(No Model.) 3 Sheets—Sheet 1

N. B. CLARK & F. B. KING.

STEAM BOILER.

No. 446,093. Patented Feb. 10, 1891.

Fig. 1.

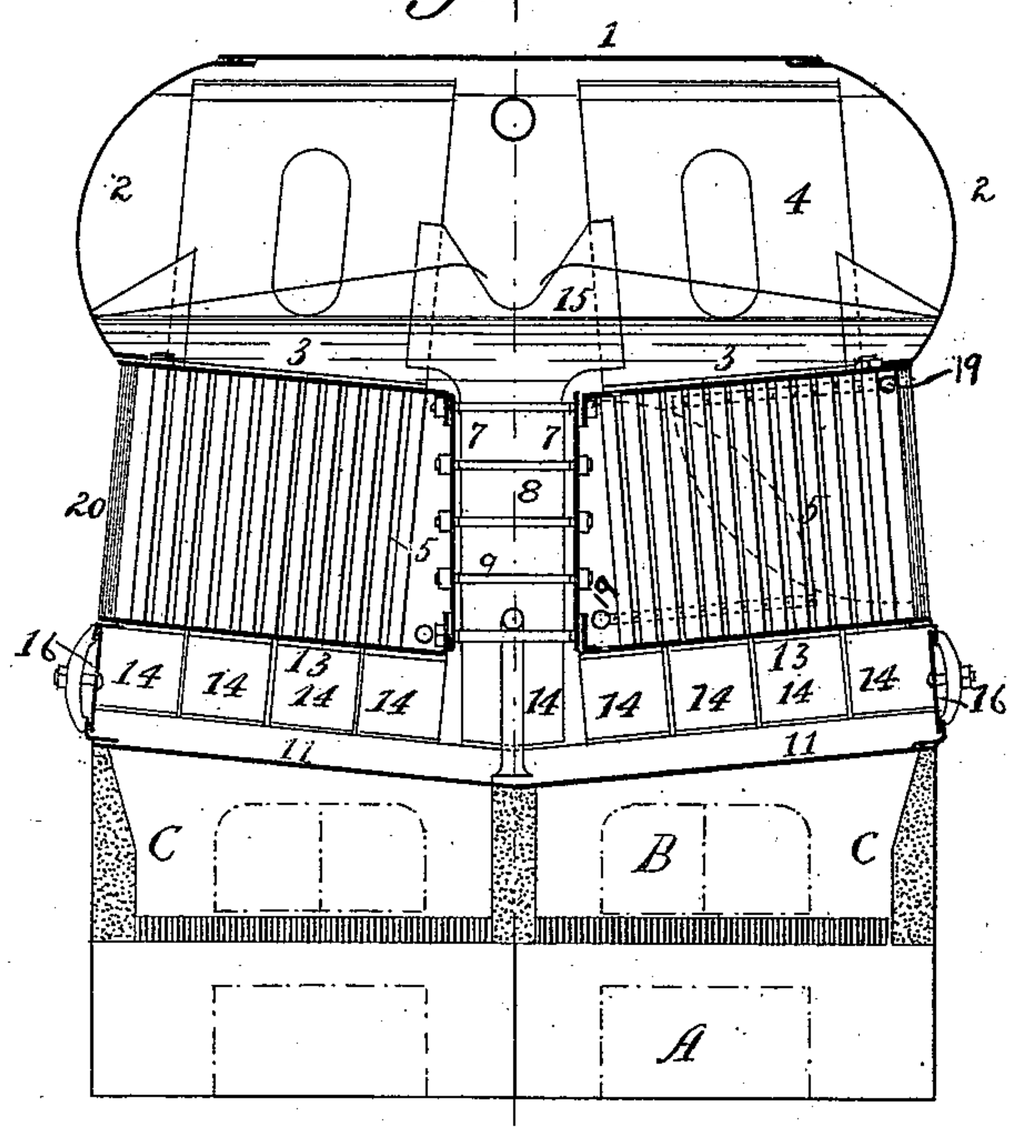

Fig. 2.

