & Co., a firm which as long ago as 1867 built the "Russia," the first of the screw-propelled Cunarders to sail to the port of New York. The same firm has in hand one of the two 25-knot, 43,000-ton liners which are being built by the same company and will be placed in service early in 1907. The dimensions of the "Carmania" are as follows: Length on deck, 672 feet 6 inches; beam, 72 feet 6 inches; molded depth, 52 feet; depth from keel to roof of navigating bridge, 90 feet; depth from keel to top of funnel, 144 feet; depth from keel to top of masts, 205 feet. With full load the great ship draws 33 feet 3¼ inches and displaces 30,918 tons. She accommodates 300 first-class, 326 second-class, 1,000 third-class, and 1,000 steerage passengers. Add to this a complement of officers, engineers, and crew of 710, and we get a total of 3,336 souls that can be housed, fed, and comfortably transported. This is the population of many a thriving and well-equipped city in the United States that calls itself populous. In spite of the great displacement of these ships, they have a coefficient of fineness of less than 0.7. In the 25-knot ships the coefficient will be not very much over 0.5.

The sister ship "Caronia" was commenced and completed within the remarkably short time of nineteen and one-half months; the "Carmania," because of the novel conditions introduced by the installation of the turbine, took slightly longer. She was begun February 29, 1904, and launched February 21, 1905. In the construction of the "Carmania" 12,000 tons of steel and 1,800,000 rivets were required. Many of the plates are 1⅛ inch thick, 32 feet long, and 5½ feet in width. The keel plate is 5 feet deep and over 1 inch in thickness, and in the framing each fifth frame, in the machinery and boiler compartment, and each sixth frame forward and aft, is of web section, built up of ½-inch plates 30 inches in depth. The shell plating, for the most part, is 1 inch in thickness. The passenger accommodation is identical with that of the "Caronia," which has already been fully described in this journal.

Interest in the "Carmania" centers, of course, in her engine room; for although the Allan Line steamships "Virginian" and "Victorian" have been running now for many months with turbine engines, the latter are small compared with those of the new ships, being of about 10,000 horse-power, whereas those of the "Carmania" on the trial trip developed nearly 25,000 horse-power. The great size of the turbines, and the necessity of familiarizing the staff with their construction and operation, led the builders to make a set of three screw marine turbines of 8,000 horse-power. A shop was set apart as an experimental station, in which the turbines were erected together with a full equipment of condensers and auxiliary machinery. The turbines were coupled to dynamos whose efficiency had been accurately determined, and thus it was possible, during the many months that the plant was under test, to gather a large amount of most valuable turbine data. Experiments were also carried out to determine the best form of stiffening for the big turbine casings, to prevent distortion due to high-temperature steam. The result of the careful experimental investigation was shown in the very successful maiden trip to this port, on which the "Carmania" had to contend with extremely heavy gales for practically the whole voyage. As compared with the reciprocating engines of the "Caronia," it is found that there is a saving of weight in the turbines of about five per cent. This is very much less than has been popularly supposed, although engineers have well understood that the saving would not in the larger turbines reach a very high figure. In the "Caronia" the boiler pressure is 210 pounds, in the "Carmania" it is 195 pounds per square inch. Steam pressure at the engines is 200 pounds in the reciprocating engine, and 150 pounds in the turbines. To insure the full advantages in economy of the turbine, it is necessary to have a very high vacuum; and hence the 27,030 square feet of condensing surface in the "Caronia" is increased to 32,436 square feet in the "Carmania," while the capacity of the centrifugal pumps is increased 100 per cent.

The turbine machinery consists of three turbines, one to each propeller shaft. The high-pressure turbine is in the center, with a low-pressure turbine on each side of it. Adjoining each low-pressure turbine is a surface condenser. The high-pressure turbine is about 8 feet in diameter, and the low-pressure turbines are about 14 feet in diameter. The turbine blades, of which there are 2,115,000, vary in length from 2 to 10 inches. At the forward end of the low-pressure turbines, on the same shaft and within the same casing, are two turbines, or turbine rotors, for driving the ship astern. The total length of the combined ahead and astern turbines and their common casing is 36 feet.

