(No Model.) 3 Sheets—Sheet 1.

C. C. WORTHINGTON.

FEED WATER HEATER FOR STEAM BOILERS

No. 485,570. Patented Nov. 1, 1892.

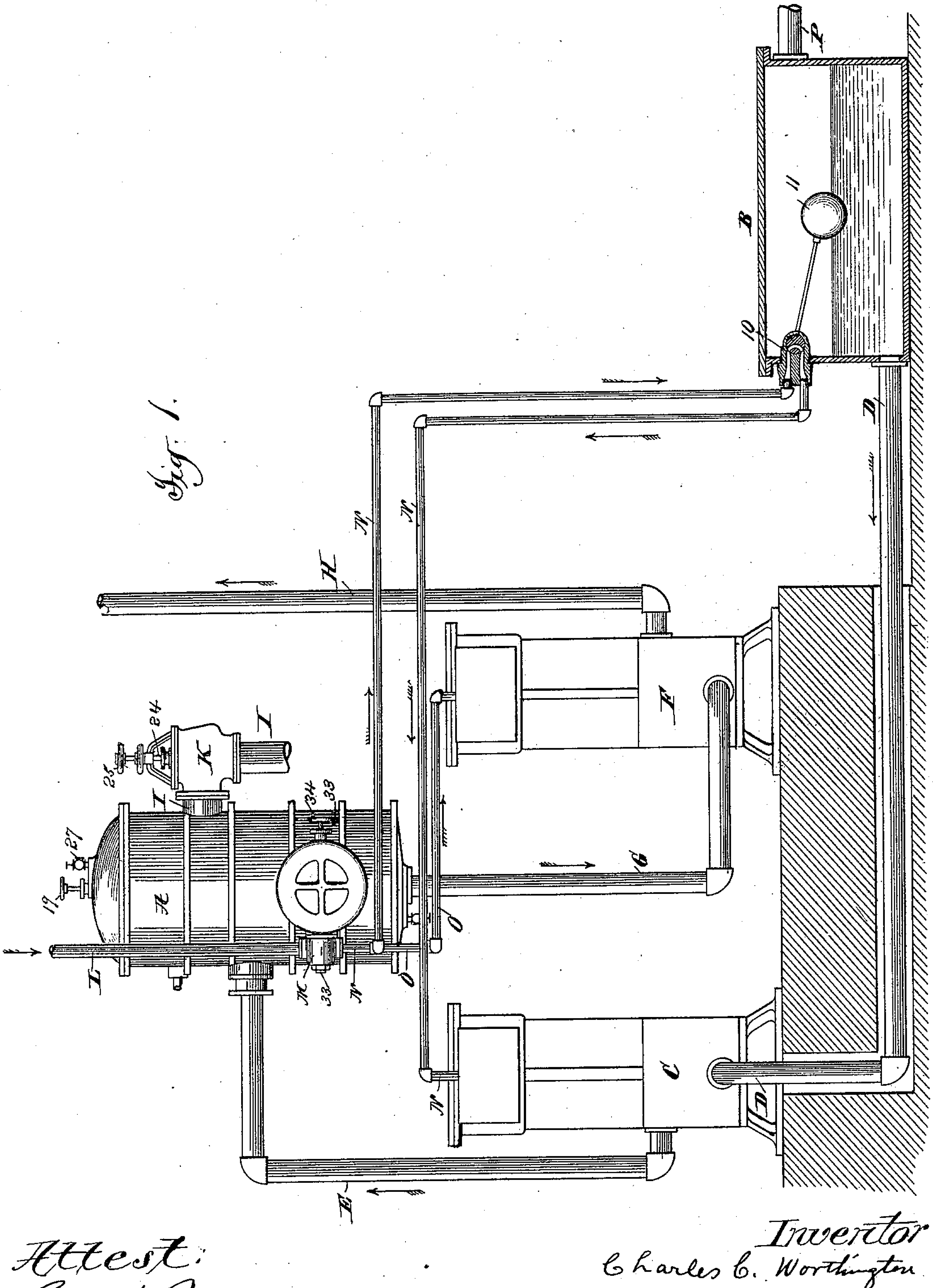


Fig. 1.

Attest:
Geo H Botts.
S. Umihal

Inventor
Charles C. Worthington
by
Philipp Munson & Phelps
Attys.

(No Model.) 3 Sheets—Sheet 2.

C. C. WORTHINGTON.

FEED WATER HEATER FOR STEAM BOILERS

No. 485,570. Patented Nov. 1, 1892.

