

by her builder, having a cylinder of 14 inches diameter and 30 inches stroke. Her boilers and flues were of copper. Her steam was used expansively, being cut off in the main valves as in modern practice. Her furnace and flue were suspended on a frame-work of cast-iron, conducing to safety from fire, and superseding much heavy brickwork. The *Juliana* rose to a speed of seven miles an hour. Robert Fulton, having exclusive rights in the Jersey City ferry, would not allow the *Juliana* to run between New York and Hoboken, so she was placed on the route betwixt Middletown and Hartford, on the Connecticut River, being the first steamer to navigate Long Island Sound, as her cousin, the *Phoenix*, had been the first, in 1808, to navigate the ocean from Sandy Hook to the mouth of the Delaware River.

John Stevens, taking a comprehensive survey of steam practice, clearly saw that great economy lay in using high pressures, especially with expansion gear. But an obstacle which had confronted James Watt remained in the path of his American successor. Workmanship in those days was inadequate to the task of tightly riveting a large boiler to resist high pressure. A means of avoiding this difficulty was to revive and improve an old invention,—a boiler which, instead of being formed of one huge cylinder, was built of many long narrow cylinders, or mere tubes, each of which could be produced perfectly tight, while so thin as to have its contained water quickly heated by an impinging flame. The first boiler of this kind on record was devised in 1766, by William Blakey, an Englishman. He connected together several water-tubes in a furnace, alternately inclined at opposite angles, and united at their contiguous ends by smaller pipes. This design was improved by James Rumsey, an American pioneer in steamboating. He patented, in 1788, several forms of this boiler. One had a firebox with flat water-sides and top, across which were horizontal water-tubes connected with the water-spaces.