From this description it will be seen that the turbine machinery of the "Carmania" is built on an imposing scale. In fact, the first impression, as one enters the engine room, is that he is facing three steam boilers, covered with Russia iron casing. As a matter of fact, the turbine equipment, with its necessarily large number of pumps and auxiliaries, occupies not much less space than the reciprocating engines of the "Caronia." The weight of each of the low-pressure turbines in the "Carmania" is 340 tons. The casings of the turbines are split longitudinally, and in order to lift the upper half for inspection, it has been necessary to install special lifting gear, which consists of a pair of massive crossheads, one at each end of the casing, to each of which is attached a heavy vertical screw, and worm-wheels and gear driven by an 18-horse-power motor. The total weight of the upper half of the low-pressure turbine casing is 98 tons, and of the high-pressure casing 45 tons. The starting platform is located at the forward end of the engine room, at about the level of the top of the turbine casings. The main throttle valve, which serves all three turbines, is shown in our illustration in the front of the platform, and in the center are shown two of the three sets of controlling levers, the center one being for the high-pressure turbine, and the two outer sets for the low-pressure turbines. High-pressure steam is admitted to the forward end of the high-pressure turbine and exhausts at the after end, from which it is led back into the forward end of the low-pressure turbine, and after passing through the blades, exhausts at their after end into the two condensers. The two go-astern turbines at the after end of the low pressures run normally *in vacuo*, and do no work. When running astern they are fed live steam direct from the main throttle.



Trial Speed, 20.5 knots. **Displacement,** 30,918 tons on 33 feet 3 inches draft.

THE NEW TRIPLE-SCREW, TURBINE LINER "CARMANIA."

Each of the three propellers is three-bladed, the blades being of the coarse pitch and large area which have been found best adapted for turbine service. They are only 14 feet in diameter, or say about 63 per cent of the diameter of the propellers of the "Caronia." They are driven at an average speed of 180 revolutions to the minute, which is by far the lowest propeller speed yet attempted with turbine engines. Except for their larger size, as described above, the condensers are of the ordinary cylindrical type. They are fitted with double-cylinder dry-air pumps, with a view to obtaining the fullest possible vacuum.

Governors are fitted to each of the turbines, and they are so adjusted that any increase beyond ten per cent in the revolutions of any of the turbines shuts off the steam until the revolutions fall to the normal speed. There is also an emergency governor provided, which entirely stops the turbines should any racing take place. We may mention in conclusion that should the "Carmania" be taken up by the British navy as an auxiliary cruiser, she would carry twelve quick-firing guns of large caliber. Moreover, two sets of steering gear are provided, one for ordinary navigation, and a duplicate set placed below the waterline, in agreement with Admiralty specifications.

