J. E. BELL.

SUPERHEATER.

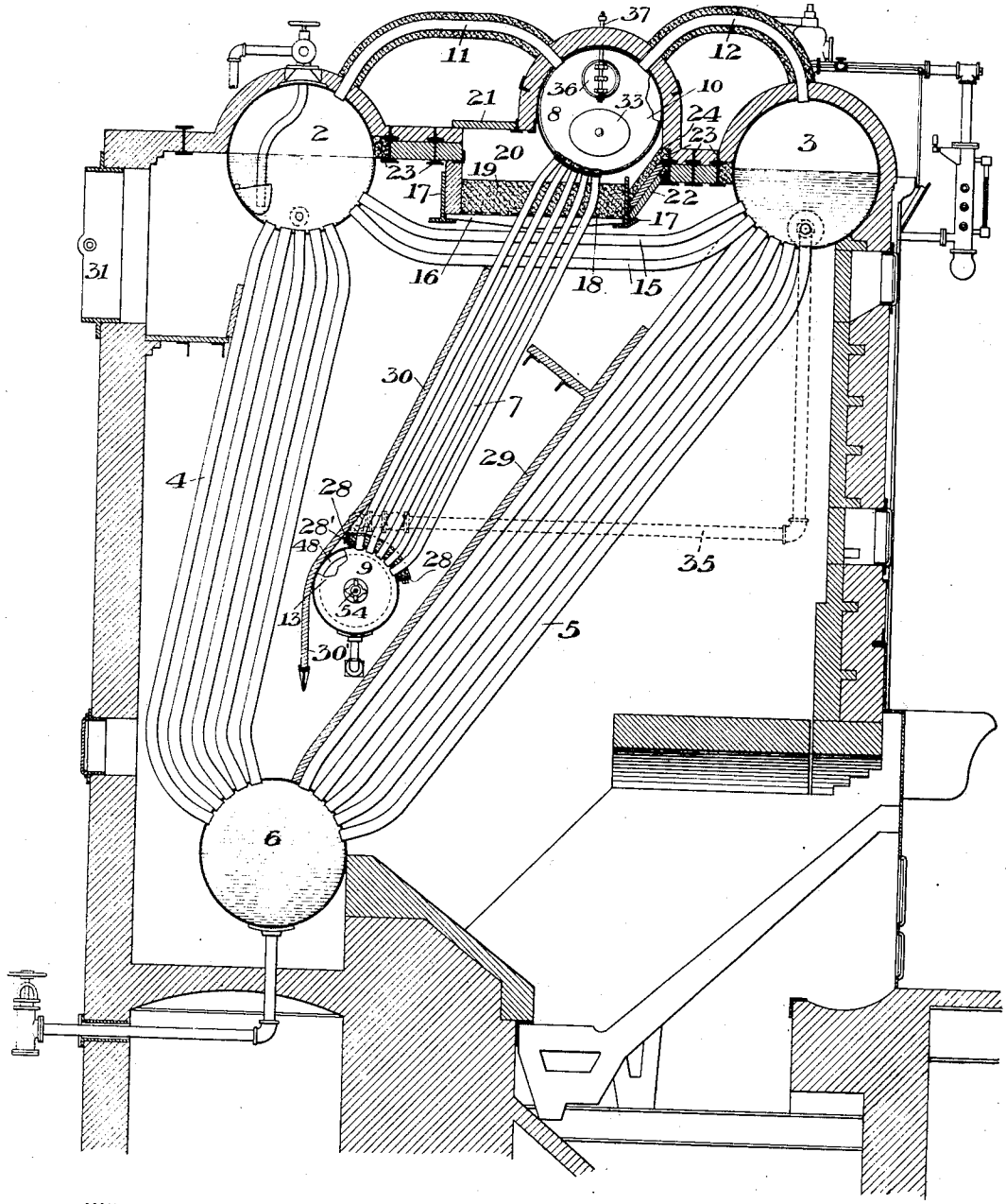
APPLICATION FILED MAY 29, 1905.

954,913.

Patented Apr. 12, 1910.

6 SHEETS—SHEET 1.

Fig. 1.



