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Patented Dec. 12, 1899.

C. ADAMS.
BOILER FEED WATER HEATER

(Application filed Mar. 29, 1899.)

(No Model.)

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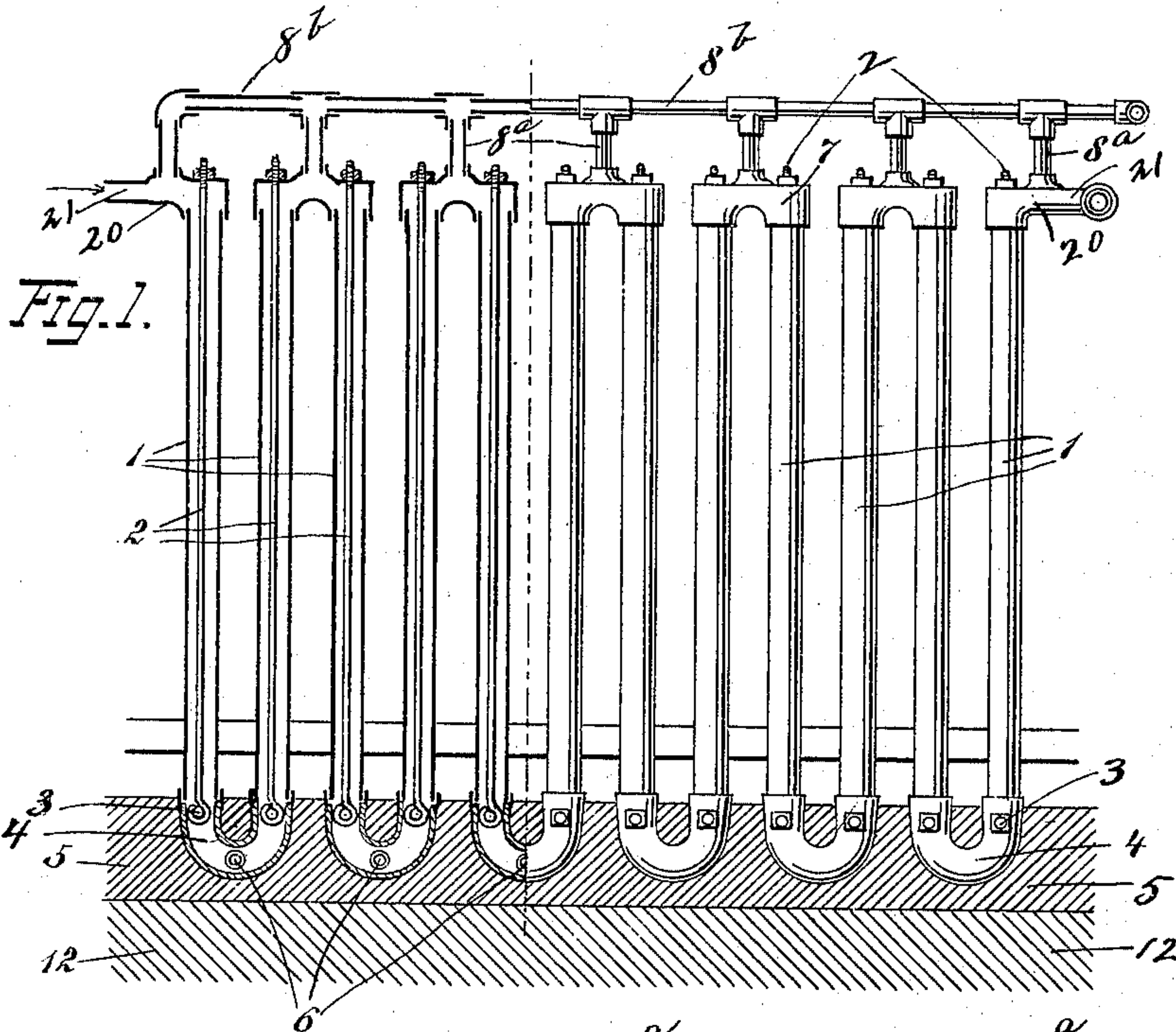
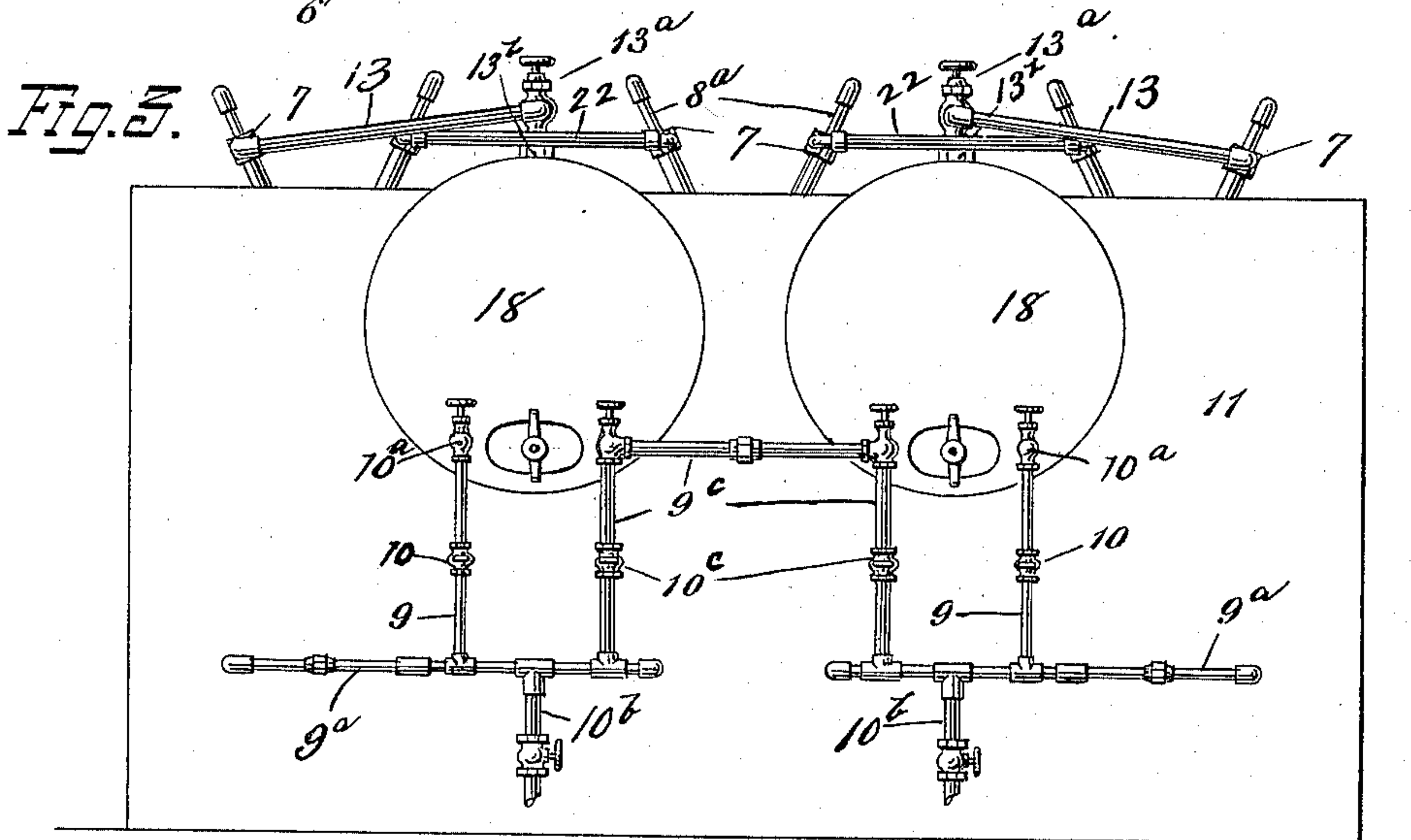
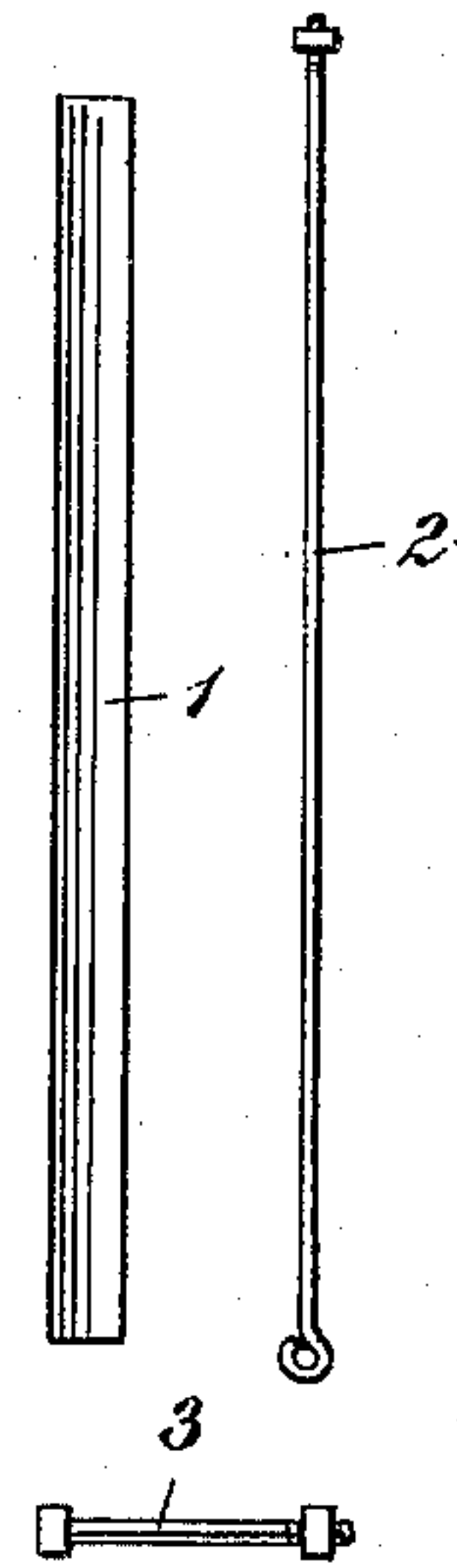


