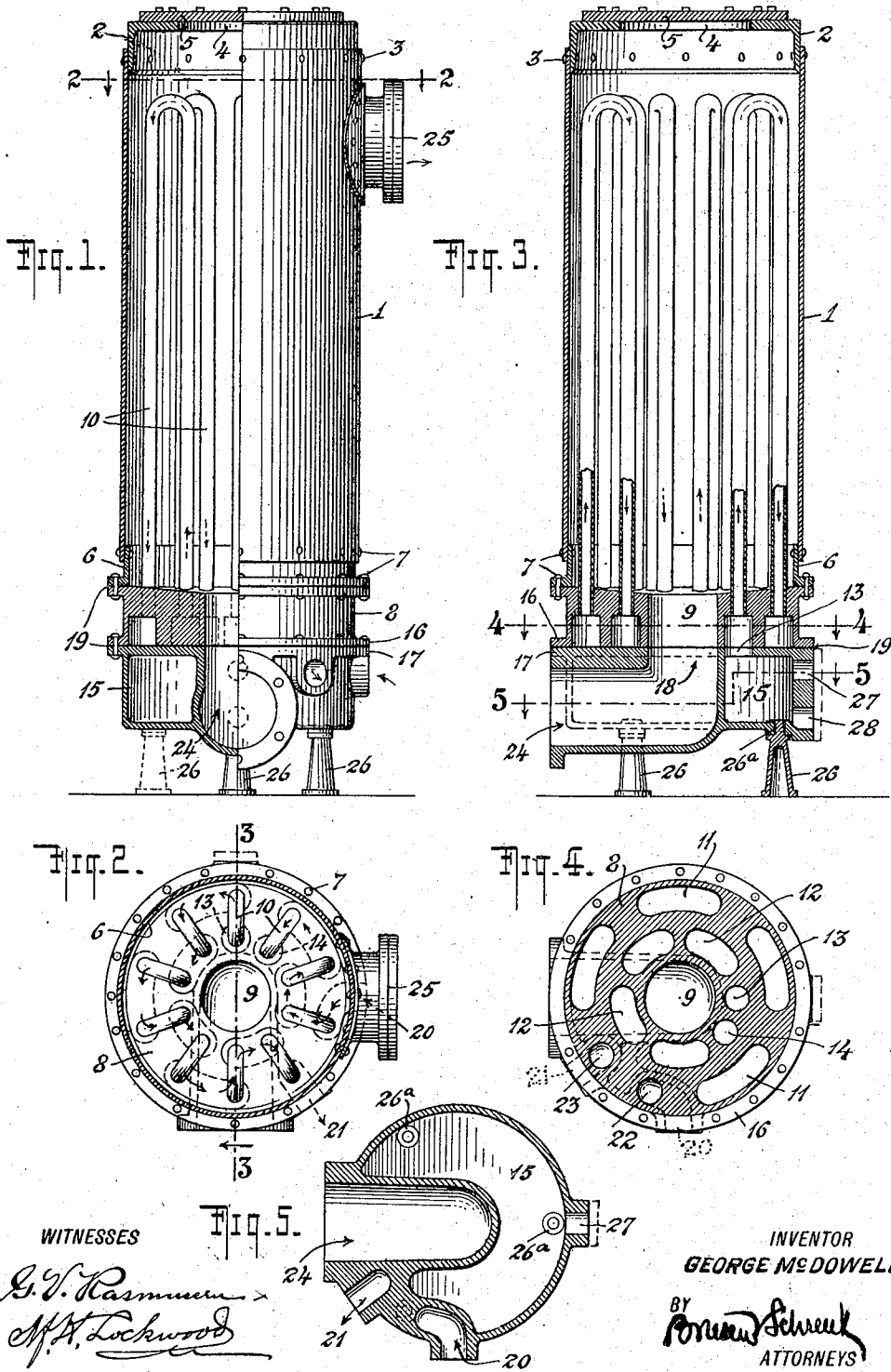


G. McDOWELL.
FEED WATER HEATER.
APPLICATION FILED JAN. 20, 1916.

1,217,795.

