No. 684,770. Patented Oct. 15, 1901.

R. J. PATTERSON.

FEED WATER HEATER.

(Application filed Nov. 19, 1900.)

(No Model.)

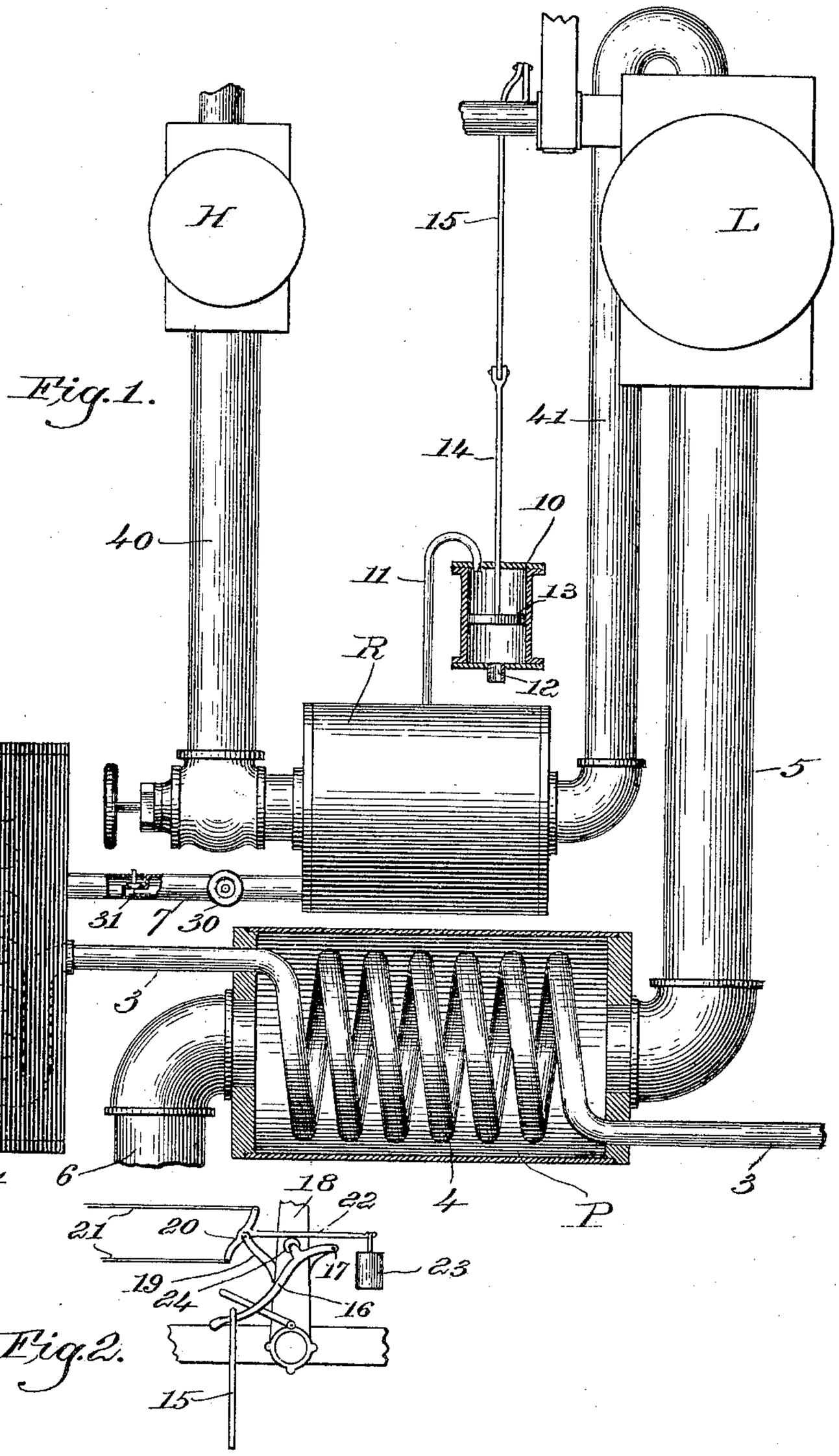
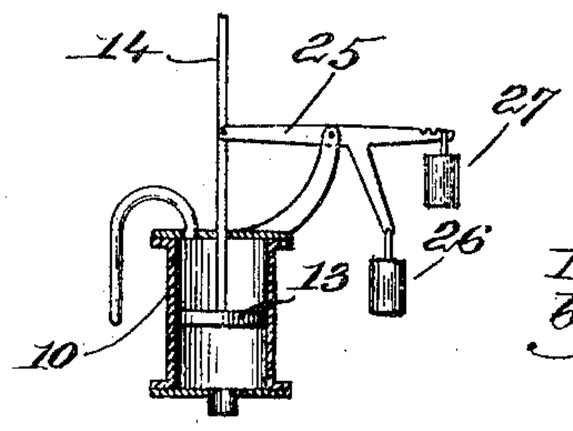


Fig. 1.

