

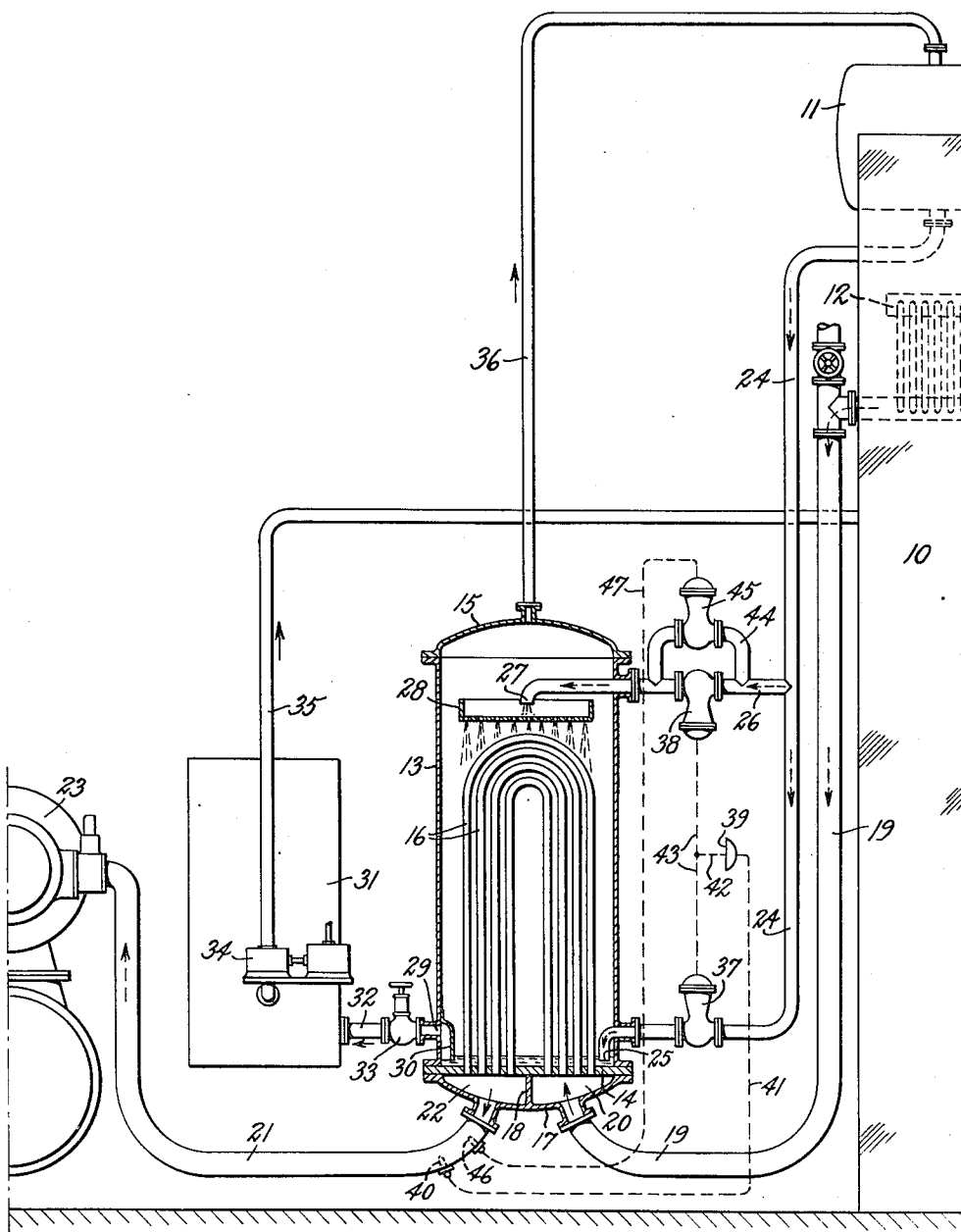
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DESUPERHEATER

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DESUPERHEATER

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This invention relates to power plants and more particularly pertains to desuperheaters.

The invention provides a novel form of desuperheater and further provides novel means for automatically controlling the desuperheater so that at all times during the operation thereof, the steam supplied thereto will be desuperheated to the extent necessary to prevent injury to the steam utilizing apparatus.