Patented Feb. 27, 1917.



WITNESSES
G. V. Kasmann
M. H. Lockwood

INVENTOR
GEORGE McDOWELL
BY
R. M. Schenk
ATTORNEYS

UNITED STATES PATENT OFFICE.

GEORGE McDOWELL, OF BROOKLYN, NEW YORK.

FEED-WATER HEATER.

1,217,795.

Specification of Letters Patent.

Patented Feb. 27, 1917.

Application filed January 20, 1916. Serial No. 73,125.

To all whom it may concern:

Be it known that I, GEORGE McDOWELL, a citizen of the United States, and resident of Brooklyn, county of Kings, and State of New York, have invented certain new and useful Improvements in Feed-Water Heaters, of which the following is a specification.

My invention relates particularly to feed water heaters in which brass tubes are inserted in a tube head and arranged for the circulation of water therethrough, the tubes being inclosed in a shell through which the exhaust steam is allowed to pass.

One of the principal difficulties to be overcome in the feed water heaters of the usual type is the breakage of the tube head when the same is made of cast iron or the like. The contraction and expansion due to the introduction of cold water into the tubes from one side of the tube sheet or head and the steam striking the other side of the head is likely to result in a rupture or cracking of the tube head.

The object of my invention is to obviate this difficulty by providing means for heating the tube head on both sides so that the difference of temperature throughout the head is not enough to cause rupture thereof. A further object is to provide a settling tank or chamber into which the feed water is introduced during its circuit through the heater, the settling tank being also heated by the steam passing through the heater. By this construction I am enabled to increase the efficiency of the apparatus and simplify the tube system.

The tube system of the ordinary feed water heater is usually such that it is impossible to take out one of the inner tubes if it should become defective and require replacing, without taking out or bending a large number of the other tubes. In my construction the tubes are symmetrically arranged in radial planes within the shell and secured to the tube head in the usual manner as, for instance, by expanding the ends of the tubes. All of the tubes being alike in my construction it is obvious that a saving in cost of manufacture is effected.

One form of my improved apparatus is shown in the accompanying drawings in which Figure 1 represents a side elevation, partially in section; Fig. 2 is a top view, the shell being in section along the line 2—2 of

Fig. 1; Fig. 3 is a vertical section on the line 3—3 of Fig. 2; Fig. 4 is a section through the tube head on the line 4—4 of Fig. 3; Fig. 5 is a section through the settling chamber and steam conduit on the line 5—5 of Fig. 3.

Referring to the drawings 1 represents the cylindrical shell of the feed water heater which is preferably made of boiler steel, the upper end of the shell is closed by a plate or shell head 2 riveted to the shell at 3 and provided with a man hole 4 covered by a plate 5 which may be bolted or otherwise secured to the plate 2 substantially as indicated in the drawing. The man hole, is adapted to facilitate removal or insertion of tubes when repairs are required. The lower end of the shell, is preferably secured to an annular flange 6 which is adapted to be secured by suitable bolts or rivets 7 to the upper flange of a tube head or plate 8 provided with a central opening 9 for the passage of steam therethrough. It will be noted that the tube head is annular in form and is provided with a plurality of vertical holes into which the ends of radially arranged inverted U-tubes 10 are secured substantially as illustrated in Figs. 1 and 3 of the drawings.

The tubes 10 are spaced from each other annularly and are located about the central opening 9 in such a way as to leave a central tube like passage along the inner legs of the pipes for the entrance and distribution of steam. The upper face of the tube head is preferably inclined in a conical or other suitable manner toward the central opening in the head so that water of condensation will drain off the head into the steam conduit from which it may be withdrawn in the usual or any preferred manner.