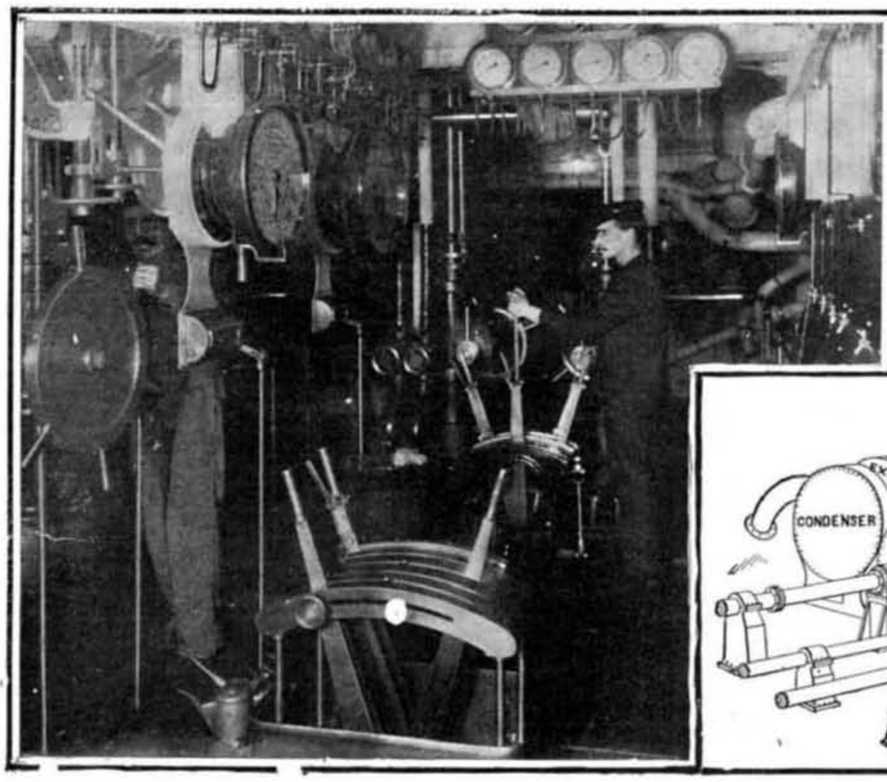
The Effect of Colored Light on Grain.

According to the experiments which have been recently made in France by J. Dumont, the different rays of the spectrum have a variable effect in the amount of nitrogen which is produced in the grains of plants, and this effect is strongly marked. Since the researches of Laurent, Marchal, and others, we are aware that light is necessary for the formation of albuminoids in the case of plants and the most refrangible rays are the most active in this respect. To show this action more clearly M. Dumont wished to observe the growing plants during the whole period of formation of the grains, after the flowering. He operates upon wheat which is cultivated in the vegetation boxes of the Grignon experimental farm. The plants grew under the best conditions, and were of regular growth at the beginning of the tests. As soon as the fecundation was accomplished he placed a series of box frames about the plants. The sides and the tops of the boxes were provided with colored glass. Means were provided for giving a good ventilation to the plants and prevent overheating. The surface of ground covered was about 800 square inches. Every week a number of heads were taken out so as to see the development. The wheat ripened normally in all cases, but it was found that the different colored glasses had a marked effect upon the composition of the grains, and the percentage of nitrogen and albumen which they contained. The colored glasses used were as follows: Blue, black (dark bistre), red, green, besides the free plants used as a check upon the results. The percentages of nitrogen in the grains corresponding to the above glasses are 2.13, 2.54, 1.91, 2.74, 2.08. For the albumen we have 13.31, 15.87, 11.94, 17.12, 13.00. The free plants given in the last figures show a normal constitution, while the differences are striking for the colored glasses. The green glass shows the highest percentage of nitrogen, or an excess of 66 per cent, then come the black, the blue and the red. These results show that the radiations which have the greatest effect upon the presence of the albuminoids in the wheat grain are those which act the least upon the chlorophylian function. All the tests were made with the same variety of wheat (Japhet wheat) and under identical conditions of soil and fertilizer, so that the results appear to be certain. We must not omit to state that all the grains were found to be formed as usual and their germinating power was not affected. Upon 100 plants, there were 92 germinations with the free plants, 94 with the black glass, 97 for the red and 99 for the blue and green. The author proposes to make further researches upon other plants.

Watt did not, of course, invent the steam engine, but he improved it so greatly as to become practically the father of modern steam engineering. He devised the separate condenser, the jacketing of the cylinder, the admission of steam to each side of the piston alternately, the steam-engine indicator, the ball governor, the poppet valve with beveled seat, the throttle valve, cross-heads and guides, the coupling of two engines together, and the water gage. He also suggested cut-off at quarter stroke as being the most economical. He found the steam engine of small power and limited usefulness owing to its disproportionate size and extraordinary consumption of fuel. He left it a complete machine, fit to be a potent element in the industrial development of the world.

