

(No Model.)

2 Sheets—Sheet 1.

J. E. HENSHALL.
WATER TUBE BOILER.

No. 468,501.

Patented Feb. 9, 1892.

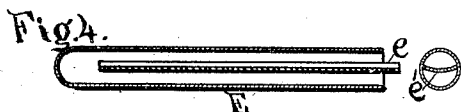
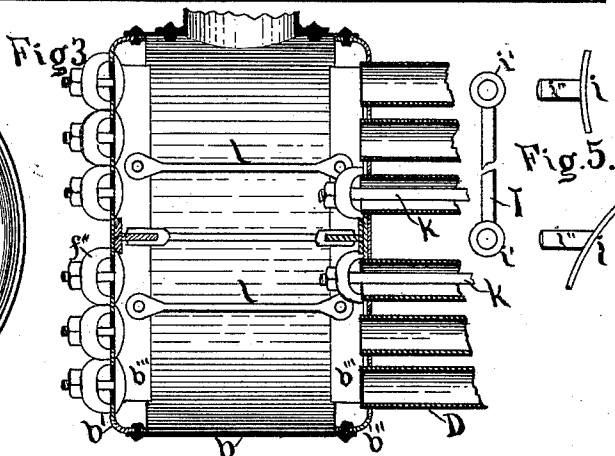
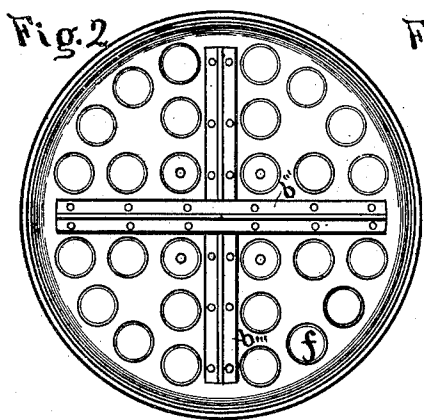
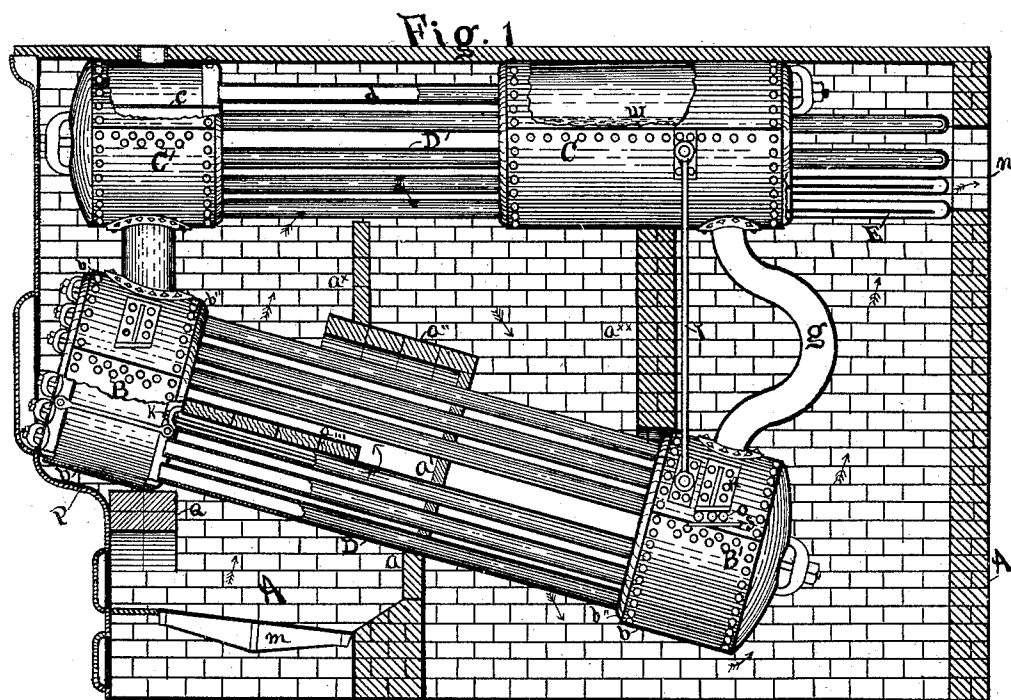


Fig. 5.