Fig. 2.



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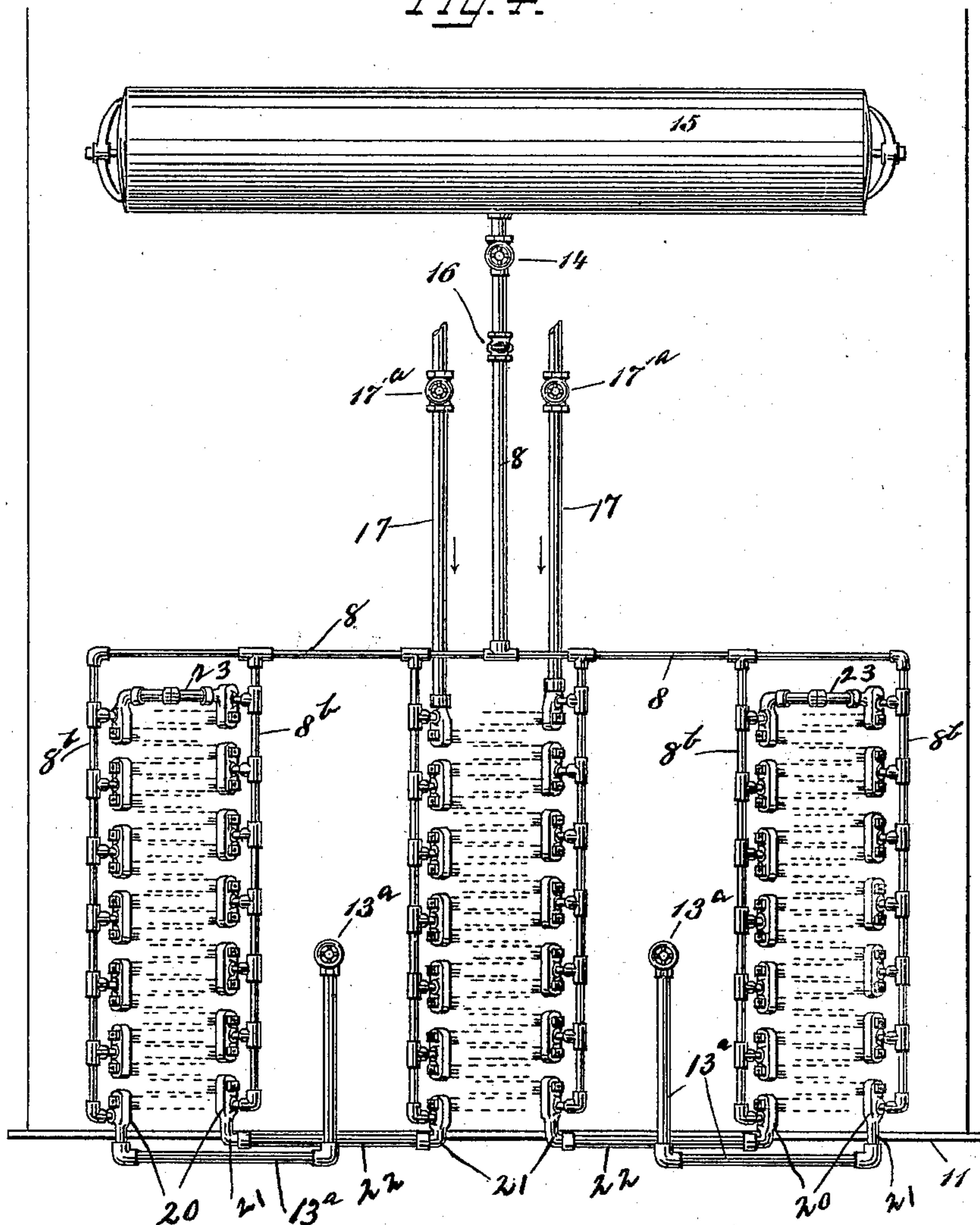
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Fig. 4.