WITNESSES

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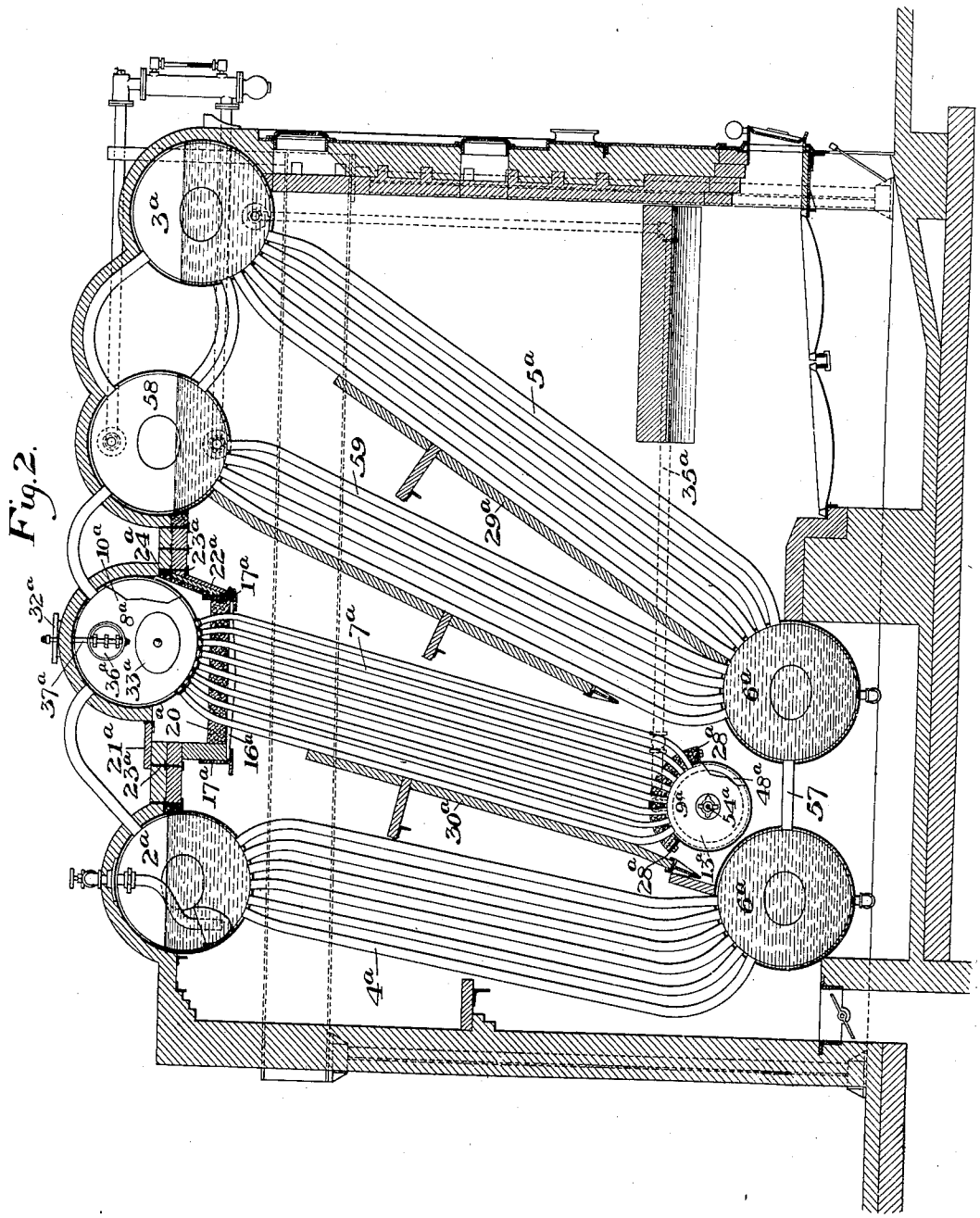
6 SHEETS—SHEET 2.

Fig. 2.



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6 SHEETS—SHEET 3.