In general, this is accomplished by providing a desuperheater in which the superheated steam is brought into heat exchange relation with water sprayed into the desuperheater from the boiler or other source to remove the desired degree of superheat. The desuperheater when supplied with boiler water, is preferably disposed so that the water therefor flows by gravity from a boiler drum. Substantially all water for desuperheating is sprayed into heat exchange relation with the superheated steam and means are provided for automatically controlling the delivery of water to the desuperheater, preferably in response to the temperature of the desuperheated steam, so as to insure that at all times the steam will be sufficiently desuperheated to prevent injury to the steam utilizing apparatus. Means are also provided to prevent the accumulation of impurities in the desuperheater.

The nature of the invention will be understood from the following description considered in connection with the accompanying drawing forming a part thereof and in which:

The single figure is a more or less diagrammatic view in elevation, with parts in section, of a desuperheater and associated apparatus embodying the present invention.

Referring to the drawing, reference character 10 designates a boiler setting having a steam and water drum 11 and a superheater 12 suitably connected to the steam space of the drum 11.

Reference character 13 denotes the shell of a desuperheater embodying the invention. As shown, the shell 13 is cylindrical and disposed with its axis vertically but it will be understood that any other suitable form of shell, suitably disposed, may be utilized. The lower end of the shell 13 is closed by a tube sheet 14 and the upper end is closed by a cover 15. A plurality of loop tubes 16 have their ends suitably secured in the tube sheet 14 and the tubes, as shown, preferably extend to a point short of the upper end of the shell. A cover 17 is secured to the lower end of the shell 13 in contact with the tube sheet 14 and is provided with a partition or baffle 18 disposed intermediate the inlet and outlet legs of the loop

tubes 16. A superheated steam line 19 is connected at one end to the superheater 12 and at its other end to the cover 17 so as to be in communication with the steam inlet chamber 20. A desuperheated steam line 21 has its inlet end connected to cover 17 in communication with the steam outlet chamber 22 and has its outlet end connected to steam utilizing apparatus such as the turbine 23 shown.

A water pipe 24 connects at its inlet end with the water space of the steam and water drum 11 and at its discharge end with the lower portion of the shell 13 at 25. A branch pipe 26 is connected to the water pipe 24 and has its discharge end 27 disposed in the upper portions of shell 13. The desuperheater is preferably disposed at a level below the steam and water drum 11 so that the desuperheating water flows therefrom to the desuperheater by gravity. The discharge end 27 of pipe 26 discharges water onto a suitable water distributing device 28 which distributes the water so that it falls in a curtain or spray over the tubes 16. The lower portion of the shell 13, preferably opposite the discharge end 25 of water pipe 24, is provided with a water discharge opening 29 which is screened by a suitable baffle 30 having its lower end disposed close to the bottom of the shell and which, as shown, is connected to a boiler feed tank 31 by a pipe 32 controlled by a valve 33. Obviously, the opening 29 may be connected to means, other than the boiler feed tank 31, for the collection or disposal of the water withdrawn from the desuperheater. The discharge end 25 of pipe 24 and the bottom of screen 30 are preferably at substantially the same level in the shell 13 and are disposed quite close to the bottom of the shell so that substantially no water is carried in storage in the shell 13 under normal operating conditions. A pump 34 withdraws water from the tank 31 and forces it through line 35 into the boiler. A vapor line 36 connects the top of the shell 13 with the steam space of the steam and water drum 11.

Water pipe 24 is controlled by a suitable valve 37 and water pipe 26 is controlled by a similar valve 38, both of which, in the embodiment of the invention shown, are controlled by a suitable master controller 39 which in turn is controlled by a thermostat 40 disposed in the desuperheated steam line 21. Thermostat 40 and master controller 39 are operatively connected by suitable means indicated 41, and master controller 39 and valves 37 and 38 are operatively connected by suitable means indicated 42 and 43. Water line 26 has a by-pass 44 around the control valve

38 and the by-pass is controlled by a suitable valve 45 which is in turn controlled by a thermostat 46 disposed in desuperheated steam line 21 and operatively connected to valve 45 by suitable means indicated 47. Thermostat 46 is arranged so as to open valve 45 at a temperature of the desuperheated steam which is slightly higher than the temperature at which thermostat 40 operates to open the valves 37 and 38 or either of these valves through the medium of the master controller 39.