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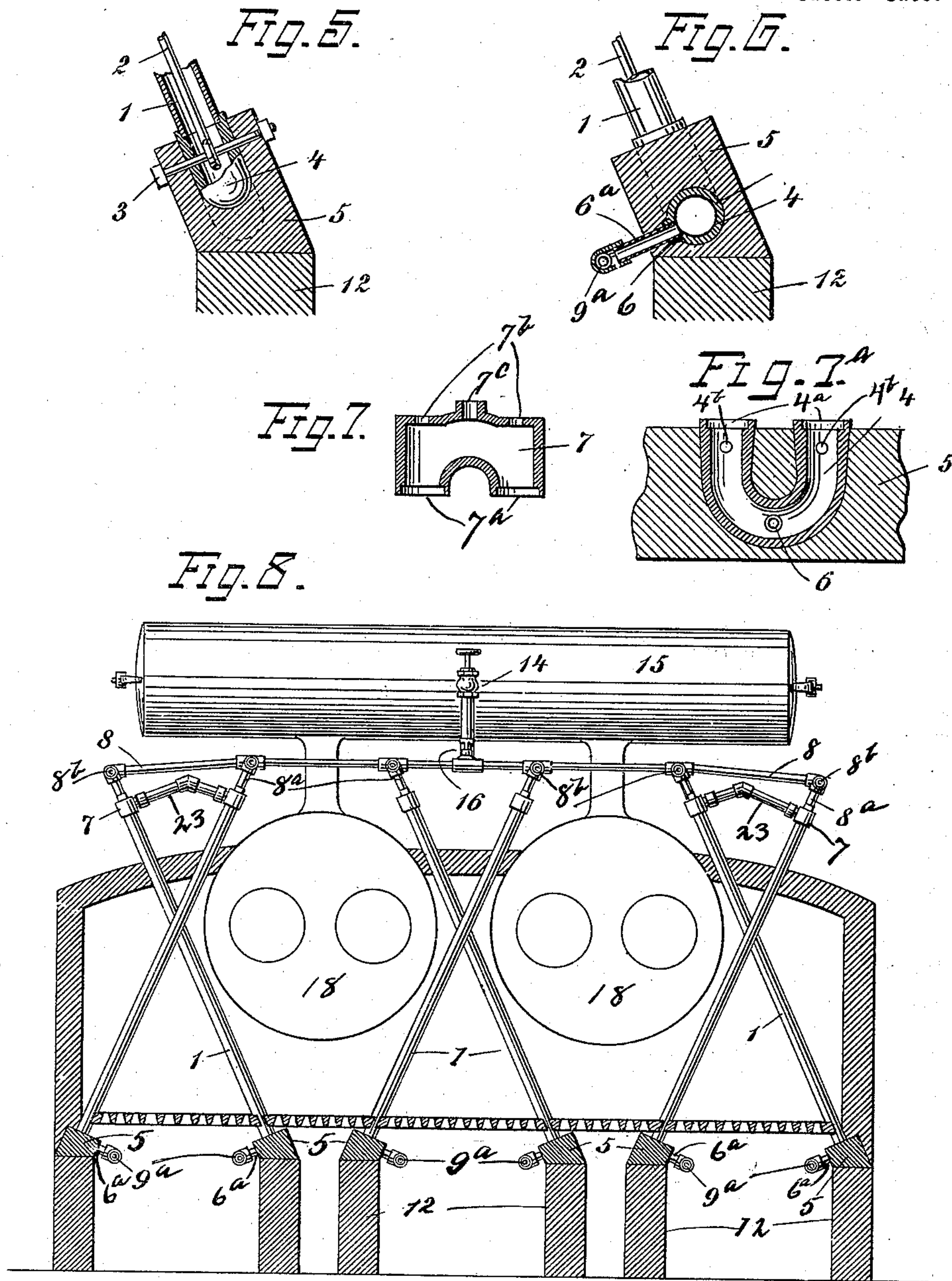
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UNITED STATES PATENT OFFICE.

