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J. E. WOOD

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STEAM PURIFICATION

Filed June 3, 1936

Fig. 1.

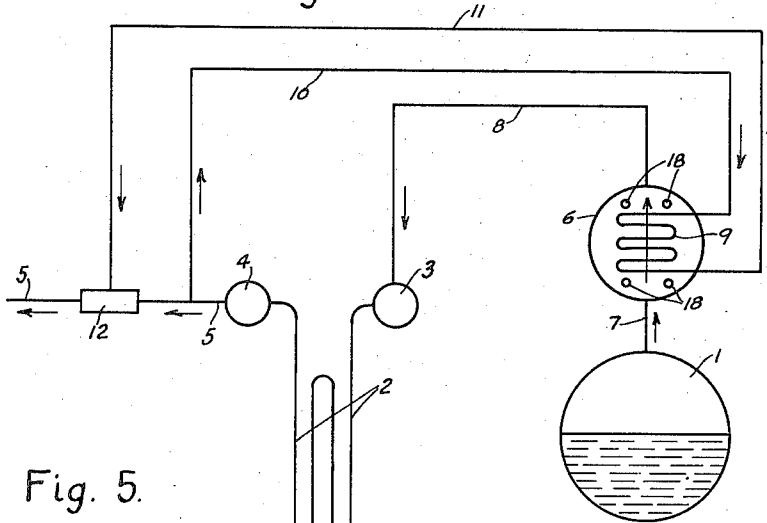


Fig. 5.

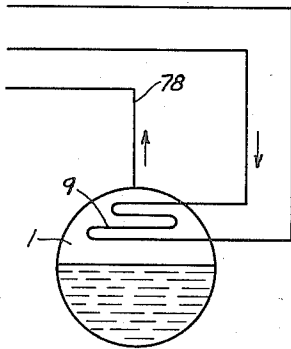


Fig. 2.

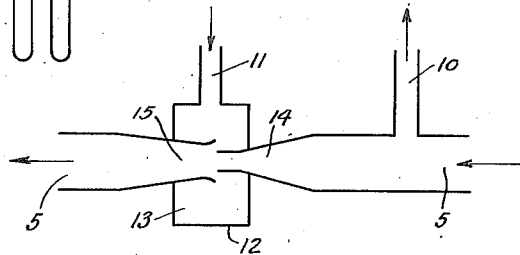


Fig. 4.

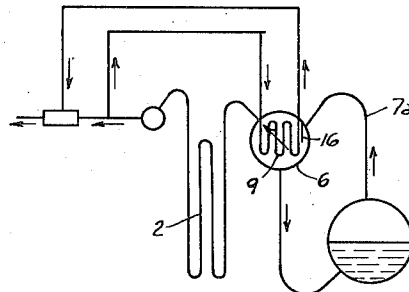
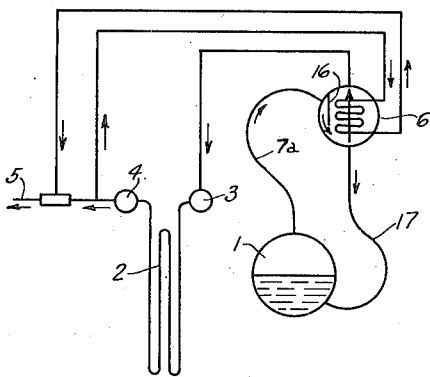


Fig. 3.



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STEAM PURIFICATION

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3 Claims. (Cl. 122—459)

This invention relates to steam generating and superheating installations and is concerned with the purification of steam generated in the boiler of the installation.

As is well known, steam leaving the water in the boiler entrains moisture and although it is the common practice to use relatively pure feed water the boiler water nevertheless usually contains impurities principally consisting of salts in solution. Thus the moisture entrained in the steam contains impurities in solution and may also contain some solids in suspension. In a power plant comprising in addition to the steam generating and superheating installation a turbine or other prime mover the impurities carried by the entrained moisture in the steam leaving the boiler are deposited either in the elements of the steam superheater or on surfaces of the prime mover and the troubles arising from such depositions are well known and need not be particularized herein.

It has been proposed heretofore to remedy this difficulty by heating the steam at a point in advance of the superheater to a temperature causing the evaporation of the moisture in the steam and the deposition of the impurities carried by the moisture on the surfaces in such preliminary heating appliance. The objection to such prior proposal however is that the heating device was so arranged that all or substantially all of the steam on its way from the superheater to the point of use had to flow through the heating device, which therefore had to be of considerable size and entailed correspondingly large expense.

