No. 745,851. PATENTED DEC. 1, 1903.

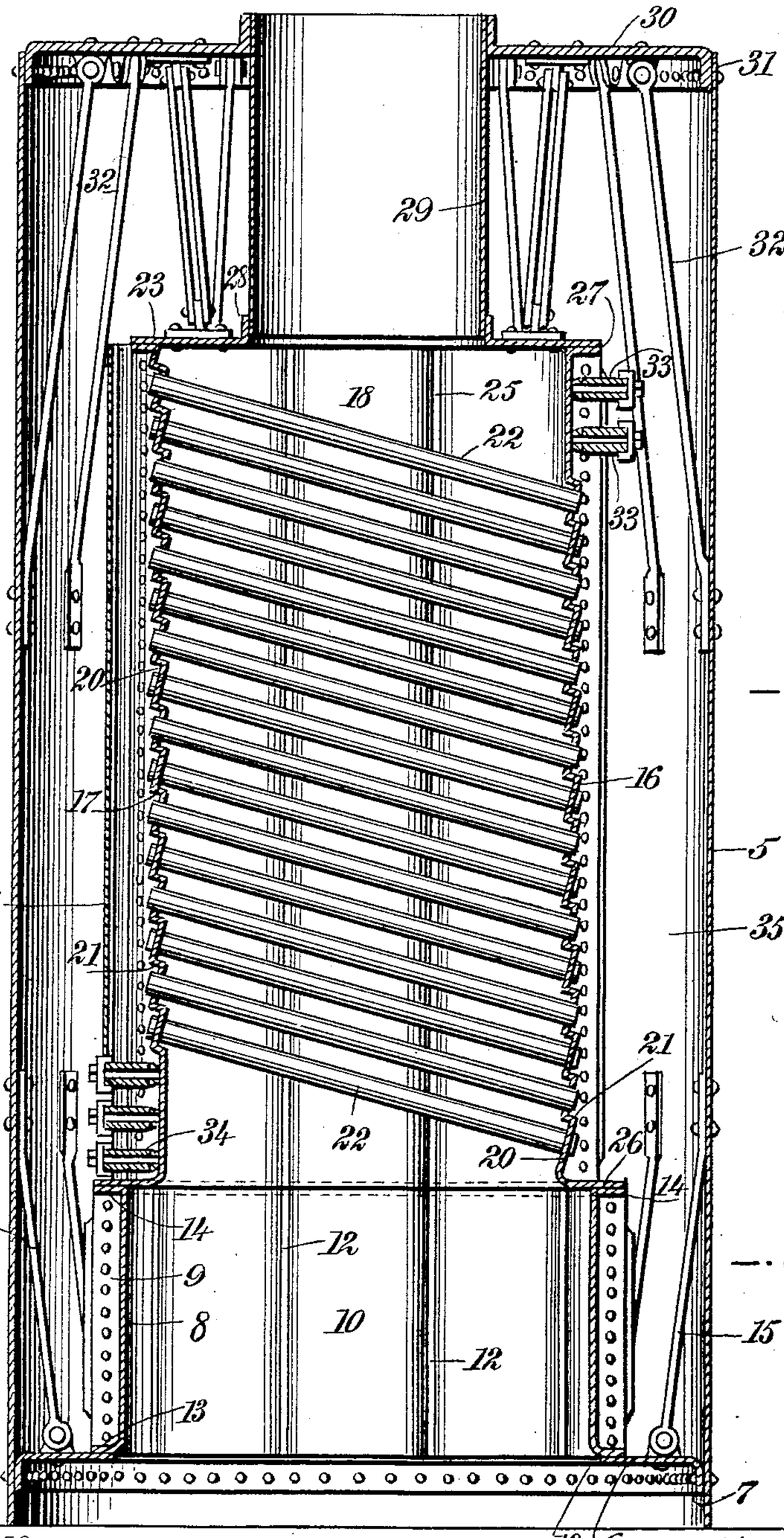
J. F. HOTTMAN, Sr. & J. F. HOTTMAN, Jr.

WATER TUBE BOILER.

APPLICATION FILED DEC. 13, 1902.

NO MODEL. 3 SHEETS—SHEET 1.