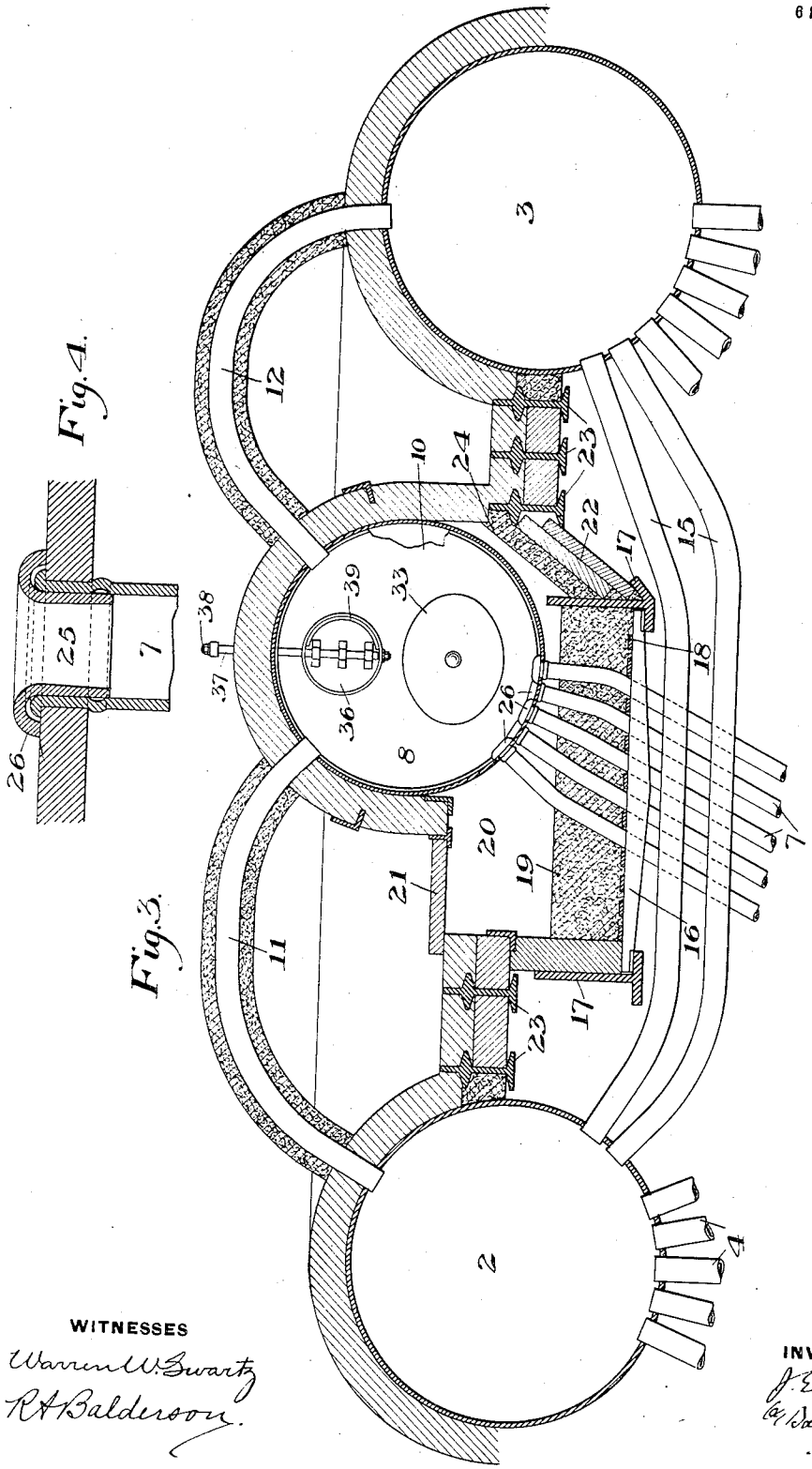

Fig. 4.

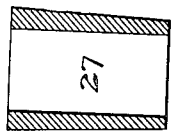

Fig. 6.

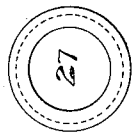

Fig. 5.

Fig. 3.

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6 SHEETS—SHEET 4.

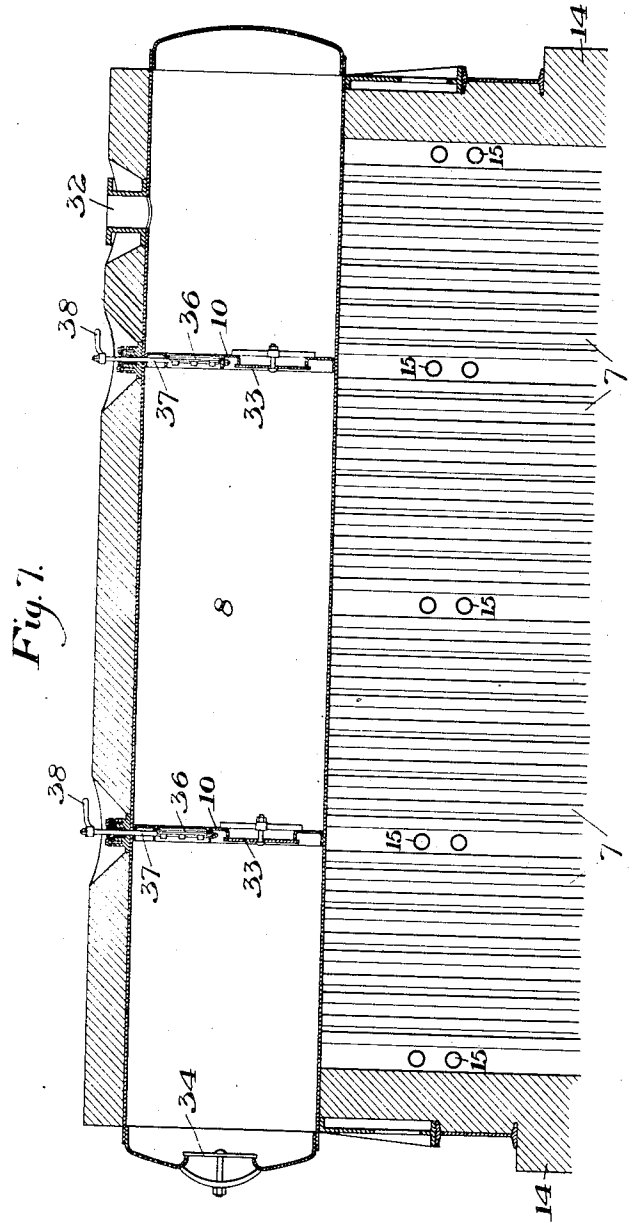

Fig. 7.