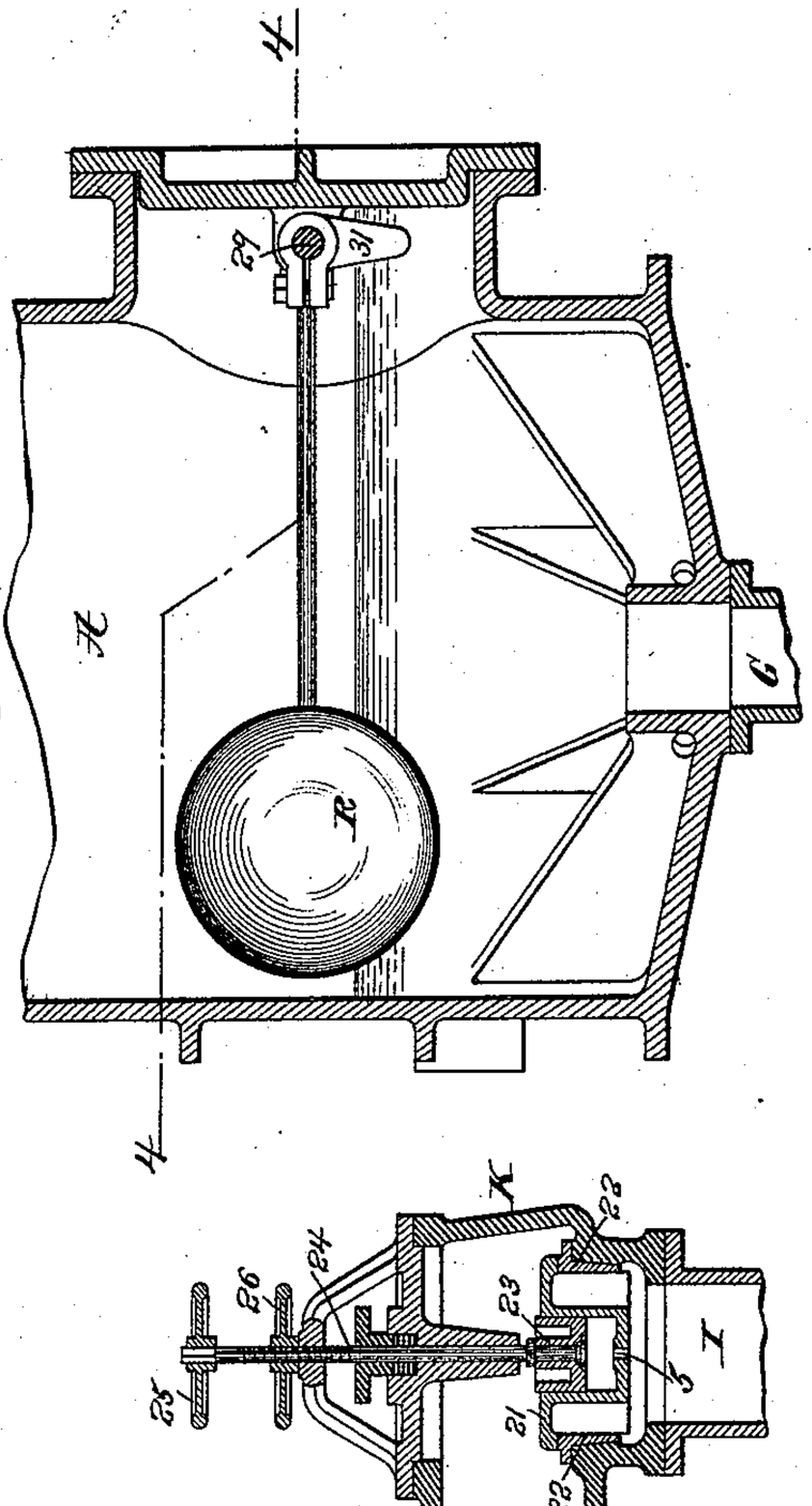


Fig. 3.

