No. 664,745. Patented Dec. 25, 1900.

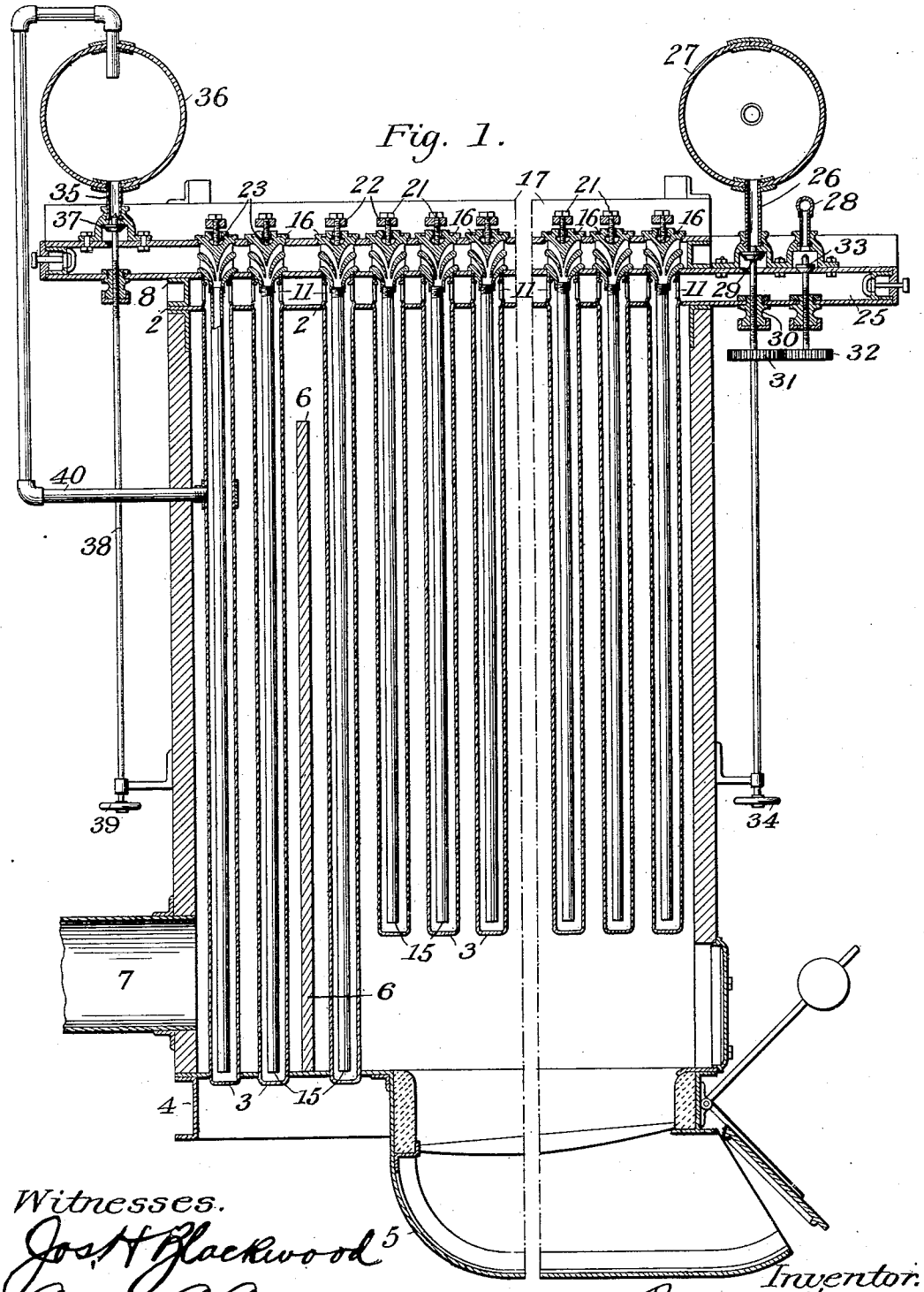
R. M. HEAD.

WATER TUBE BOILER.

(Application filed Apr. 3, 1899.)

(No. Model.) 3 Sheets—Sheet 1.

