

JOHN AND ROBERT LIVINGSTON STEVENS 13

Another was a coiled tube within a cylindrical firebox, connected at its two ends with the annular surrounding water-space. This was the first "coil boiler." A third type was the vertical tubular boiler, as built to-day. John Stevens' design was patented in Great Britain in 1805, by his son, John Cox Stevens, who said:

"The principle of this invention consists in forming a boiler by combining a number of small vessels, or tubes, instead of using a single large one. . . . Suppose a plate of brass one foot square, in which a number of holes are perforated, into each of which holes is fixed one end of a copper tube, of about one inch in diameter and two feet in length; the other ends of these tubes being inserted in like manner in a similar piece of brass. In order to insure tightness, these tubes are to be cast in the plates; these plates are to be inclosed at each end of the pipes, and the cast-iron cap at each end; the caps at each end are to be fastened by screw-bolts passing through them into the plates. The water supply is to be injected by a forcing pump into the cap at one end, and through a tube inserted into the cap at the other end the steam is to be conveyed to the steam cylinder of the engine. The whole is then to be inclosed in brickwork or masonry in the usual manner, placed either horizontally or perpendicularly at option."

In adopting and improving the water-tube boiler, Mr. Stevens showed his wonted sagacity. Since his day its advantages have been fully realized in improved designs. Let us remark how it excels a boiler of the fire-tube model: First of all, the flames rush *across* its tubes, so that they are much more thoroughly and quickly heated than if the fire merely glided along their length. A fire-tube accumulates dust, ashes, and soot on its inside surface, with risk of utter choking. These deposits attach themselves, and in much less quantity, to the outside of a water-tube, whence they are easily removed. All the joints of a water-tube boiler may be placed elsewhere than in the hottest parts