No. 868,274. PATENTED OCT. 15, 1907.

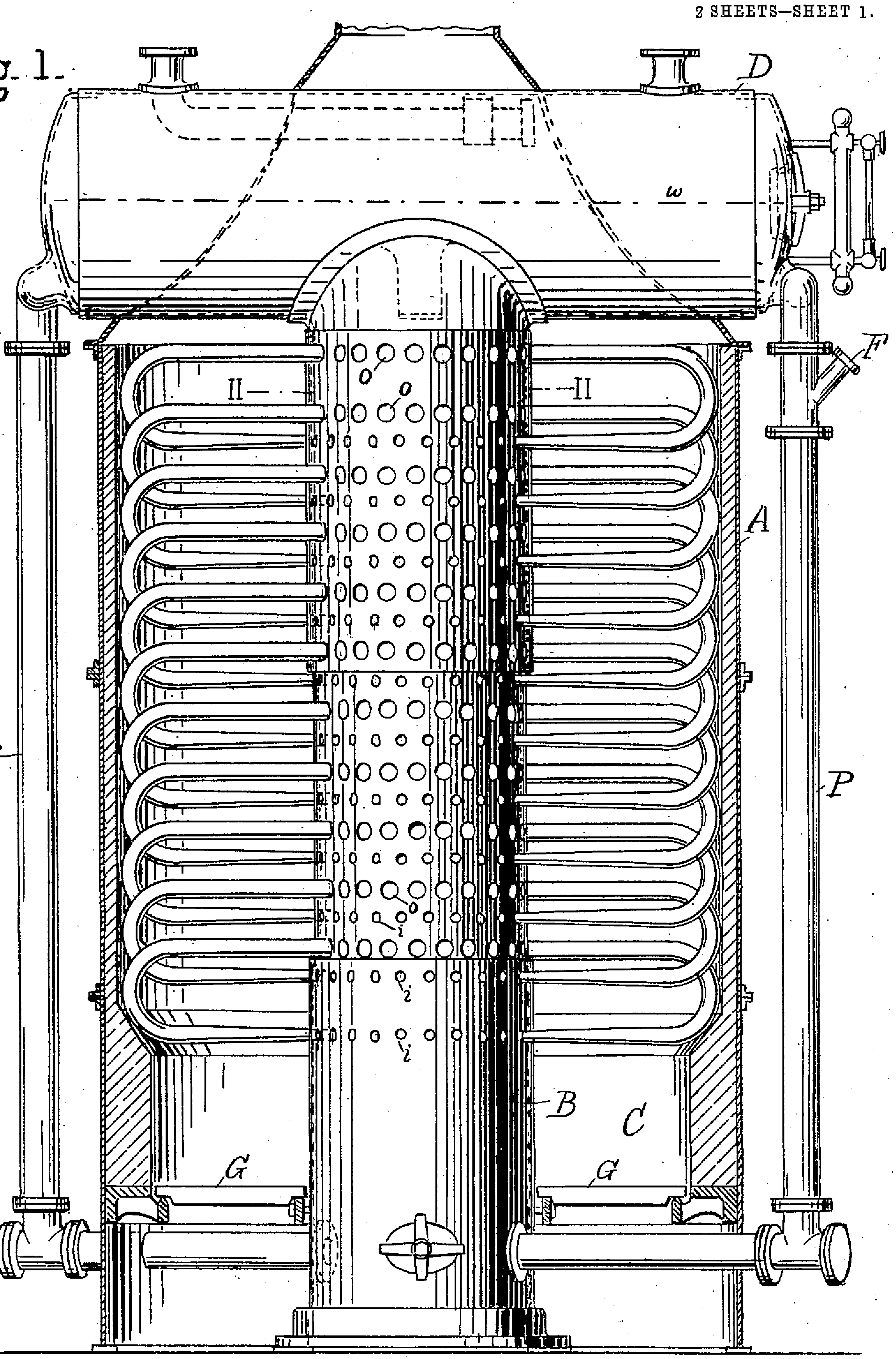
A. E. JONES.

