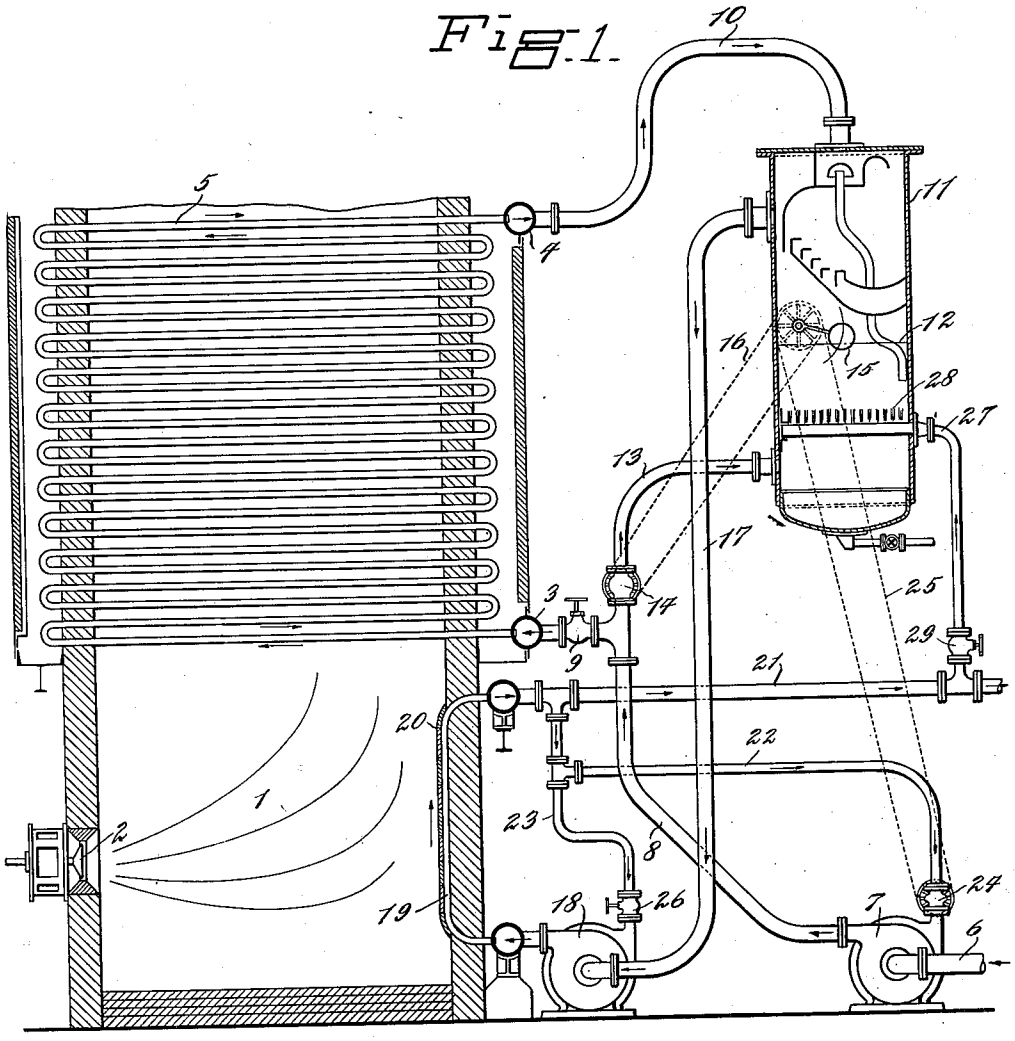
March 3, 1936. H. J. KERR 2,032,368

HIGH PRESSURE BOILER

Original Filed April 22, 1930 3 Sheets-Sheet 1

Fig. 1.