This is the epitaph on Watt's monument in Westminster Abbey:

"Not to perpetuate a name, which must endure while the peaceful arts flourish, but to show that mankind have learnt to honor those who best deserve their gratitude, the king, his ministers, and many of the nobles and commoners of the realm raised this monument to James Watt, who, directing the force of an original genius, early exercised in philosophic research, to the improvement of the steam engine, enlarged the resources of his country, increased the power of man, and rose to an eminent place among the most illustrious followers of science and the real benefactors of the world. Born at Greenock, MDCCXXXVI. Died at Heathfield, in Staffordshire, MDCCCXIX."



Starting-Platform Showing Main Throttle and Turbine Control Levers.

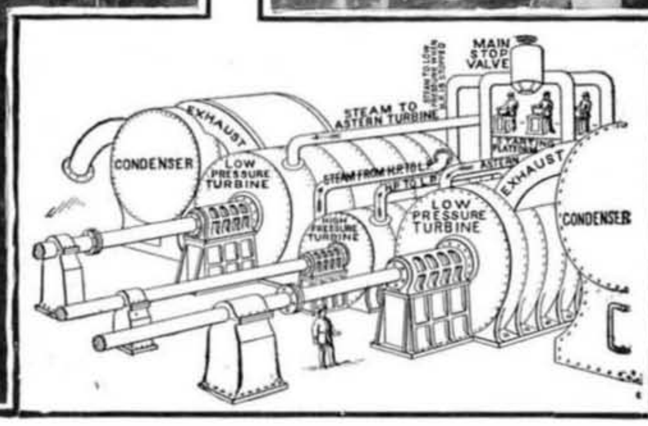
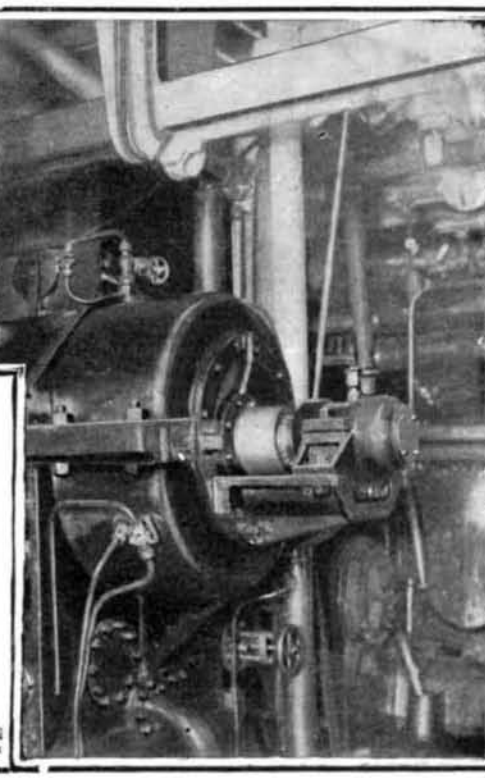
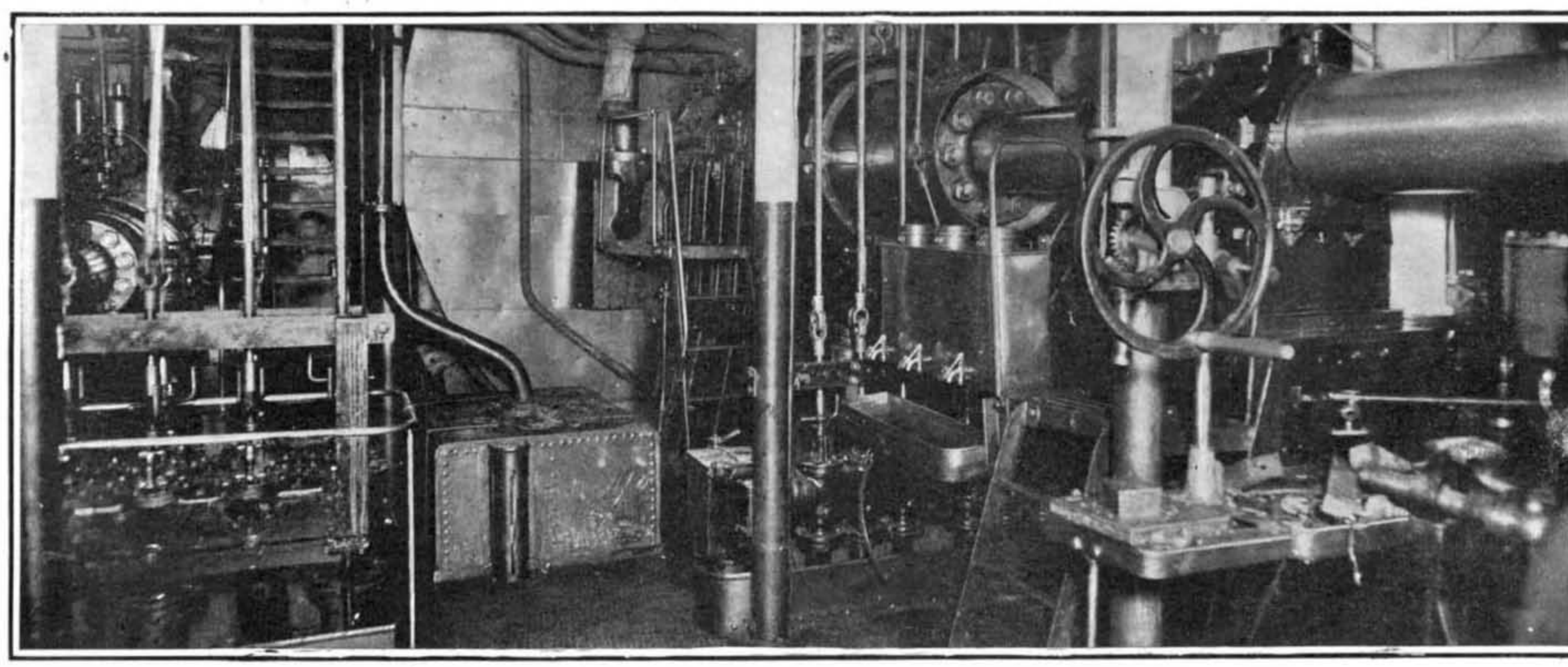


