than anything else the location of Hamburg at the head of the (for sea-going vessels) navigable river Elbe. Yet imagine a bridge like the one at Quebec put up at the entrance to this river from the bay. The result would be that you could buy the whole city of Hamburg, with her four square miles of commercial harbor basins for a song, if that bridge could not be raised or altered so as to provide sufficient and undoubted clearance; for the shipping would immediately be shifted to the competing harbors at the North Sea shores. Montreal has—and she knows it—the most splendid location for a modern commercial harbor plant; and I can easily imagine the sickening feeling with which she will observe the wheat from the great North-West follow the rail to Quebec, because it there can find a lower freight rate by using a large steamer. The bridge clearance of 150 feet corresponds to a draught of 25 feet, and that means a sea-going steamer of 10,000 tons capacity—quite a formidable vessel compared to those now plying on the St. Lawrence. Yet it takes three boats of this size to carry the cargo of one of the present day's standard freighters. If the clearance of the bridge had been 75 feet instead of 150, special vessels would be built with adjustable masts and telescope funnels; yet as these features are nuisances in marine architecture, they will not be resorted to except on vessels built for special routes, where such subterfuges are a necessity, and smaller ships would be used, because these always would be on hand. It is easy enough to say that sailing ships can lower their masts, but if this lowering means additions to the number of the crew, to the building and operating expenses, for instance, by making towing past the bridge necessary, we may safely predict that the sailing ships then would regard the waterway as closed and disappear.

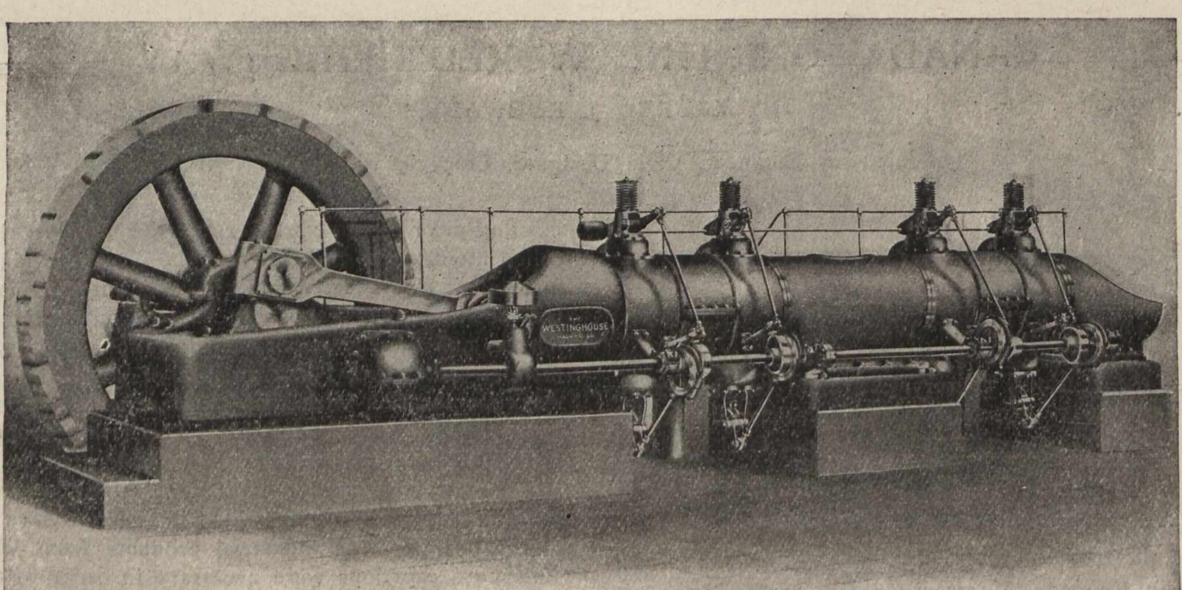
The importance of the large ship in its relation to calculations of the future development lies not alone in the fact that it is more economical in operation, but also in the other fact that it makes standardization of ship-building material possible. The personal whim of the shipowner or the inventor—which has led to a legion of ship types—will practically cease when the huge modern freighter takes the lead. And in this consideration of the large ship lies the key to the future of Montreal, or other ports aspiring to a leading role, and also the answer to the bridge clearance question. It should not be forgotten either in this connection, that the Quebec bridge is the only bridge in the world spanning the waterway to a leading harbor. The other bridges mentioned are spanning sections of inner harbors or waterways of less importance to harbor navigation.

NOTES ON THE DESIGN OF LARGE GAS ENGINES

WITH SPECIAL REFERENCE TO RAILWAY WORK.

By Arthur West.

The following remarks, as the title indicates, are applicable to large size gas engines only. The smaller sizes are unsuited to important electric railway installations on account of first cost, multiplicity of parts and greater expense for attendance, etc. The tendency of the modern plant is constantly in the direction of large size units. This is indicated by the rapid increase in the size of steam turbines installed in modern stations. Similar reasons will, it is believed, cause a demand for large size gas engines for electric railway work in conjunction with producers to operate them.



Westinghouse Horizontal Double Acting Gas Engine. Heavy Duty Tandem Type.

One of the most important considerations in the design of large gas engines is the arrangement of the cylinders. In a single cylinder single acting four cycle engine an explosion takes place once in every two revolutions. In order, therefore, to get the same rotative effect as with a double acting steam cylinder, it is necessary to work four single acting cylinders on the shaft or two double acting gas cylinders tandem on one crank pin. With this arrangement four explosions are obtained in two revolutions, or an explosion every 180° of crank angle. In case of a misfire or premature ignition due to bad gas, the crank can only move one-half a turn before another explosion takes place. In a single cylinder single acting engine the crank must move two whole turns before the next explosion, while with two single acting cylinders opposed to each other or one double acting cylinder the crank may be required to move one and one-half turns before the next explosion. The relative evil effects of a premature or misfire are, therefore, in the follow ratios:—

Two double acting cylinders	1
Two single acting cylinders, opposed type	3
One double acting cylinder	3
One single acting cylinder	4

Gas engines and producers to be commercially successful must be designed to be run with the same class of help as is employed on Corliss engines and boilers. This being