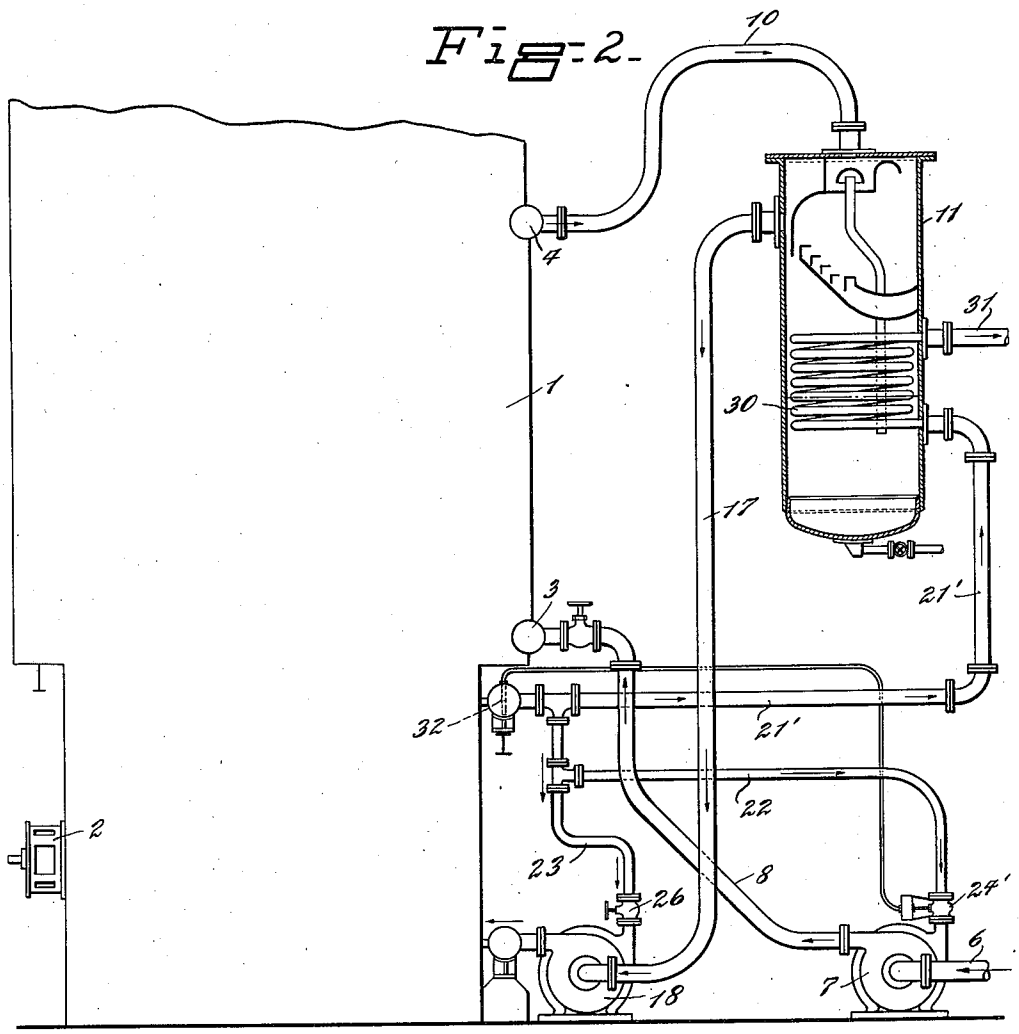
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HIGH PRESSURE BOILER

Original Filed April 22, 1930 3 Sheets-Sheet 2

Fig. 2.