CHARLES ADAMS, OF NEW ORLEANS, LOUISIANA.

BOILER FEED-WATER HEATER.

SPECIFICATION forming part of Letters Patent No. 639,128, dated December 12, 1899.

Application filed March 29, 1899. Serial No. 711,005. (No model.)

To all whom it may concern:

Be it known that I, CHARLES ADAMS, a citizen of the United States, residing at New Orleans, in the parish of Orleans and State of Louisiana, have invented certain new and useful Improvements in Boiler Feed-Water Heaters; and I do hereby 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.

My invention relates to improvements in boiler feed-water heaters by which the water to be supplied to the boiler is previously heated by contact with the flames of the furnace; and the objects of my invention are to supply water to the boiler at a high temperature, to economize time and fuel, and at the same time provide a commercially practicable device within a reasonable cost.

My invention will be understood by reference to the accompanying drawings, wherein the same parts are indicated by the same figures throughout the several views.

Figure 1 is a detail view of the heaters, part of the series being in vertical section and part in elevation. Fig. 2 is a detail of the heater-pipe, eyebolt, and lower elbow-bolt. Fig. 3 is a front view of the boilers, boiler-front, and equalizing-pipes, heaters showing above the boiler-front. Fig. 4 is a top plan view of the heaters, supply-pipes, and steam-drum. Figs. 5 and 6 are detail sectional views, enlarged, of the lower elbow-casting, casing, and foundation. Fig. 7 is a front view, in vertical section, of the upper and lower elbow-castings; and Fig. 7^a is a similar view of the lower elbow-casting and the casing. Fig. 8 is a vertical sectional view near the rear end of the boiler of the heaters and the rear connections with the steam-drum.

In Figs. 1 and 2, 1 represents the heater-pipe, and 2 the eyebolt for holding the upper and lower elbow-castings together. This eye is attached to the lower elbow-casting by the small bolt 3, which passes through suitable apertures in the lower elbow-casting and through the eye of the eyebolt. The eyebolt is secured to the upper elbow-casting by a nut working on its threaded end, which draws the two castings firmly against the ends of the pipe 1, suitable gaskets being provided to

make a water-tight joint. The lower elbow-castings are incased in or cast solid with a suitable casing 5 to give rigidity. They are provided with apertures at 6, into which fit unions 6^a, communicating with the equalizing-pipes 9, as seen in Fig. 9. The upper elbow-castings 7 are provided with unions 8^a, connected to pipes 8^b, communicating with the steam-equalizing pipes 8. The heater-casing rests on a suitable foundation 12.