Fig. 1.



Witnesses.
Jos. H. Blackwood
Albert B. Blackwood.

Inventor.
Reuben M. Head
by W. H. Dorsett & Son
attorneys

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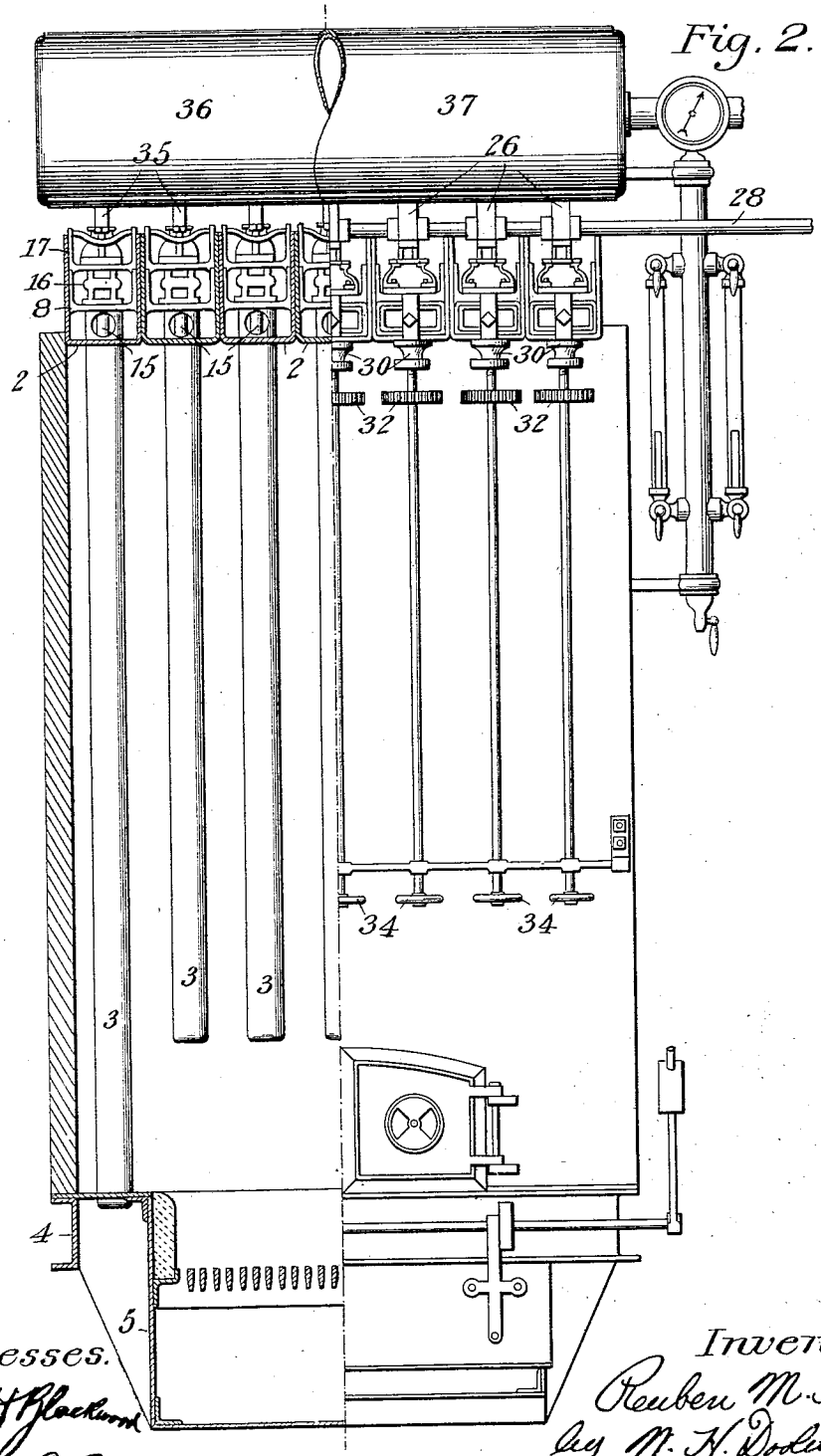
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(Application filed Apr. 3, 1899.)