STEAM BOILER.

APPLICATION FILED JAN. 14, 1905.

2 SHEETS—SHEET 1.

Fig. 1.



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2 SHEETS—SHEET 2.

Fig. 2.

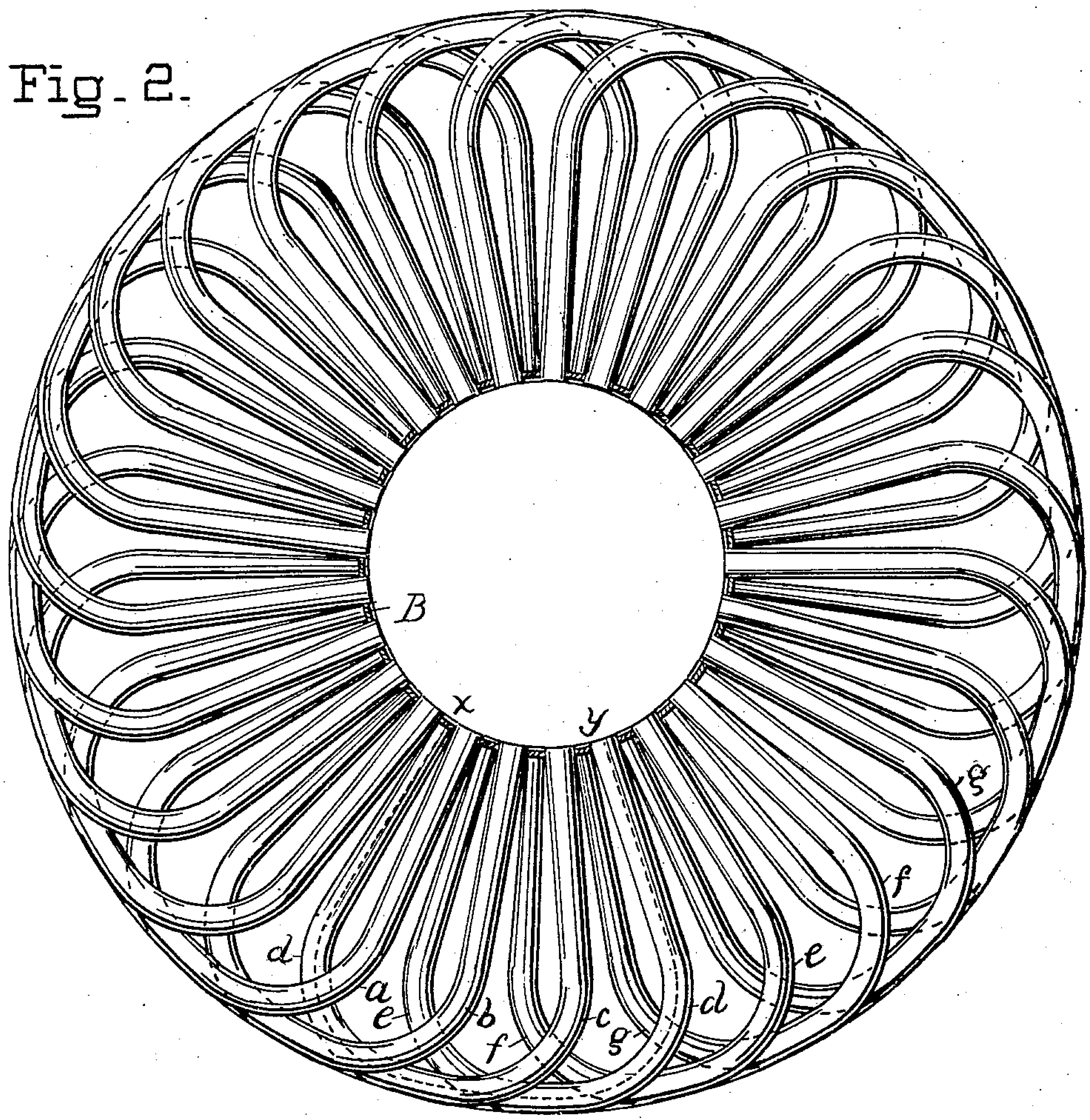
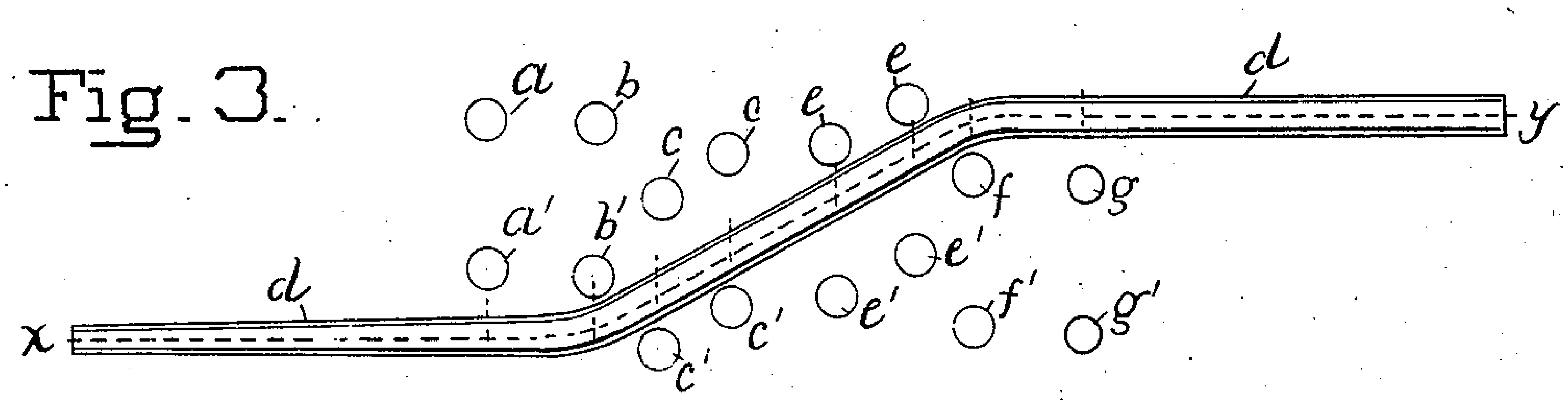