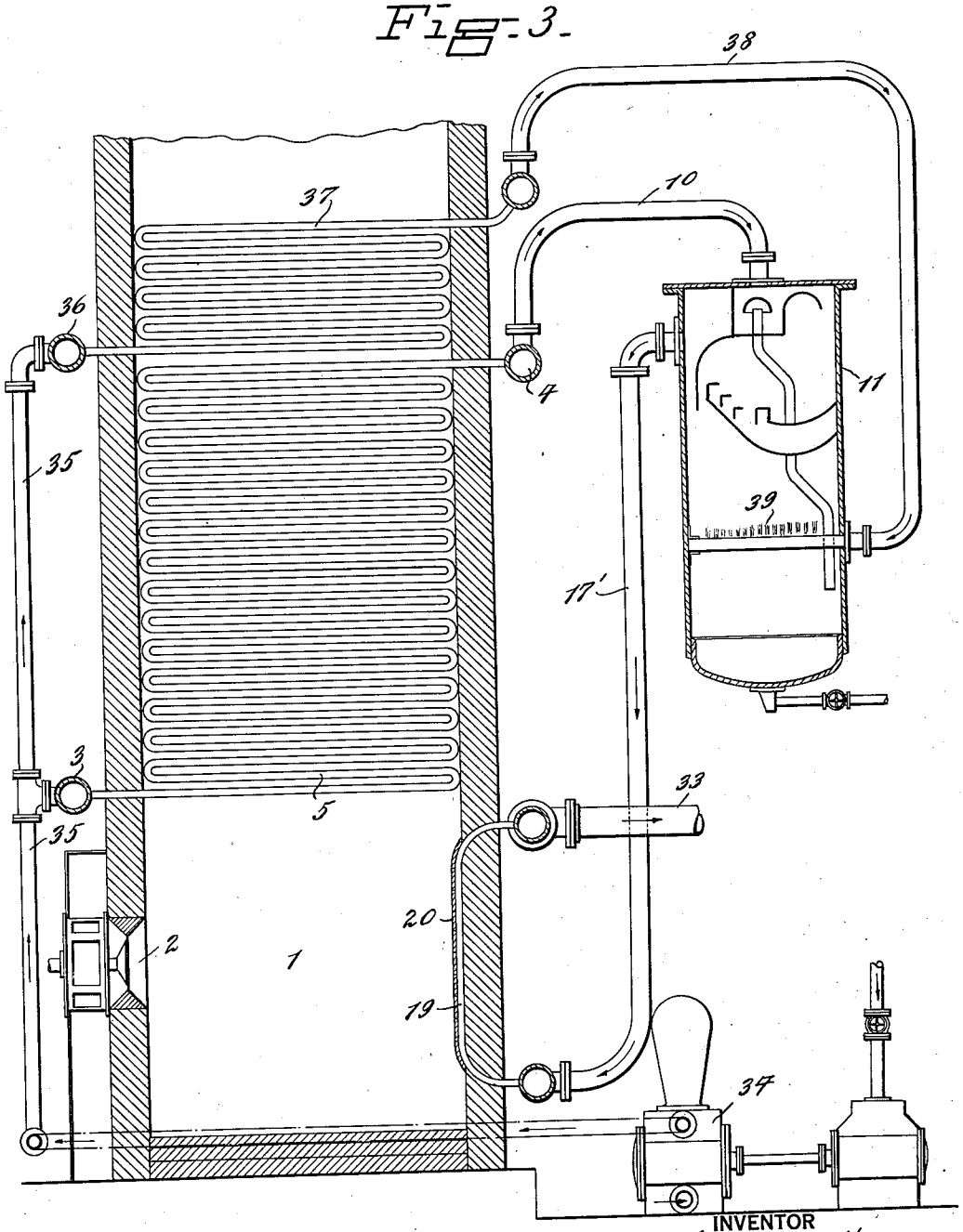
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Fig. 3.



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2,032,368

UNITED STATES PATENT OFFICE

2,032,368

HIGH PRESSURE BOILER

Howard J. Kerr, Westfield, N. J., assignor to The Babcock & Wilcox Company, Bayonne, N. J., a corporation of New Jersey

Application April 22, 1930, Serial No. 446,221
Renewed March 15, 1934

7 Claims. (Cl. 122—235)

This invention relates to a novel and improved form of boiler, particularly one of the high pressure type, and the novel features will be best understood from the following description and the annexed drawings, in which I have shown selected embodiments of the invention and in which:

Fig. 1 is a semi-diagrammatic view showing one embodiment which the invention may take.