Fig 1



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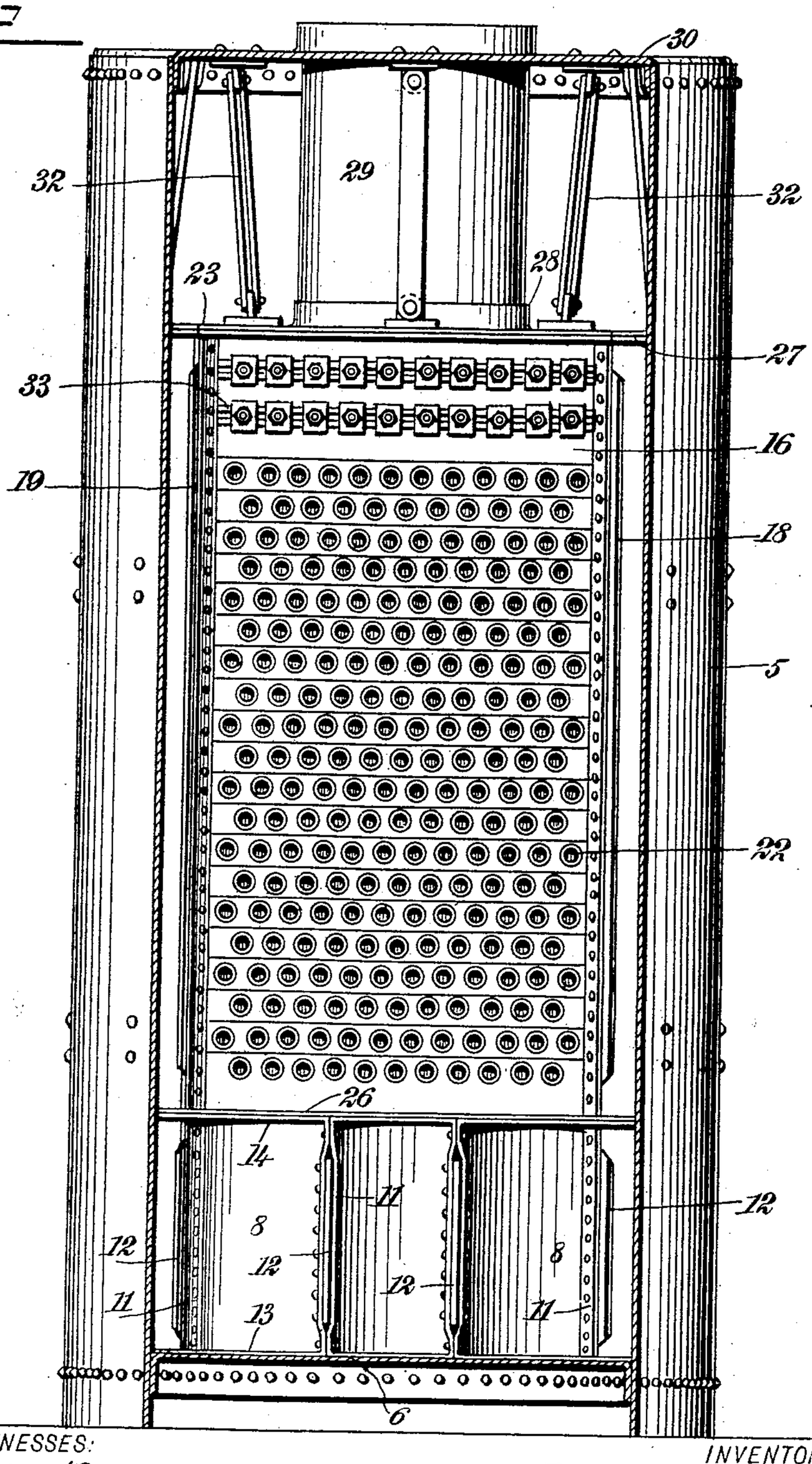
NO MODEL. 3 SHEETS—SHEET 2.

Fig 2



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NO MODEL. 3 SHEETS—SHEET 3.