Fig. 3.



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UNITED STATES PATENT OFFICE.

ALFRED E. JONES, OF NEW YORK, N. Y.

STEAM-BOILER.

No. 868,274. **Specification of Letters Patent.** **Patented Oct. 15, 1907.**

Application filed January 14, 1905. Serial No. 240,979.

To all whom it may concern:

Be it known that I, ALFRED E. JONES, a citizen of the United States of America, and a resident of the borough of Brooklyn, county of Kings, city of New York, and State of New York, have invented certain new and useful Improvements in Steam-Boilers, of which the following is a specification.

My invention relates to that type of water-tube boiler wherein the steam is chiefly generated in yoke-shaped tubes, which lie in an annular fire chamber, and the ends of which are set in a boiler shell which forms the interior wall of the annular fire chamber and contains the water of the boiler under pressure. In the design of a boiler of this type for efficient strength and durability there should be sufficient tube length for the desired heating surface, the tubes should be so disposed as not to unduly obstruct the draft of the furnace, and that no parts of the tubes will be unduly shielded from the heat of the furnace gases, they should be so disposed and supported that they will not touch each other. These are conditions which are best met by a design in which the tube-yokes are of comparatively short length of tube, avoiding tortuous paths. But to obtain sufficient heating surface the tubes must be somewhat greater in number than if they were longer, thereby increasing the number of tube ends to be riveted into the boiler shell. And it is necessary to avoid too great a mutilation of this shell by the holes in order to preserve the necessary strength. This I attain by making each of the tubes of reduced diameter at one end and tapering preferably for about a third of its length, so that half of the holes in the boiler shell may be of smaller diameter. The tubes are interlaced, and the large and small ends alternated vertically, so that the large and small holes in the shell will also alternate to preserve as uniform a distribution of strength as possible. The small end of each tube is where the water enters, as the water occupies a much smaller volume when entering than in other parts of the tube, where it is surcharged with steam, and the smaller diameter at the point of entering is desirable to increase the velocity and prevent the deposition of scale.