The underside of the tube sheet or head 8 is provided with a plurality of recesses, alternating long and short, arranged circumferentially of the annular portion of the tube head as indicated at 11 and 12 in Fig. 4. The long recesses 11 are adapted to connect the outer ends of two adjacent tubes while the shorter recesses 12 are adapted to connect the inner ends of adjacent tubes, the connections alternating in such a way as to produce a continuous circuit of the tubes *i. e.*, the outlet end of one tube is connected with a recess to which the inlet end of the adjacent tube is connected. The

tube sheet is also provided with a pair of straight holes 13 and 14, which occupy the space of one of the inner or shorter recesses, the holes adapted to connect with a settling tank 15 located below the tube head 8.

The tube head 8 is provided with a flange at 16 which is bolted to a corresponding flange 17 forming the upper plate or cover to the settling tank 15. This plate or flange extends entirely across the settling tank except for a central opening at 18 which is arranged to coincide or register with the central opening 9 in the tube head 8 as will be seen in Fig. 3 of the drawings. The annular flange or cover 17 of the settling chamber is adapted to fit tightly over the lower face of the tube head 8 so as to seal the recesses 12 and 13 and thereby give the continuity of circuit through the inverted U-tubes hereinbefore referred to. A gasket 19 may preferably be inserted between the lower face of the head 8 and the annular cover 17 of the settling chamber to insure more perfect sealing of the recesses.

The cover plate 17 of the settling chamber is provided with holes positioned to coincide or register with the holes 13 and 14 so as to permit the inlet and outlet of water from the settling chamber into and through the circuit of the tubes. The plate 17 is also provided with lateral openings 20 and 21 leading to holes 22 and 23 in the tube sheet or head for the inlet and outlet of the water passing through the heater.

The central and lower part of the settling tank is preferably provided with a steam passage or conduit 24 through which the steam may pass to or from the interior of the shell 1. This arrangement of the steam conduit provides means for heating the water in the settling tank which, as will be seen, is located below and in contact with the lower face of the tube sheet or head, the upper face of the tube head being heated in the usual manner by the steam in the shell in its passage therethrough. Thus by my arrangement the difference of temperature between the two faces of the tube head is reduced to a minimum.

The shell is provided with a steam nozzle or flanged port at 25 which may be connected with the exhaust of the engine either as an inlet or outlet as may be desired or preferred. The entire feed water heater is supported upon three legs 26 which are preferably removably inserted in sockets 26^a in the bottom of the settling tank substantially as indicated in Figs. 1 and 3 of the drawings. The settling tank is provided with holes at 27 and 28 which may be closed by a plate or suitable plugs when the apparatus is in operation, but may be used when opened to flush out and clean the mud or other sediment out of the settling tank when required.

When in operation I preferably introduce steam through the conduit 24 the steam passing up through the central opening 9 of the tube head where it will spread out and fill the shell surrounding the tubes 10 and exhaust out through the nozzle or pipe connection 25. The water is introduced say through the opening 20 and will pass up through the hole 22 into the outer end of one of the inverted U-tubes, it will then pass through the U-tube and into the first of the shorter recesses 12 then through the inner leg of the next adjacent U-tube, then down through the outer leg and through the outer connecting recess 11 to the outer leg of the next adjacent tube, the inner leg of which is connected with the hole 14 which, as previously indicated, communicates with the settling chamber 15 so that the water will flow down into and through the settling chamber and return up through the hole 13 to the next adjacent tube and then on through the tubes and recesses until the last tube leads it into the hole 23 which, being connected with the outlet 21, will deliver the hot water to any suitable pipe connection that may be desired. Any water of condensation will run down through the central opening 9 into the conduit 24 owing to the slant of the upper face of the tube head 8.

Various modifications of the specific details of construction may be made without departing from the spirit and scope of the invention, and obviously the apparatus may be disposed horizontally instead of vertically as shown.

