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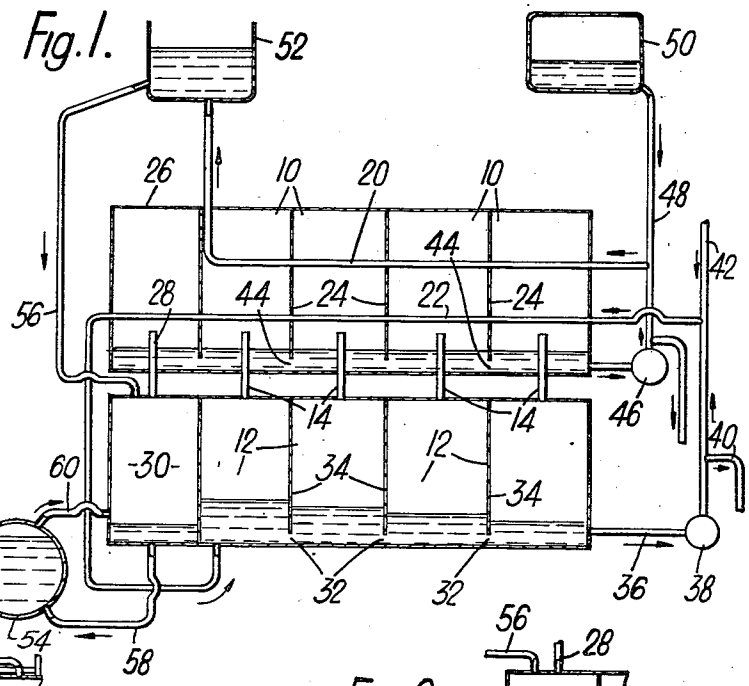
STEAM GENERATING PLANTS

Filed March 22, 1960

Fig. 1.



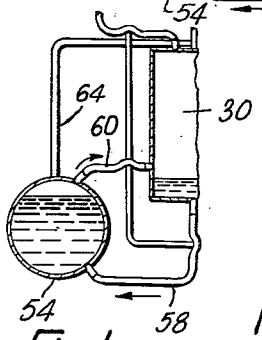


Fig. 1a.

Fig. 2.

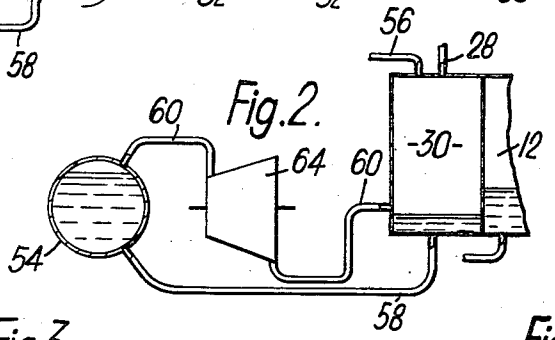


Fig. 3.

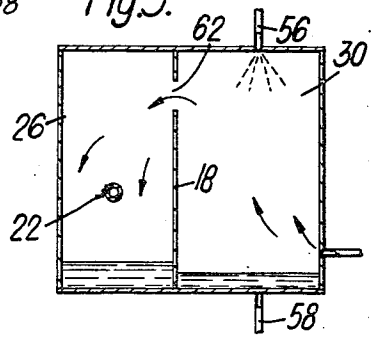
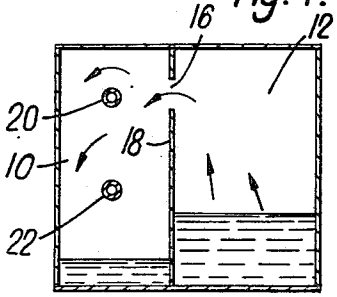


Fig. 4.



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STEAM GENERATING PLANTS

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This invention relates to a steam-generating plant which includes a boiler having a steam draw-off connected to the heat-input section of a flash evaporator.

It is customary in such installations for a small part of the steam output of the boiler to be used to deaerate make-up water which is supplied to the boiler, and this is generally carried out in a deaerator in which the steam and the make-up water are made to flow in countercurrent. The amount of steam supplied to the deaerator for this purpose is mainly determined by the temperature of the make-up water, and is such that most of the steam is condensed by its contact with the water. The small quantity of steam which is not condensed is used to vent the deaerator, and is kept to as low a value as possible since its heat is either lost or degraded. One of the disadvantages of this method is that great care is required to ensure that all the water particles are exposed to the scrubbing action of the limited quantity of steam, as otherwise the deaeration is not complete. It is therefore one of the aims of the present invention to provide means by which a more thorough deaeration of the make-up water is made possible.