That portion of the boiler which carries the water-tubes is preferably a vertical cylinder and is surmounted by a cross-drum which forms a substantially unitary chamber with the vertical cylinder so that the water level can be maintained in the cross-drum above all the yoke-shaped tubes and also afford greater water surface for the steam to disengage. To insure adequate circulation, large pipes connect the ends of the cross-drum below the water level, with the lower end of the vertical portion of the boiler below the water tubes and the fire chamber.

In the accompanying two sheets of drawings, which form a part of this application, Figure 1 is an elevation of a boiler constructed in accordance with my invention, together with its surrounding fire chamber, the walls of the latter being broken away along a vertical median plane, and the water-tubes being omitted, with the exception of those lying along two vertical rows on either side. Fig. 2 is a section on the line II—II of Fig. 1, showing the manner in which the tubes are interlaced. The axial line x—y serves to identify the tube d throughout its length. Fig. 3 is a development of the tube d, or, in other words, a straightening out of the bends of the tube which are shown in Fig. 2. The circles represent the points of crossing of the contiguous tubes.

My boiler, as illustrated, is inclosed within vertical cylindrical furnace walls A, and comprises a cylindrical vertical shell B, between which and the furnace walls is an annular fire chamber C, and the cylindrical vertical shell is surmounted by a cross-drum D, in which the water level w is maintained. Circulating pipes P are carried from the ends of the cross-drum below the water level downwardly outside the fire chamber and into the lower end of the vertical portion of the boiler, below the water-tubes, and preferably below the grates G at the bottom of the fire chamber. By reason of these circulating pipes being isolated from all sources of heat, the water in them is kept as cool as possible and free from steam so that circulation therein will be downward. Feed water enters through one of the circulating pipes at F.

The vertical shell is perforated with circumferentially disposed rows of holes i and o of different sizes, the holes o being larger than the holes i. The two lowest rows are of the smaller size, the two uppermost rows are of the larger size, and the other rows alternate in size, and are half the distance apart of the two uppermost and the two lowest rows. Water-tubes a b c d e f g, etc., each of which is tapered at one end, are riveted in these holes. The smaller tapered end of each tube is riveted in one of the smaller holes and the larger end is riveted in one of the larger holes up above, and at a point seven-fiftieths of the circle or $50\frac{2}{5}$ degrees around the cylinder from the point at which the smaller is riveted. The course of the tube d is indicated in Fig. 2 by the axial line x—y. This course, commencing at the smaller end, where the water enters, is along a radial and substantially horizontal line from the boiler shell to the outer periphery of the fire chamber; thence it follows the periphery along a spiral line for about 50°, and then turns back toward the axis along another radial and horizontal line through the boiler shell, where the water and steam are discharged from the tube. Each of the courses above traced is somewhat shortened by reason of the courses being connected by more or less gradual bends in the tube. The tubes vertically under the tubes a b c d e f and g of Fig. 2 are indicated in Fig. 3 by the characters a' b' c' d' e' f' and g' respectively.

