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W. E. PETERS ET AL

3,101,595

FEED WATER HEATERS

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2 Sheets-Sheet 1

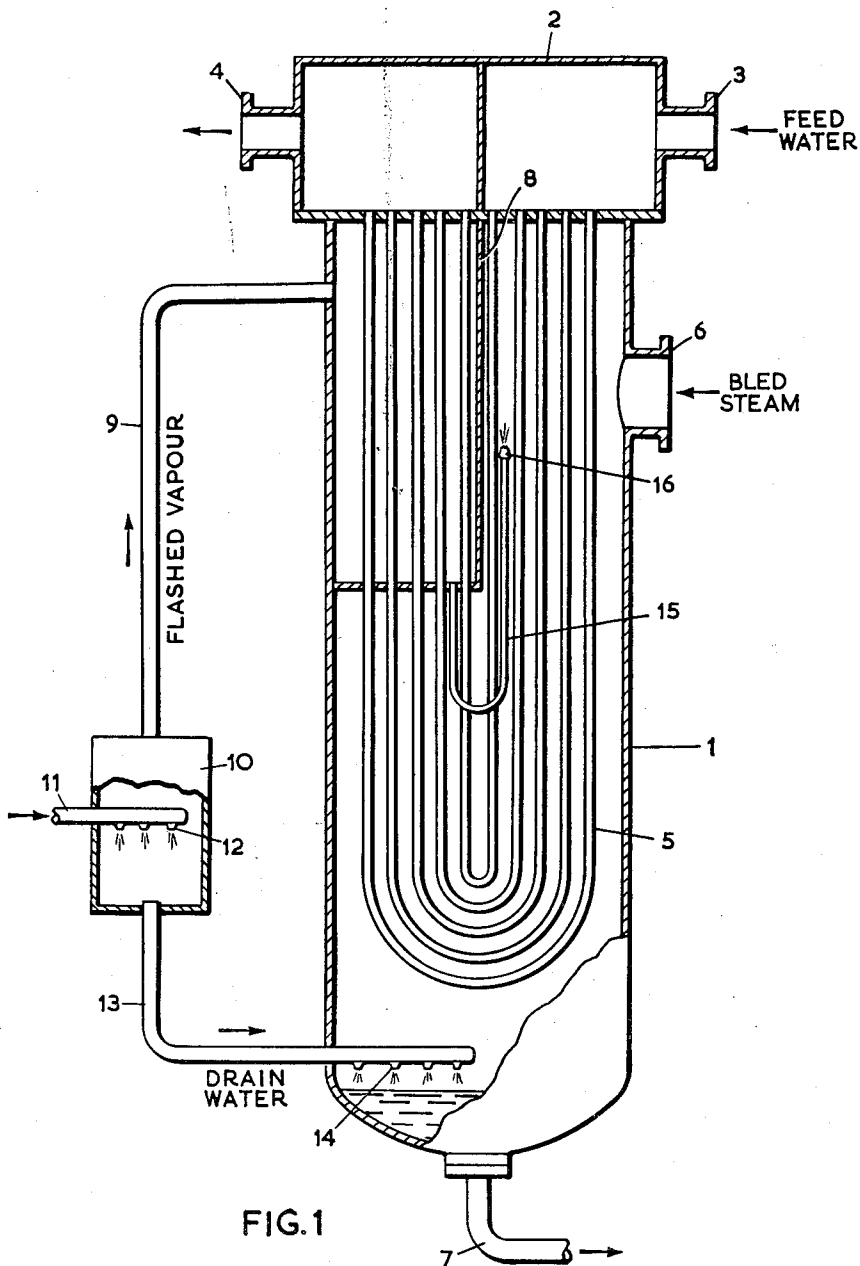


FIG. 1

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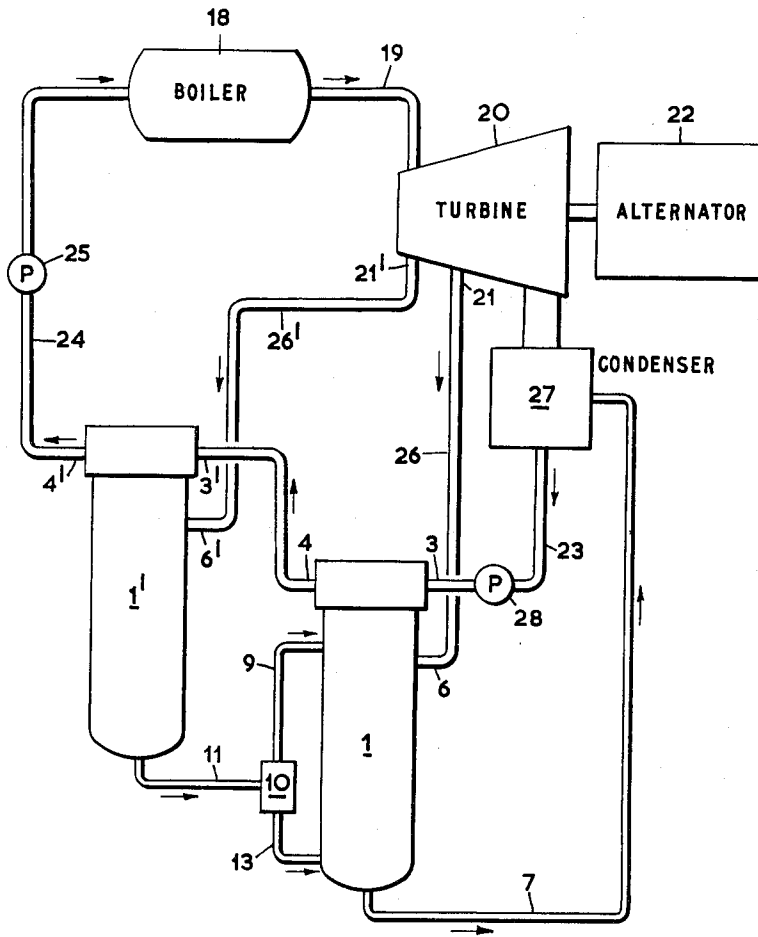


FIG. 2

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## FEED WATER HEATERS

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1 Claim. (Cl. 60-67)

The present invention relates to a multi-stage feed water heater system having an integral condensed bled steam cooling system. In a vertical heater of this type the static head difference between the inlet and the outlet of a water-to-water condensed bled steam cooling section plus the friction head may be greater than or close to the pressure drop available between the bled steam conditions of adjacent feed water heaters. In conventional feed water heating systems where condensed bled steam cooling is not used, the condensed bled steam is usually cascaded down from heater to heater, and accordingly the heat content thereof is utilized at a level corresponding to the pressure in the lower heater.

According to the present invention, hot condensed bled steam from a higher pressure heater is flashed in a flash box and the flashed-off steam is condensed in a sealed section of the next lower stage feed water heater casing at a pressure intermediate between those of the said two feed water heaters, the condensate from this sealed section and water from the said flash box being discharged into the said casing, and, together with the condensate of bled steam condensed in said casing is passed into the flash box of a lower pressure heater, if any. By utilizing the heat