According to the invention, a steam-generating plant comprises a boiler connected to a steam inlet in the heat-input section of a flash evaporator by a steam passage-way which includes a deaerator having a connection with the boiler for the passage of boiler make-up water.

Such a construction allows the quantity of steam supplied to the deaerator for deaeration of the make-up water to be greater than that supplied to the deaerator in the prior method described above. This ensures thorough deaeration of the make-up water in all parts of the deaerator. Thereafter, the steam which is not condensed is passed to the heat-input section of the evaporator instead of being vented to atmosphere. Thus, the heat contained in this steam is not wasted nor degraded.

If desired, all the steam which is fed to the heat-input section of the evaporator can be passed through the deaerator. Alternatively, a second steam passage-way between the boiler and the heat-input section can be provided so that a portion of the steam fed to the heat-input section passes through the deaerator while the other portion by-passes the deaerator. In each case, however, the total quantity of steam which is passed to the heat-input section should be sufficient to heat the liquid passing through the heat-input section to the required temperature.

A number of examples of a steam-generating plant in accordance with the invention will now be described with reference to the accompanying drawings, in which:

FIGURE 1 is a diagrammatic part-sectional view of one form of plant;

FIGURE 1*a* is a view illustrating a modification of the plant shown in FIGURE 1;

FIGURE 2 is a similar view illustrating a modification of the plant shown in FIGURE 1; and

FIGURES 3 and 4 are vertical sections illustrating constructional variations.

The evaporator shown in FIGURE 1 comprises a number of adjacent heaters **10** and a number of adjacent flash chambers **12**, each flash chamber being associated with a

heater and communicating therewith through a passage **14**. Alternatively, each flash chamber can be arranged to communicate with its associated heater through a simple aperture **16** in an internal dividing wall **18** common to the associated heater and flash chamber as shown in FIGURE 4. The internal dividing wall **18** in FIGURE 4 lies in a vertical plane, but it may be arranged horizontally, depending on the arrangement of the heater relative to the flash chamber. Two sets of liquid-conveying means are arranged in the heaters, and each set **20** and **22** consists of a single tube which passes through an aperture or apertures provided in one or more partition walls **24** between adjacent heaters. Alternatively, each set may comprise a number of tubes extending between opposite end faces and providing for a number of parallel streams in each set. As a further alternative, each of the liquid-conveying means **20** and **22** in each heater may consist of a number of tubes arranged so as to provide a number of parallel streams. Each tube arranged for conveying a stream may consist of a number of tube units connected in series. In this case, the tubes, or the series-connected tube units, constituting the set **20** and the set **22** respectively are joined in series to the respective tubes or tube units in the adjacent heaters.

The tube or tubes **22** serve to convey liquid to be evaporated through the heaters **10** in the direction indicated by the arrows. The heated liquid then passes through a heat-input compartment **26** which forms part of the evaporator and which receives steam as a heating medium through a tube **28** from a deaerator compartment **30**. On leaving the heat-input compartment **26**, the liquid passes into the first one of the line of flash chambers **12** and passes from flash chamber to flash chamber through simple apertures **32** formed in internal partition walls **34** separating adjacent flash chambers. In each flash chamber some of the liquid is evaporated, and the vapour thus produced enters the heaters **10** through the passages **14** shown in FIGURE 1 or through the simple apertures **16** shown in FIGURE 4.

The liquid which remains unevaporated leaves the final flash chamber through a tube **36** and passes through a circulating pump **38**. From here, part of the liquid is blown down to waste through a blow-down pipe **40**, while the bulk is recirculated after fresh liquid, which enters the system through a pipe **42**, has been added thereto in order to replace the distilled and discharged quantities.

The vapour which enters the heaters **10** from the flash chambers **12** gives up its heat to liquid passing through the tubes **20** and **22** and is thereby condensed. The condensate forms the distillate which it is desired to produce in the evaporator, and is cascaded from heater to heater through simple apertures **44** in the partition walls **24** separating adjacent heaters. The distillate is removed from the final heater by means of a distillate-extraction pump **46**. Alternatively, the distillate may be extracted from each heater individually. Some of the distillate is mixed with condensate which enters the system through a pipe **48**. This condensate is from an external source of supply **50** which, for example, may be a steam condenser.

The mixture of condensate from the external source of supply **50** and distillate from the heaters **10** is then passed through the tube or tubes **20** so that the mixture is heated by vapour from the flash chambers **12**. After passing through the final heater **10**, the mixture is taken to a storage tank or other container **52** which is arranged to supply make-up water to a steam boiler **54** through pipes **56** and **58**. The pipe **56** leads into the deaerating compartment **30** so that the make-up water is thoroughly deaerated by steam which enters the said compartment through a pipe **60** from the steam space of the boiler **54**. The deaerated water is fed from the bottom of the com-

partment 30 through the pipe 58 to the boiler, and the steam in the compartment 30 which is not condensed by its contact with the make-up water passes into the heat-input compartment 26 through the passage 28.