Fig 3

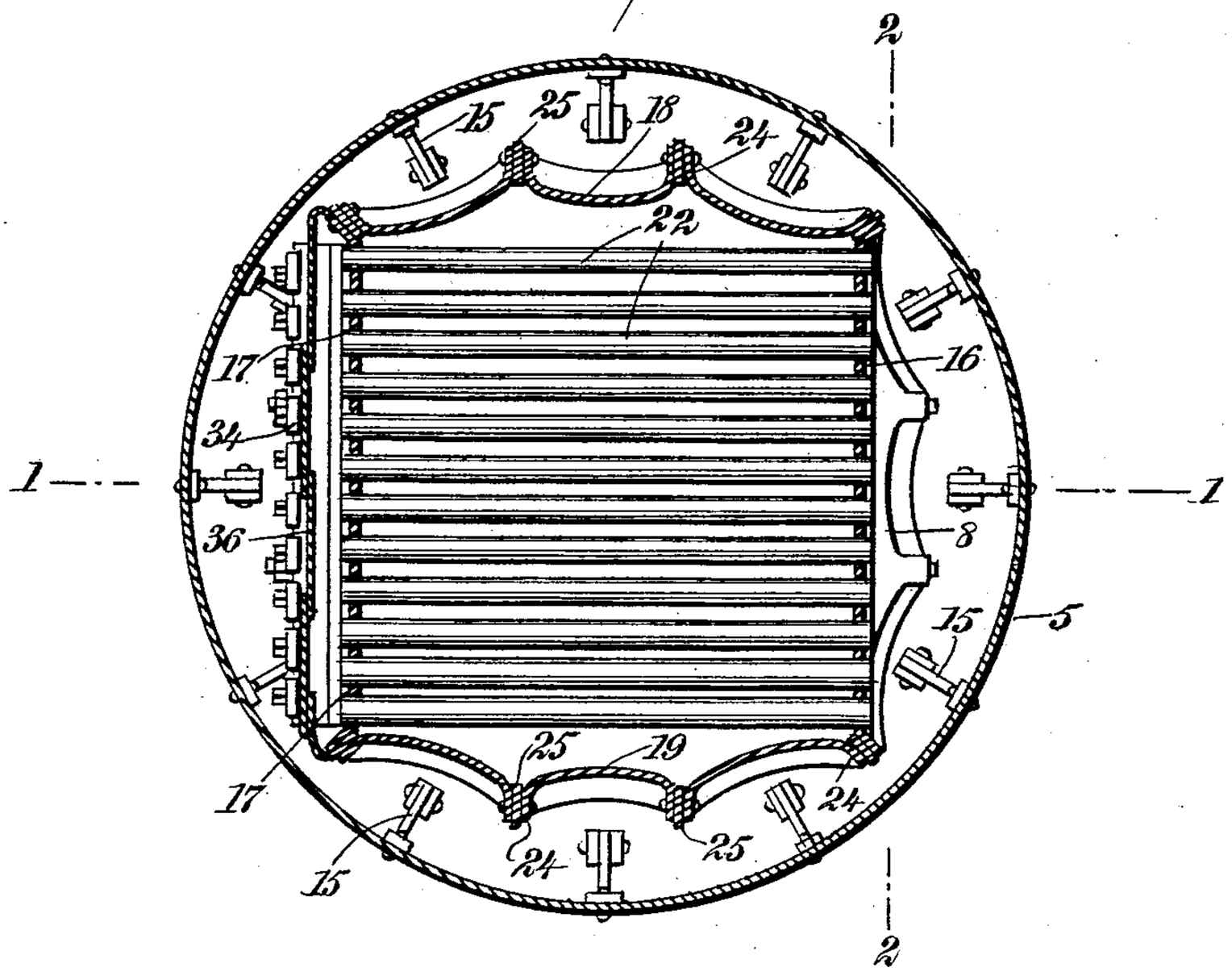
