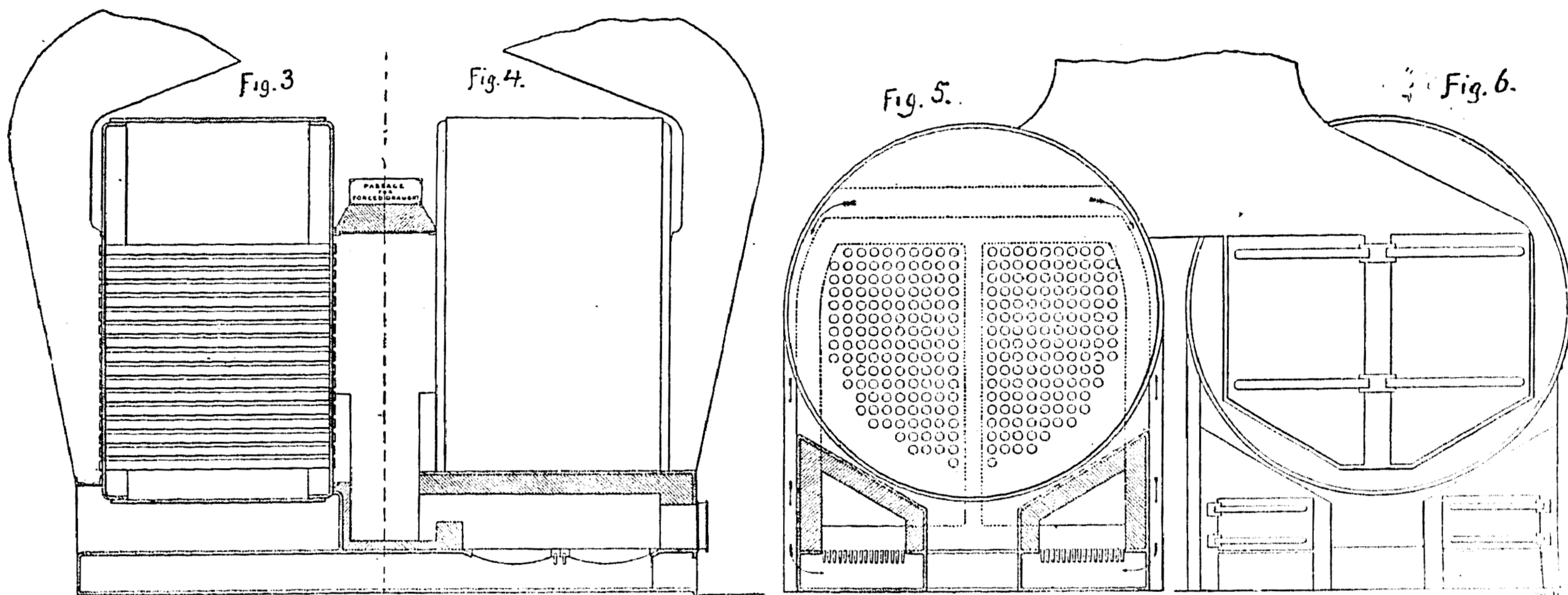


form the tube-plates at one end of each series of tubes, the other ends being secured in the lower half of the cylindrical upper chamber. Each of the three chambers is about 6 ft. long, and the upper cylinder has a diameter of about 20 in.; each is made in two parts, with longitudinal flange joints. By removing the lower (circular) portions of the water-pockets *AA* and the upper part of the top cylinder *B* all the tubes are rendered accessible for cleaning or renewal. There is no direct connection between the lower chambers, and the whole system has complete freedom for expansion. The grate *D* occupies the space between the water-pockets, and the fire gases ascend between the tubes on either side, as indicated in the sketch, and over the top cylinder to the funnel. With the exception of the

order to make a satisfactory structure for 250 lbs. pressure. With this pressure difficulties will arise with the furnaces and the flat sides of the combustion chambers. To get over these difficulties the writer proposes to put the furnaces and combustion chambers outside the boiler altogether. The boiler then becomes a simple cylinder, the tubes running from end to end. As shown in figs. 3, 4, 5 and 6, the boilers are arranged back to back, with the combustion chambers between them. The furnaces and combustion chamber may be of cast or wrought iron, lined with firebrick. In order to keep down the grate surface, and thus economize space athwartships, it will be of advantage to use forced draft, and all the air on its way to the furnaces is made to pass over the top and sides of the