in the condensed bled steam at a higher temperature level the feed cycle efficiency is improved. The feed water to be heated is passed through conventional nests of tubes arranged in the said casing, said tubes passing through the said sealed section before reaching the feed water outlet.

Owing to the flash vapour heating the problem of overcoming friction and static heads does not arise in the feed water heater according to the present invention.

In order that the invention may be clearly understood and readily carried into effect an embodiment thereof will now be described with reference to the accompanying drawings, FIGURE 1 of which is a diagrammatic elevation, partly in section, of a feed water heater of the system according to the present invention, and FIGURE 2 diagrammatically illustrates a system according to the present invention. Referring firstly to the general arrangement of FIG. 2, a boiler 18 supplies steam through a pipe 19 to a turbine 20 driving an alternator 22. The expanded steam from the turbine 20 is discharged into a condenser 27, and the turbine has also two tapping points 21', 21 for bled steam, 21' being at a higher intermediate pressure than 21. The condensate is extracted from the condenser 27 through a pipe 23 including an extraction pump 28, and is fed consecutively through two feed water heaters 1 and 1' arranged in series, and from the outlet 4' of the latter through a pipe 24 containing the boiler feed pump 25 back into the boiler 18. The general arrangement described so far is conventional and is not claimed as such. The invention will now be described with reference to FIG. 1, with cross references to FIG. 2 to explain the position of the new combination within the conventional general arrangement.