(No Model.) 3 Sheets—Sheet 2.

Fig. 2.



Witnesses.
Jas. H. Blackwood
Albert B. Blackwood.

Inventor.
Reuben M. Head
by M. N. Dodsworth & Son
Attorneys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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Fig. 3.

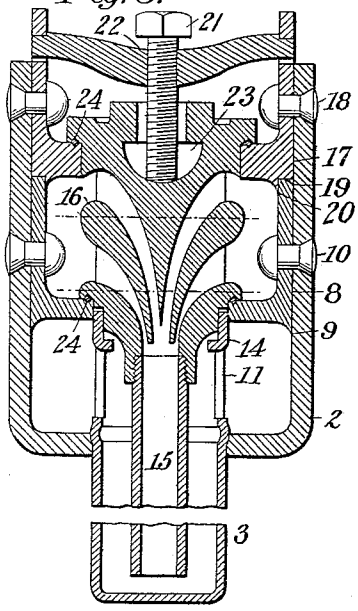


Fig. 4.

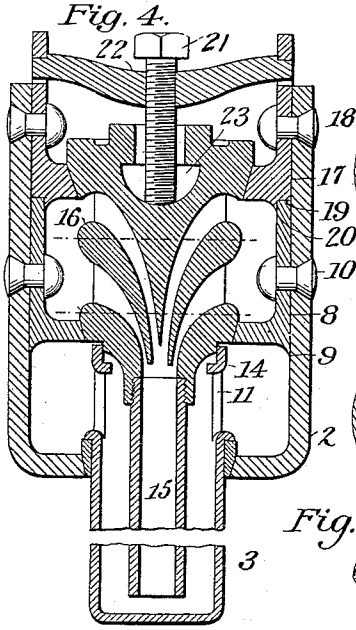


Fig. 5.

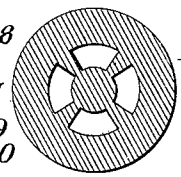


Fig. 12.

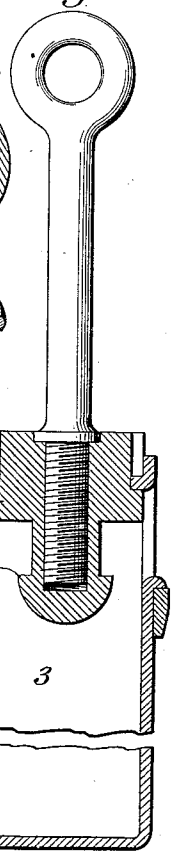


Fig. 6.

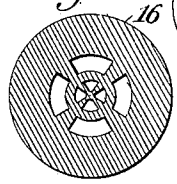


Fig. 7.



Fig. 8.

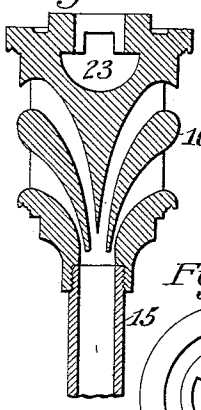


Fig. 9.

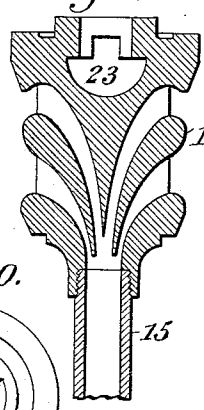


Fig. 13.

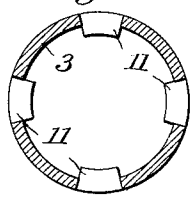


Fig. 10.

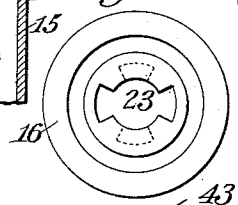


Fig. 14.

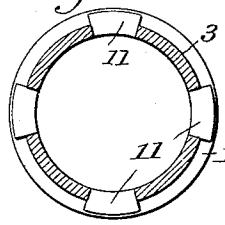


Fig. 15.