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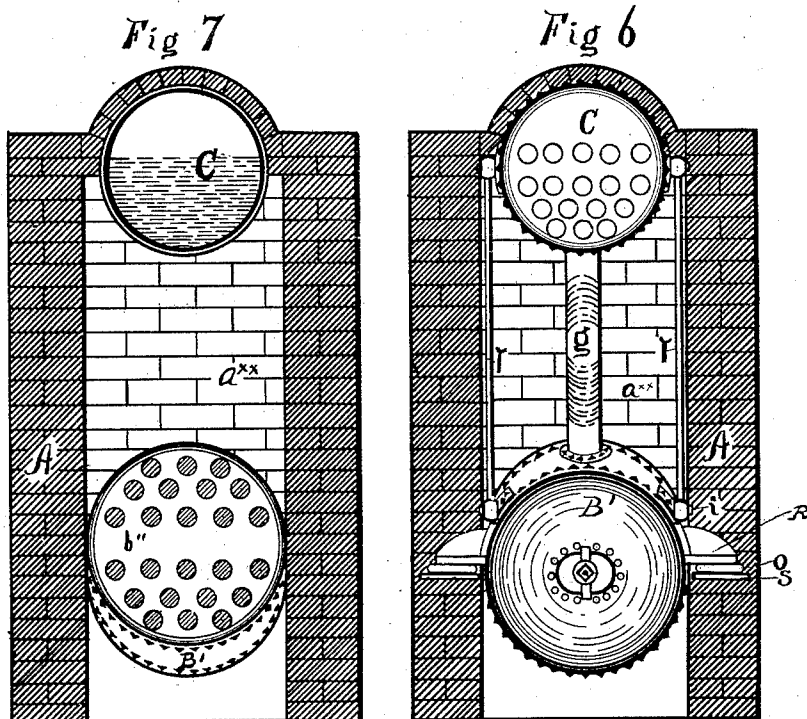
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2 Sheets—Sheet 2.

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WITNESSES:

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JOHN E. HENSHALL, OF PHILADELPHIA, PENNSYLVANIA.

WATER-TUBE BOILER.

SPECIFICATION forming part of Letters Patent No. 468,501, dated February 9, 1892.

Application filed May 27, 1891. Serial No. 394,251. (No model.)

To all whom it may concern:

Be it known that I, JOHN E. HENSHALL, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Water-Tube Boilers; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

My invention relates to improvements in steam-boilers, and has for its object certain new and improved constructions in that class of boilers known as "water-tube."

The improvements consist, essentially, in the improvements in the construction and manner of mounting the boilers in the form of the front, whereby the tube-sheets are protected from the flame, and in the construction of cross-walls and checkers to carry the flame and the products of combustion in the direction desired, the provision in the top boiler of superheated steam tubes and spaces, the provision of expansion pipes and rods to connect the rear ends of the boiler, and in the provision of means for allowing the boiler to swing to accommodate itself to expansion and contraction, all as will be hereinafter set forth, and pointed out in the claims.

The accompanying drawings illustrate what I consider the best means for carrying my invention into practice.

Figure 1 is a longitudinal section of the masonry, showing the boilers in elevation and parts broken away to show the interior. Fig. 2 is a transverse section of one of the boiler-drums, showing the inside of the outer head. Fig. 3 is a longitudinal section of one of the drums. Fig. 4 is a longitudinal and transverse section of one of the closed extension-tubes. Fig. 5 shows details of the supports for the rear steam-drum. Fig. 6 is a rear elevation of the boilers, taken inside of the housing. Fig. 7 is a vertical sectional view taken in front of the lower rear drum and through the upper rear drum, showing the wall in front of and protecting the expansion-pipe.

