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BOILER FEEDWATER SYSTEM

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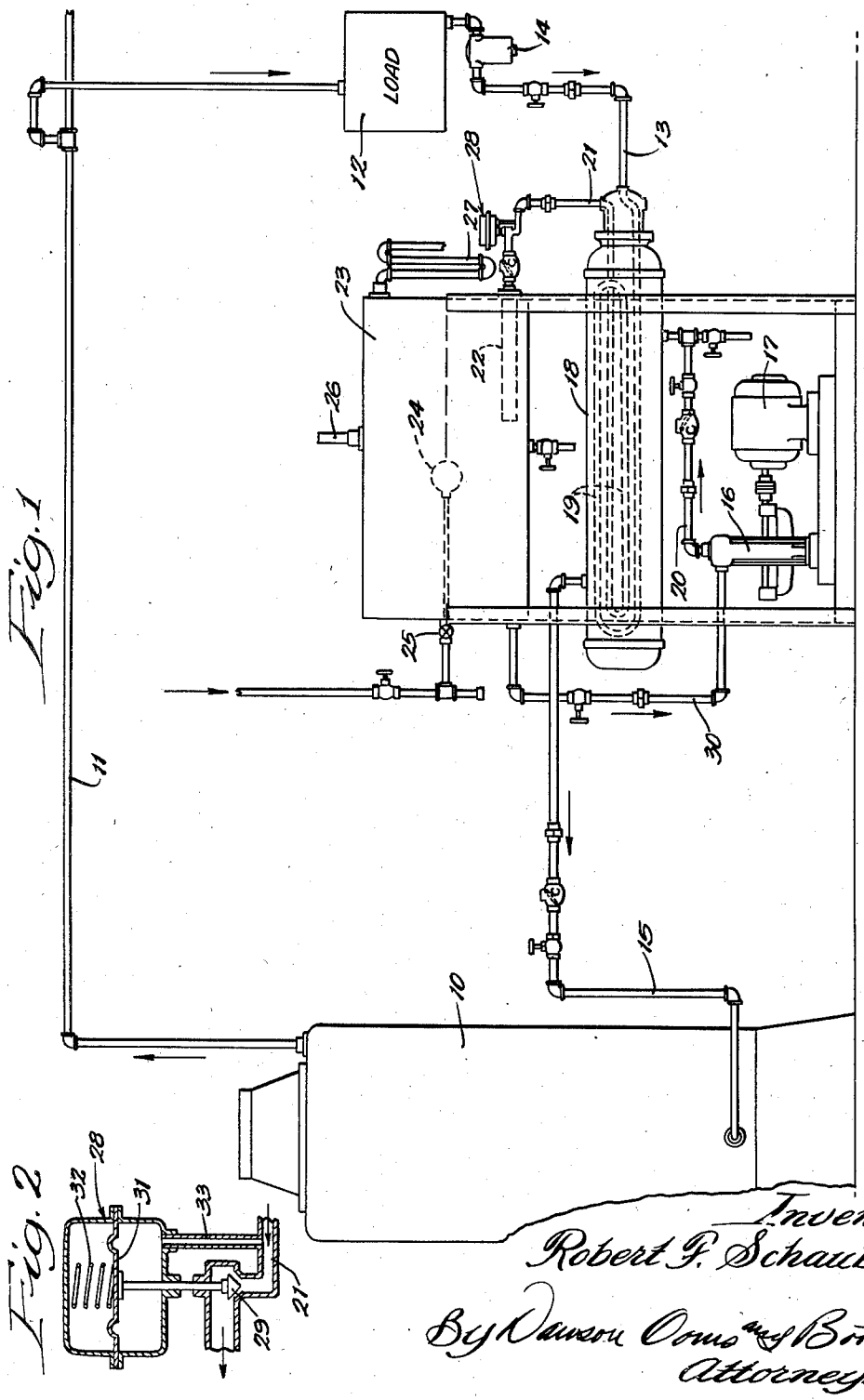


Fig. 1

Fig. 2

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BOILER FEED-WATER SYSTEM

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4 Claims. (Cl. 237—67)

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This invention relates to boiler feedwater systems and more particularly to such a system in which the boiler feedwater is heated by the returning condensate before being pumped into the boiler.