PROPOSED HIGH-PRESSURE MARINE BOILER.

lower portion of the water-pockets, the whole is enclosed in a double wrought-iron casing filled with asbestos. All the tubes and chambers are of steel, and galvanized within and without. The feed-water is introduced from the front into the top cylinder near the middle of its length.

The circulation takes place upward through the hotter inner tubes—next the furnace—and downward through the outer tubes. Contrary to what might have been expected from the design, it is stated that no priming takes place.

Boilers of this kind have been in use for some time, and it is stated that no trouble has been experienced from leaking tube joints. As compared with a locomotive boiler suited for the same work, it is stated that the new generator is about 10 per cent. lighter, including coal and water. The cost is about the same in both cases.

The other boiler is shown in the second illustration, and is not of the tubulous type, but is a modification of the ordinary tubular marine boiler. In the engraving—for which we are indebted to *Industries*—fig. 3 is a section through the boiler; fig. 4 a section through the furnace; fig. 5 a transverse section and fig. 6 an end elevation. This form of boiler was recently suggested in a paper read before the Northeast Coast Institute of Shipbuilders & Engineers at Newcastle, England, and can best be described by a condensation of the paper.

To sum up his argument very briefly, the writer has endeavored to show that the economy of the three-crank triple-expansion over the two-crank compound has been mainly due to the increase of boiler pressure, and, to a small extent, to the increase of piston speed. That by increasing the boiler pressure to 250 lbs. per square inch a steam economy of, say, 15 per cent. can be obtained over the present three-crank triple. That an increase of piston speed, besides increasing the economy of steam, will also increase the weight economy, so that the piston speed should be increased up to the practicable limit. That the best type of engine to use this higher pressure, and best adapted to run at a high speed, is the four-crank four-cylinder engine, with unjacketed cylinders and separate steam and exhaust valves.

Passing on to the question of the type of boiler to be adopted, the writer is of opinion that a considerable departure from the present design of boiler is necessary, in

combustion chamber, thus reducing to a minimum any loss from radiation.

The advantages of a boiler of this type are obvious. It is perfectly suitable for a high pressure. There will be no straining from unequal temperatures. The cost of manufacture will be considerably less than that of the present type of boiler. For the same heating surface the space occupied is less; the boiler shown in figs. 3, 4, 5 and 6 is 10 ft. 6 in. diameter, and contains the same heating surface as a boiler of the present type, 13 ft. 6 in. diameter, the lengths in both cases being the same.

#### A PARISIAN SUBWAY.

(From *Le Genie Civil*.)

THE Sceaux Railroad, built about 1848 on the plans of the Engineer Arnoux, was intended to show the possibility of using curves of very small radius. The principle of the system adopted consisted in the use of guiding rollers or wheels to keep the engines on the track, while the driving-wheels had no flanges.\* Unfortunately this system was somewhat complicated for ordinary use and required a very wide gauge, so that it did not come into general use.

The Orleans Company recently bought this short road, and is now rebuilding it as an ordinary road and supplying it with equipment of the ordinary types. In connection with this rebuilding the road is being extended from the old terminus for some distance into the city. The new terminus is at the Rue Medicis, and the underground line by which that point is reached is to be extended across the city to the Orleans station on the Quai Maubert. The extension from the Rue Medicis is being surveyed. With a short addition outside of the city this will make a very convenient loop.

The extension now building is entirely underground. With the exception of a short distance under private property it runs under the street, most of the way under the Boulevard St. Michel. The line is double track, and for most of the distance has a grade of 2 per cent. Where it is sufficiently below the surface the tunnel is arched over with masonry; at other points there are retaining walls

\* This system was described and illustrated in the *JOURNAL* for January last, page 46.