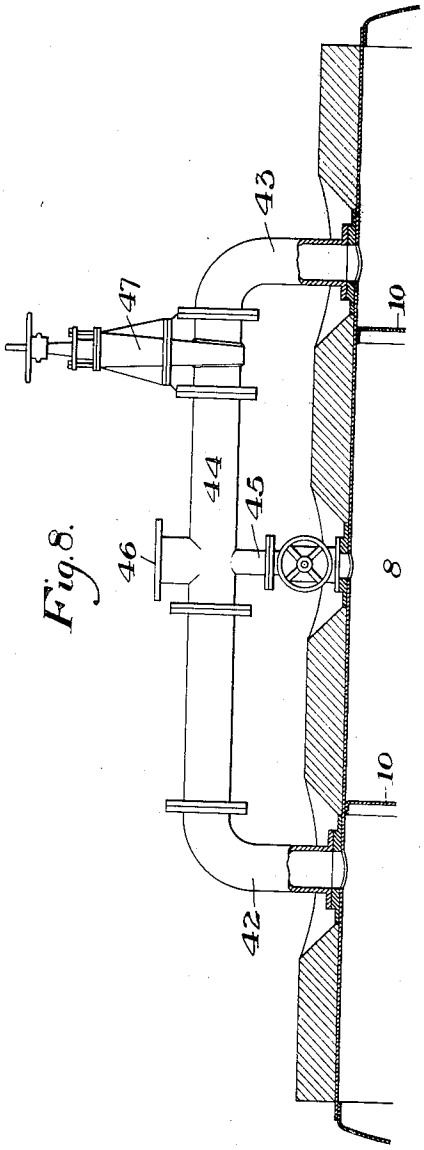

Fig. 8.

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6 SHEETS—SHEET 5.

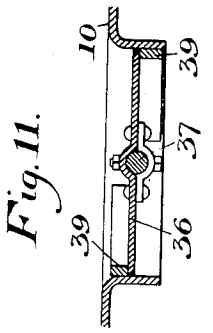

Fig. 11.

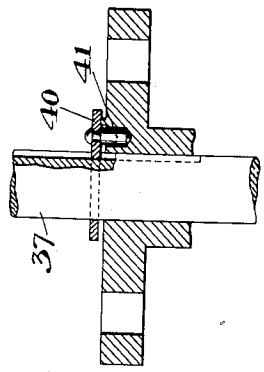

Fig. 12.

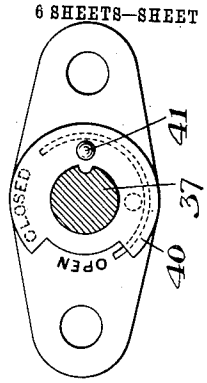

Fig. 13.

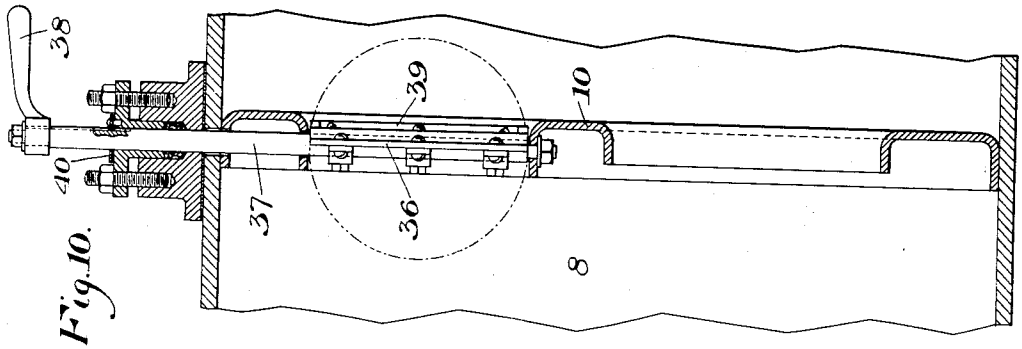

Fig. 10.