I claim:

1. A feed water heater comprising an upright shell, a tube head forming the bottom thereof, inverted U-tubes secured in the tube head and extending into the shell, said head being provided with suitable recesses on its lower side to form connecting channels between the outlet and inlet ends of adjacent tubes and a plate member covering said recesses.

2. A feed water heater comprising an upright shell secured to a tube head, a plurality of inverted U-tubes secured in said tube head, the tubes being symmetrically arranged annularly of the head and an inclosed settling chamber below said tube head and secured thereto, holes and recesses being provided in and between the tube head and settling chamber whereby feed water may circulate in series through said tubes and the settling chamber.

3. A feed water heater comprising an upright shell, a plurality of inverted U-tubes symmetrically arranged annularly within said shell, a tube head forming the bottom of the shell in which said tubes are secured, said head being provided with recesses for connecting the outlet end of one tube with

the inlet end of the next and a settling chamber connected in series with said tubes substantially as described.

4. A feed water heater comprising a shell, 5 an annular tube head, a plurality of inverted U-tubes arranged radially around the opening in said head, the upper surface of said head sloping toward the center for drainage, the under surface thereof being provided 10 with recesses connecting the adjacent ends of successive tubes to form a continuous circuit therethrough and a settling chamber provided with a head adapted to cover the recesses in said tube head, suitable connections through said heads being provided for 15 placing the settling chamber in circuit with said tubes substantially as described.

5. In a feed water heater the combination 20 with a shell of a plurality of inverted U-tubes arranged in vertical planes radially of said shell, a central space being left along the inner legs of the tubes for the passage of steam, a tube head provided with a central opening, around which said pipes are 25 concentrically arranged, a settling tank adapted to form a continuous circuit with said tubes and a steam conduit through said tank and the central opening of said tube head whereby the water in the settling tank 30 is heated.

6. In a feed water heater the combination 35 with a cylindrical shell of a plurality of inverted U-tubes arranged in radial planes concentrically within said shell to leave a central passage therethrough, a tube head with a central opening communicating with 40 said passage and a horizontal settling tank, below and secured to the tube head, provided with a steam conduit therethrough connecting with the central opening in said 45 head whereby the water in the settling tank is heated, said tube head being heated on one side by steam and on the other by the water in said settling tank.

7. A feed water heater comprising a shell, 45 a tube head constituting one end thereof, said

head being provided with a steam passage, a plurality of U pipes within the shell having their ends fixed in the head, one end of one 50 of the pipes being adapted to serve as a water inlet and one end of another pipe being adapted to serve as a water outlet, the other ends of the two pipes and the ends of the remaining pipes being joined in series 55 so as to conduct the water from inlet to outlet, there being also a second steam passage opening to the interior of the shell.

8. A feed water heater comprising a shell, a tube head for one end of said shell, a plurality of U pipes within the shell with their 60 ends fixed in said tube head, passages in said tube head connecting the ends of said tubes so as to place the tubes in series, an end of each of two pipes serving as inlet and outlet respectively, and means for bringing steam 65 into contact with both sides of the tube head.

9. A fluid heater comprising a shell, a tube head closing one end of the shell, a plurality of serially connected pipes within the shell 70 the ends of the series being supported by the tube head, an inlet and outlet for each of said ends, a passage through the tube head into the shell, a part of the outer side of the tube head constituting one wall of the pas- 75 sage and a second passage from the outside to the inside of the shell.

10. A feed water heater comprising a shell, a closure at one end thereof, U tubes 80 having ends secured in the closure and extending into the shell, said closure having passages forming connecting channels between the outlet and inlet ends of the several tubes so as to join them all in series and permit a fluid to be flowed therethrough, and 85 means for bringing a second fluid of different temperature from the first fluid, into contact with both sides of the closure and with the pipes inside the shell.

In testimony whereof I have hereunto set 90 my hand.

GEORGE McDOWELL.