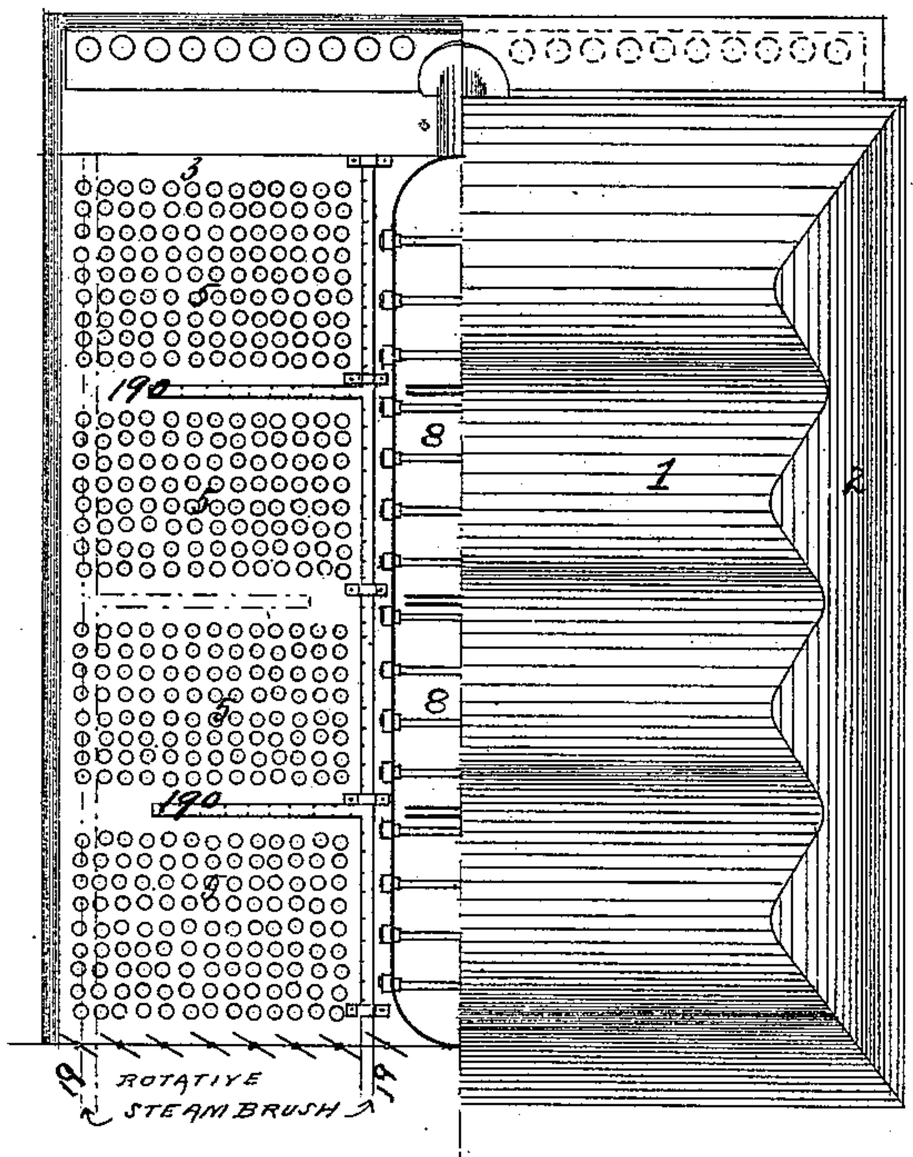

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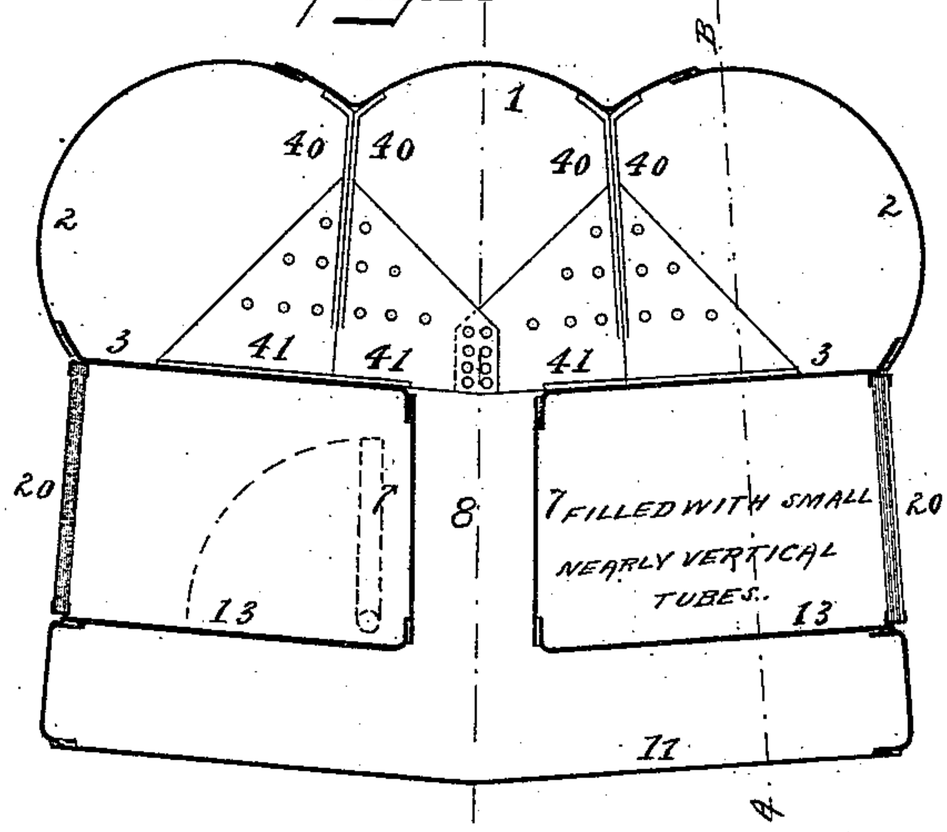
Fig. 3.