Systems of this type operate at maximum efficiency when the boiler feedwater is heated to the maximum possible temperature by the condensate before being pumped into the boiler. It is, therefore, desirable to retain the condensate in the heat exchanger the maximum permissible amount of time under the maximum pressure which can be carried without adversely affecting the load.

Heretofore the flow of condensate thru the heat exchanger has been controlled by a manually adjustable valve at the heat exchanger outlet which is set to accommodate maximum condensate flow. As a result when the load varied the back pressure on the heat exhanger as well as on the load also varied. This resulted in possible loss of efficiency at the load and in a distinct loss of efficiency in the heat exchanger since the boiler feedwater was not heated to the maximum possible temperature before being pumped into the boiler.

It is accordingly one of the objects of the present invention to provide a boiler feedwater system in which the back pressure on the load is automatically maintained at a constant value.

Another object is to provide a boiler feedwater system in which the back pressure on the heat exchanger for heating the boiler feedwater from returning condensate is maintained at the optimum value under all load conditions.

The above and other objects and advantages of the invention will be more readily apparent from the following description when read in connection with the accompanying drawing in which—

Figure 1 is a diagrammatic view of a system embodying the invention; and

Figure 2 is a sectional view of the pressure regulating valve.

In the system of Figure 1, a steam boiler 10 which may be of conventional construction supplies steam to a main 11, which may be connected to one or more steam consuming loads indicated at 12. The loads 12 may be any desired type of apparatus which consumes steam during operation such, for example, as steam heated molds or presses for rubber or plastic, laundry processes, jacketed kettles, driers, or the like. Condensate from the load is returned to the return line 13 thru a trap device indicated at 14. The trap device may be a conventional steam trap or any other desired type of apparatus which will function to substantially prevent live steam from flowing from the load thru the return conduit 13. Such trap devices will prevent the passage of any substantial quantity of live steam but even when in good working order will pass some live steam along with the condensate.

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Feedwater is supplied to the boiler 10 thru a conduit 15 into which it is pumped by a pump or the like indicated at 16 and driven by a motor 17. It will be understood that operation of the feedwater pump is controlled in a conventional manner by devices not shown to maintain the water in the boiler at a substantially constant level.

According to the present invention the feedwater is heated by the returning condensate and such live steam as may pass thru trap device 14, before being pumped into the boiler and for this purpose a heat exchanger is connected between the pump and the boiler. As shown, the heat exchanger comprises a shell 18 connected thru a pipe 20 to the pump outlet to receive water from the pump. The feedwater pipe 15 is connected to the shell to receive feedwater therefrom and conduct it to the boiler. Within the shell there is arranged a bundle of tubing 19 connected at one end to the pipe 13 to receive condensate therefrom and at its opposite end to an outlet connection 21. In operation condensate and steam flowing thru the tube bundle 19 supplies heat to the feedwater flowing around the bundle thru the shell 18 to bring the feedwater to elevated temperature approximating that of the condensate return.

Condensate flowing out of the tube bundle 19 thru the conduit 21 is conducted into a submerged perforated pipe 22 in the lower part of a feedwater supply tank 23. The tank 23 is adapted to contain water at a minimum level controlled by a float 24 which operates a water supply valve 25 so that if not enough condensate is supplied to the tank, makeup water from a city water system or other desired source will be added to the tank to maintain the level above that for which the float is adjusted. The tank is vented to atmosphere thru a vent pipe 26 and excess water may be discharged therefrom thru an overflow pipe 27. A conduit 30 connects the lower part of the tank to the feedwater pump 16.

With a system as so far described, the pressure on the condensate will be substantially reduced when it passes the trap so that a substantial amount of condensate will flash into steam. This

steam together with the live steam passing the trap causes the mixture to flow rapidly through the tubing 19 so that a relatively low heat recovery is obtained in the heat exchangers. Furthermore, fluctuations in flow in response to variations in load demand cause the discharge characteristics of the traps to vary so that under some conditions they may pass excessive quantities of live steam.