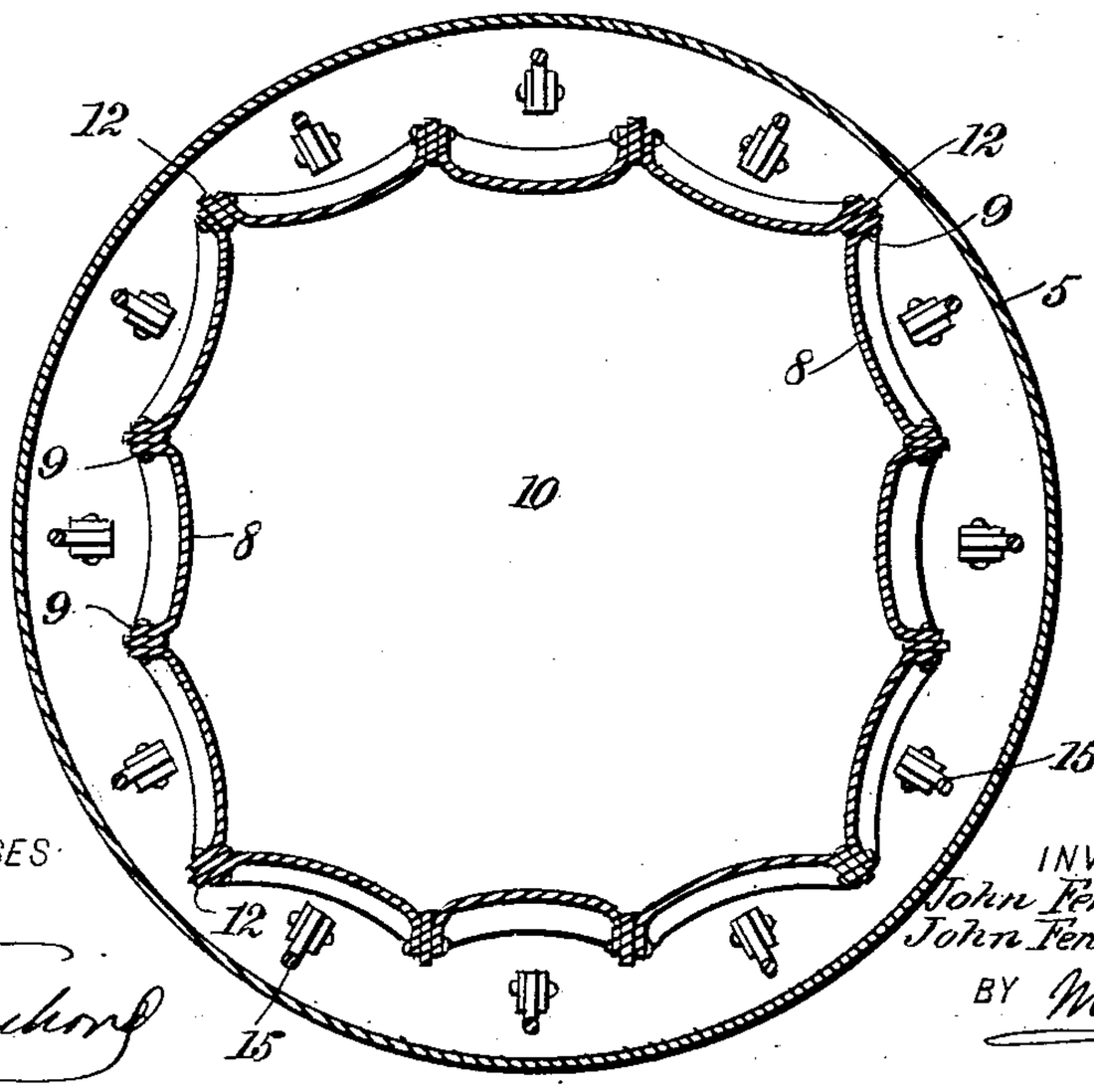