Fig. 2 is a view similar to Fig. 1 but illustrating a second embodiment.

Fig. 3 is a third view similar to Fig. 1 but showing still another embodiment.

Referring first to Fig. 1, I have shown therein a furnace 1 adapted to burn fuel by any suitable means here exemplified as a pulverized fuel burner 2. The furnace has a single upwardly extending pass across which is disposed the boiler. In this case, the boiler is shown as of the type having an inlet 3 and an outlet 4 which are joined together by a continuous conduit 5. In the illustration, this conduit is shown as being formed of a plurality of tubes joined together by return bends, so as to form, in effect, a single element. Of course, other forms may be used, it only being necessary that there should be a continuous passage for the flow of water and/or steam through the passage and, for the sake of simplicity, I shall hereinafter refer to the boiler as having a continuous conduit, the particular form of the conduit being subject to considerable change in design without affecting the invention. In the drawings, the inlet and outlet are shown as headers, and of course it is understood that there are a large number of conduits 5 connected to these headers, but all carrying fluid in the same direction from the inlet header to the outlet header.

Water is supplied from a pipe 6 and forced by a feed pump 7 through a pipe 8 to the inlet, a suitable valve 9 being provided to regulate the flow of water. There is discharged at the outlet 4 of the boiler a mixture of steam and water at high pressure, and this mixture is conducted through the pipe 10 to a separator 11. Here separation takes place and the water is collected in the bottom of the separator and the steam in the top, the water line being indicated at 12. If desired, this water line may be maintained by means of a connection 13 from the feed pump, a valve 14 being supplied in this connection and controlled by means of a float 15 connected to the valve by a chain 16.

Steam from the separator passes through the pipe 17 to a pump 18 which forces it through a superheater here shown as a superheater of the radiant heat type, located at 19 in a wall of the combustion chamber of the furnace.

From the superheater the steam is led through the pipe 21 to an engine or other point of use. A certain proportion of the superheated steam may be supplied to the turbines driving the pumps 17 and 18 by means of the pipes 22 and 23, respectively, the flow of superheated steam in the pipe 22 being controlled by a valve 24 which is also operated from the float 15 by means of a chain 25. Flow through the pipe 23 is controlled by a hand valve 26.

A portion of the superheated steam is diverted from the main 21 through the pipe 27 into the water space of the separator and is there discharged as indicated at 28. Of course, due to the additional pressure impressed upon it by the pump 18, the superheated steam thus discharged is at a higher pressure than is the steam and water entering the separator through the pipe 10, and this superheated steam gives up its superheat to evaporate some of the water in the separator forming saturated steam which mingles with that entering through the pipe 10. In the pipe 27 is a valve 29, by means of which flow of superheated steam to the separator may be regulated.

By proper adjustment of the various parts described above, it is possible for the amount of steam supplied at 28 to the water in the separator to be so regulated as to evaporate the excess water introduced into the separator from the pipe 10. This means that an excess of steam over that required for power or other purposes, leaving through the pipe 21 can be superheated in the radiantly heated superheater 19, this excess conveying sufficient heat in its superheat to supply the heat necessary to completely evaporate all of the water separated out in the separator 11 from the wet saturated steam entering through the pipe 10. By employing the steam booster pump 18, the steam passing through the superheater 19 is under control and there is no danger of the superheater tubes being burned out. At the same time this pump increases the pressure of the steam sufficiently so that the superheated steam leaving through the pipe 21 is at a slightly higher pressure than the saturated steam and water in the separator 11, and the superheated steam will therefore flow through the pipe 27 as regulated by the valve 29 into the separator 11 and assist in evaporating the excess water carried in through the pipe 10 by the wet saturated steam from the boiler.