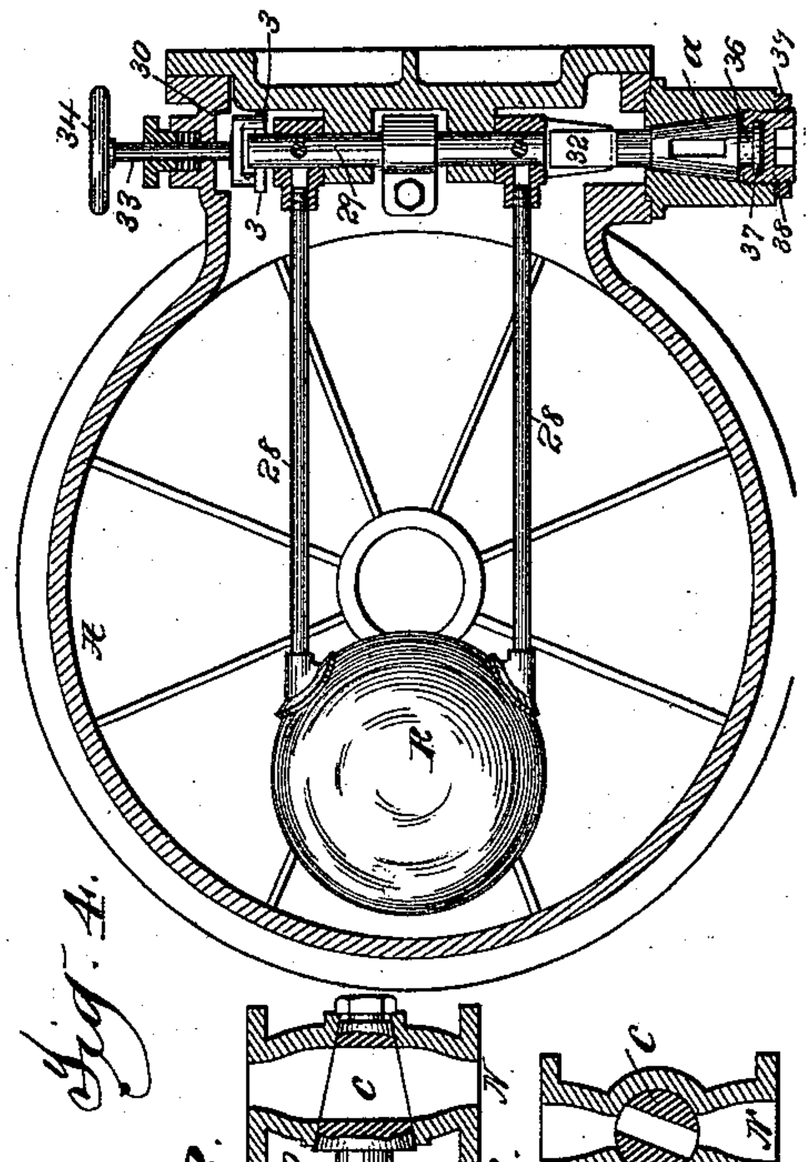


Fig. 4.

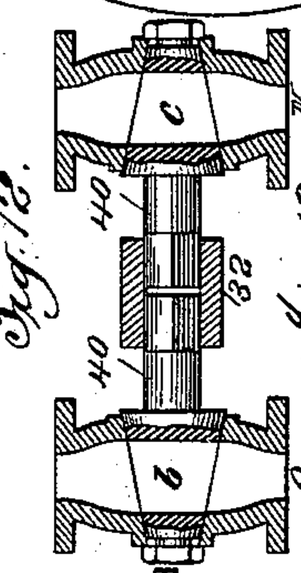


Fig. 12.

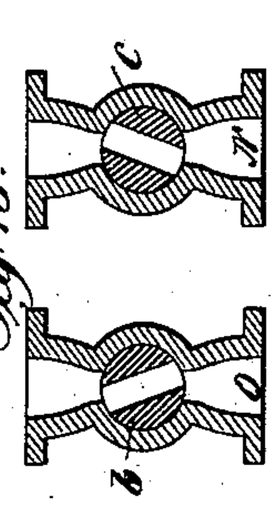


Fig. 13.

Fig. 2.

Attest:
Geo. H. Botts
S. Stuthab.

Inventor
Charles C. Worthington
by Philipp Munn & Phelps
Attys

(No Model.) 3 Sheets—Sheet 3.

C. C. WORTHINGTON.

FEED WATER HEATER FOR STEAM BOILERS

No. 485,570. Patented Nov. 1, 1892.

Fig. 5.