Fig 4



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UNITED STATES PATENT OFFICE.

JOHN FERDINAND HOTTMAN, SR., AND JOHN FERDINAND HOTTMAN, JR.,
OF DUBUQUE, IOWA.

WATER-TUBE BOILER.

SPECIFICATION forming part of Letters Patent No. 745,851, dated December 1, 1903.

Application filed December 13, 1902. Serial No. 135,045. (No model.)

To all whom it may concern:

Be it known that we, JOHN FERDINAND HOTTMAN, Sr., and JOHN FERDINAND HOTTMAN, Jr., citizens of the United States, and residents of Dubuque, in the county of Dubuque and State of Iowa, have invented a new and Improved Water-Tube Boiler, of which the following is a full, clear, and exact description.

Our invention relates to improvements in water-tube boilers in which we aim to secure a vertical compact structure adapted to take up a limited amount of space. We also seek to strengthen the internal construction, to resist the pressure without the employment of stay-bolts, and, furthermore, to provide means which enables us to use straight tubes for the circulation of water in a way to increase the rapidity of water circulation and rapidity in the generation of steam.

Further objects and advantages of the invention will be disclosed in the course of the subjoined description, and the novelty will be defined by the annexed claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures.

Figure 1 is a vertical central section through a vertical water-tube boiler constructed in accordance with our invention, the plane of the section being indicated by the dotted line 1 1 of Fig. 3. Fig. 2 is another vertical sectional elevation taken in the plane of the dotted line 2 2 of Fig. 3. Fig. 3 is a horizontal section on the line 3 3 of Fig. 1, and Fig. 4 is a horizontal section through the fire-box in the plane of the dotted line 4 4 of Fig. 1.

5 designates the outer shell or inclosing casing of our improved vertical water-tube boiler, the same being of any suitable dimensions and constructed in any desired way known to those skilled in the art, but preferably this outer shell is circular in cross-section, as shown by Figs. 3 and 4, thereby producing a structure which is of cylindrical form. At the lower end of the vertical cylindrical shell 5 is the bottom head 6, having a flange 7, which is united in any preferred or usual way to the inclosing shell 5—as, for example, by rivets—and to this bottom head is united the internal fire-box, which is constructed as indicated more clearly by Figs. 1, 2, and 4.

The substantially circular wall of this fire-box consists of a number of curved plates 8, which are placed in vertical positions and assembled in edgewise abutting relation, as shown by the drawings. Each vertical plate 8 is arched or curved transversely to a segment of a circle, and the side edges of said vertical plate are flanged, as indicated at 9. The series or plurality of plates are assembled in abutting relation to present the convex surfaces thereof to the internal-combustion chamber 10 of the fire-box, while the concave surfaces of the plates are in opposing relation to the cylindrical casing or shell 5, as shown more clearly by Fig. 4. The flanged edges 9 of each pair of curved plates 8 are bent laterally, as at 11 in Fig. 2, and between the abutting flanges 9 of each pair of plates is interposed a reinforcing metallic bar or strip 12. The length of the reinforcing bar or strip is not equal to the plates 8, and the end portions of this bar or strip are tapered or scarfed, as also shown more clearly by Fig. 2. From this construction it will appear that the bar or strip, with its scarfed ends, is interposed between the abutting flanges of two adjacent plates in a way to permit the flanges to have abutting engagement at the upper and lower ends of said plates, whereby the top and bottom edges of the vertical plates may be flanged horizontally, as at 13 14 in Figs. 1 and 2. The employment of the reinforcement bars or strips 12 between the flanged edges of the plates and the use of a group of plates which are curved or arched inwardly produces a substantial construction of the fire-box, which is self-bracing or self-supporting, and thereby dispenses with the employment of stay-plates or any other form of stays that are usually employed in the construction of steam-boilers.

The flange 13 at the lower edge of the arched plates forming the fire-box rests upon the lower head 6 and may be united thereto in a substantial way—as, for example, by riveting the parts together.

The lower head 6 is united to the surrounding shell 5 by a series of stays 15, the end portions of which are fastened to the shell

and to the head, respectively, in any suitable way.

Above the fire-box and within the cylindrical shell 5 we employ an inner shell adapted to support a plurality of water-circulating tubes which are disposed in inclined positions to facilitate the circulation of the water, and said tubes extend across the internal shell to lie in the path of the flame and escaping products of combustion which pass from the fire-box into and through the inner shell. This inner shell consists of front and rear flue-sheets 16 17, a group of curved plates 18 at one side, and a similar group of curved plates 19 at the other side, said flue-sheets and the curved plates being united together in a substantial way to produce the internal shell, which is adapted to rest upon the fire-box formed by the series of curved plates 8 heretofore described. The flue-sheets 16 17 are disposed in vertical parallel positions and at a suitable distance one from the other, and these sheets are peculiarly fashioned to enable us to use a plurality of water-tubes, which are essentially disposed in rows and in inclined positions. The peculiarity in the construction of each flue-sheet 16 or 17 resides in bending the sheet at regular frequent intervals to produce the inclined members 20, each of these members extending the full width of the flue-sheet and disposed in a plane inclined to the vertical plane of the sheet proper, each inclined member 20 lying between offsets or shoulders 21. It is to be understood that the offsets or shoulders are bent in the flue-sheet at regular intervals to produce the inclined members 20, and the flue-sheets 16 17 are disposed in the opposing relation shown by Fig. 1, so as to bring the inclined members 20 at different elevations and at right angles to the plurality of tubes 22.