Referring now to Fig. 2, I have shown therein

an apparatus similar to what is shown in Fig. 1, and in which similar reference characters have been used to a large extent. In this form, however, the entire quantity of superheated steam is passed through the pipe 21' which is connected to a coil 30 in the separator 11. The outlet of this coil is connected to a pipe 31 which forms the steam main. In this manner all of the steam required for power or other purposes is superheated to a temperature above that required in actual use, the excess heat being given up in the separator 11 in passing through the coil 30 to assist in evaporating the excess water carried into the separator 11 through pipe 10 by wet saturated steam from the boiler. The same result is attained as with the construction described in connection with Fig. 1, but by employing a modified construction and method of operation.

In this form, the valve 26 controlling the supply of steam to the turbine driving the pump 18 is used as before, but the valve 24' controlling the supply of steam to the turbine driving the feed pump 7 is thermostatically controlled by a thermostat 32 disposed at the outlet end of the superheater. In this manner the rate of feed to the boiler is regulated by means of the temperature of the superheated steam leaving the superheater and is so arranged that after giving up part of its heat to evaporate the excess water in the separator 11, the steam leaves through the pipe 31 with the necessary superheat required for power or other purposes.

Referring now to Fig. 3, I have shown a different embodiment which accomplishes the same result as the two embodiments previously described, but employs a different method of operation and eliminates the superheated steam booster pump.

The water is supplied by a feed pump 34 to a pipe 35 which is connected to the inlet 3 of the boiler 5 and also to an inlet 36 of a secondary or auxiliary boiler 37 in the same setting as the main boiler 5. This boiler 37 is smaller than boiler 5. The pressure of the water entering both boilers through headers 36 and 3, respectively, is approximately the same, but with this construction of boiler employing continuous conduits, the pressure drop through the larger boiler 5 will, of course, be greater than the pressure drop through the smaller boiler 37, so that the resulting steam or steam and water leaving through the outlet 38 of the small boiler 37, will be at a higher pressure than that leaving through the outlet 10 of the larger boiler 5 and consequently the steam leaving the smaller boiler will have a greater heat content per unit. In addition to the increased pressure the relation between the small boiler 37 and the larger boiler 5 can be such that all of the water passing through the smaller boiler 37 can be evaporated or even superheated before leaving. The steam and water is discharged from the main boiler 5 in the usual manner through the outlet 10 and enters the separator 11, the water separating from the steam and occupying the lower portion of the chamber while the steam occupies the upper portion. The higher pressure steam from the smaller boiler, whether saturated or superheated, enters the separator 11 through the pipe 38 and gives up its excess heat to the water separated out from the wet saturated steam delivered from the main boiler, in this way evaporating part of it, the steam thus formed mingling with the separated saturated steam and flowing through the pipe 17' and then through the radiantly heated superheater 19 to the outlet 33 to be used for power or other purposes. In this arrangement sufficient water is evaporated in the small boiler so that the excess heat in the steam formed will evaporate the water separated out of wet saturated steam entering the separator 11 through the pipe 10 from the main boiler 5.

In each of the modifications illustrated and described, the object is to operate this once-through type of boiler in such a manner that there is no danger of burning out the tubes. When only sufficient water to meet the steam requirements for power or other purposes is fed to such a boiler, all of the water must be evaporated in the boiler section before the steam goes to the superheater, and due to differences in load conditions, it is possible that all of the steam might be evaporated before reaching the end of the so-called boiler section and superheating of the steam might take place in this section, in which case the tubes in which superheat takes place might possibly be burned out. With the method of operation I have described, this situation cannot arise as in every case wet saturated steam is discharged from the boiler section into a separator, the water being separated out and evaporated by means of excess heat from superheated steam or steam at higher pressure and the total amount of saturated steam thus formed superheated as required. In all cases dry or nearly dry saturated steam is supplied to the superheater.