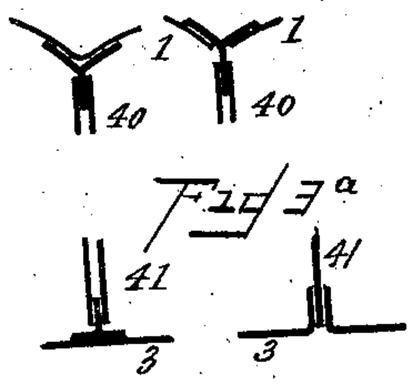


Fig. 3a.

Fig. 4.

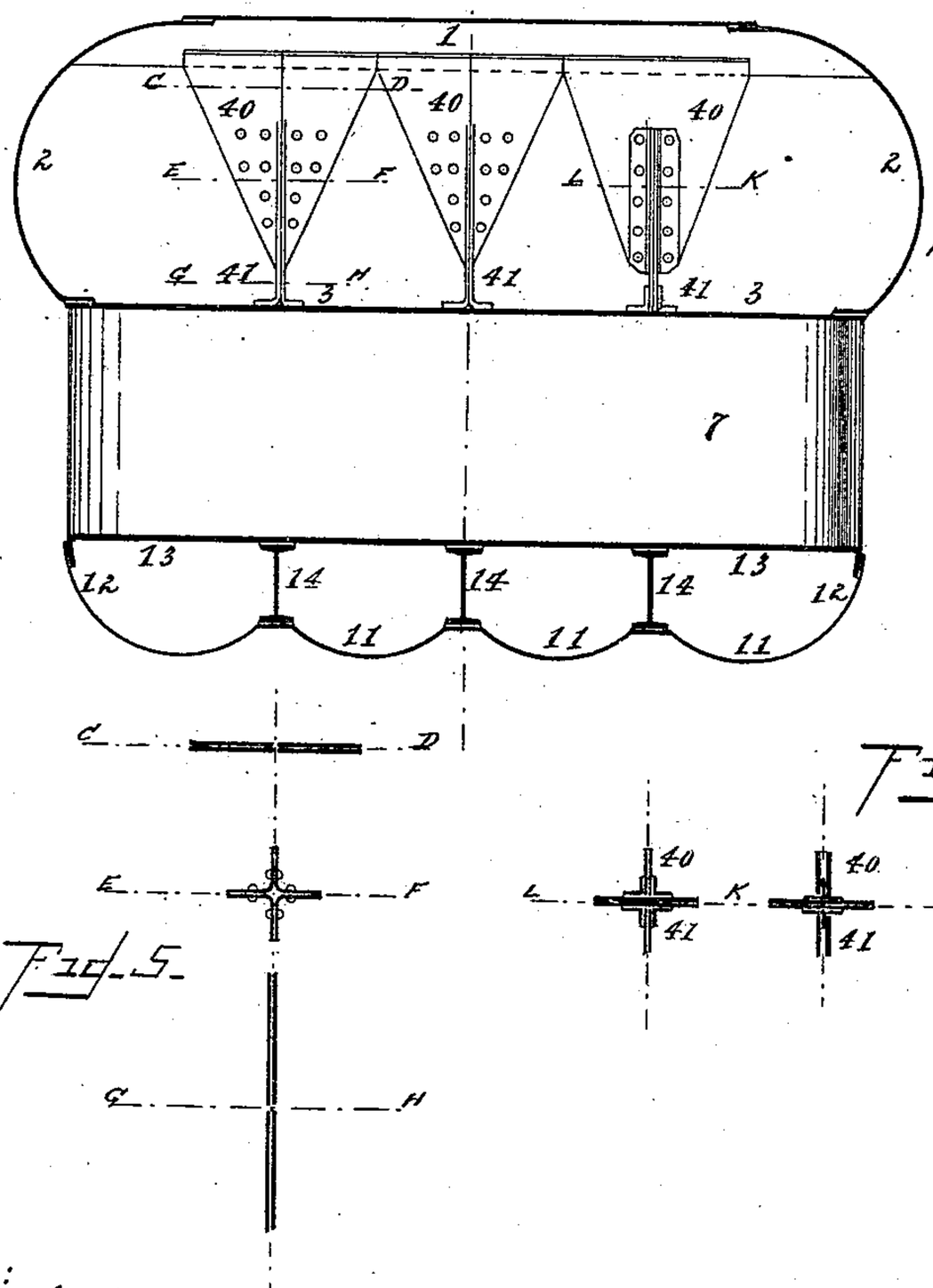


Fig. 5.

Fig. 6.

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(No Model.) 3 Sheets—Sheet 3.