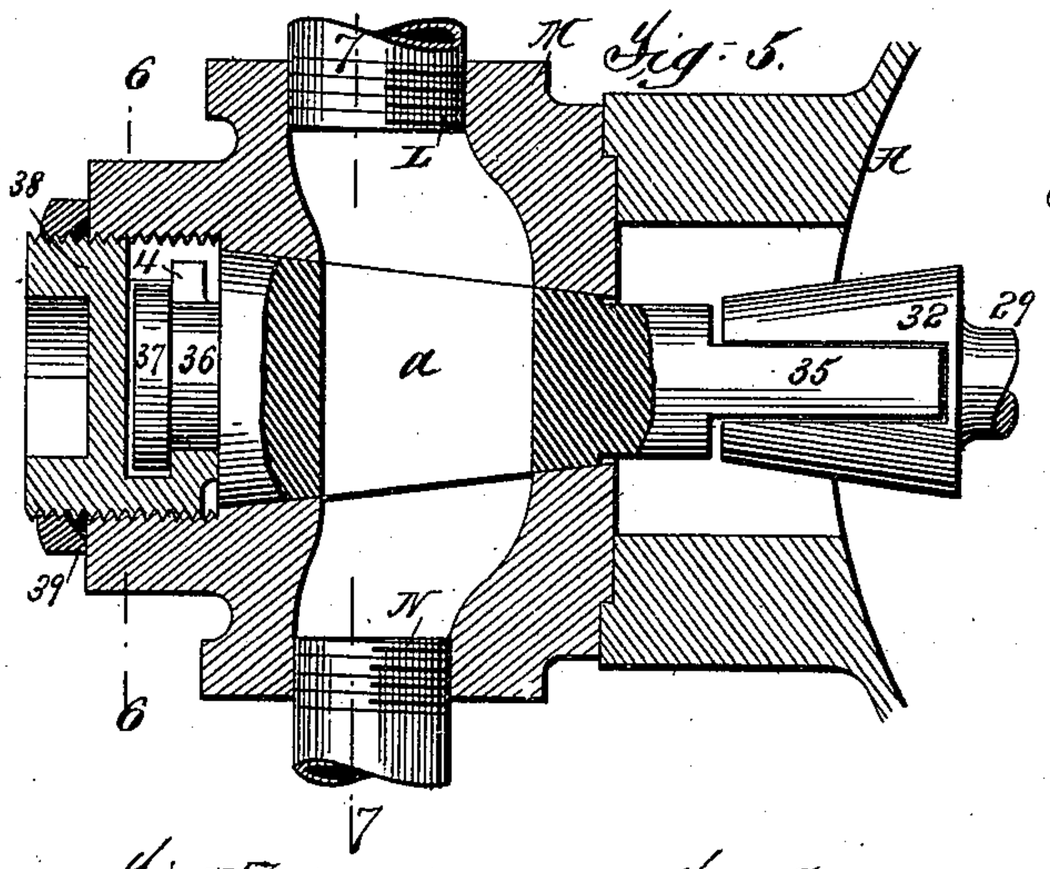


Fig. 6.

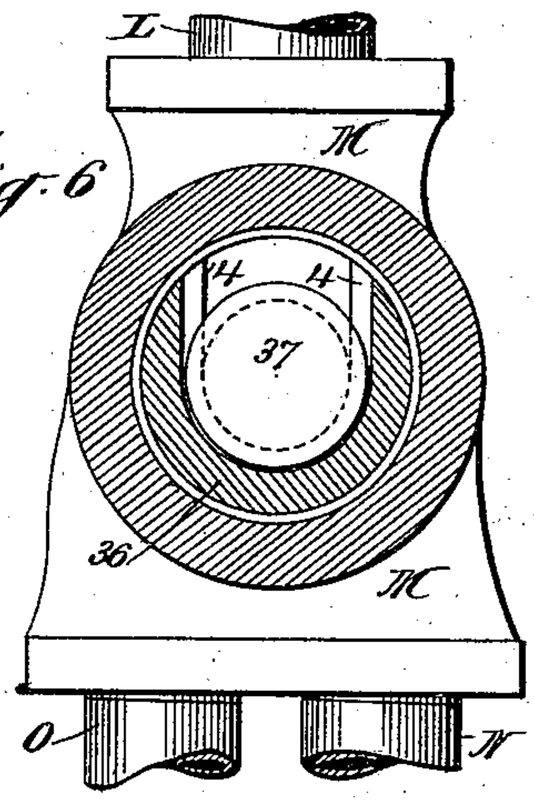


Fig. 7.

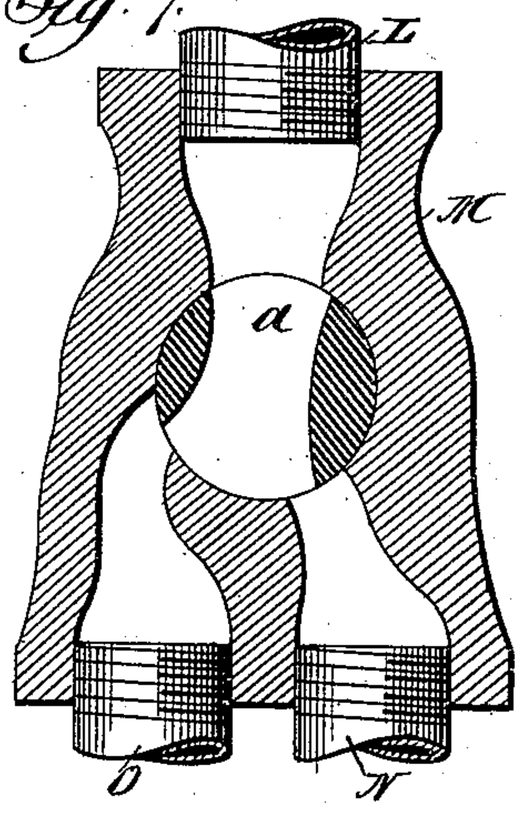


Fig. 8.