I claim:

1. In combination with a furnace providing hot products of combustion and a radiant heat zone, a fluid vapor generating circuit absorbing the sensible heat of said products of combustion to convert a major portion of the fluid in said circuit into vapor in a single passage therethrough, a separator for liquid and vapor, a superheater in the radiant heat zone with a supply from the vapor space of said separator and a discharge beneath the liquid level thereof to convert the excess liquid in the separator into vapor, and means regulating the supply of liquid to said vapor generating circuit to maintain only a predetermined excess in said separator.

2. The method of operating a vapor generator with a fluid circuit in a convection heat zone and a vapor superheating circuit in a radiant heat zone, and both of said circuits connected with the same liquid and vapor separator, which comprises circulating only a slight excess of liquid through the fluid circuit to generate a major portion of the vapor from sensible heat in the gases passing the convection heat zone, permitting separation of vapor and liquid in the separator, and passing vapor from the separator through the vapor superheating circuit and back to the separator to generate a minor portion of the vapor from the slight excess of liquid always passing through the fluid circuit.

3. The method of operating a vapor generator including a heated furnace, a flow path continuous from inlet to outlet with long small bore conduit portions arranged for parallel flow, a separator for liquid and vapor, and a superheater, which comprises supplying a liquid throughout the flow path at a rate providing an excess preventing scale deposit while generating vapor, separating the excess liquid to produce dry saturated vapor, superheating the dry saturated vapor and using at least some of it to evaporate excess liquid.

4. The method of operating a vapor generator including a heated furnace, a flow path contin-

uous from inlet to outlet with long small bore conduit portions arranged for parallel flow, a separator for liquid and vapor, and a superheater, which comprises supplying liquid throughout the flow path at a rate providing an excess preventing scale deposit while generating vapor, separating the excess liquid to provide dry saturated vapor, raising the pressure of the dry saturated vapor and superheating the same, and then using at least some of the higher pressure superheated vapor in fluid contact to evaporate excess liquid.

5. The method of operating a vapor generator with a liquid and vapor circuit and a vapor superheating circuit, both of said circuits connected with the same liquid and vapor separator, which comprises circulating only a slight excess of liquid through the liquid and vapor circuit to generate a major portion of the vapor from sensible heat in the gases passing the liquid and vapor circuit, permitting separation of the vapor and liquid in the separator, and passing vapor from the separator through the vapor superheating circuit and back to the separator to generate a minor portion of the vapor from the slight excess of liquid always passing through the fluid circuit.

6. The method of operating a vapor generator including a heating furnace, a flow path continuous from inlet to outlet with long small bore conduit portions arranged for parallel flow, a separator for liquid and vapor, and a superheater, which comprises supplying a liquid throughout the flow path at a rate providing an excess preventing scale deposit while generating vapor, separating the excess liquid to provide dry saturated vapor, superheating the dry saturated vapor and using at least some of it to evaporate excess liquid in the separator while maintaining a constant level of liquid in the separator.

7. In combination, a vapor generator including a heated furnace, a flow path continuous from inlet to outlet with long small bore conduit portions arranged for parallel flow, a separator for liquid and vapor, a separator receiving the discharge from said flow path, a secondary vapor generator also heated by the aforesaid furnace and including a flow path continuous from inlet to outlet with long small bore conduit portions arranged for parallel flow, means for supplying liquid to the flow path of the first mentioned vapor generator at a rate providing an excess preventing scale deposit while generating vapor, means for supplying liquid to the last mentioned vapor generator, the generators having a differential in pressure drop between the two whereby the last named generator operates at a higher pressure than the first named generator, and means connecting the last named generator to the separator of the first named generator to introduce vapor of higher pressure and temperature into the separator to evaporate excess liquid discharge by the first named generator.

HOWARD J. KERR.

CERTIFICATE OF CORRECTION.

Patent No. 2, 032,368.

March 3, 1936.

HOWARD J. KERR.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, first column, line 29, claim 6, for the word "heating" read heated; and second column, line 13, claim 7, for "a" read said; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 27th day of October, A. D. 1936.

(Seal)

Henry Van Arsdale
Acting Commissioner of Patents.