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STEAM BOILER.

No. 446,093. Patented Feb. 10, 1891.

Fig. 7.

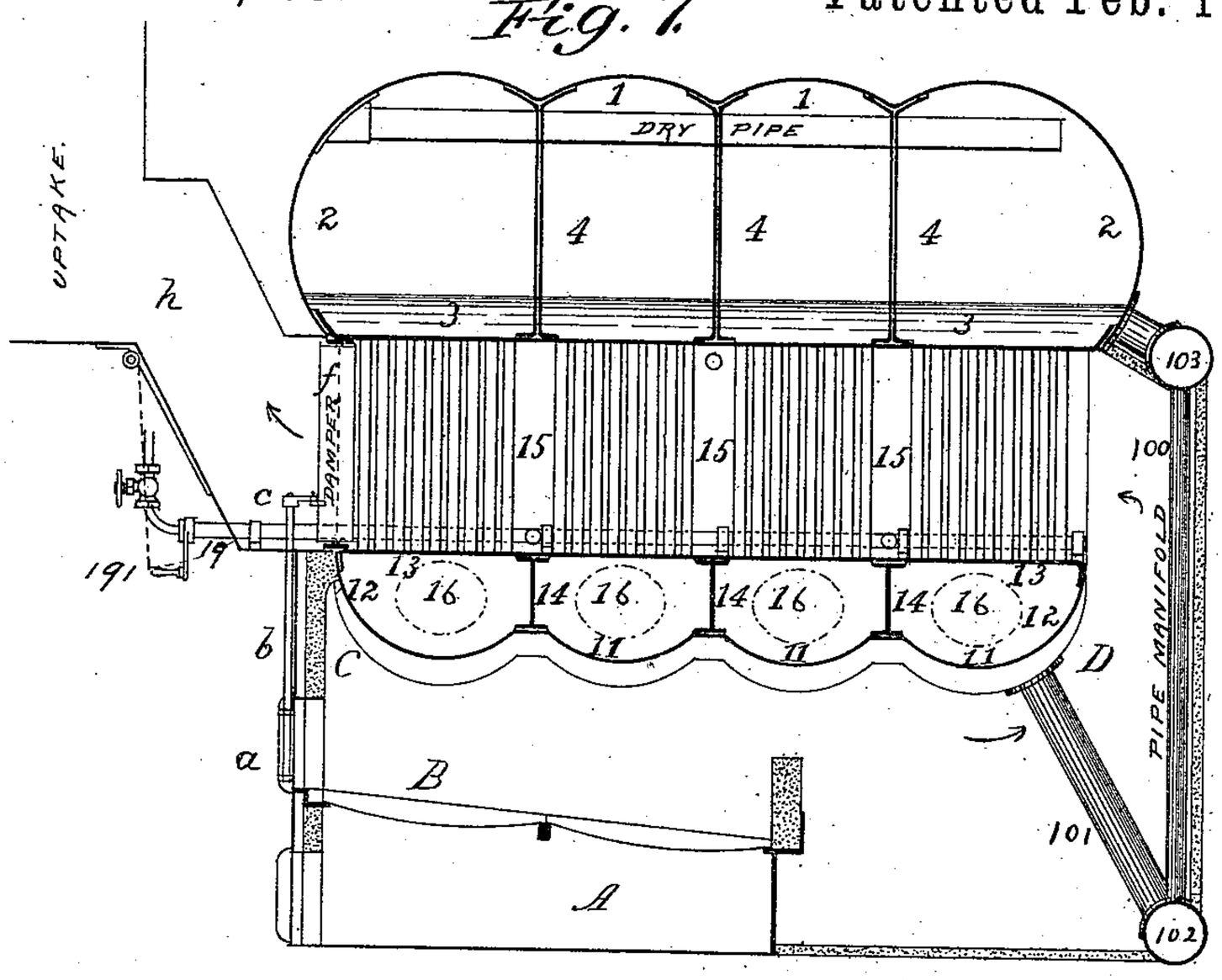


Fig. 8.