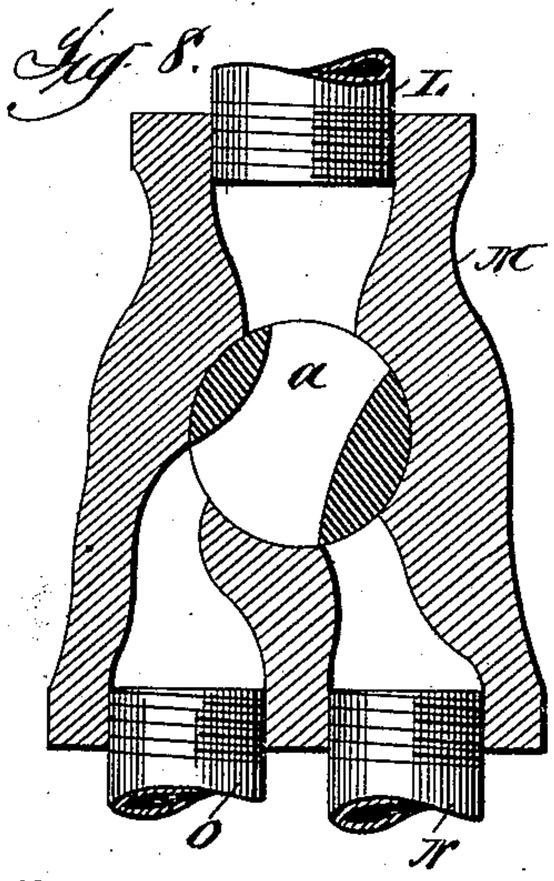


Fig. 9.

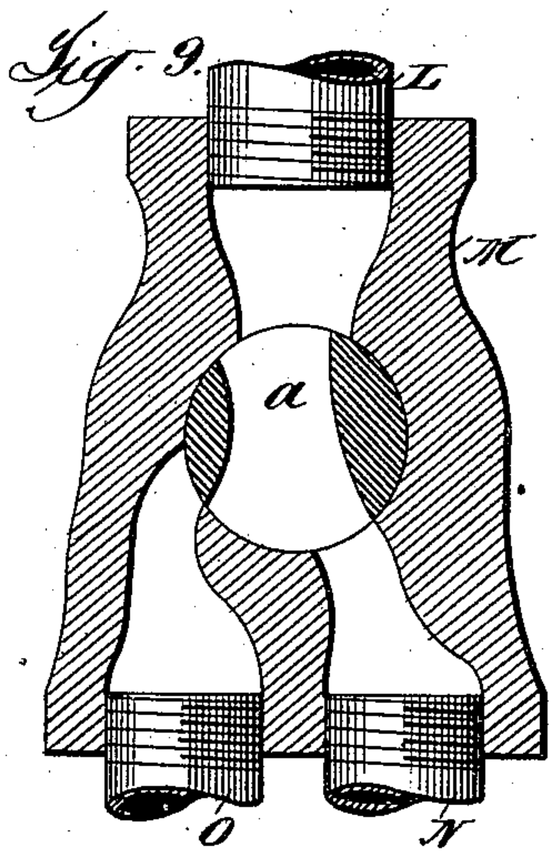


Fig 10

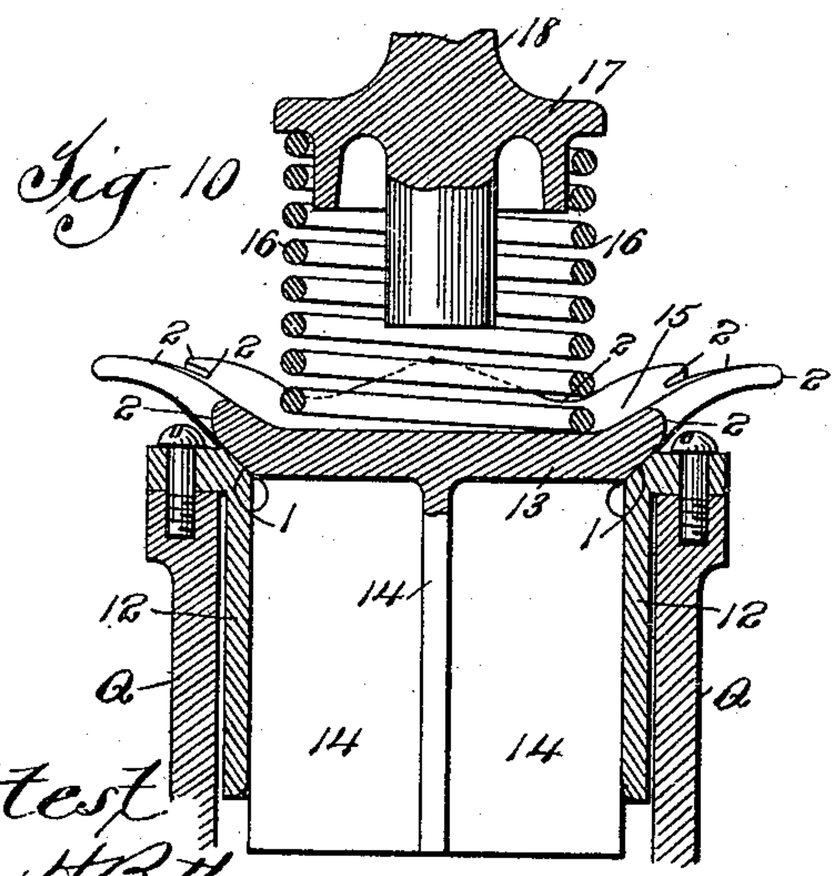
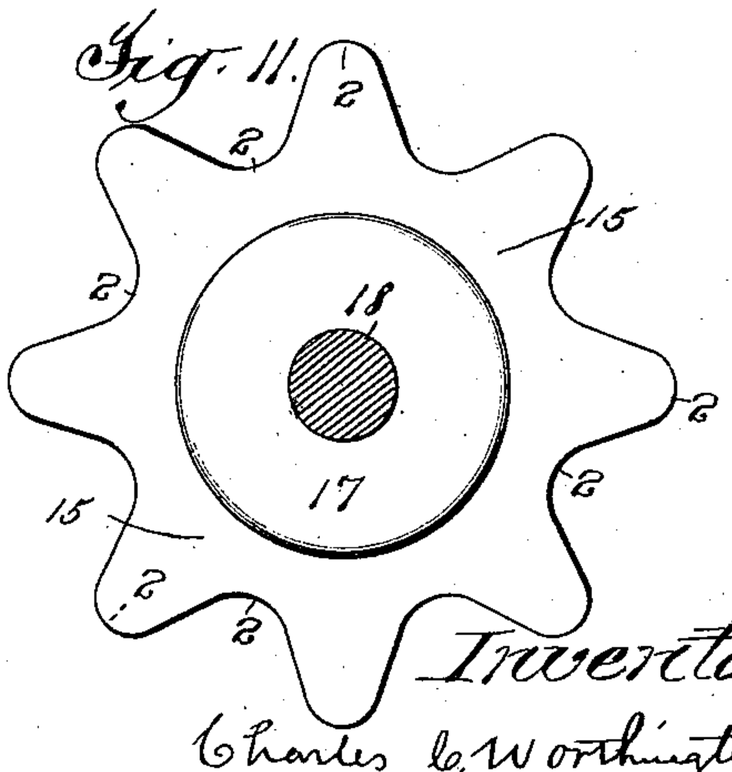