According to the present invention, these difficulties are overcome to maintain substantially constant trap characteristics, to minimize flashing and to increase retention time in the heat exchanger by maintaining a constant back pressure on the discharge from the tubing bundle 19. For this purpose, a pressure control valve indicated generally at 28 is mounted in the conduit 21 between the heat exchanger outlet and the tank inlet. This valve may be constructed as indicated diagrammatically in Figure 2 with a control valve 29 to control flow thru the pipe 21 connected to a flexible diaphragm 31. The diaphragm 31 is urged in a valve closing direction by a spring 32 acting on the upper side of the diaphragm and the lower side of the diaphragm is connected thru a passage 33 to the pipe 21 at the inlet side of the valve. If the pressure in the pipe 21 drops to a value below that for which the spring 32 is adjusted, the valve 29 will close until the pressure in the pipe 21 builds up to the desired value. Upon an increase in pressure, the valve will open reducing the restriction to flow and allowing the pressure to drop to the desired value. This valve, therefore, functions to maintain a substantially constant back pressure on the heat exchanger and on the load regardless of variations in the condensate flow.

In operation of the system condensate and some steam may leave the load at a relatively high temperature above the boiling point and is conducted thru the tube bundle 19. The valve 28 maintains the desired back pressure on the condensate so that it will not flash in the tube bundle and so that it will be retained in the tube bundle the maximum possible amount of time. When the boiler demands feedwater, the pump 16 will operate to withdraw water from the storage tank 23 and to force it around the tube bundle 19 into the boiler. Since the tank 23 is vented, the temperature of the water therein can never exceed the boiling point so that in practice the pump is never called upon to handle water at a temperature in excess of approximately 210° F. However, in passing thru the heat exchanger the water may be heated to a temperature substantially in excess of 210° F., so that it is supplied to the boiler at the maximum temperature to which it is possible to heat it by the returning condensate. After the condensate passes the control valve 28 a portion of it may flash into steam which will be discharged thru the pipe 22 and bubble up thru the water in the supply tank to maintain it substantially at the boiling point.

The pressure regulating valve of the present invention when employed in a system as shown, not only insures that the maximum possible amount of heat will be extracted from the returning condensate before it is discharged into the storage tank regardless of variations in load conditions but also maintains the back pressure on the trap device 14 and on the load at a constant value. Since both the load and the trap device can operate under constant back pressure conditions, the efficiency thereof will be increased. It

will be understood that the valve 28 may be adjusted to provide the optimum back pressure with respect to both the load and the heat exchanger.

While two embodiments of the invention have been shown and described in detail herein, it will be understood that these are illustrative only and are not intended as a definition of the scope of the invention, reference being had to the appended claims for this purpose.

What is claimed is:

1. In a boiler feedwater system including a boiler and a steam consuming load connected thereto, a feedwater pump connected to the boiler to pump water into it, a water storage tank connected to the pump inlet, a condensate return connection from the load to the water storage tank, trap means in the return connection to prevent the return of live steam from the load to the storage tank, and a pressure regulating device in the connection between the trap means and the storage tank to maintain a substantially constant back pressure on the trap means and the load.

2. The construction defined in claim 1 in which the storage tank is vented to atmosphere and the condensate return connection opens into the lower part of the storage tank.

3. In a boiler feedwater system including a boiler and a steam consuming load connected thereto, a feed water pump connected to the boiler to pump water into it, a water storage tank connected to the pump inlet, a heat exchanger connected between the pump and the boiler to impart heat to the feedwater, a condensate return connection from the load through the heat exchanger to the storage tank to supply heat to the heat exchanger from the condensate and a pressure regulating device between the heat exchanger and storage tank responsive to the outlet pressure from the heat exchanger to maintain the outlet pressure substantially constant.

4. In a boiler feedwater system including a boiler and a steam consuming load connected thereto, a feedwater pump connected to the boiler to pump water into it, a water storage tank connected to the pump inlet, a heat exchanger connected between the pump and the boiler to impart heat to the feedwater, a condensate return connection from the load through the heat exchanger to the storage tank to supply heat to the heat exchanger from the condensate, trap means between the load and the heat exchanger to prevent the flow of live steam from the load to the heat exchanger, and a pressure regulating device between the heat exchanger and storage tank responsive to the outlet pressure from the heat exchanger to maintain the outlet pressure substantially constant.

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