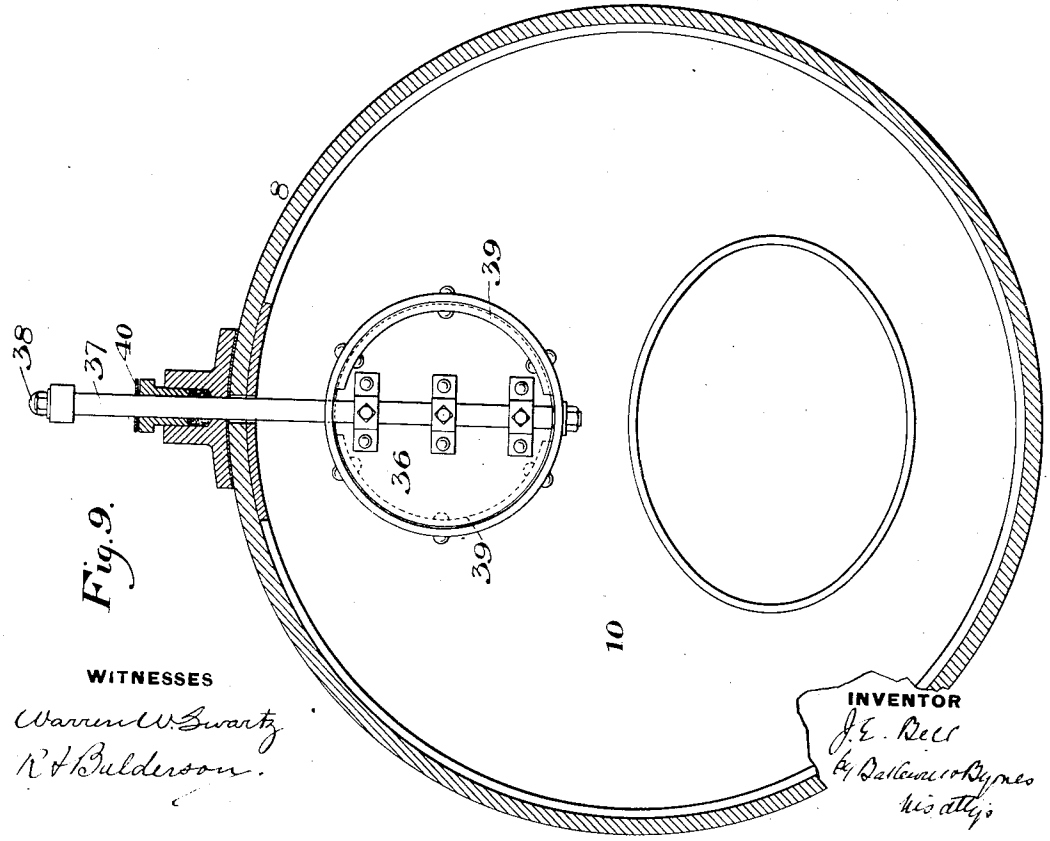

Fig. 9.

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APPLICATION FILED MAY 29, 1905.

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6 SHEETS—SHEET 6.

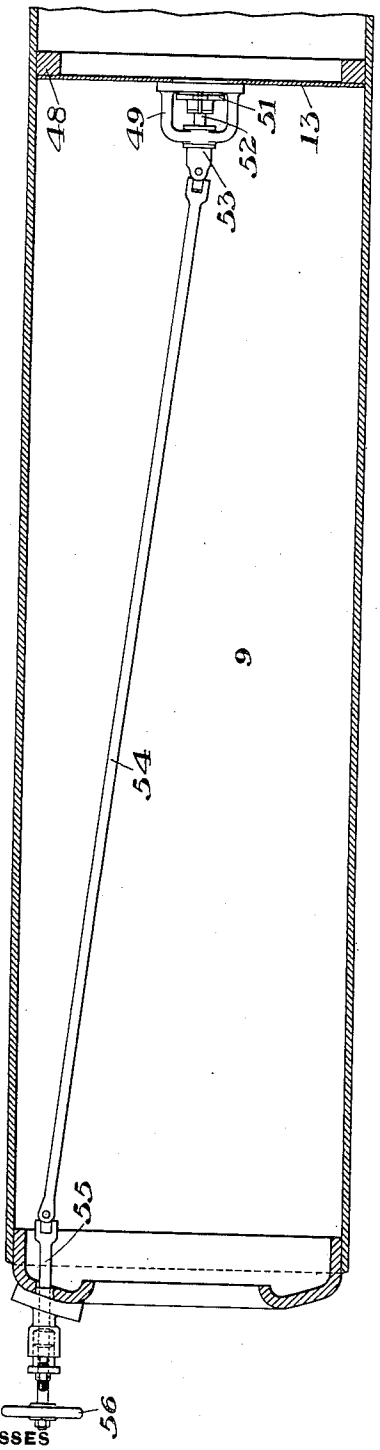

Fig. 14.

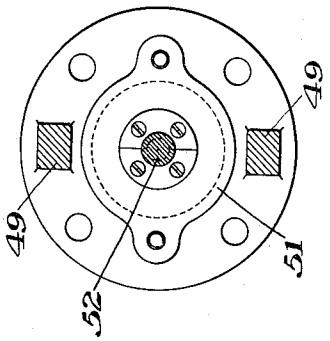

Fig. 16.