The peculiar construction of the offset flue-sheets with the inclined members enables us to use straight water-tubes 22, which have their end portions extended through the members and expanded therein or otherwise united thereto. These straight water-tubes 22 are arranged in rows, as shown by Figs. 1 and 2, each row being inclined upwardly from the flue-sheet 16 toward the flue-sheet 17, a plurality of these rows of tubes being used throughout the depth of the internal shell, whereby the lowermost row of tubes lies immediately above the combustion-chamber 10 and the uppermost row of tubes is immediately below the crown-sheet 23. The series of vertical plates 18 19 are assembled in abutting relation, each sheet of the series being disposed in a vertical position and each sheet being furthermore curved or arched transversely in the segment of a circle. Furthermore, each sheet of the series 18 19 is flanged at its side edges, as at 24, and the adjacent sheets are disposed in abutting relation, except that provision is made for the reception between the flanges 24 of the reinforcement-bars 25, the latter having their ends beveled or scarfed and terminating within the upper and lower edges of the sheets in a similar way to the arrangement of the reinforcement-bars 12 as to the plates 8 of the fire-box heretofore described.

The arched plates forming the series 18 19 are disposed to present their convex surfaces to the products of combustion which circulate within the internal shell, while the concave surfaces of the series of plates 18 19 are presented in opposing relation to the cylindrical casing 5. The employment of the curved plates and the reinforcement-bars produces an internal shell which is self-supporting and of the necessary internal strength to withstand the pressure within the boiler without resorting to the employment of stay-plates or other means to secure said internal shell within the inclosing casing. The vertical reinforcement-bars 25 terminate short of the upper and lower edges of the plates 18 19, so that the flanges at the end portions of the plates will be brought into abutting relation, and the internal shell is thereby adapted to be flanged at its bottom, as at 26, and at its top, as at 27. The flange 26 at the bottom of the internal shell registers with the flange 14 at the top of the fire-box, so that the shell and the fire-box may be united in a substantial way, as by riveting the parts. The crown-sheet 23 is adapted to rest on the flange 27 at the upper end of the internal shell, and these parts may also be riveted or otherwise secured. The crown-sheet is furthermore provided with an upstanding central flange 28, to which is riveted the lower end of a smoke-pipe 29, adapted to pass through the steam-dome of the boiler and through the upper head 30, said head being flanged, as at 31, and riveted within and to the upper end of the cylindrical casing 5. This upper head, as is usual in the art, is stayed by the employment of the braces 32, which have their opposite ends fastened to the shell 5 and to the head 30. (See Figs. 1 and 2.)

The flue-sheet 16, at the upper end thereof, above the uppermost row of tubes 22, is reinforced by the stay-bars 33, which are fastened to the straight portion of the flue-sheet by stay-bolts in a way well known to those skilled in the art. In a similar way the lower straight portion of the flue-sheet 17, below the lowermost row of tubes 22, is reinforced by a series of stay-bars 34, which are also fastened to the flue-sheet by stay-bolts. The fire-box and the internal shell are disposed within the boiler to provide a water-space 35, which surrounds the joints between the several parts and flows over the crown-sheet 23, so as to partly surround the smoke-pipe 29, and in this water-chamber 35 is arranged a diaphragm 36. This diaphragm is disposed adjacent and parallel to the offset flue-sheet 17, and it extends from the fire-box to the upper end of the internal shell. This diaphragm

may be secured in place within the boiler in any preferred way, and by disposing it quite close to the flue-sheet 17 the water-space between the diaphragm and the flue-sheet is made quite narrow, thus forming an uptake for a rising column of steam and water at the upper end of the tubes and promoting the rapid circulation of water through the plurality of inclined tubes.