It will be seen that, in the installation shown in FIGURE 1, the boiler make-up water is derived from distillate produced in the flash evaporator. It is therefore convenient in such an installation for the deaerator 30 to be made an integral part of the evaporator, and where the evaporator comprises a vessel divided internally by partition walls into compartments serving as heaters and flash chambers, one of the compartments will normally be used instead as a deaerator. The disposition of the compartment is not critical, but it is preferably located adjacent the heat-input section 26 of the evaporator so that steam passing through the deaerator 30 can then enter the heat-input compartment 26 by way of a simple aperture 62 (see FIGURE 3) in the partition wall 18 dividing the deaerator 30 from the heat-input compartment 26 of the vessel.

The installation of FIGURE 1 is designed so that all the steam which is fed to the heat-input compartment 26 is passed through the deaerator 30. However, it is possible to provide a second passage 64 (see FIGURE 1*a*) between the steam space of the boiler 54 and the compartment 26 which by-passes the deaerator. This allows a portion of the steam to be passed through the deaerator 30 while the other portion by-passes the deaerator. Whichever system is adopted, the total quantity of steam which is passed to the heat-input compartment 26 should be sufficient to heat the liquid passing through the said compartment to the required temperature.

FIGURE 2 shows a modification to the steam-generating plant of FIGURE 1. The modification consists in arranging a steam-turbine 64 in the passage 60 between the boiler 54 and the deaerator 30, the remainder of the plant being the same as in FIGURE 1.

It will therefore be seen that the invention allows a comparatively large quantity of steam to be passed through the deaerators 30, with the result that the make-up water is more thoroughly scrubbed and deaerated than in previous arrangements. At the same time, heat losses are reduced to a minimum since the steam or its condensate leaving the deaerator 30 is not discharged to atmosphere but is instead passed into the heat-input section 26 of the evaporator which, in effect, serves as a condenser for the deaerator. It is also advantageous in certain cases for deaerator 30 to be made an integral part of the evaporator vessel, which allows the number of pipe connections and the material required for the walls of the deaerator to be appreciably reduced.

We claim:

1. A steam generating plant comprising a boiler and a flash evaporator, said evaporator comprising a plurality of serially connected heaters, a heat-input chamber connected to said heaters, means conveying liquid to be evaporated, said means passing through the heaters and heat-input chamber in heat exchange relation thereto, a plurality of serially connected flash chambers having outlets connected to the heaters for passing steam thereto, the liquid conveying means having one end connected to at least one of the flash chambers, a boiler make-up water supply, a deaerator connected to said make-up water supply, said deaerator having a make-up water outlet, the boiler being connected to said deaerator make-up water outlet, a steam outlet connecting the boiler to the deaerator and conduit means for conveying excess steam from the deaerator to the heat-input chamber.

2. A steam-generating plant according to claim 1, in which said boiler is also connected to said heat-input section of said flash evaporator by a second steam passageway which by-passes said deaerator.

3. A steam-generating plant according to claim 1, in which said deaerator is an integral part of said evaporator.

4. A steam-generating plant according to claim 1, in which said deaerator and said heat-input section of said evaporator are located adjacent to each other and have a common dividing wall which separates them from one another.

5. A steam-generating plant according to claim 1, in which a dividing wall separates said deaerator and said heat-input section of said evaporator, said wall having a simple aperture through which steam may pass from said deaerator to said heat-input section.

6. A steam-generating plant according to claim 1, in which said steam passage connection between said boiler and said deaerator includes a steam turbine.

7. A steam-generating plant according to claim 1, in which said evapoartor includes at least one heater provided with two sets of liquid-conveying means, one set being arranged for the passage therethrough of liquid to be evaporated while the other set is arranged for the passage therethrough of distillate produced in said evaporator.

8. A steam-generating plant according to claim 1, in which said deaerator is connected to the delivery end of a set of liquid-conveying means which serve to convey distillate through at least one heater in said evaporator.

9. A steam-generating plant according to claim 1, in which said evaporator comprises a vessel divided by internal partition walls into a number of adjacent heaters and a number of adjacent flash chambers.

10. A steam-generating plant according to claim 1, in which said evaporator includes a number of flash chambers and a number of heaters, and in which simple apertures are provided in partition walls in said evaporator whereby to allow the passage of liquid from flash chamber to flash chamber, the passage of distillate from heater to heater, and the passage of flashed vapour from said flash chambers to said heaters.

11. A steam generating plant according to claim 1 in which the boiler make-up water supply is a distillate-collecting section of the evaporator.

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