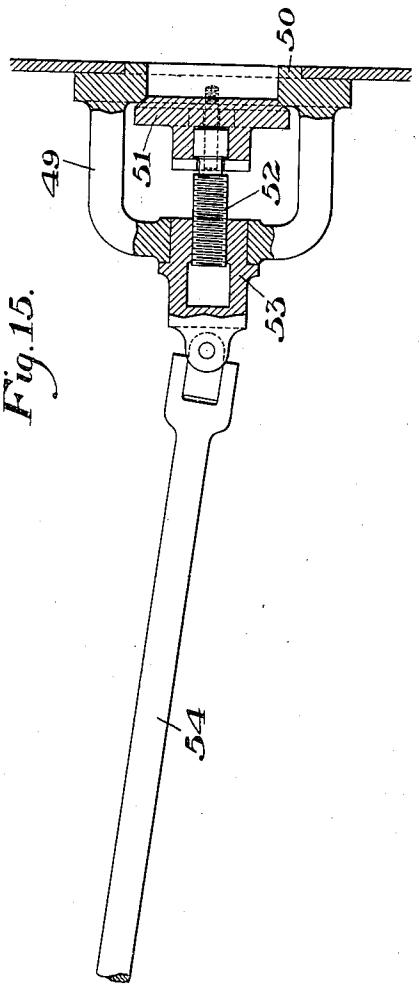

Fig. 15.

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UNITED STATES PATENT OFFICE.

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SUPERHEATER.

954,913. Specification of Letters Patent. Patented Apr. 12, 1910.

Application filed May 29, 1905. Serial No. 262,794.

To all whom it may concern:

Be it known that I, JOHN E. BELL, of Barberton, Summit county, Ohio, have invented a new and useful Improvement in Superheaters, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a sectional side elevation showing one form of superheater boiler constructed in accordance with my invention; Fig. 2 is a similar view showing another form of the invention; Fig. 3 is an enlarged detail view showing the upper drums and connections; Fig. 4 is an enlarged detail view of the superheater tube connection; Figs. 5 and 6 are detail views showing another form of plug for the superheater tube connection; Fig. 7 is a longitudinal section of the upper superheater drum and connections; Fig. 8 is a partial side elevation of a modified form of connection for the superheater compartments; Fig. 9 is a cross-section of the upper superheater drum on a larger scale; Fig. 10 is a cross-section of the upper superheater drum partition and valve; Fig. 11 is a cross-section of the valve; Figs. 12 and 13 are detail views of the turning means for the valve; Fig. 14 is a partial longitudinal section of the lower superheater drum showing a preferred form of valve connection; Fig. 15 is a sectional elevation of the lower valve on a larger scale; and Fig. 16 is a cross-section of Fig. 15.

My invention relates to the class of superheaters, and more especially to superheaters combined in the same structure with boilers; although certain features of my invention may be used in other types of superheaters.

The invention consists in certain features of construction in connection with drum and tube superheaters; and also in certain proportions of the superheating surface relative to the water-heating surface; as hereinafter more fully described and claimed.

In the drawings, referring to the form of Figs. 1, 3, 4, 7, 9, 10, 11, 12, 13, 14, 15 and 16, 2 and 3 represent the upper transverse steam and water drums of a boiler of the general Stirling type, connected by banks of tubes 4 and 5 to a lower transverse mud drum 6. Between the banks of tubes 4 and 5 is the superheating surface consisting of tubes 7 connecting an upper transverse steam drum 8 and a lower transverse steam drum 9. I have shown the drum 8 as divided into three compartments by transverse partitions 10, 10, with steam inlet tubes 11 and 12 leading from the steam spaces of the drums 2 and 3 into one of the end chambers. I have shown the drum 9 as provided with a single central partition 13 dividing it into two compartments of substantially equal length. I preferably arrange the tubes 7 in four groups with spaces between the groups at the partition lines of the upper and lower superheater drums, and also spaces between the tubes and the side-walls 14 of the setting, as shown in Fig. 7. Extending through these five spaces between the superheater tubes I provide the water-circulating tubes 15, which I have shown as arranged in groups of two and connecting the water spaces of the drums 2 and 3. The drum 8 is preferably located slightly above the drums 2 and 3, and above the tubes 15 I arrange supporting-bars 16 which rest upon the transverse metal shapes or beams 17 between the side-walls. On the bars 16 rest the cross-bars 18, which extend transversely of the setting side by side. On the bars 18 is packed asbestos filling 19, which surrounds the superheater tubes and closes off the chamber 20 from the gases. This chamber may be entered through the cross aperture closed by removable blocks or tiles 21.

22 are inclined tiles connecting the front shape 17 with the cross-beams 23, 24 being an asbestos filling over the tiles 22.