Our improved boiler is self-contained—that is to say, all the parts are assembled and united into one integral structure, so that the boiler can be set up in a short space of time or be moved from place to place without the inconvenience following the use of other types of steam-boilers. There are no rivets or joints exposed to the action of the fire, and we are able to use a single thickness of steel which is exposed to the fire, thus permitting the employment of a comparatively heavy grade of steel in the manufacture of the structure. By using steel sheets of greater thickness than can ordinarily be employed we are able to maintain a high steam-pressure, and the strength and durability of the boiler are materially promoted. The products of combustion pass through the smoke-pipe and through the steam-dome, thus superheating the steam, which is of great advantage in the operation of expansive-engines employed in land and marine practice. The arrangement of the internal parts of the boiler secures a free and unobstructed passage for the circulation of the water, thereby lessening the deposit of scale. The water-tubes serve to brace and stay the flue-sheets, and the circulation is increased by the use of straight tubes and by arranging these tubes in inclined positions.

The boiler can be used as an internally-fired boiler by placing fire-doors in convenient points in the lower fire-box, or it can be fired by the use of the Dutch oven-furnace or by any of the different styles of mechanical stoker-furnaces now on the market. The construction of the boiler insures a large water-supply and a rapid generation of the steam, thus maintaining a constant delivery of steam and a steady uniform water-line.

Having thus described our invention, we claim as new and desire to secure by Letters Patent—

1. In a steam-boiler, a fire-box consisting of a plurality of vertically-ranging plates, each curved on a given radius, said plates being assembled to bring their concave surfaces in opposing relation to a surrounding water-space and with their convex surfaces forming the boundary of the combustion-chamber.

2. In a steam-boiler, a fire-box consisting of a plurality of flanged curved plates assembled for their flanges to have abutting engagement, and stay-bars provided with reduced ends and secured between the flanges of the plates, each stay-bar being shorter than the plates.

3. In a steam-boiler, a fire-box having a plurality of vertically-ranging curved plates assembled in abutting relation along their vertical edges and provided with vertical flanges, and a series of interposed reinforcement-bars secured between the flanges of said plates.

4. In a steam-boiler, a fire-box having a plurality of arched or curved plates having flanges, and a series of reinforcement-bars provided with tapered ends and secured to and between the flanges of the adjacent plates.

5. In a water-tube boiler, an internal shell consisting of a series of vertical plates arched transversely, and opposing flue-sheets united to the arched plates and provided with a series of inclined offsets, combined with straight tubes secured in the offsets of said flue-sheets and disposed in corresponding inclined positions across the internal shell.

6. In a water-tube boiler, an internal shell consisting of flue-sheets, and a series of curved plates all assembled in a substantial relation, combined with an external shell, and rows of inclined water-tubes secured in the flue-sheets of said internal shell.

7. In a water-tube boiler, an internal shell consisting of parallel flue-sheets, and two series of curved plates disposed in abutting relation and united to the flue-sheets, combined with a fire-box to which the internal shell is united, an external shell inclosing the internal shell and the fire-box, a series of tubes secured in the flue-sheets of the internal shell, and a crown-sheet fastened to the internal shell.

8. In a water-tube boiler, an internal shell having offset members in opposing relation, a series of vertically-ranging members between the offset members, said vertically-ranging members being curved transversely and assembled in abutting relation along their vertical edges, and reinforcement strips or bars secured to and between the abutting edges of adjacent members, combined with an external shell, and a series of tubes supported by the offset members within the internal shell.

9. In a water-tube boiler, an internal shell consisting of parallel offset flue-sheets, and curved or arched plates united in series to the flue-sheets, combined with an external shell, and straight inclined tubes secured between the offset portions of the flue-sheets.

10. In a water-tube boiler, the combination of a fire-box, an internal shell secured to said fire-box and having opposing flue-sheets provided with inclined offsets, straight inclined tubes secured in the offsets of said flue-sheets and disposed within said internal shell, all of said tubes being inclined in one direction, an external shell, and a diaphragm secured between the external and internal shells and disposed in close relation to the flue-sheet to which is secured the elevated ends of the correspondingly-inclined tubes.

11. In a water-tube boiler, the combination

of a fire-box, an internal shell having offset flue-sheets provided with straight upper and lower portions, stays secured to said straight portions of the flue-sheets at the upper and lower ends thereof, a series of straight tubes secured to the flue-sheets between the offset portions thereof, an external shell, a crown-sheet secured to the internal shell, and a smoke-pipe leading from said crown-sheet.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

JOHN FERDINAND HOTTMAN, SR.
JOHN FERDINAND HOTTMAN, JR.

Witnesses:
JOHN P. SCHROEDER,
C. B. SCHERR.