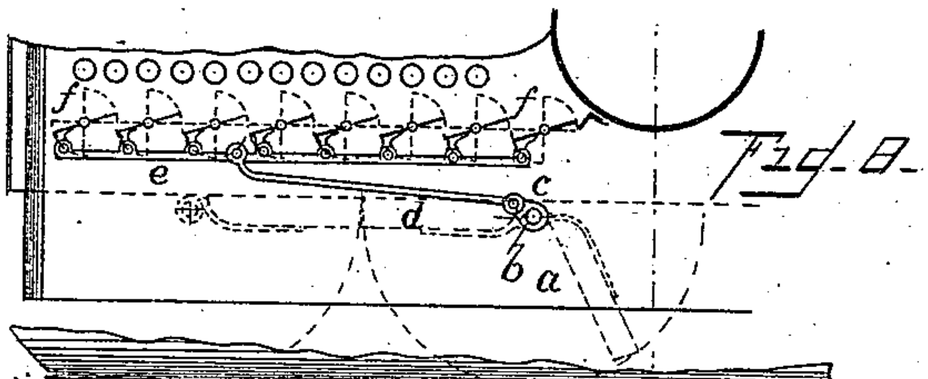


Fig. 9.

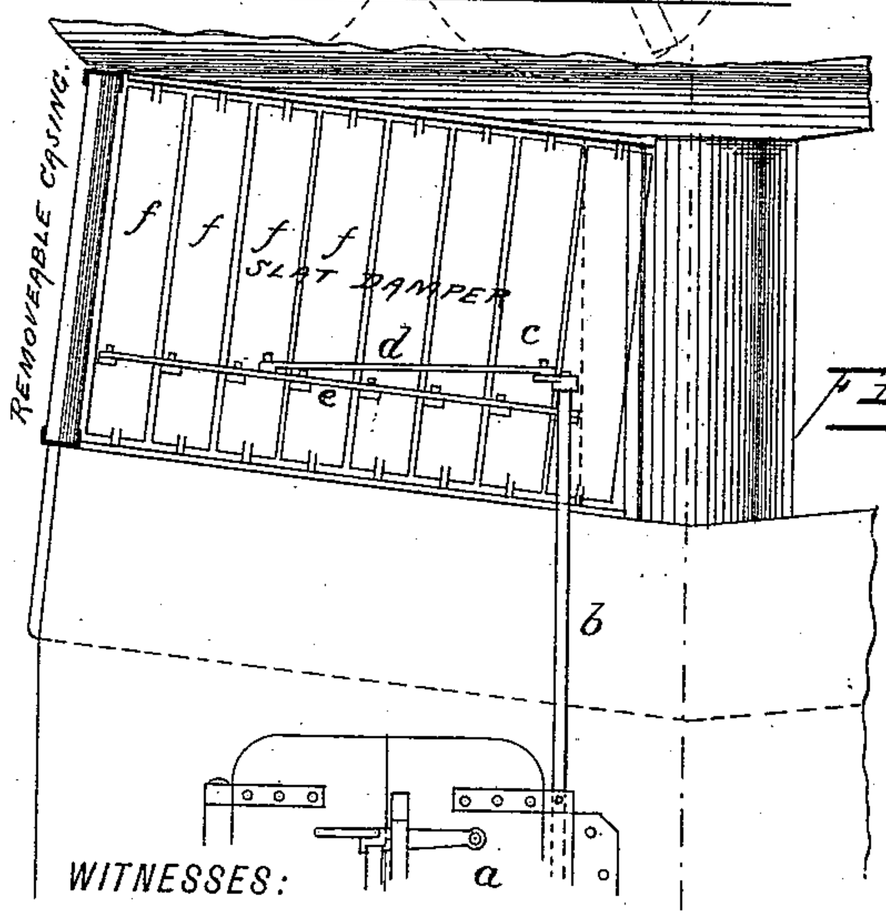
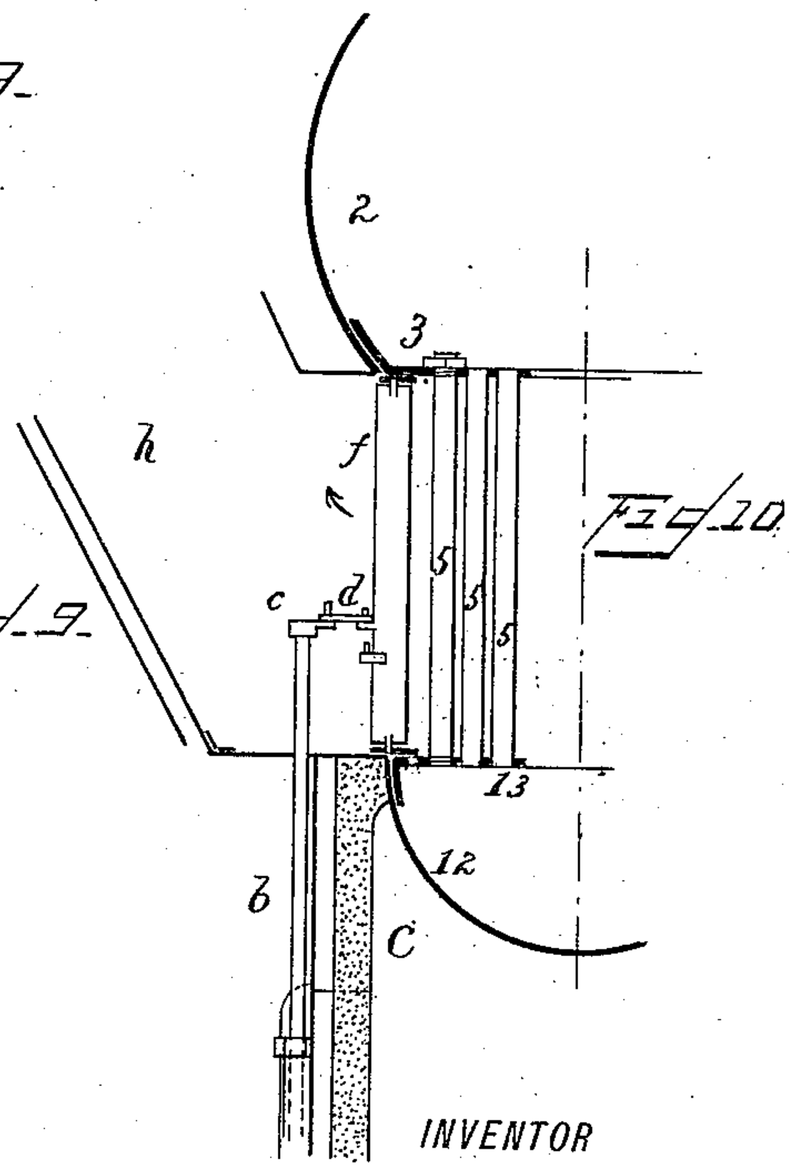


Fig. 10.



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UNITED STATES PATENT OFFICE.

NATHAN B. CLARK, OF WASHINGTON, DISTRICT OF COLUMBIA, AND FRANK B. KING, OF BALTIMORE, MARYLAND.

STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 446,093, dated February 10, 1891.

Application filed December 6, 1888. Serial No. 292,853. (No model.)

To all whom it may concern:

Be it known that we, NATHAN B. CLARK, chief engineer United States Navy, (retired,) of Washington, District of Columbia, and FRANK B. KING, residing at Baltimore, in the State of Maryland, have invented certain new and useful Improvements in Steam-Boilers, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to steam-boilers of a combination character, having a large number of practically vertical water-tubes as well as a considerable heating-surface in horizontal water-chambers and a large steam-space above the water-tubes.

The exterior of our boiler is formed of a series of arched sections secured in reverse directions to the upper and lower tube-sheets, in which tube-sheets vertical water-tubes are fitted as well as downcast water-conduits.

The object of the invention is to make a strong and light boiler capable of safely carrying high pressures and having a large heating-surface suitable for forced draft, with all parts freely accessible for inspection, cleaning, and repairs.