To protect the ends of the superheater tubes from the action of the steam, I preferably provide the two ends with lining ferrules or thimbles. In the form shown in Figs. 3 and 4, these thimbles 25 are driven into the ends of the tubes within the superheater drum and are beaded over at their inner ends as shown at 26 to cover the ends of the tubes proper. The superheater tube may be expanded in the tube seat in the ordinary manner, and the ferrule or thimble will protect it from the cutting action of the steam. Instead of the form shown in Figs. 3 and 4, I may employ a straight tapered ferrule 27, as shown in Figs. 5 and 6, these being driven into the ends of the tubes within the drums.

The lower drum 9 is exposed to the action of the flame and gases from the furnace;

and to protect the superheater tube connections thereinto, I preferably provide longitudinal metallic angles or brackets 28 which are connected by curved bolts 28′ and extend longitudinally of the drum. Between these holding angles is packed asbestos filling or refractory material which covers the tube joints and protects them from the direct action of the heated gases. I have shown these gases as rising through the front bank over the top of the baffle 29, thence flowing down through the superheater tubes in front of the baffle 30 having an extension 30′, and then rising through the rear tubes to the outlet 31. The steam entering the one end of compartment of the upper drum flows down to the lower drum, thence up to the central compartment of the upper drum; thence down again to the lower drum 9, and thence to the third compartment of the upper drum, where it issues through outlet 32.

The partitions in the upper drum are preferably provided with manholes in their lower portions, which are covered by removable manhole-plates 33. One head of the drum is also provided with a manhole and manhole-plate 34 so that access can be had to all the compartments. These partitions may be made removable if desired.

A flooding pipe 35 is provided which preferably leads from the front upper drum into the lower drum 9 of the superheater to convert the superheater into water-heating surface. In such case the compartments of the upper drum are preferably connected with each other; and for this purpose I preferably employ by-pass valves 36, which are shown in detail in Figs. 9, 10 and 11. Each of these valves is preferably of the butterfly type carried on a shaft 37 extending upwardly through a stuffing-box in the top of the cylinder and provided with actuating handle 38. Semi-circular seats 39 are preferably provided at the opposite sides of the flanged partition opening, against which the butterfly seats when closed. In order to lock the valve in open or closed position, I preferably provide a ring or disk 40 which is splined to the shaft 37 and provided with a pin 41 adapted to enter either of two recesses in the top plate of the stuffing-box or gland. On this top plate the words "Open" and "Closed" are located in such manner that a cut-away portion of the plate 40 will cover one of these words, while the other is open to view. By lifting the plate 40 to release the pin the plate will be turned with the valve, when the pin will drop into the other hole and lock the valve in either the open or closed position, one of the words showing in which position the valve is placed. Instead of this system of connections between the compartments, I may employ the piping connections shown in Fig. 8. In this form pipes 42 and 43 lead from the end compartment to a common pipe 44 connected to the central compartment by the valve-pipe 45. The pipe 44 is provided with a central outlet 46, and its connection with the pipe 43 is provided with a gate-valve 47. When the superheater is used for superheating steam, the valve 47 and the valve and pipe 45 are closed. When the superheater is flooded, these valves are opened and the saturated steam passes from the three compartments to the outlet.

The partition in the lower drum is preferably removable, and consists of a plate resting against a ring 48 welded or otherwise secured to the interior of the drum. I have shown an open yoke or frame 49 secured to the center of this partition and provided with a valve-seat 50 extending within a central hole in the partition, the opening being controlled by valve 51 moving within the yoke or cage. The valve is provided with a screw-threaded stem 52 engaging screw-threads in a rotary sleeve 53 within the yoke connected by a universal joint with a rod or shaft 54 extending to the end of the drum, where it connects by another universal joint with a turning-shaft 55 extending through a suitable stuffing-box to an external hand-wheel 56. By turning the hand-wheel 56 the valve may be opened or closed. The shaft also holds the partition in place against the ring 48.

In the superheater boiler shown in Fig. 2, two lower drums 6^a are provided, these being connected by tubes 57. In addition to the upper drums 2^a and 3^a, I provide another upper drum 58 connected to the front mud drum 6^a by bank of tubes 59. The superheater tubes 7^a are between the second bank 59 and the third bank 4^a of water tubes. The details of construction may be the same as those previously described.

The tubes of the superheater are preferably of smaller size than those of the water-heating surface, and in both cases the tubes are preferably spaced in groups of two, the spaces between the groups being of greater width than the tubes proper. This spacing enables any tube to be removed from the drums and pass through the wider spacing of the banks. Hence, any of the tubes in the boiler or superheater may be replaced without disturbing any other tube.

