(No Model.)

L. SAUNDERS.

BOILER.

No. 551,652. Patented Dec. 17, 1895.

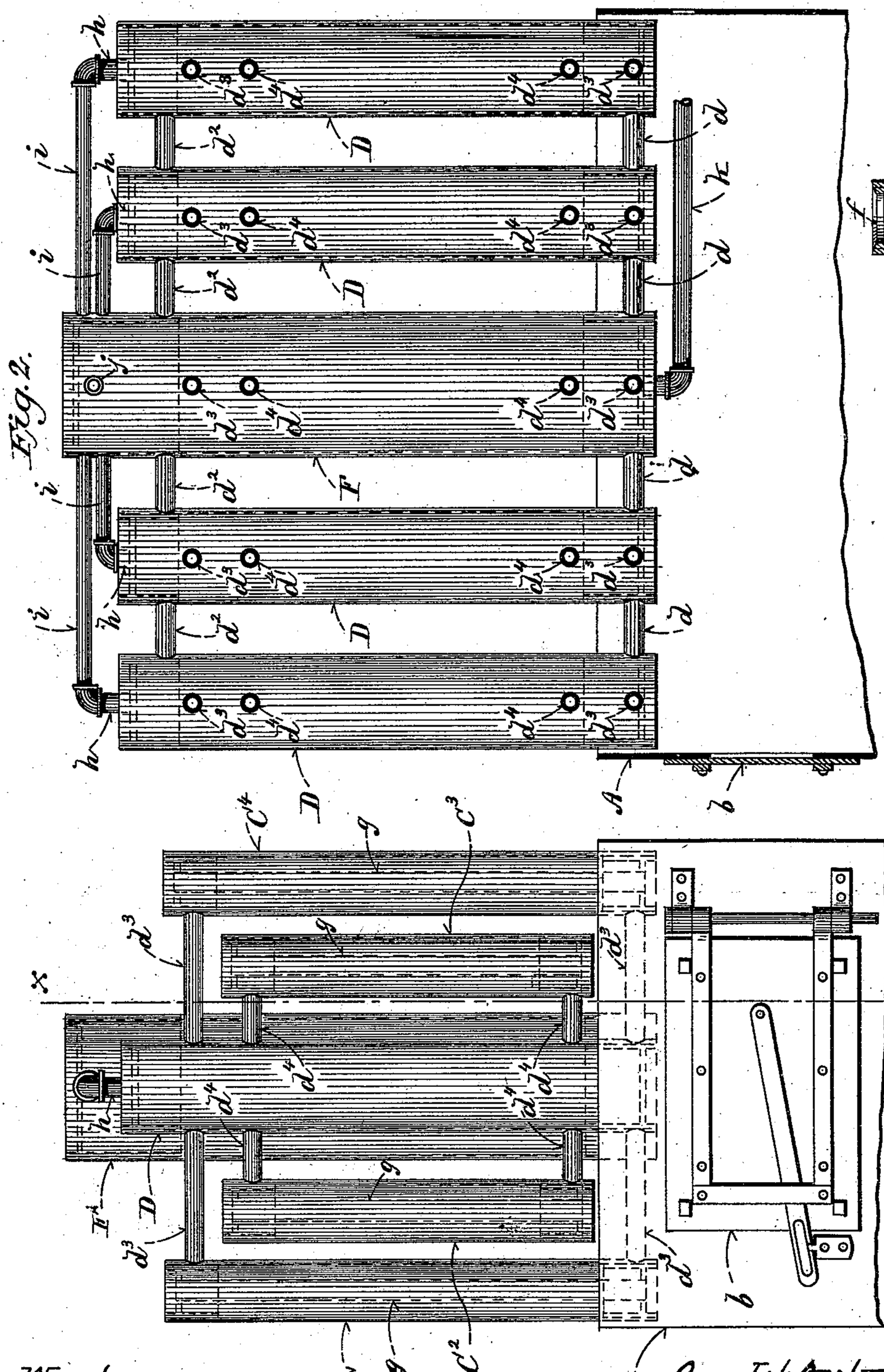

Fig. 2.

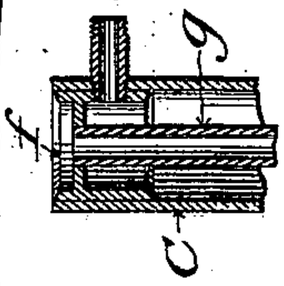

Fig. 3.