It is the principal object of the present invention to provide improved means of this general type and for this same purpose which use only a fraction of the superheated steam for such preheating, this fraction being caused to flow in a path including the heating appliance and to return to join the main steam current.

In order that the manner in which the invention may be carried into practice may be appreciated, some embodiments of the invention, selected as examples, will now be described with reference to the accompanying drawing; it is to be understood that the invention is not necessarily restricted to the embodiments which will be described.

In the accompanying drawing:

Fig. 1 shows diagrammatically the superheater and a steam and water drum of a boiler, and certain other apparatus embodying the present invention.

Fig. 2 shows to a larger scale than Fig. 1 a portion of the apparatus according to the present invention shown in that figure and described hereinafter.

Figs. 3 and 4 show diagrammatically alternative embodiments of the invention which will be described herein, and

Fig. 5 is a fragmentary view illustrating a further manner in which the invention may be carried into practice.

In the several figures of the drawing 1 is a steam and water drum of a boiler and 2 indicates the elements of the superheater of such boiler. The installations shown in Figs. 1 and 2 include a superheater inlet header 3 and a superheater outlet header 4, 5 being the pipe conveying superheated steam from the installation shown.

Referring now more particularly to Fig. 1, 6 is a drum into which saturated steam from the steam space of the drum 1 flows by way of pipe 7 and from which drum 6 the steam flows by way of pipe 8 to the inlet header 3 of the superheater. In the drum 6 are housed a number of relatively closely spaced tube coils 9, these coils 9 being connected to appropriate inlet and outlet headers not shown. The coils 9 are fed with superheated steam by a pipe 10 which is connected to the pipe 5 through which superheated steam passes on its way from the outlet header 4 of the superheater to the steam main of the installation. After passing through the coils 9 the superheated steam is delivered back into the pipe 5 through a pipe 11. Preferably a number of pipes 7 would be provided for the passage of saturated steam from the drum 1 into the drum 6. The coils 9 are highly heated by the superheated steam which flows through them. As the saturated steam flows over the coils 9 the moisture contained in such saturated steam will be vaporized and the impurities in such moisture will be deposited on the said coils.

It will be understood that a proportion only of the superheated steam delivered by the superheater is passed through the heating or drying coils 9 and while such proportion may vary as between different installations, its relation to the total quantity of steam generated in the boiler and passed through the superheater will be relatively small,—it may be in the region of 10% of the output of steam from the boiler,—and will be determined by the quantity of heat found necessary to vaporize the moisture contained in the saturated steam.

In order to minimize the pressure loss which would otherwise result from the passage of a

portion of the superheated steam through the heating coils 9 such steam after passing through said coils is delivered to an appropriate apparatus 12 which effects a relatively large regain of the pressure loss in the coil circuit. The preferred form of apparatus for this purpose is illustrated more or less diagrammatically in Fig. 2 and comprises a housing or chamber 13 in which are arranged axially aligned converging and diverging nozzles 14, 15 respectively. To the housing 13 the pipe 11 leading from the heating coils 9 is connected. As will appear from Fig. 1 the apparatus is interposed in the pipe 5 beyond the point at which the pipe 10 is connected to such pipe 5, and the main body of the steam from the pipe 5 flows through the converging nozzle 14 into the mouth of the diverging nozzle 15 and in so doing will draw from the chamber or housing 13 the steam entering such chamber from the pipe 11 and which has passed through the coils 9. In flowing through the converging nozzle the pressure energy of the steam will be converted into velocity energy and in the diverging nozzle 15 the velocity energy will be reconverted into pressure energy. By means of the apparatus illustrated, the loss of pressure in the steam which has flowed through the coils 9 will be largely regained.

The superheated steam which passes through the heating or drying coils 9 will be desuperheated or partially desuperheated and thus will tend to reduce the temperature of the steam flowing from the diverging nozzle 15 to the steam main, but this lowering of temperature of the steam flowing to the main may be offset to a certain extent as a higher outlet temperature or degree of superheat is to be expected from the superheater 2 seeing that the steam will enter such superheater free or substantially free from entrained moisture, and it may be, with its temperature already raised some degrees as the result of flowing over the heated coils 9.

Where the heating coils 9 are arranged in a drum other than a steam and water drum of the boiler the saturated steam from the boiler may be delivered to said drum by any appropriate arrangement of ducts. In the embodiment of the invention shown in Fig. 1 the steam enters the drum 6 at the bottom by a number of pipes 7 as already described. If desired, the saturated steam from the drum 1 may be delivered into the upper portion of the drum 6 by any appropriate number of pipes 7a as shown in Fig. 3, the steam being deflected by a plate or baffle 16 towards the bottom of the drum and thereafter flowing upwardly over the heating coils as in the arrangement shown in Fig. 1. A pipe or pipes 17 would be provided from the bottom of the drum 6 for leading back to the water space of the boiler any water which may be collected in the drum 6.