Fig. 11.



Attest
Geo. H. Bottle.
S. Whitehead.

Inventor
Charles C. Worthington
by
Philipp Munson & Phelps
Attys

UNITED STATES PATENT OFFICE.

CHARLES C. WORTHINGTON, OF IRVINGTON, NEW YORK.

FEED-WATER HEATER FOR STEAM-BOILERS.

SPECIFICATION forming part of Letters Patent No. 485,570, dated November 1, 1892.

Application filed April 4, 1892. Serial No. 427,745. (No model.)

To all whom it may concern:

Be it known that I, CHARLES C. WORTHINGTON, a citizen of the United States, residing at Irvington, county of Westchester, and State of New York, have invented certain new and useful Improvements in Feed-Water Heaters for Steam-Boilers, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

The object of the present invention is to provide an improved feed-water-heater construction for use in engines in which the feed-water for the boiler is heated by steam, the invention being especially applicable to compound and triple-expansion engines in which partially-spent steam is used, being drawn preferably from the intermediate receiver, and to simple non-conducting engines in which the exhaust-steam is used, although it will be understood that the construction embodying the invention may be used and the steam be taken from either the boiler or the engine or an independent boiler, if desired.

To this end the invention consists in an improved arrangement of feed-water heater and co-operating parts in a feed-water-heating system and in various improved constructions and combinations of parts in a feed-water heater for use in such systems, all of which will be fully described in the following specification and pointed out in the claims.

For a full understanding of my invention a detailed description of the same will now be given, reference being had to the accompanying drawings, in which I have shown a feed-water-heating system and construction of feed-water heater embodying my invention in its preferred form.

Referring to said drawings, Figure 1 is a diagrammatic side elevation of the feed-water system. Fig. 2 is a central vertical section of the feed-water heater. Fig. 3 is a central section on the line 3 of Fig. 2. Fig. 4 is a horizontal section on the line 4 of Fig. 3. Fig. 5 is a detail section of the valve for controlling the supply of steam to the pumps. Fig. 6 is a section on the line 6 of Fig. 5. Figs. 7, 8, and 9 are sections on the line 7 of Fig. 5, showing the valve in different positions. Fig. 10 is an enlarged detailed section of the spraying apparatus for admitting the water to the heater. Fig. 11 is a plan view of the same. Fig. 12 shows a modified construction of valve for controlling the supply of steam to the pump, and Fig. 13 shows the relative positions of the two valves in this construction.

Referring to said drawings, A is the feed-water heater, to which the water to be heated is fed from the tank B by supply-pump C, having suction-pipe D and force-pipe E, and from which the heated feed-water is fed to the boiler by delivery-pump F, having suction-pipe G, connected to the bottom of the heater and force-pipe H. The steam for heating the feed-water enters the heater through pipe I and valve-chest K, and steam is supplied to the pumps C F through pipe L, valve-chest M, and pipes N O, the pipe N, supplying steam to the first pump C, being extended from the valve-chest M to the supply-tank B and provided with a valve 10, by which the supply of steam to the pump C is controlled by a float 11 within the tank, operating in the usual manner, so that as the water in the tank B falls below a certain point the supply of steam is cut off. In engines employing a condenser and hot well the supply-tank B is the hot well, which is fed through pipe P from the condenser by an air-pump in the usual manner.