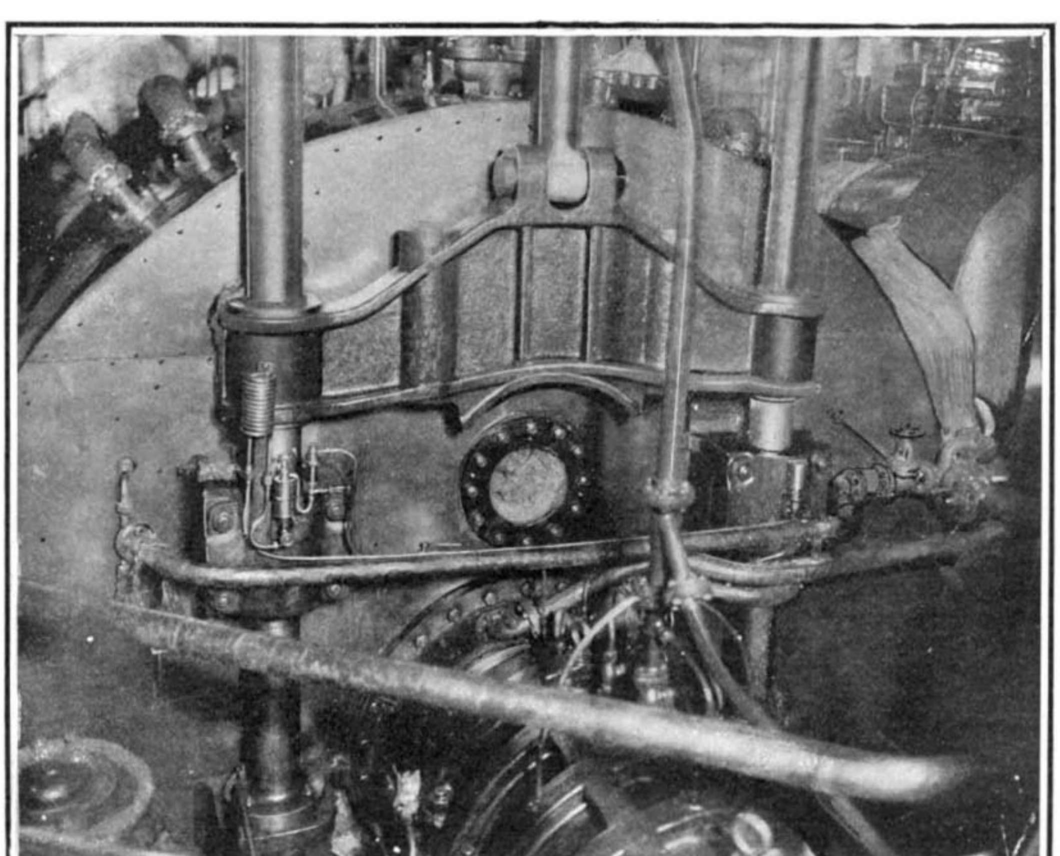
Diagram Showing Arrangement of Turbines and Condensers.