In Fig. 3, 9 represents the water-equalizing pipes, which are continuations of the water-equalizing pipes 9^a, attached to the lower end of the heaters, as shown in Fig. 8. These pipes are provided with check-valves 10 10, opening outwardly from the boiler, and with globe-valves 10^a 10^a near their points of discharge into the boiler, which globe-valves are normally open. Suitable blow-offs 10^b 10^b, with valves normally closed, are attached to the water-equalizing pipe 9^a. 13^a is a globe-valve in the pipe 13, controlling the discharge of the heated water after it leaves the last series of pipes into the boiler, where it is discharged under the surface of the water therein. 11 is a boiler-front of any suitable construction.

In Fig. 4, 14 is a valve controlling the supply of steam from the steam-equalizing pipes to the steam-drum 15, which valve is normally open. 15 is a steam-drum of any usual construction. 16 is a check-valve reversed, and so adjusted that any steam from the heaters can pass into the steam-drum, but the pressure of water (from the heaters) against it will close it and prevent water from entering the steam-drum. 17^a 17^a are valves on supply-pipes 17 17 which furnish water from supply-pumps (not shown) to the first series of heaters.

In Fig. 5 the cross-section of the lower elbow-casting is made at a point so as to show the pipe 1, eyebolt 2, and the method of attaching the eyebolt 2 by the bolt 3 to one elbow of the lower elbow-casting.

In Fig. 6 the cross-section is made of the lower elbow-casting through the center of the elbow, showing the connection by unions 8^a with the water-equalizing pipe 9.

In Fig. 7 the construction of the upper elbow-casting is shown, and in Fig. 7^a the construction of the lower elbow-casting is shown.

The upper elbow-casting 7 has seats 7^a 7^a for the upper ends of the heater-tubes 1 1 and openings 7^b 7^b in its head for the passage of the tie-bolts 2. A connection 7^c is also provided on the head of this casting for the engagement of the union 8^a, connected to the water-equalizing pipe 8^b, as hereinbefore described. The lower elbow-casting 4 has seats 4^a 4^a for the lower ends of the heater-tubes, and in addition to the opening 6 for the connection of a union 6^a, above described, has radial openings 4^b 4^b for the passage of the bolts 3 3, used in securing the lower ends of the bolts 2 2.

In Fig. 8 the pipes composing the heaters are shown passing through the grate-bars and resting on foundations 12. Also the method of connection with the water-equalizing pipes 9^a with the steam-equalizing pipes 8 is shown.

In Figs. 3, 4, and 8 my invention is shown as applied to two boilers, forming a double system consisting of six sets of heaters, though it may be applied to one boiler or more than two.

In the construction and application of my device the boilers to which it is to be connected are suitably incased and provided with boiler-fronts and grate-bars of any suitable form. Foundations are built in the wall incasing the boilers and also under each boiler, as seen at 12 in Fig. 8, to support each set of heaters between the tops of these foundations and the grate-bars, a space being left for the purpose of allowing the lower parts of the heaters, which rest on these foundations, to be some inches below the grate-bars, and thus allow access to them, as seen in Fig. 8.