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The casing of the feed water heater 1 has a cover 2, wherein the feed water inlet 3 and the feed water outlet 4 are provided between which banks of U-shaped feed water tubes 5 are arranged in the casing 1. Bled steam is introduced through pipe 26 from the tapping point 21 into the upper portion of the casing 1 at 6, and condensate is drawn off at the bottom of said casing at 7 towards a lower pressure heater if any, or to the condenser 27 (FIG. 2).

A sealed section enclosed in an envelope 8 inside the top portion of the casing 1 and occupying for example one quadrant thereof is provided, and is connected by a pipe 9 to a flash box 10 into which a higher pressure heater 1' connected at 6' by a pipe 26' to the tapping point 21' (FIG. 2) discharges the condensate drawn off its lower portion by means of a pipe 11 having orifices 12 in the flash box 10. While the steam flashed in the flash box 10 upon partial relief of the pressure acting on the hot water emerging from pipe 11 is passed into the sealed section within the envelope 8 through said pipe 9, any water accumulating at the bottom of box 10 is drawn off through a pipe 13 and discharged from orifices 14 into the bottom portion of the casing of the low pressure heater 1 just above the level of the condensate therein, or into a separate vessel (not shown).

A U-shaped pipe 15 is connected to the bottom of the sealed section 8, and discharges through an orifice 16 into the casing 1 at a level above that of the bottom of said sealed section 8, the level difference corresponding to the difference between the intermediate pressure in the envelope 8 to that in the casing 1.

In operation, feed water is introduced at 3, flows through the banks of U-pipes 5 and leaves at 4. Bled steam is introduced into the casing 1 at 6, and hot water under pressure is introduced from the higher pressure heater 1' through pipe 11 and the orifices 12 into the flash box 10, where it flashes into steam owing to partial release of pressure to an intermediate pressure. This steam flows through pipe 9 into the sealed section of the casing 1 within the envelope 8, where it condenses. The condensate is discharged into the casing 1 through the U-pipe 15 and orifice 16.

Water from the flash box 10 is discharged through pipe 13 and orifices 14 into the lower portion of the casing 1. The combined condensate of the bled steam from 6, of the condensate from orifice 16, and the hot water from the orifices 14 is drawn off at 7 and may be passed to a lower pressure heater (not shown) or directly to the condenser 27 (FIG. 2) through a pipe 7 corresponding to pipe 11 of the feed water heater shown in FIG. 1. The heat contained in the condensed bled steam is therefore utilized at a higher level than in previous feed water heater systems, and the present system does not require the use of separate drain cooling vessels, automatic level controls or other extraneous equipment.

What we claim as our invention and desire to secure by Letters Patent, is:

In a bled steam turbine plant having a boiler and a condenser, a multi-stage feed water system comprising in combination: at least two feed water heaters each comprising a casing and a bundle of U-tubes arranged in said casing, wherein said boiler, turbine, condenser and bundles of U-tubes of said feed water heaters are arranged in series with one another in a closed circuit, tapping points at different intermediate pressure zones of

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said turbine being connected to the upper portions of said casings of said feed water heaters, respectively, the lower portions of said casings being connected in series with one another and with said condenser, a flash box arranged in the connection between the lower portions of successive feed water heater casings, a sealed portion having a bottom arranged in at least one of said casings, a steam pipe connected with each flash box with said sealed portion of its associated feed water heater casing, each of said sealed portion being in restricted communication with the interior of its associated casing, said bundles of tubes passing with their downstream ends through said sealed portion of the associated casing.

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## References Cited in the file of this patent

## UNITED STATES PATENTS

1,857,865 Phelps ----- May 10, 1932  
2,979,443 Frankel ----- Apr. 11, 1961

## OTHER REFERENCES

"The Fundamentals of Boiler Blowdown" by W. J. Ryan, published in "Power," March 1, 1932, see pages 327 and 328. (Copy in Division 19; 122/379.)