Fig. 1.

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LEWIS SAUNDERS, OF LAWRENCE, MASSACHUSETTS.

BOILER.

SPECIFICATION forming part of Letters Patent No. 551,652, dated December 17, 1895.

Application filed January 11, 1894. Serial No. 496,468. (No model.)

To all whom it may concern:

Be it known that I, LEWIS SAUNDERS, of Lawrence, in the county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Boilers, of which the following is a description sufficiently full, clear, and exact to enable any person skilled in the art or science to which said invention appertains to make and use the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a front elevation of my improved boiler; Fig. 2, a vertical longitudinal section taken on line $x\,x$ in Fig. 1; Fig. 3, a sectional view showing the method of heading the tubes.

Like letters of reference indicate corresponding parts in the different figures of the drawings.

My invention relates to a vertical tubular boiler and is designed particularly as an improvement on the device shown in W. B. Fowler's United States Letters Patent No. 482,999, dated September 20, 1892. In such device difficulty is experienced from the water rising into the steam-dome from lack of water and steam space below said dome. In my present invention I seek to overcome this objection while retaining all of the advantages attending an arrangement by which a square boiler of any desired size is produced.

In the drawings, A represents the fire-box, which is rectangular in form and is provided with the ordinary door *b*.

In the top of the fire-box centrally there is a row of cylinders D F, arranged vertically and the series extending longitudinally of the fire-box. The cylinders D F have their lower ends closed and are consecutively connected by horizontal ducts *d*, which open flush with the flanged heads *f*. This form of head is employed for the ends of all the cylinders and circulation-tubes in my improvement.

The cylinders D F are connected at their upper ends by horizontal circulation-ducts d^2 an appreciable distance from the ends of the cylinders. The central cylinder F is longer than the companion cylinders D, and any number of these cylinders may be employed in the series.

Arranged in parallelism at opposite sides of the row of water-cylinders D F there are series of vertical circulation-tubes C C^4. The ends of these tubes are closed by inwardly-depressed heads connected by flues *g*. The upper and lower ends of the circulation-tubes C C^4 are connected by horizontal ducts d^3 with the corresponding cylinder D or F. The upper ducts d^3 enter the cylinders below the cylinder-connecting ducts d^2, as shown in Fig. 2.

Between the central cylinders and the row of circulation-tubes described a row of shorter circulation-tubes C^2 C^3 are arranged at opposite sides of the cylinders between them and the outer rows of circulation, and each tube of the series C^2 C^3 is connected by ducts d^4 with the adjacent cylinder F or D.

The upper end of each cylinder D is provided with a nipple *h*, to which a pipe *i* is connected leading into the top of the central cylinder F. (Shown in Fig. 2.) Said cylinder F near its top is provided with a coupling *j*, from which steam may be taken.

The circulation-tubes arranged as described present a very large heating-surface to the action of the fire in comparison to the size of the boiler. The supply *k* enters the lower end of, preferably, the larger tank or cylinder F, directly over the fire-box, whereby the water is heated as it is delivered to the boiler. Water circulates through the tubes C C^2 C^3 C^4, each of which has an independent entrance into one of the tanks D or F. These tanks or cylinders afford a very extended water-space for the water heated in the circulation-tubes and returned thereto. An independent circulation is established between each cylinder D and its adjacent tubes C^2 C^3 and C C^4, no connection being had directly between said circulation-tubes. The space in each cylinder above the upper ducts d^3 d^4, through which the water flows, affords sufficient steam-space and, said ducts opening below the steam-ports d^2 and said independent circulation being established, the water will not rise to interfere with the steam. Through the pipes I steam can pass into the top of the larger cylinder F from the cylinder D, or said pipes I may be omitted and the steam taken from any of the cylinders which perform the functions of a steam-chest. Condensation oc-

curs directly in the tubes and does not interfere with dry steam in the top of the cylinder F.

Having thus explained my invention, what I claim is—

In a boiler, the cylinders, D F, connected by ports, d^2; pipes, *i*, connecting the cylinders, D, with the cylinder, F, above the ports, d^2, and circulation tubes having independent connection with said cylinder below said ports, substantially as described.

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