Similar letters of reference indicate corresponding parts in all the figures where they occur.

A A are the side and rear walls of the masonry surrounding the boilers, and a is the rear wall of the fire-chamber, extending solidly to the bottom of the tubes.

a' is a checker extending between the tubes of the lower boiler, preferably at a slight inclination of the wall a .

a^2 is an arch, spreading over a part of the length of the tubes of the lower boiler and meeting the checker a' , as seen. Extending up from the arch a^2 is a vertical wall reaching nearly or quite to the tubes of the upper boiler, and a'' is a rear wall reaching from the rear drum of the lower boiler, thereby protecting the pipe g from the direct action of the heat, to the rear drum of the upper boiler.

a^3 is a plate or tile, laid upon the tubes of the lower boiler at suitable height therein, and extending from the front drum of the lower boiler back under the arch a^2 .

m is the grate-surface, and Q is an arch springing over the front portion of the fire-space to support and protect the front drum of the lower boiler.

P is the bowed front of the boiler-housing, which permits the front drum of the lower boiler to project forward far enough to escape the direct action of the flame. The lower boiler is made up of a front drum B , a rear drum B' , and connecting water-tubes D . The front drum B , as already stated, rests upon the arch Q and projects out into the bowed front, and the rear drum lies under and just back of the intercepting wall a'' . Each of the drums is formed of a shell b , a head b' , and a tube-sheet b^2 . The head and the tube-sheet may be united and stiffened by means of brackets or rods I . The front head is provided with a number of holes f corresponding to the tubes, and these holes are closed by means of plates and clips f^2 , which are removed when the tubes are to be attended to. Instead of having one such opening f for each tube, the opening may be made large enough to permit the removal of several tubes through it, and thus reduce the number of openings required. This idea of enlarging the opening for the removal of the tubes is illustrated in

the rear drum, where but one is used, as shown. The tube-sheets of the two drums B and B' are connected and braced by a suitable number of rods k , which extend through the tubes D and are held and tightened by clips and nuts, as shown. The lower boiler is preferably set at an inclination, the front end being higher. The upper boiler is placed in close proximity to the top of the housing, and is preferably horizontal. It, like the lower boiler, is made up of two drums C and C', connected by tubes D'. The front drum C' is preferably of about the same length as the drums on the lower boiler, while the rear drum C may be of greater length, if desired. These drums are formed and equipped substantially similar to those of the lower boiler; but I have shown only one opening in each drum for the removal of the tubes D', and the front drum C' has a horizontal division-plate c in it just below the upper tubes d , so that these tubes and the space above the plate form what I term a "superheated-steam chamber," where the steam receives additional heat and drying before passing out above from the space above the plate c . The water-line, as indicated at w , coming below the upper tubes d , gives this free steam-space in both upper drums and upper tubes. The drums B and C' are connected by a neck large enough for a man to pass through, and the rear drums C and B' are connected by an expansion-pipe g , of which there can be one or more, and these rear drums are also connected by means of a rod i on each side of the boiler, which have bosses i' at their ends to take over pins i^2 on brackets i , which are bolted to the drums. This form of rod connection permits the pipe or pipes g to expand and contract freely without effecting the position of the joints or other parts of the drums. In addition to this provision for expansion the lower boiler may be mounted in such manner as to allow for a longitudinal expansion and contraction by having rollers o fixed at suitable points on the side of the drum or drums, which ride upon a bracket or wall-plate S, secured to the masonry of the furnace. These rollers o are between the wall-plate S and the bracket R bolted to the drums.

