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F. SAMUELSON

FEED WATER HEATER

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Fig. 1.

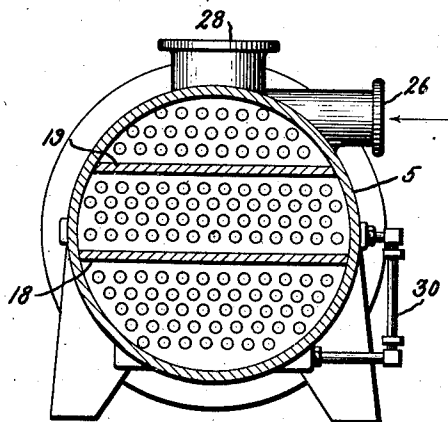
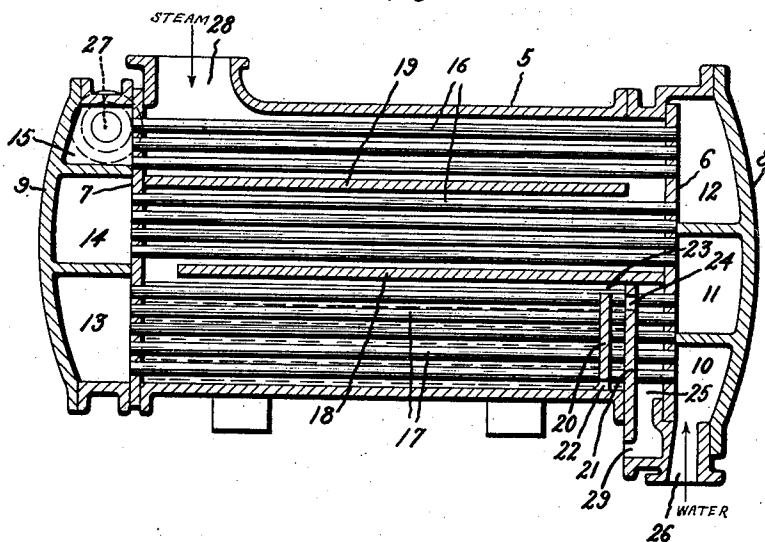


Fig. 2.



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UNITED STATES PATENT OFFICE.

FREDERICK SAMUELSON, OF RUGBY, ENGLAND, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

FEED-WATER HEATER.

Application filed September 19, 1921. Serial No. 501,703.

To all whom it may concern:

Be it known that I, FREDERICK SAMUELSON, a subject of the King of Great Britain, residing at Rugby, in the county of Warwickshire, England, have invented certain new and useful Improvements in Feed-Water Heaters, of which the following is a specification.

The present invention relates to feed water heating in steam turbine installations wherein low pressure steam which may be tapped from the main turbine or taken from some other suitable source is utilized for heating the feed water on its return to the boilers. As is well understood in connection with turbine installations, the feed water comprises usually the condensate from the main condenser of the turbine or such condensate plus the required amount of make-up water. In order to attain a high efficiency the heating steam should do as much work as possible in the turbine and therefore may be at the tapping point at a pressure below that of the atmosphere, depending upon the degree of heating desired.

My invention relates particularly to heaters of the surface type in which the water to be heated, for example, the condensate from the main condenser, passes through tubes of the heater serving to condense on the outside of the tubes the heating steam taken from a low pressure stage of the main turbine or from some other suitable source, the heating steam eventually going as cooled water to the bottom of the main condenser and being removed therefrom with the main condensate and used as a part of the feed water.

In heaters of this kind, particularly when operating under pressures below atmosphere, it is an advantage to be able to cool the condensate and heating steam to as low a temperature as possible before it is returned to the condenser and also to extract the maximum heat from the air and non-condensable vapors carried to the heater with the low pressure heating steam.

The primary object of my invention is to provide a heater or heating arrangement which will extract the maximum amount of heat from the steam and from the air and non-condensable vapors and which is so arranged as to provide for the automatic operation of the device over a wide range of varying conditions.

To this end my invention comprises dividing the surface for the exchange of heat into three portions; in the first portion, sufficient surface is allowed to condense the heating steam to be dealt with; in the second portion, the condensate is cooled, and in the third portion, the heat is abstracted from the air and non-condensable vapors thus ensuring that the available heat is absorbed by the feed water to the greatest extent.

My invention furthermore comprises the provision of suitable division plates, weirs and orifices to enable the apparatus to operate under widely varying conditions of quantities and temperatures.

In carrying my invention into effect according to one modification the feed water heater is arranged horizontally and has horizontal baffle or division plates directing the steam over several banks of tubes; the condensed heating steam is collected into the lower portion of the heater by means of a double weir so arranged as to pass out the cooled condensate from the bottom of the heater body and having orifices through which the air and non-condensable vapors are passed into a chamber where they come into contact with tubes through which the incoming feed water is passing. The condensate and cool air and vapors pass out through a discharge pipe to the bottom of the main condenser.