Figure 1 is a cross-section of a boiler, showing the general principles of construction. Fig. 2 is a top plan and partial section of a boiler or so much thereof as is necessary to illustrate the invention. Fig. 3 is a cross-section of a boiler with parts omitted, showing especially a mode of connecting the plates of the shell by brace-plates. Fig. 3ª shows details of the brace-plates. Fig. 4 is a section on the line A B, Fig. 3. Fig. 5 shows cross-sectional details of the brace-plates on the lines indicated in Fig. 4. Fig. 6 illustrates in section modes of building up brace-plates by means of angle-irons. Fig. 7 is a cross-section showing boiler in section and position of automatic damper relatively thereto. Fig. 8 is a horizontal section through the automatic damper. Fig. 9 is a front end elevation of the damper. Fig. 10 is a detail section showing the relation of the damper with the shell and tubes of the boiler.

The letter A indicates the ash-pit; B, the grate; C, the walls of the fire-chamber.

In Fig. 1 the top member is composed of a shell having connected arched plates 1, forming the cover thereof, curved plates 2, forming the sides of the steam-space, and flat or slightly-curved tube-plates 3 3, extending from the sides and inclining slightly downward toward the center of the boiler.

The bottom member of the boiler is composed of a series of connected arches formed by connected curved or corrugated bottom plates 11, curved at 12 to form the ends of the bottom member and united to tube-plates 13, which extend inward toward the center of the boiler. The plates 3 and 13 are connected at their inner edges by practically vertical plates 7 7, which inclose a water box or leg 8 extending nearly the whole length of the boiler, forming a water-connection between the top and bottom members of the boiler. The side plates 7 of the leg 8 are strengthened by tie bolts or rods 9. The spaces at each side of the water-leg 8 contain a large number of water-tubes 5, which connect the top and bottom members through the tube-plates 3 13.

The tube-plates 3 and 13 and the bottom plates 11 of the boiler preferably incline toward the center of the boiler, so that all sediment tends in that direction.

The circulation is downward through the water-leg 8 and upward through tubes 5 by reason of the greater relative heating-surfaces of the tubes, which causes the water therein contained to rise.

The top member is strengthened by ties 4, extending from the downward bends of top plates 1 to tube-plates 3. These ties or braces may be simply angle-plates, as shown clearly in Fig. 7, and are preferably cut away in parts for lightness and to permit free passage of water and steam. The top member thus made resembles a series of arches closely connected and communicating at their sides. In similar manner the bottom member has tie-plates 14, connecting the outer plates forming the shell of the boiler. As shown in Fig. 7, the bottom plate is shaped in such manner as to give close bearings to the flanges of these tie-plates 14. The tie-plates 4 and 14 are connected through the trunk or leg 8 by tie-plates 15, Figs. 1 and 7. In this manner the different members are not only stayed sepa-

rately, but are very rigidly tied to each other, yet the connections are such as to permit expansion and contraction.

The arches of the bottom member extend transversely of the boiler in Fig. 1 and have man-hole plates 16 at their outer ends, permitting easy access to the interior of the boiler.

The spaces between the top and bottom members occupied by water-tubes 5 are inclosed at the outer sides by removable plates 20. These plates 20 form the fourth side of the tube-boxes through which the products of combustion circulate around the water-tubes, as indicated by the arrows, Fig. 7. The space may be kept clean by means of steam-brushes 19. The steam-pipe 19 is mounted in bearings, so that it may oscillate and yet receive a continuous steam-supply, as described in our application of June 27, 1888, No. 278,381. This pipe has numerous small perforations, and also has branching arms 190, also provided with perforations. The pipes 19 can be passed between the tubes 5 by turning the branches 190 to a position parallel with said tubes 5. After the pipe 19 is in position it can be rocked on its axis, as shown in Fig. 1, carrying the arms 190 in the arc of a circle between the water-tubes, thus throwing jets of steam (or compressed air, when used) on all sides of said tubes, cleaning them thoroughly. As many pipes 19, having arms 190, may be used as desirable. (See Fig. 1.)

In Figs. 3 and 4 a number of modifications of the internal stays of the boiler are shown. Where the arches of the top member are at an angle to those of the bottom member, as indicated in these figures, it is important that the ties 4 and 14 shall mutually support and brace each other. To this end in the upper member the ties 4 consist of plates 40, secured at their edges to the top plate 1 and extending downward, where they are bent at an angle about a practically vertical axis. The part 41 extends up from the bottom in like manner, but at right angles to the part 40. (See sections C D E F G H, Fig. 5.) Parts 40 and 41 thus form angle-plates with their faces in contact, and a right and left plate from the top will with the corresponding bottom plates form a cruciform brace at the midsection. These plates, being connected by bolts or rivets, will have both strength and elasticity. The cross-sectional area of the united plates 40 and 41 should be about the same at any horizontal section, the width of one flange diminishing as the other increases. The plates 41 may be made to overlap each other and be secured together at the central part, as shown in Fig. 3. Tube-plates 3 may be flanged up and riveted to said tie-plates. The connections may be made by means of angles and other shapes, also by flanging the tube-sheet, as shown at Fig. 3ª. The top plate may be distinct from the lower ones, the connection of the two being made by angles, T's, or other shapes, as shown in section, &c., when economy of workmanship prevails over economy of weight.