Referring now to the construction of the heater A, the water from the tank B is delivered through pipe E to a pipe Q, entering the side of the heater A and extending upward, so as to deliver the water in the upper part of the heater. The water is delivered from the pipe Q in a fine spray, the spraying apparatus being preferably formed as follows: Inside the upper end of the pipe Q is mounted a sleeve of brass or similar hard metal 12, and a plate 13 of similar metal, forming a valve, is mounted to slide within this sleeve by ribs 14, this plate and sleeve engaging by inclined surfaces 1 so as to form a spray between the plate and sleeve. This plate 13 is also provided with wings 15, projecting outwardly from the inclined surfaces 1 in all directions and provided with curved surfaces 2 between and upon the wings, the curves of these surfaces being so formed that the water passing between the inclined surfaces 1 is thrown outward and downward in all directions to form a fine spray. The valve 13 is spring-

pressed by a coiled spring 16, resting thereon and held under tension by a cap 17, carried by a bar 18, extending through the head of the heater and screw-threaded therein, so as to be adjustable by hand-wheel 19 outside the heater. The heater is provided at the top with a small pipe 27, controlled by a throttle and forming an air-escape, which may be connected to the condenser or air-pump or open to the atmosphere if the pressure in the heater be sufficient. The steam from pipe I enters the heater opposite the spraying apparatus through a perforated circular plate 20, forming a chamber extending about the heater, the steam thus being divided up finely by the perforations in plate 20. It will be seen that by this construction of heater and arrangement of water and steam admission thereto a perfect mixing of the fine particles of steam and water is produced and all the heat of the steam utilized by the meeting of the water and steam directly as the steam enters the heater. It will be seen, also, that the spraying apparatus and all the operating parts within the heater are readily accessible by removing the head of the heater and without interfering with the water or steam connections.

The valve admitting the steam through the pipe I to the chamber consists of the valve proper 21, seated upon a hard-metal ring 22 in the valve-chamber K and opening inward, so as to form a check-valve to prevent the return of water through the valve in case the pressure inside the heater should exceed that in pipe I, a dash-pot to prevent concussion being formed by a small opening 5 in the base of the valve connecting with a chamber in which is a plug 23, upon which the valve 21 slides, this plug 23 being adjustable, so as to regulate the dash-pot by rod 24, connected to the plug 23 and extending through the head of the valve-chest, in which it is screw-threaded, so as to be adjusted by a hand-wheel 25 outside the valve-chest and secured in position by a set-nut 26. By this construction, also, the heater may be cut out when desired by forcing the plug 23 home on valve 21 and securing the rod 24 so as to hold the valve closed.

For the purpose of controlling the supply of steam for the pumps C F in accordance with the amount of water in the heater I provide the following construction: The arms 28, carrying the float R within the heater, are secured to a rod 29, mounted in a casing 30, formed on the side of the heater, this rod being provided with an arm 31, which engages the inner side of the casing 30, so as to hold the float from striking the bottom of the heater, and with a fork 32, by which the valve-stem is engaged. This rod 29 is provided at one end with a cross-pin 3, which is engaged by a forked rod 33, extending outside the casing and provided with a hand-wheel 34, so that the shaft may be turned by hand to start the valve in case the float fails to operate it. This rod 33 may be withdrawn, so as not to engage the pin 3, thus relieving the shaft 29 from the friction of rod 33, so that it may be operated easily by the float R.

The valve-chest M is provided with a single port for the supply-pipe L and with double ports for the pipes N O, through which, respectively, steam is supplied to the supply and delivery pumps C F, these ports being controlled by the single valve *a*, as shown in detail in Figs. 5 to 9. The valve *a* is provided with a stem 35, adapted to be engaged by the fork 32 for turning the valve, and is of conical form, so as to enable a close joint within the valve-chest M to be formed by forcing in the valve. The head of the valve *a* is provided with a reduced neck 36 and cap 37, by which the valve may readily be introduced into and removed from a screw-plug 38, which is cut away on one side to form a recess for the cap 37 and shoulders 4, engaging the cap as the plug is withdrawn. By this construction the valve *a* is moved inward and outward with the screw-plug 38, so that it may readily be adjusted by the screw-plug or withdrawn from the valve-chest, while at the same time the valve is not rotated by the rotation of the screw-plug. The blade-and-fork connection of the rod 29 and valve-stem 32 also permits the valve and valve-chest to be removed without interfering with the float construction, and vice versa. The plug is held in position when adjusted by a set-nut 39, preferably packed for greater security, as shown.