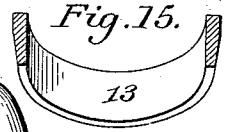
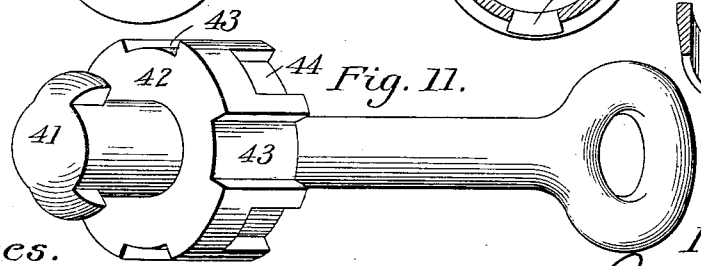


Fig. 11.



Witnesses.

Jas. N. Blackwood

Albert B. Blackwood.

Inventor.

Reuben M. Head

by W. N. Dorlander & Son

Attorneys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

REUBEN M. HEAD, OF ALLEGHENY, PENNSYLVANIA.

WATER-TUBE BOILER.

SPECIFICATION forming part of Letters Patent No. 664,745, dated December 25, 1900.

Application filed April 3, 1899. Serial No. 711,525. (No model.)

To all whom it may concern:

Be it known that I, REUBEN M. HEAD, of Allegheny, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Water-Tube Boilers, 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 vertical longitudinal section of my improved boiler. Fig. 2 is a front elevation of the same, partly in section. Figs. 3 and 4 are enlarged vertical sections showing the headers and two forms of making steam-tight connections with the drop-tubes and inspirators. Figs. 5 and 6 are detail cross-sections through the inspirators on the lines indicated in Figs. 3 and 4. Fig. 7 is a detail view of a metallic packing-ring used in forming the steam-tight connections of Fig. 3. Figs. 8 and 9 are detail views of the inspirators of Figs. 3 and 4, respectively. Fig. 10 is an end view of the inspirators. Fig. 11 is a perspective view of the withdrawing-tool for the inspirators and drop-tubes. Fig. 12 is a cross-section showing the tool as engaged with the drop-tube to draw it out. Figs. 13 and 14 are cross-sections of the drop-tube, and Fig. 15 is a detail view of the beveled bearing ring or seat as welded or shrunk upon the drop-tubes.

My invention relates to that class of water-tube boilers wherein large drop-tubes are employed which depend from headers and are provided with inner smaller circulating-tubes; and its objects are to provide a new and improved boiler of this type wherein the water in the inner circulating-tube shall connect with an upper body of water in such a way that siphonic action will take place, so as to preserve the same water-level throughout the unequally-heated drop-tubes; to improve the connections of the tubes, so that by means of devices hereinafter explained they may be readily withdrawn and replaced without emptying the boiler, drawing the fires, or wholly disconnecting the same; to provide separate steam and water drums the connections to which may be closed when replacing tubes without danger from excessive pressure or of burning out the remaining tubes during the operation; to make the water-supply drum subserve the purpose of an automatic feeding device; to provide an inspirator or injector system which may be used in connection with live steam from an auxiliary boiler or other source, whereby a quick circulation can be induced and steam got up more rapidly, and to provide a drop-tube boiler where the water-level is intermediate of the length of the tube and the feed-water is delivered from a space overlying the steam-space.

In the drawings I show a series of horizontally-extending headers 2, formed of pressed sheets or plates, each of which is provided with a series of large drop-tubes 3. I have shown the boiler as arranged for marine purposes, it being supported upon channels 4 and having a depending structure 5, containing the grate-bars and ash-pit. The drop-tubes over the furnace-chamber are shorter than those in the rear thereof, and a baffle-plate 6 extends upwardly between the rear tubes, so as to hold the gases in contact with the tubes and compel them to take a tortuous course on their way to the lower offtake 7. Each header is divided into upper and lower compartments by a horizontal channel 8, having lower fillets 9 and secured within the header by rivets 10. In my preferred form of construction (shown in Fig. 4) the upper end of each large drop-tube extends into the lower compartment and is provided with side holes 11, the lower edges of which are flanged outwardly at 12 to rest on a metallic ring 13, having a cone-face bearing upon a corresponding face in the bottom of the header. The tube is flanged inwardly at 14 above the side openings 11, so that these inward flanges or lugs may be engaged by a withdrawing-tool, as hereinafter described. The upper end of each inner circulating-tube 15 is secured within the lower end of an inspirator 16, the lower portion of which has a beveled bearing, with a hole in the bottom of the longitudinal partition 8, while the upper portion has a corresponding bearing in a similar hole in channel 17, secured within the upper part of each header by rivets 18. The lower edges of channel 17 are recessed at 19 to receive the upper ends of the channel 8 and are provided with a fillet 20, which bears on the inner face of the lower channel. The inspirators are