As this boiler will generally be used with a forced draft, it is important that cold air in large quantities shall not be admitted when the furnace-doors are opened, as the sudden cooling of parts, especially the water-tubes, causes contraction and unequal strains, to the great detriment of the boiler. This objection is obviated in manner as will now be stated.

The furnace-doors *a* are connected to rock-shafts *b*. The rock-shaft *b* may be the pintle of the hinge to turn with the door or may be otherwise connected to rock as the door opens or closes. Shaft *b* has a crank *c*, which moves a pitman *d*. The pitman *d* is connected to the rod *e*, which is connected to each of the metallic blind-slats *f*. The metallic slats *f* are pivoted like those of a window-blind and similarly connected by a rod. The slats together constitute a damper, which may be placed at any convenient part of the smoke and hot-air passage. In Figs. 7, 9, and 10 the damper is shown near the entrance of the uptake or smoke-stack *h*. When the doors are opened, the dampers will be closed, and vice versa, the operation being automatic.

The course of the smoke and other gaseous products of combustion from the grate B is backward under the bottom segments, through passage D, Fig. 7, then up and forward between the top and bottom members of the boiler—that is, above plate 13 and below plate 3—and in contact with the plates 7 of water-trunk 8, the gaseous currents being broken up by tubes 5. From these tube-chambers the gases pass forward to the uptake.

To protect the boiler-casing from intense heat, as well as to give additional heating-surface, a pipe-manifold 100 may be connected with downcast 101 and branches 102 and 103, as shown in Fig. 7, thus forming an auxiliary circulating system between the top and bottom members of the boiler.

The side plates 20, preferably asbestus lined, are hinged or otherwise attached so as to move away and permit ready access to all the water-tubes of the boiler.

This boiler contains some features described in patents to Clark and King, Nos. 386,526 and 386,527, of July 24, 1888, and in application Serial No. 278,381, filed June 27, 1888. A reference to said patents will explain more in detail the theory and mode of operation of this boiler.

We claim—

1. A steam-boiler consisting of an arched top member and an arched bottom member connected by a water-trunk and having ties connecting the top plate and bottom plate passing through said trunk.

2. A steam-boiler consisting of a top member and bottom member and a central water-

trunk of less width extending lengthwise of the boiler, whereby chambers for water-tubes are supplied at each side of the central trunk.

3. The combination, in a steam-boiler, of a top member and a bottom member, a water-trunk extending lengthwise of the boiler and of less width than the top and bottom members, water-tubes connecting the members at each side of said trunk, and inclosing-plates at the sides of the water-tube chamber, substantially as described.

4. In a steam-boiler of the character described, a top member having inclined bottom plates, a bottom member, and a connecting water-trunk of less width than said members extending lengthwise of the boiler, all in combination, substantially as described.

5. In a steam-boiler, the top member, the water-trunk of less width connected centrally thereto and extending lengthwise of the boiler, and the bottom member composed of arches inclined toward the center, so that the greatest depression is under said water-trunk, substantially as described.

6. In a steam-boiler of the character described, a top member composed of arches, as described, a water-trunk of less width connected thereto, and a bottom member composed of connected arches extending transversely of the boiler, said bottom arches having man-holes outside the casing, substantially as described.

7. In combination with the plates forming the shell of a boiler member, a pair of tie-plates secured at opposite sides and extending in different directions along the shell, said plates having proximate surfaces secured together, substantially as described.

8. In a steam-boiler of the character described, the combination, with the top plate 1, of an angle-plate having its base secured to said plate, and the plate 3, having an angle-plate secured thereto with its base at about a right angle with the first-mentioned angle-plate, the two plates extending into proximity and secured together, substantially as described.

9. In a steam-boiler, the combination of the arched plates constituting the shell and tie-plates connecting the same, said tie-plates being braced and strengthened by angle-irons, substantially as shown and described.

10. In combination with the water-tubes of a boiler, a movable steam-pipe in proximity to said tubes and a perforated branch pipe connected to said movable pipe, substantially as described.

In testimony whereof we affix our signatures in presence of two witnesses.

NATHAN B. CLARK.
FRANK B. KING.

Witnesses:
JOHN R. FARNUM,
GEORGE P. MORGAN.