The holes *i* and *o* must be located not only where the ends of the tubes can be conveniently brought to them, but also with proper regard to preserving sufficient strength in the boiler shell. The strains in a cylindrical boiler shell, as is well understood, are twice as great circumferentially as longitudinally, and hence rupture is more likely along a longitudinal element. Therefore, in locating the holes, it is important that there be less mutilation along any longitudinal element or line of least strength that can be traced in a general longitudinal direction, than along any circumferential element. This results in the combination illustrated first, from the staggering of the holes of contiguous circumferential rows with respect to each other, so that only a zig-zag longitudinal line can be drawn through a hole in each row; second, from the alternation of large and small holes along any such line; and third, from the rows being spaced further apart than the holes in the rows.

By reason of the feed water being introduced into the boiler through the circulating pipes, it promotes the circulation from the cross-drum, it is heated by mingling with the water which comes into the pipe through the cross-drum, and before it enters the boiler, and thereby the precipitation of solids held in suspension by the feed water is promoted and such solids are deposited in the vertical shell below the fire chamber.

What I claim as new and desire to secure by Letters Patent of the United States is:—

1. In a water-tube boiler the combination of a cylindrical shell and yoke-shaped tubes each tapered at one end, the small ends of the tubes alternating with the large ends along longitudinal elements of the shell, substantially as described.

2. In a water-tube boiler, the combination of a vertical cylindrical portion, a fire-chamber surrounding the vertical cylindrical portion and having its inner wall formed thereby, a cross-drum surmounting and forming a substantially unitary chamber with the vertical cylindrical portion, and circulating pipes isolated from all sources of heat, the upper ends of which connect the ends of the cross-drum with the lower end of the vertical cylindrical portion below the grate, substantially as described.

3. In a water-tube boiler, the combination of a vertical cylindrical portion, a fire-chamber surrounding the vertical cylindrical portion and having its inner wall formed thereby, a cross-drum surmounting and forming a substantially unitary chamber with the vertical cylindrical portion, and circulating pipes isolated from all sources of heat which connect the ends of the cross-drum with the lower end of the vertical cylindrical portion, substantially as described.

4. In a water-tube boiler, the combination of a vertical cylindrical portion, a fire-chamber surrounding the vertical cylindrical portion and having its inner wall formed thereby, yoke-shaped tubes arranged in the fire-chamber about the periphery of the cylindrical portion and each having both ends secured in the cylindrical portion, a cross-drum surmounting and forming a substantially unitary chamber with the vertical cylindrical portion, and circulating pipes isolated from all sources of heat which connect the ends of the cross-drum with the lower end of the vertical cylindrical portion, substantially as described.

5. In a water-tube boiler, the combination of a vertical cylindrical portion, a fire-chamber consisting of a fire-box surrounding the lower part of the vertical cylindrical portion, and a combustion space directly over the fire-box, water-tubes arranged in the combustion space, a cross-drum surmounting and forming a substantially unitary chamber with the vertical cylindrical portion, and circulating pipes isolated from the fire-chamber which connect the ends of the cross-drum with the lower end of the vertical cylindrical portion, substantially as described.

6. In a water-tube boiler, the combination of a vertical cylindrical portion, a fire-chamber surrounding the vertical cylindrical portion and having its inner wall formed thereby, a cross-drum surmounting and forming a substantially unitary chamber with the vertical cylindrical portion, circulating pipes isolated from all sources of heat which connect the ends of the cross-drum with the lower end of the vertical cylindrical portion, and feed connections with a circulating pipe, substantially as described.

7. In a water-tube boiler, the combination of a vertical cylindrical portion, a fire-chamber surrounding the vertical cylindrical portion, a cross-drum surmounting and forming a single unitary chamber with the vertical cylindrical portion, and water circulating pipes, the flow through which is downwardly, isolated from all sources of heat, the upper ends of which connect the ends of the cross-drum below the water level therein with the lower end of the vertical cylindrical portion below the grate.

Signed by me at New York city, N. Y., this 12th day of January, 1905.

ALFRED E. JONES.

Witnesses:
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SAMUEL W. BALCH.