The valve *a* is so positioned relatively to the ports connecting with the pipes N O that in the normal position of the float R, as shown in Fig. 3, with a sufficient supply of water in the heater, the valve is held in the position shown in Fig. 7, with the steam passing from supply L to both of the pipes N O, the steam through pipe N passing through the valve 10 on the hot well B to the pump C and both pumps being in operation, the pump C supplying water to the heater through the pipe E and the pump F delivering heated feed-water to the boiler through pipe H. If, however, the feed-water in the heater rises above a certain amount, the valve *a* is turned by the rising of the float R into the position shown in Fig. 8, in which the supply of steam to the pump C through pipe N is cut off, thus stopping the supply of water to the heater. If the water in the heater falls below a certain point, the valve is turned by the falling of the float into the position shown in Fig. 9, in which it operates to cut off the steam from the pump F, thus stopping the delivery of water from the heater until the float has been raised again by the delivery of water from the hot well by pump C. The valve and ports are preferably so arranged that as the float moves the valve from its central or normal position in either direction and begins to cut off the supply of steam to one of the engines it opens the other port to increase the supply to the other engine, so that the proper balance of

power in both engines is preserved and the proper delivery of water to and from the heater secured by the rise and fall of water in the heater. It will be understood, also, that the supply of steam to the pump C is controlled by the valve 10 and float 11 in the hot well, so as to secure the shutting off of the steam from pump C when the water in the hot well falls below a certain point, the supply to this pump thus being controlled by both the heater and hot well, so that the pump C is stopped when the supply of water in the heater is too great or that in the hot well too small.

It is evident that the form of the valve *a* may be varied and that any suitable construction may be used for the purpose of controlling both pumps from the rod 29. Thus, as shown in Figs. 12 and 13, the fork 32 may engage a stem 40, carrying at its opposite end plug-valves *b c*, provided with single passages and controlling, respectively, pipes N O, the float thus cutting off the steam from one pump or the other in the same manner as previously described in connection with valve *a*.

It will be understood that various other modifications may be made in the construction shown without departing from my invention, and I am not to be limited to the exact construction of any of the devices shown.

What I claim is—

1. The combination, with a feed-water heater and a supply-tank and supply and delivery pumps therefor, of independent valves controlling the supply of steam to the supply-pump and controlled by floats in the heater and supply-tank, substantially as described.

2. The combination, with a feed-water heater and a supply-tank and supply and delivery pumps therefor, of a float in said heater, controlling the supply of steam to both the supply and delivery pumps, substantially as described.

3. The combination, with a feed-water heater and a supply-tank and supply and delivery pumps therefor, of a float in said heater, controlling the supply of steam to both the supply and delivery pumps, and a float in the supply-tank, controlling the supply of steam to the supply-pump, substantially as described.

4. In a feed-water heater, the combination, with a water-spray, of a perforated plate surrounding the spray, said spray and plate being constructed and arranged to admit the sprayed water and fine jets of steam to the same space from opposite directions and located in such adjacency to each other that the steam and water meet under pressure from opposite directions, substantially as described.

5. The combination, with central vertical pipe Q, extending upward, and valve 13 thereon engaging said pipe by inclined surfaces and having wings 15 and curved surfaces 2, of perforated plate 20, surrounding the valve through which the steam is admitted from the side of the casing, substantially as described.

6. In a feed-water heater, the combination, with central vertical pipe Q, extending upward, and valve 13 thereon engaging said pipe by inclined surfaces and having wings 15 and curved surfaces 2, of perforated plate 20, surrounding the valve, through which the steam is admitted, steam-pipe I, entering the side of the casing, and delivery-pipe G, entering the lower part of the casing, substantially as described.

7. In a feed-water heater, the combination, with central vertical pipe Q, extending upward, and a spray thereon by which the water is thrown outward transversely to the pipe, of perforated plate 20, surrounding the spray through which the steam is admitted, steam-pipe I, entering the side of the casing, and delivery-pipe G, entering the lower part of the casing, substantially as described.

8. The combination, with pipe Q, of valve 13, engaging said pipe by inclined surfaces and having wings 15 and curved surfaces 2, substantially as described.

9. The combination, with pipe Q, of valve 13, engaging said pipe by inclined surfaces and having wings 15 and curved surfaces 2, spring 16 on said valve, and means for adjusting the tension of said spring, substantially as described.

10. A spray-valve consisting of the plate 13, having wings 15 and curved surfaces 2, substantially as described.

11. The combination, with float R, rod 29, connected to and rocked by said float, and a valve actuated by said rod, of means extending through the wall of the casing for rocking said rod from outside the casing and adapted to be disengaged inside the casing from said rod, substantially as described.

12. The combination, with float R, of rod 29, connected to and rocked by said float, a valve actuated by said rod, and rod 33, engaging said rod and projecting outside the casing, said rod being mounted to slide into or out of position to engage rod 29, substantially as described.

13. The combination, with valve 21, having opening 5, of plug 23, forming a dash-pot outside said valve, and adjustable rod 24, connected to said plug and extending outside the casing, substantially as described.

14. The combination, with conical valve *a*, having neck 36 and cap 37, of screw-plug 38, recessed to receive said cap, and having shoulders 4, by which the cap is withdrawn with the plug, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

CHARLES C. WORTHINGTON.

Witnesses:

A. J. CALDWELL,

F. IRWIN.