The embodiments of the invention shown in Figs. 1 and 3 may be modified so that the drum 6 itself constitutes the inlet or saturated steam header of the superheater and such a modification is illustrated in Fig. 4. In the construction shown in Fig. 4 saturated steam is delivered by a pipe 7a to the upper portion of the drum 6 and, as in Fig. 3, a baffle plate 16 directs the steam to the lower portion of the drum the steam after flowing over the heating coils 9 in the drum entering the superheater elements 2 which are directly connected thereto. It will be noted that while in Figs. 1 and 3 the heating coils 9 are shown as having their loops disposed horizon-

tally, in the embodiment of the invention shown in Fig. 4 the loops of the heating coils 9 are disposed vertically. The heating coils may be of any appropriate shape, but conveniently each coil is constituted by a number of straight lengths of tubing joined in series by machine forged integral or other return bends to provide a continuous path for the flow of steam through the coil. The constituent tube lengths of a coil would be arranged parallel or substantially parallel with each other and would be closely pitched and the coils would be arranged close together so that ample surface is provided in the path of the saturated steam.

While in many cases it will be more convenient to house the heating or drying coils in a drum other than one of the steam and water drums of the boiler, or in other words to embody the invention on the lines described with reference to Figs. 1, 3 and 4, it is to be understood that the invention is not restricted to the employment of a separate drum for housing the said coils. Where that steam and water drum from which saturated steam is taken to the boiler is of sufficient capacity the drying coils 9 may be disposed in the steam space of such drum as shown diagrammatically in Fig. 5 the arrangement then being such that the steam rising in the steam and water drum 1 will flow over the drying coils 9 to the steam take-off pipe or pipes 18 at the top of the said drum.

While it may be considered preferable to employ as the heating medium flowing through the drying coils superheated steam from the final outlet of the superheater, it is within the ambit of the invention to utilize as the heating medium steam which has passed only through the primary section of a superheater comprising primary and secondary or final sections. In this as well as in the embodiments of the invention already described, the flow of steam through the heating coils will be directly proportional to the load on the boiler.

In order that the external surfaces of the heating coils 9 may be cleaned from time to time, the drum or vessel in which they are mounted may also house one or more pipes 18, Fig. 1, whereby jets of water from the feed water line may be sprayed onto the coils, when the boiler is not on load, and thus wash the deposited impurities off the surfaces of the coils, these impurities flowing with the water into the boiler.

What I claim is:

1. Apparatus for purifying steam generated in the boiler of a steam generating and superheating installation comprising, in combination, means defining a path for saturated steam flow from the boiler to the superheater, an assembly of closely spaced tubes disposed in said path, a conduit to carry steam away from the superheater outlet, a connection from the conduit to the inlet of said assembly, a connection from the outlet of said assembly to the conduit at a point more remote from the superheater outlet than said first connection, and means to induce steam flow through the said assembly and the two connections.

2. Apparatus for purifying steam generated in the boiler of a steam generating and superheating installation comprising, in combination, means defining a path for saturated steam flow from the boiler to the superheater, an assembly of closely spaced tubes disposed in said path, a conduit to carry steam away from the superheater outlet, a connection from the conduit to

the inlet of said assembly, a connection from the outlet of said assembly to the conduit at a point more remote from the superheater outlet than said first connection, and an ejecting device
5 at the point where the second connection enters the conduit to induce steam to flow through the said assembly and the two connections.

3. Apparatus for purifying steam generated in the boiler of a steam generating and superheating installation comprising in combination a
10 heat exchanger of the type wherein heat may be transferred from one fluid to a second fluid without the two fluids coming into contact with each other, conduits to convey steam from the boiler
15 to the heat exchanger, and from the heat exchanger to the superheater inlet and from the

superheater outlet to a point of use, steam conducting means from some point in the conduit from the superheater outlet to the heat exchanger and from the heat exchanger to a second
5 point in the conduit from the superheater outlet more remote in the direction of steam flow from the superheater than the first named point, and means to cause some of the steam from the superheater outlet to flow through said steam
10 conducting means and the heat exchanger, the said last named means being an ejecting device at said second point and arranged to cause the steam on its way to the point of use to induce the said flow.

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15