In the accompanying drawings, Fig. 1 is a transverse sectional view of a feed water heater embodying my invention, and Fig. 2 is a longitudinal sectional view thereof.

Referring to the drawing, 5 indicates the feed water heater body. At its two ends it is provided with tube plates 6 and 7 beyond which are heads 8 and 9. The spaces between tube plate 6 and head 8 is divided by partition plates into chambers 10, 11 and 12 and the spaces between tube plate 7 and head 9 is divided by partition plates into chambers 13, 14 and 15. Extending from tube plate 6 to tube plate 7 are condenser tubes which may be considered as comprising two groups, 16 and 17, the same being separated from each other by a horizontal plate 18. The group of tubes 16 is divided into two portions by a baffle plate 19. At the lower right hand portion of the feed water heater is a double weir comprising plates 20 and 21. Plate 20 has suitable openings 22 at its lower end and terminates just short of

partition plate 18 so as to provide a passage 23. Plate 21 is provided with suitable passages 24 which are located at a level lower than passage 23. This arrangement provides a chamber 25 between weir plate 21 and tube plate 6, the ends of tubes 17 extending across such chamber. The feed water to be heated is admitted through a conduit 26 which communicates with chamber 10, and is discharged through a conduit 27 which communicates with chamber 15. The heating steam is admitted to casing 5 through a conduit 28 and the condensed heating steam, air and non-condensable vapors are discharged through conduit 29 which communicates with chamber 25. At 30 is a suitable gauge for indicating the height of the water around tubes 17.

In operating, the feed water is admitted through conduit 26 to chamber 10 from whence it flows through the lower portion of tubes 17 to chamber 13, thence back through the upper portion of tubes 17 to chamber 11. From here it flows through successive portions of tubes 16 to chambers 14, 12 and 15, being discharged eventually through conduit 27. The steam for heating the feed water enters through conduit 28 and circulates over tubes 16 toward the bottom of the feed water heater, being required to travel back and forth by baffle plates 19 and 18.

The heating steam is condensed by tubes 16 and accumulates in the bottom of the feed water heater around tubes 17. The level of the water in the bottom of the heater is defined by openings 24 in weir plate 21. The condensed heating steam in flowing from the heater passes through openings 22 and 24 to chamber 25 from whence it is discharged by way of conduit 29 to the bottom of the main condenser or other suitable point. By this arrangement it will be noted that it is the lowermost strata of the water which is drawn off which means, of course, that it is the coolest water. The air and non-condensable vapors flow through passage 23 and openings 24 to chamber 25 where they circulate around the ends of tubes 17 in said chamber and are discharged by way of conduit 29. The air and non-condensable vapors in passing through chamber 25 circulate around the ends of tube 17 through which flows the incoming feed water. They thus give up heat to the incoming feed water and are cooled to the greatest possible degree. It will be seen that the feed water is first heated in chamber 25 by the air and non-condensable gases and by the condensate discharged from the water, after which it is further heated by the water surrounding the tubes 17, and finally by the heating steam surrounding the tubes 16. The arrangement is such that the entering

heating steam encounters the feed water in its last passage through tubes 16. By this arrangement I utilize in a most efficient manner the maximum heat from the heating steam, heating the feed water to the maximum temperature and extracting the maximum amount of heat from the heating steam.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, but I desire to have it understood that the apparatus shown is only illustrative and that the invention may be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A feed water heater comprising a casing, tubes in the casing over which heating elastic fluid flows and through which feed water to be heated flows, and means dividing the tubes into three portions, a portion over which the elastic fluid flows and is condensed, a portion which is surrounded by condensed elastic fluid, and a portion over which the air and non-condensable gases flow.

2. A feed water heater comprising a casing, tubes in the casing through which the water to be heated flows, the water entering the lowermost tubes, flowing through successive layers of tubes and leaving the uppermost tubes, a conduit at the upper portion of the casing for the admission of heating elastic fluid, a weir in the casing which establishes a level of condensed elastic fluid therein, and provides a chamber through which tubes pass, and an outlet conduit leading from such chamber, the air and non-combustible vapors passing over the tubes in such chamber.

3. A feed water heater comprising a casing, tubes in the casing, a weir in the casing which establishes a level of condensate therein and defines with an end of the heater a chamber through which tubes pass, the air and non-condensable vapors passing over such tubes.

4. A feed water heater comprising a casing, tubes in the casing, a weir plate in the casing which establishes a level of condensate therein and defines with an end of the heater a chamber through which tubes pass, the air and non-condensable vapors passing over such tubes, and a second weir plate having openings at its lower end whereby the condensate which passes over the first weir plate flows from the bottom of the casing.

In witness whereof, I have hereunto set my hand this 5th day of September, 1922.

FREDERICK SAMUELSON.