held in place by screws 21, passing through cross bars or yokes 22 and entering recessed holes 23 in the upper portions of the inspirators.

In the form of Fig. 3, in place of using the conical seats for the inspirator, I show the inspirator as provided with lateral shoulders which bear upon the bottoms of the channels and are provided with interposed metallic packing-rings 24, the drop-tubes beneath being expanded into place in the usual manner.

From a front extension 25 of the lower compartment of each header a branch 26 leads to the steam-drum 27. Each extension 25 is also provided with an opening leading to a common tube 28, which is open to the air. The passage from extension 25 to the steam-drum 27 is controlled by a valve 29, whose stem is screw-threaded within a gland 30 and is provided with a pinion 31, engaging a similar pinion 32 upon the stem of a valve 33, which controls the port from extension 25 to the pipe 28. The stem of valve 33 is also screw-threaded, and when the handle 34 of valve 29 is turned so as to open or close this valve the valve 33 will be moved in the opposite direction. By this connection whenever the steam-drum is shut off from connection with the header this header will be open to the outer air, so as to relieve the same of any danger from excessive pressure.

The upper compartment of each header is extended rearwardly and provided with a connection 35 with a feed-water drum 36, the connection being controlled by a valve 37, having a stem 38, provided with operating-handle 39. The rear drop-tube of one of the headers is connected with the drum 36 by a pipe 40, which leads from just below the normal water-level into the top of the feed-drum.

The two compartments of the headers formed by the division plate or channel 8 are closed at the ends by a cast or pressed steel head flanged to receive the riveting and provided with hand-holes, as shown, where required.

In removing and replacing the tubes I employ the tool of Fig. 11, having the end lugs 41, which are adapted to enter the hole in the inspirator and then being turned to engage the inner shoulders will draw out the inspirator and circulating-tube. The tool is also provided with an annulus 42, having through-recesses 43 and other recesses 44 extending downwardly only a part of the width of the annulus. After the inspirator has been drawn out the tool is inserted in the upper end of the drop-tube, the recesses 43 being brought into registry with the lugs 14. The tool then being turned into the position shown in Fig. 12 will draw out the drop-tube, and another may then be inserted and the inspirator and circulating-tube inserted and secured in place as before.

In starting the boiler into operation it is filled with water up to about midway of the upper compartments of the headers. The fires are lighted, and live steam from auxiliary sources, if desired, may then be admitted to the feed-water-supply drum through a suitable connection and passing into the upper compartments of the headers and down through the inspirators will induce a strong circulation, so that steam will be generated rapidly. The steam formed will pass from the upper part of the drop-tubes, and thence through the forward extension of the headers into the steam-drum. When the pressure rises to the desired point or to a point where the steam-pressure will more than overbalance the pressure of the water due to the elevation of the supply-drum, the auxiliary steam, if employed, is turned off and the water in the lower compartments of the headers is blown down to bring the water-level at the working point, which is at about the point indicated in the water-level of Fig. 2—*i. e.*, intermediate of the length of the drop-tube and above the juncture of the pipe 40 with the rear tube. With the blowing down of the water-level to the working point by back pressure of the steam a corresponding body of water is forced upward into and maintained within the supply-drum and upper compartments of the headers, completely filling the same, and as the water in each circulating-tube of the header connects therewith the levels of the water in the drop-tubes will be maintained at the same point by siphonic action between the different circulating-tubes through this upper body of water. If the water-level drops below the opening into the pipe 40, steam will pass up into the feed-water drum and cause a flow of water into the upper compartments of the headers. With the outflow of water from the supply-drum the action of the feed-pump which replenishes the same is automatically accelerated by the opening of a valve in the pipe which supplies steam thereto, which is controlled by a float (not shown) in the supply-drum in the usual manner.