In setting up the device the lower return elbow-castings 4 and their inclosing or integral casing 5 are first placed in position upon the foundations 12 prepared for them, the series belonging to one set of heaters being taken at a time. Two eyebolts 2 are introduced, one in each elbow, the eye of the bolt being in a line with the side apertures in the elbow. The small bolt 3 is then passed from the outside through the other aperture and also through the eye of the eyebolt and through the other aperture. A nut is then fitted on the threaded end of the bolt 3 and screwed up, washers being provided to make a water-tight joint. There are then two eyebolts 2 projecting upwardly, one from each elbow-casting 4, and attached to said elbow-castings by the bolt 3. Pipe 1 is slipped over one end of the eyebolts down to the elbow-casting, where the lower end of the pipe rests on a gasket. The eyebolts being longer than the pipes, the ends extend out of the upper end of said pipes. Over the ends of one of the eyebolts is fitted the upper elbow-casting 7, the eyebolt passing through the top aperture in upper elbow-casting, and being threaded is fitted with a nut, which, screwed down, brings the upper elbow-casting (provided with a suitable gasket) firmly against the gasket in the lower elbow-casting, making a water-tight connection.

The other elbow of upper casting fits over a similar pipe 1 and the eyebolt 2 connected with the second lower elbow-casting, and so on until the series of pipes are all connected, forming free passages for the circulation of water. The first and last elbow in each series of heaters is a single one, as seen at 20 in Fig. 4, and has a neck 21 to connect by suitable unions, as shown, with pipes 22 and 23, leading to the next heater series. This heater rests on foundations 12, as shown in Fig. 8, and inclines toward the boiler at an angle from the perpendicular of about forty degrees. The next set of pipes, forming the second heater, rest on the second foundation under the boiler and inclines away from it, intersecting the first set at an acute angle, passing through the top of the tile or brick casing. Each subsequent set of pipes is similarly arranged, in the present application of the device six sets being shown. The third heater is connected with one feed-supply pipe 17, (see Fig. 4,) and the third heater connects with the second and first heater through pipes 22 and 23, which connect with a discharge-pipe 13, entering the boiler at 13^b and discharging below the surface of the water therein. In the adjoining boiler a similar connection extends from another supply-pipe 17 through the heaters to discharge-pipe 13. It is to be observed that the six heaters are almost entirely packed in the heat area of the furnace, such portions of the heaters as are above the casting or below the grate-bars being only for the purpose of ready access to make repairs when necessary.

In each system the pipe 9^a connects in its initiative with the particular elbow-casting that is attached to the heater-pipe nearest the feed-water supply at 4 in Fig. 1 and also connects from one to the other of the first three heaters, terminating in the boiler, where it opens under the surface. It is provided with a blow-off valve at a suitable point, with a globe-valve normally open near its point of connection with the boiler, and with a vertical check-valve 10 reversed, which opens when water flows from the boiler and closes when water flows toward the boiler.

The steam-equalizing pipe 8 connects in its initiative with that particular elbow-casting which is attached to the pipe nearest the feed-water supply, as seen to the left in Fig. 1, and also connects, through the branch pipe 8^b, from one to the other of the first three heaters, terminating in the steam-drum 15. It is provided nearest its point of connection with the drum with a globe-valve normally open and with a vertical check-valve 16 reversed, which closes when water is forced toward the steam-drum and opens when the pressure of said water is removed.

In practice the operation of my device is as follows: Water is forced by supply-pump through pipes 17 and 17 into heater-pipes 1, Fig. 1, and so on to next series, until it discharges into the boiler at 13^a, the valve being open.

When the proper level is reached in the boilers, the pump is stopped, and the water reaches the same level in boilers and in heaters, (regulated by the blow-off valve.) After fire is started in the furnace and steam begins to generate and the water is vaporized and runs below the level the supply-pump is set to work. The water circulates through each successive pipe and return-elbow until it reaches the last pipe of the series, each pipe extending in the heat area contributing to raise its temperature and discharges into the boilers below the surface of the water therein. As the heater-pipes 1, &c., fill with water the water-equalizing pipe carries same up to and against valve 10, which it closes and keeps closed as long as the supply-pump is working. This forces the supply of water to find its outlet at 13 after traversing all the pipes and being exposed to the heat area. Such water as rises through the steam-equalizer and reaches the valve 16 closes before any water enters the drum 15. By this means the water that enters the boiler at 13 is at a high temperature and a large proportion of heat units are utilized. When the water reaches the required level in the boilers, the pump is stopped, the valves 10 open, and water in the pipes and in the boiler is kept level. As soon as the water-supply gets low the pump is started and the process of supply continues, as first stated.