At the outer end of drum C, I have shown additional circulating-tubes E. They are closed at their outer ends and are provided with circulating plates or partitions e , which are forced to take a curved shape into the tubes apart of their length only, leaving the closed ends of the tubes unobstructed for circulation. These plates fit so tightly in the tubes as to need no fastening means, as the spring in the curve forces the edges tight against the sides of the tubes. The drums may be provided with T-irons b^3 on their heads and tube-sheet to strengthen and stiffen the parts, and at the same time to afford a convenient means for attaching the links or braces I. The circulation of the flames and products of combustion will be from the fire-

pot back beyond the plates a^3 , between tubes D, and up, around, and through tubes D', guided by the wall a , checker a' , arch a^2 , and wall a'' . After descending from the upper tubes the course of the flames and products of combustion is down through the rear end of the tubes D, guided by the wall a'' , around the drum B', and up around tubes E, whence they escape through flue n to chimney. (Not shown.) The intense action of the fire on tubes D causes a rapid circulation of the water through tubes D, cylinder B, neck H, drums C', tubes D' to cylinder C, and down expansion-pipes g to cylinder B'. The steam arising in drum C passes through the superheating-tubes d into the space above plate c in drum C'. For long boilers three cylinders, similar to drum B, may be used by placing one in the center of the tubes and conducting heat and flames accordingly.

Where more power is required and there is not sufficient room to make a long boiler, two lower boilers may be used instead of one. The upper boiler can be made a plain cylinder boiler, if desired.

Having thus described my invention, I claim—

1. The combination of an upper horizontal boiler and a lower inclined boiler, composed of two drums connected by water-tubes, with a rigid neck connecting their approaching ends and an expansion pipe or pipes connecting their more widely-separated ends, and a wall or fire-guard between said widely-separated ends, said wall extending vertically from the front end of the rear drum of the lower boiler to the upper boiler directly in front of the expansion-pipe, and thereby protecting it from the direct action of the flame and deflecting the flame downward through the tubes and under the rear of the lower boiler, as set forth.

2. The combination of a water-tube boiler having an end drum B', with steam-drum C, and an expansion pipe or pipes connecting the drums and having supporting-rods loosely set upon pins connecting the said drums on the sides, as set forth.

3. In a steam-generating apparatus, the combination of the two boilers, each composed of two drums having connecting water-pipes, said boilers being connected in the manner set forth with a flame-directing plate set in the tubes of the lower boiler, a solid rear fire-wall, a checker extending between said tubes, an arch joining said checkers and extending forwardly thereof, a wall extending from said arch nearly or quite to the tubes of the upper boiler, and an intercepting vertical wall between the rear drums of the two boilers, substantially as and for the purpose set forth.

4. In a steam-generating apparatus, the combination of the two boilers, each composed of two drums having connecting water-pipes, said boilers being connected in the manner set forth with the flame-directing plate a^3 , rear fire-walls a , checkers a' , and arch join-

ing said checkers and extending forwardly thereof, and the bowed front *q*, as set forth.

5 5. The combination of an upper horizontal boiler and a lower inclined boiler, composed of two drums connected by water-tubes, a rigid neck connecting the approaching ends of the two boilers, and expansion pipe or pipes connecting their more widely-separated ends with the arch *Q* underneath the forward drum of the lower boiler, extending back beyond the tube-sheet of said lower drum *B*, and a bowed front, the lower part of which is set back under the said drum *B*, as set forth.

10 6. In a water-tube boiler, the combination of the drums *B* and *B'*, having connecting water-tubes, brace-rods *I*, the tube-sheet *b*², and head *b'*, having holes therein corresponding to each other, with the *T*-irons *b*³ across the center of the tube-sheet at right angles to each other and between the tubes and brace-rods, as set forth.

7. A steam-boiler consisting of two boilers united as described, and each composed of drums united by water-tubes, a partition-plate in one of the upper drums, and tubes connecting it with the other upper drum above the water-line, combined and arranged for operation as set forth.

8. The combination, with a steam-boiler consisting of drums connected by water-tubes, of circulating-tubes having closed ends and provided with partitions extending part of their length, as described, said circulating-tubes being connected to the outer end of the rear drum and extended into the heat-space, as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN E. HENSHALL.

Witnesses:

THOS. D. MOWLDS,
CHARLES E. LEX.