Fig. 2.



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UNITED STATES PATENT OFFICE.

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FEED-WATER HEATER.

SPECIFICATION forming part of Letters Patent No. 684,770, dated October 15, 1901.

Application filed November 19, 1900. Serial No. 36,983. (No model.)

To all whom it may concern:

Be it known that I, RALPH J. PATTERSON, a citizen of the United States, and a resident of Woburn, county of Middlesex, State of Massachusetts, have invented an Improvement in Feed-Water Heaters, of which the following description, in connection with the accompanying drawings, is a specification, like letters and numerals on the drawings representing like parts.

This invention relates to feed-water heaters; and it has for its object to provide a system wherein the feed-water is heated to 212° Fahrenheit or over before its entrance to the boiler and is maintained at a uniform temperature.

In the most economic systems for heating feed-water the said water should be fed to the boiler at as near the temperature of the water in the boiler as possible, whereby the water entering the boiler will not cool the water in the boiler to any appreciable extent.

It is the common practice to utilize the waste steam from steam-engines to heat the feed-water prior to its entrance to the boiler, and this is usually accomplished by passing the water through a heater which derives its heat from the exhaust-steam from the engine, the heater usually being placed between the exhaust-valve and the condenser, if one is employed. In such systems, however, it has generally been impossible to heat the water to more than 140° Fahrenheit, and the water is therefore fed to the boiler at a considerably lower temperature than the water in the boiler, thus requiring a greater consumption of fuel to maintain said water at the proper temperature to evaporate. To obviate this difficulty and to add to the efficiency of this system, it has been common to provide an auxiliary heater and to utilize the waste steam from the pumping-engine or the air-pump for the condenser in such auxiliary heater, the pipe carrying the water through the auxiliary heater being common to the feed-water pipe of the main heater, which utilizes the waste steam from the engine. With such a system the feed-water is given its primary heating in the primary heater by means of the waste steam from the engine and is then taken to the auxiliary or secondary heater, where it is there additionally heated by means of the waste steam from the pumping-engine or air-pump for the condenser or other suitable source. One difficulty with this system is that the source of steam-supply for the auxiliary or secondary heater varies in pressure, and consequently the steam varies in temperature, so that the water as it passes from the secondary heater to the boiler has a varying temperature. It is obvious, of course, that the varying temperature of the feed-water is detrimental to the efficiency of the boiler. Moreover, in modern steam plants the auxiliary mechanism, such as the feed-pump or air-pump for the condenser, is generally driven by electrical apparatus or some connection from the engine, so that this source of steam-supply for the auxiliary heater is not available.

In the system of feed-water heating which forms the basis of this application I aim to feed the water to the boiler at a uniform temperature, which is as near as possible to that of the water in the boiler, and this I accomplish by providing a plurality of heaters which have a feed-water conduit common to all of said heaters, and I supply a heating medium, preferably steam, to the several heaters at different temperatures, and further provide mechanism whereby the temperature of the last heater of the series is maintained constant. With this system the feed-water is initially heated in the primary heater or that which has the lowest temperature and then passes to the other heaters of the series, and because of the constant high temperature in the last heater of the series the water emerges therefrom at a uniform temperature which is as near that of the boiler-water as possible.

Referring to the drawings, Figure 1 is a view, partially diagrammatic, illustrating my system of heating feed-water as applied to a compound engine; and Fig. 2 is a detail showing one form of mechanism for keeping a constant temperature in the last heater of the series.

Although I have illustrated my invention as used in connection with compound engines, yet I wish it understood that the invention is not limited to such use, but may be used in connection with multiple-cylinder engines or with single-cylinder engines.