In replacing a tube the headers may be shut off from the steam and water drums by the disconnecting-valves 29 and 37, the header at the same time being opened to the air through the valve 33 in the relief-pipe, the remaining drop-tubes being protected from burning by the water therein and by the subsidence of the water in the upper compartments of the disconnected header into the lower portion of the drop-tubes. The temperature of the water in the tubes of the disconnected header soon subsides to that due to atmospheric pressure, and with the additional vent afforded by the removal of one of the inspirators the cooling process may be hastened by the introduction of colder water through a connection which may be made with the relief-pipe. With the removal of a drop-tube the vapors which arise from the water contained in the tubes of the disconnected header will be drawn into the fire-box or furnace with the in-rush of cold air through the opening thus afforded. In this manner, then, during the tem-

porary banking of the fires the retubing may be carried on by a procedure which is simple and direct and which in any other form of boiler would necessitate a complete shutdown and consequent delay.

The advantages of my invention will be apparent to those skilled in the art. The use of the upper body of water above the steam and communicating with the circulating-tube insures the same water-level throughout the tubes. The tubes may be readily removed and replaced without stopping the boiler and without danger of excessive pressure. The feed-water supply is automatic, and the steam may be rapidly made by the application of the inspirators. The use of the separate steam and water drums is also of advantage, and the apparatus is simple and readily repaired.

Many changes may be made in the form and arrangement of the parts without departing from my invention, since

I claim—

1. In a tubular boiler, a header formed of a single plate, plates, or bars, dividing the header into an upper and a lower compartment, said plates, or bars having filleted shoulders or legs to facilitate the insertion of pressed flanges, closing the ends of the compartments and insuring the steam-tightness of the corner-joint therewith, a drop-tube extending into the lower compartment and having flanged openings to engage with the header, substantially as described.

2. A drop-tube boiler having an upper water-space above the steam-space, and connected with circulating-tubes within the drop-tubes, and inspirators in the upper water-space directed into the circulating-tubes; substantially as described.

3. A drop-tube boiler having inner circulating-tubes provided with inspirators connected to an auxiliary steam-supply; substantially as described.

4. A drop-tube boiler having a header provided with horizontal compartments, the drop-tubes extending into the lower compartment and provided with side holes opening into the lower compartment and flanges or lugs to engage the header, a series of circulating-tubes opening into the upper compartment which is connected with a water-supply, substantially as described.

5. A drop-tube boiler having a valved connection to a steam-drum and a relief-valve arranged to be opened when the valve to the steam-drum is closed; substantially as described.

6. A boiler having separate headers each having valved connections to a steam-drum and a water-drum and relief-valves arranged to be opened when the steam-drum is shut off; substantially as described.

7. A water-tube boiler having drop-tubes with upper side openings having lower outwardly-extending lugs or flanges to reinforce its support and upper inwardly-extending lugs to engage an extracting-tool; substantially as described.

8. In a tubular boiler, a header comprising a water-compartment above a steam-compartment, a series of drop-tubes extending into the header and opening into the steam-compartment, a series of circulating-tubes opening into the water-compartment and arranged to cause siphonic action for maintaining the same water-level in the drop-tubes, substantially as described.

9. In a drop-tube boiler, a header formed of a single plate with openings in its bottom, channel bars or plates, dividing the header into a water-compartment and a steam-compartment, said channels being filleted to form steam-tight joints between the compartments, inspirators extending into the water-compartment, drop-tubes having side openings in communication with the steam-compartment and lugs, or flanges, for engaging with the header, and inner circulating-tubes attached to the inspirators, substantially as described.

In testimony whereof I have hereunto set my hand.

REUBEN M. HEAD.

Witnesses:
L. N. REDMAN,
G. B. BLEMMING.