I have discovered that instead of the usual amount of water-heating surface per rated horse power which is the standard for water tube boilers, a smaller percentage of water-heating surface per horse power should be used where a superheater is located in the boiler setting. In other words, the superheater should not be added as additional heating surface to the ordinary boiler; but the water-heating surface of the boiler should be reduced where the superheater is

placed in the boiler setting. The ordinary amount of water-heating surface is 10 square feet per rated horse power. I have found that the amount of water-heating surface should be less than this—preferably about 8 or 9 square feet of water-heating surface per rated horse power, the amount of superheating surface depending on the amount of superheat desired and on the location of the superheater. I have also found that to give proper efficiency, the water-heating surface should not only be reduced, but the amount of superheating surface added should increase the total heating surface to more than that employed in a water-tube boiler without a superheater. For example, in the form of superheater shown in Fig. 2, arranged for 100 degrees superheat, the water-heating surface should be about 9 square feet per rated horse power. I have also found that in a boiler having up and down passes for the gases over separate and successive banks of tubes, the superheating surface should be reduced the nearer the superheater is brought to the source of heat. Thus, in the form of Fig. 1, where the gases contact with the superheater in the second pass, there should be only about 1½ to 2 square feet of superheating surface per rated horse power. The providing of fewer square feet of water-heating surface per horse power than required for a saturated steam boiler applies particularly to cases where the superheater is so located that at least 25 per cent. of the water-heating surface is placed between the superheater and the furnace or source of heat. In such case the superheater may be placed either in the rear of all the water-heating surface or in an intermediate position with water-heating surface on both sides between the superheater and the furnace and between the superheater and the outlet for the gases.

The advantages of my invention result from the simplicity and economy of construction, the connections for giving up and down passes to the steam, while providing for flooding the superheater and using it as a part of the boiler, and also from the proportioning of the water-heating surface and superheating-surface, as above described, giving higher efficiency to the heating surface as a whole.

Many variations may be made in the form and arrangement of the parts without departing from my invention.

I claim:—

1. A superheater boiler having transverse upper steam and water drums connected by banks of tubes to a lower mud drum or drums, a superheater between the banks and having an upper chamber with depending superheater tubes arranged in sets separated from each other longitudinally of the drum, and water-circulating tubes connecting the water spaces of two of the steam and water drums and extending between the separated sets of superheating tubes; substantially as described.

2. A superheater drum or chamber having a transverse partition with a hole therein, a valve controlling said hole, and a rotary valve stem extending longitudinally through the chamber and through its end head, and having a screw device for adjusting the valve; substantially as described.

3. A superheater boiler having upper steam and water drums connected by banks of tubes to a lower mud drum or drums, a superheater between two of the banks of tubes and having an upper drum or chamber with depending superheating tubes and a chamber around the upper ends of the superheating tubes with refractory material between it and the interior of the setting, said chamber having a bottom composed of bars extending longitudinally of the chamber between the superheating tubes with refractory material overlying the bars; substantially as described.

4. A water-tube boiler having upper steam and water drums connected by banks of tubes to a lower mud drum or drums, a superheater having a drum or chamber with superheating tubes between the banks of water-tubes, partitions dividing the superheating chamber into different compartments, water circulators connecting two of the steam and water drums and located in line with the partitions; substantially as described.

5. A superheater having upper and lower cross-partitioned drums connected by superheating tubes, and water tubes extending transversely between the superheating tubes and in line with the partitions; substantially as described.

6. In a superheater, a steam drum or chamber having a transverse partition dividing it into steam compartments, superheater tubes connected to said compartments, and means for connecting or disconnecting said compartments; substantially as described.

7. In a superheater a drum or chamber having superheating tubes connected thereto, a transverse partition in the chamber forming superheater compartments, a hole through the partition, and means for opening and closing said hole; substantially as described.

8. A superheater drum or chamber having a partition, and a valve in the partition having external controlling means; substantially as described.

9. A superheater drum having an end manhole and a partition with a manhole therein; substantially as described.

10. In a superheater a drum or chamber having a transverse partition, a manhole and

manhole-plate therein, and a valve in said partition having external controlling means; substantially as described.

11. In a superheater a drum or chamber having a partition, an oscillating valve in said partition, an external handle for said valve, and means for locking the valve in open and closed position; substantially as described.

12. In a superheater, a chamber having a partition with a hole therein, a valve controlling said hole, and a valve-rod extending longitudinally of the chamber through its end head and having an external handle; substantially as described.

13. In a superheater, a chamber or drum having a partition with a hole therein, a rod extending through the chamber and arranged to hold the partition in place, and a valve controlled by said rod; substantially as described.

14. In a superheater, a chamber having superheating tubes, a partition in said chamber forming superheater compartments, means for flooding the superheater, and means for connecting the superheater compartments formed by the partition, said means being independent of the superheating tubes; substantially as described.

15. In a superheater boiler, a superheater drum or chamber at a suitable level to contain a steam chamber when the superheater is flooded, means for flooding the superheater, a partition in the upper superheater chamber forming superheater compartments, and means for drawing off steam from both compartments formed by said partition; substantially as described.

In testimony whereof, I have hereunto set my hand.

JOHN E. BELL.

Witnesses:
M. E. HAMLIN,
M. L. HOFFMAN.