H represents the high-pressure cylinder of

a compound engine, and L the low-pressure cylinder, these cylinders having intermediate them the usual receiver R, the said receiver being connected to the high-pressure cylinder by the pipe 40 and to the low-pressure cylinder by the pipe 41, as usual in this class of devices. The engine is illustrated diagrammatically merely, for it may be of any familiar type, but preferably of the Corliss type, and inasmuch as the invention relates to the feed-water heater and not to the engine it is deemed unnecessary to illustrate more in detail the construction of the engine. The feed-water is heated by means of a plurality of different heaters having heat furnished thereto at different temperatures, and in this embodiment of my invention I have illustrated a series of two heaters, P representing the primary heater and S the secondary or auxiliary heater. These heaters are each preferably what are known as "closed heaters"—that is, heaters wherein the feed-water is on one side of tubes and the steam or heating medium on the other side, the heat being transmitted through the tubes to the water—and, as illustrated, the feed-water is conducted through the pipe 3, which enters the chamber of the primary heater P and passes through the chamber in a series of coils. The heating medium, which in this instance is steam, is the exhaust-steam from the low-pressure cylinder of the compound engine, this exhaust-steam passing through the pipe 5 to the chamber of the primary heater P and passing through said chamber out through the exhaust-pipe 6 to the condenser. The heat in the exhausted steam is sufficient to raise the temperature of the feed-water to about 140° Fahrenheit, and having passed through its primary heater the feed-water is conducted to the secondary heater S, which is also preferably a closed heater and is so connected to the primary heater that the feed-water conduit 3 after leaving the primary heater passes through the secondary heater in a series of coils 4′, (shown in dotted lines in Fig. 1,) after which the said feed-water conduit conducts the water to the boiler.

The secondary heater S takes its supply of steam from a source independent from the source of supply for the primary heater, and preferably I connect the chamber of the secondary heater to the receiver R by means of the pipe 7, whereby the steam-pressure in the secondary heater is the same as that in the receiver. The chamber of the secondary heater has the outlet 8, which is normally closed by the valve 9, so that the steam from the receiver does not pass through the secondary heater, but merely into the chamber thereof, and the secondary heater is, in effect, a compartment of the receiver, the pressure in said heater being always the same as that of the receiver. The valve 9 is merely for the purpose of draining off the water of condensation.

The utilization of steam from the receiver for furnishing heat to the secondary heater S results in varying the pressure in the receiver, and consequently varying the temperature of the steam therein, and in order to maintain a constant temperature in the secondary heater, so as to give to the water passing from the heater a uniform temperature, I have attached to my receiver or source of supply for the secondary heater a pressure-regulator, this regulator operating to preserve a constant pressure in the receiver, and as a consequence the steam utilized in the secondary heater has a uniform constant temperature. This is a highly-important feature in my system.

The pressure-regulator used in connection with the receiver may be of any suitable type, but as illustrated it consists of the cylinder 10, having one end thereof connected to the receiver by means of the pipe 11, the opposite end of the cylinder being open to the atmosphere, as at 12. A suitable piston 13 operates in the said cylinder, the piston-rod 14 thereof being connected by means of the link 15 to a lever 16, suitably pivoted, as at 17, on a stand or support 18, which may be mounted in any suitable way upon the engine-frame. Pivotally mounted to an arm 19 on said stand 18 is a lever 20, having the rods 21 connected to opposite ends thereof, the said rods being operatively connected to the releasing mechanism of the valve-gear, which may be of the Corliss type. An arm 22, rigidly connected to said lever 20, carries at its end the weight 23 and rests intermediate its ends upon a roll 24, carried by the lever 16. The weight 23 is sufficient to maintain a constant contact of the arm 22 with the roll 24.

An arm connected to the upper end of the cylinder 10 carries a pivotally-mounted lever 25, connected at one end to the piston-rod 14 and carrying at its other end suitable weights 26 27. With this construction it will be obvious that any increase in receiver-pressure will operate to depress the plunger or piston 13, and consequently lower the lever 16 through the piston-rod and link 14 15. As the lever 16 is lowered the weight 23 operates to swing the lever 20 about its fulcrum-point, and thus operating the reach-rods 21 and the releasing mechanism of the valve-gear, so that the cut-off to the low-pressure cylinder is lengthened, whereby the said low-pressure cylinder will take more steam, and consequently reduce the receiver-pressure. As soon as the receiver-pressure tends to fall below normal the pressure upon the top of the piston will be diminished and the weights 26 27 operate to raise the piston-rod 14 and link 15 and through the lever 16 raise the lever 22, which by swinging the lever 20 operates all the reach-rods 21 to shorten the cut-off, whereby the low-pressure cylinder will take less steam, with the result that the receiver-pressure will increase. It will thus be seen that I have provided a mechanism for maintaining a constant uniform pressure in the receiver, and consequently maintaining