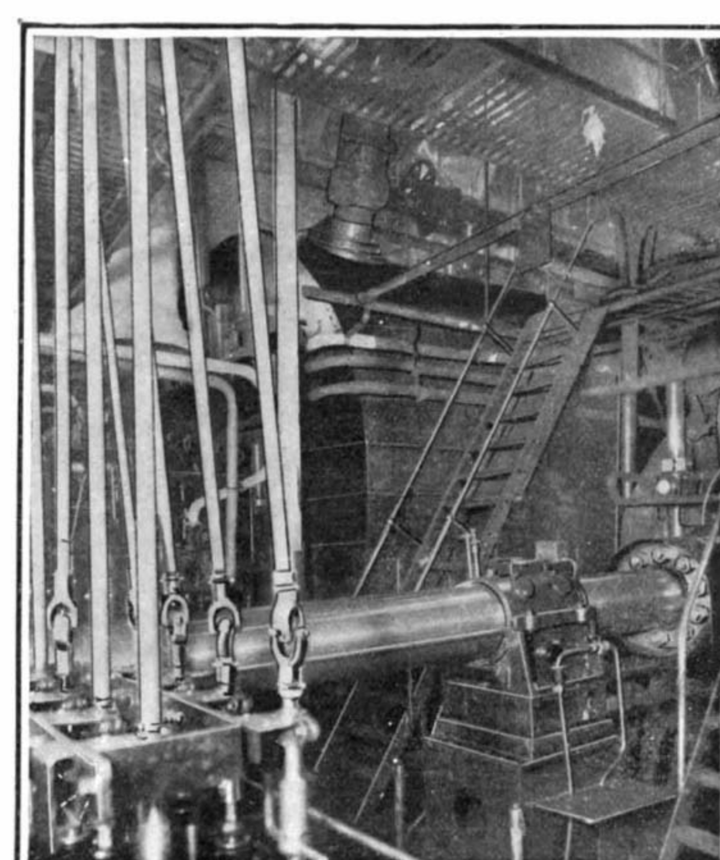
Forward Bearing of High-Pressure Turbine Shaft.



View Looking Forward, Showing After End of Turbines, With Starboard Turbine 14-inch Shaft to the Right.



Forward End of Starboard Low-Pressure Turbine Showing Cross-Head and Guides for Lifting the Casing.



High-Pressure Propeller Shaft and After Face of High-Pressure and Port Low-Pressure Turbine.

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