In case of accident to any of the pipes or nuts and it is desired to remove the pipes all that is necessary is to take out the fire in the furnace and unscrew the nut on top of the eyebolt, that is connected with the damaged pipe, releasing the upper and lower casting and the pipe, which is slipped out, together with the adjacent pipe, and in place of the two pipes taken out an emergency connection, consisting of short heater-pipes attached to an upper elbow-casting, is fitted to the lower casting. This emergency connection is short enough to allow its being fitted underneath the grate-bars, and this can be done rapidly, even while steam is in the boiler, it being only necessary to let the fire die down a little to cool the grate-bars off sufficiently to allow access beneath them.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. The combination with the furnace and grates, and two or more boilers, arranged parallel and spaced from each other; of a system of water-tubes arranged in sets crossing each other between the boilers within the fire-chamber and extending beneath the fire-grate; elbows connecting the ends of said tubes in series forming a continuous zigzag passage through each set; pipes connecting one of said sets of tubes to a water-supply; pipes connecting said sets to each other and to the boiler; a steam-drum connected with the boiler; steam-equalizing pipes connecting the upper elbows of said tubes with each

other and with the steam-drum; water-equalizing pipes connecting the lower elbows of said pipes with each other and with the water-space of the boiler-sections; valves for controlling the circulation of steam and water through said equalizing-pipes; and connections between the boilers, substantially as described.

2. The combination with the furnace and grates, and two or more boilers, arranged parallel and spaced from each other; of a system of water-tubes arranged in sets crossing each other between the boilers within the fire-chamber and extending beneath the fire-grate; elbows connecting the ends of said tubes in series forming a continuous zigzag passage through each set; a solid casing inclosing said lower elbow connection; pipes connecting one of said sets of tubes to a water-supply; pipes connecting said sets to each other and to the boiler; a steam-drum connected with the boiler; steam-equalizing pipes connecting the upper elbows of said tubes with each other and with the steam-drum; water-equalizing pipes connecting the lower elbows of said pipes with each other and with the water-space of the boiler-sections; valves for controlling the circulation of steam and water through said equalizing-pipes; and connections between the boilers, substantially as described.

3. The combination with the furnace and grates, and two or more boilers, arranged parallel and spaced from each other and sides of the fire-chamber; of a system of water-tubes arranged in sets crossing each other between and upon the sides of the boilers within the fire-chamber and extending beneath the fire-grate; supports for said water-tubes; elbows connecting the ends of said tubes forming a continuous zigzag passage through each set; pipes connecting one of said sets of tubes to a water-supply; pipes connecting said sets to each other and to the boiler; a steam-drum connected with the boiler; steam-equalizing pipes connecting the upper elbows of said tubes with each other and with the steam-drum; water-equalizing pipes connecting the lower elbows of said pipes with each other and with the water-space of the boiler-sections; a check-valve in one of said steam-equalizing pipes and a check-valve in one of said water-equalizing pipes arranged to be closed by pressure of water from the said tubes; and connections between the various boilers, substantially as described.

4. The combination with the furnace and grates, and two or more boilers, arranged parallel and spaced from each other and sides of the fire-chamber; of a system of water-tubes arranged in sets crossing each other between and upon the sides of the boilers within the fire-chamber and extending beneath the fire-grate; supports for said water-tubes; elbows connecting the ends of said tubes forming a continuous zigzag passage through each set; a solid casing inclosing said lower elbow con-

nection; pipes connecting one of said sets of
tubes to a water-supply; pipes connecting
said sets to each other and to the boiler; a
steam-drum connected with the boiler; steam-
5 equalizing pipes connecting the upper elbows
of said tubes with each other and with the
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ing the lower elbows of said pipes with each
other and with the water-space of the boiler-
10 sections; a check-valve in one of said steam-
equalizing pipes and a check-valve in one of

said water-equalizing pipes arranged to be
closed by pressure of water from the said
tubes; and connections between the various
boilers, substantially as described. 15

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

CHAS. ADAMS.

Witnesses:

R. A. TICHENOR,
T. CRABITES.