the steam which is used in the secondary heater at a constant temperature. As stated above, this results in giving to the feed-water a constant high temperature and results in an extremely efficient system of heating feed-water. Preferably the pipe 7, which conducts the steam from the receiver R to the secondary heater, will have an ordinary stop-valve 30 therein, by which communication between the receiver and secondary heater may be cut off at will, and also a check-valve 31, of any suitable type, for the purpose of preventing water or steam from the secondary heater from rushing into the receiver in case of accident to the pipe 3.

Various changes may be made in the structure of my device without departing from the spirit of my invention, which consists in providing a closed primary heater connected to the exhaust of the low-pressure cylinder of a multiple-cylinder engine and a closed secondary heater connected to the receiver or exhaust from the high-pressure cylinder and a feed-water conduit common to said heaters, together with means to maintain a uniform pressure in the receiver or source of steam-supply for the secondary heater, whereby the said secondary heater furnishes water for the boiler at a constant high temperature.

Having fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an apparatus of the class described, a multiple-cylinder engine, including a low-pressure cylinder and receiver, combined with a feed-water heater comprising a primary heater, a pipe or conduit connecting the same to the exhaust of the low-pressure cylinder of said engine, a secondary heater, means to connect the same with the receiver of the engine, a feed-water conduit common to both of said heaters, and a pressure-regulator connected to the said receiver to maintain a uniform pressure therein.

2. In an apparatus of the class described, a multiple-expansion engine having a series of cylinders, and a receiver combined with a feed-water heater, comprising a closed primary heater, a pipe or conduit connecting the same to the exhaust of the low-pressure cylinder of said engine, a closed secondary heater, means to connect said secondary heater to the receiver of said engine, a feed-water conduit common to both of said heaters, and a pressure-regulator connected to said receiver to maintain a uniform pressure therein.

3. In an apparatus of the class described, a multiple-expansion engine including a low-pressure cylinder and a receiver, combined with a feed-water-heating apparatus comprising a closed primary heater, means to connect the same to the exhaust of the low-pressure cylinder of said engine, a closed secondary heater, means to connect said secondary heater to the receiver of said engine, whereby steam from the receiver is admitted to said secondary heater, said heater having a normally closed outlet, whereby the water of condensation may be removed therefrom, a feed-water conduit common to both of said heaters, and means connected to the receiver to maintain a uniform pressure therein.

4. In an apparatus of the class described, a multiple-expansion engine including a low-pressure cylinder and a receiver, combined with a feed-water heater comprising a closed primary heater having a normally closed outlet for the escape of water of condensation, a pipe or conduit for connecting the said secondary heater to the said receiver, whereby steam from the receiver is admitted to the secondary heater, a check-valve in said pipe, a feed-water conduit common to both said heaters, and means to maintain a uniform pressure in the receiver.

5. In an apparatus of the class described, a compound engine including a low-pressure cylinder and a receiver, combined with a closed primary heater connected to the exhaust of said low-pressure cylinder, a closed secondary heater comprising a heating-chamber, means for connecting said chamber to the said receiver, whereby steam is admitted to said chamber from the receiver, means for withdrawing the water of condensation from said chamber, a feed-water conduit common to both said heaters, and a pressure-regulator connected to the receiver to maintain a uniform pressure therein.

6. In an apparatus of the class described, a compound engine, including high-pressure and low-pressure cylinders and receiver, combined with a feed-water-heating apparatus comprising a closed primary heater connected to the exhaust of the said low-pressure cylinder, a closed secondary heater having a heating-chamber, means for connecting said chamber to the said receiver, whereby steam from the receiver is admitted to said chamber, means for withdrawing the condensed steam from said chamber, a feed-water conduit common to both said heaters, and a pressure-regulator connected to the receiver to maintain a uniform pressure therein, said pressure-regulator having means operated by variations of receiver-pressure to control the cut-off of the low-pressure cylinder.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

RALPH J. PATTERSON.

Witnesses:
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LOUIS C. SMITH.