The operation of the apparatus disclosed is as follows: Superheated steam from the superheater 12 enters line 19 and is delivered thereby to the chamber 20 from which it passes through the loop tubes 16 in the shell 13 and is desuperheated to the desired extent as will hereinafter appear. The desuperheated steam enters chamber 22 and is withdrawn therefrom by steam line 21 which conducts it to the steam utilizing apparatus 23. Water from the drum 11 flows through pipe 24 and branch pipe 26 into both the upper and lower portions of the shell 13, but substantially all water for desuperheating purposes flows through branch pipe 26 from the drum 11 and substantially all water for deconcentrating purposes flows through pipe 24 during normal operation of the system. This is accomplished by arranging the control valve 37 to pass approximately only that amount of water which is necessary to deconcentrate or prevent the accumulation of impurities in the bottom of the shell. The capacity of valve 37 normally should not be greater than the capacity of the run off orifice valve 33. Water entering the shell 13 through pipe 26 is discharged onto distributing member 28 and flows in a curtain or spray of water over the tubes 16 to the lower part of the shell. Water withdrawn from the shell 13 is delivered to the feed tank 31 and is withdrawn therefrom by pump 34 and returned to the boiler through line 35, thereby providing for a positive circulation of the water through the desuperheater. Any steam evolved in the shell 13 is delivered to the steam space of the drum 11 through line 36. Thermostat 40, master control 39 and valves 37 and 38 are so arranged and adjusted that valve 38 normally permits sufficient water to flow therethrough and to be sprayed over the tubes 16 to remove the required degree of superheat from the steam flowing through the tubes 16 and so that valve 37 normally permits sufficient water to be supplied to the bottom of the shell 13 to wash out through pipe 32, the concentration of impurities flowing down the tubes to thereby prevent the accumulation of impurities in the bottom of the desuperheater. If for any reason valve 38 should fail to supply the necessary quantity of water to the desuperheater, thermostat 40 acting through the controller 39 will cause valve 37 to open more widely than normal and cause the level of the water in the bottom of the shell 13 to rise and submerge the tubes 16 to an extent which is sufficient to remove the desired degree of superheat from the steam. In the event both valves 37 and 38 should not function to supply the necessary quantity of water to the desuperheater, thermostat 46 will cause valve 45 controlling by-pass 44 to open and permit water in the necessary volume to flow into the desuperheater and be sprayed over the tubes 16. Thermostat 46 and valve 45 are set to operate to open valve 45 at a temperature slightly higher than that at which thermostat 40 and the valves 37 and 38 are normally operative, as a result of which the by-pass

44 is ordinarily maintained closed until failure of the valves 37 and 38 to supply the volume of water required. The control herein disclosed will prevent the desuperheater from flooding for the reason that as soon as the temperature of the desuperheated steam falls below the normal temperature, the thermostats 40 and 46 will operate to close the control valves. Should any failure of the run off orifice or valve 33 occur, the water in the shell 13 would gradually rise to the point where more of the desuperheating is effected by the submergence of the tubes than by the water sprayed thereover until a balance is reached and no water is admitted through either the top spray valve or the lower deconcentrating line, after which desuperheating will continue by reason of the water submerging the tubes until enough water is evaporated to cause the control to be actuated to admit more water through the spray valve 38 or the lower valve 37 thus maintaining the balance referred to and effecting the degree of desuperheating required and thus protecting the steam utilizing apparatus. In the event, for any reason, valve 37 and/or valve 38 should supply too much water, the water in the shell would flood the entire tube bundle, and the amount of desuperheating would be greater than that required to protect the steam utilizing apparatus, so that no damage would be done pending the proper regulation of the parts and the resumption of normal operation.

With this arrangement, it will be seen that the steam will at all times both during normal and abnormal operation be sufficiently desuperheated to prevent injury to the steam utilizing equipment and that the accumulation of impurities in the desuperheater is effectually prevented. With normal operation little or no water is maintained in the bottom of the desuperheater and all the water required for desuperheating is sprayed over the steam tubes. This provides a flexible control and one which is quickly responsive to variations in the temperature of the superheated steam and accordingly affords many advantages over the types of desuperheater heretofore in use which depend upon a large storage volume of water and no spraying and are as a result sluggish and have a slower reactance to variations of steam temperature because of the necessity of either accumulating or evaporating relatively large quantities of water.

As an alternative arrangement to that disclosed, the valves 37 and 33 may be proportioned so that not only the amount of water required for deconcentrating the desuperheater shell may be passed through the bottom of the desuperheater while maintaining little or substantially no water in the shell but the volume of water blow down that may be required to deconcentrate the main boiler drum may also be passed through the bottom of the shell. With this arrangement, the operation will be substantially the same as previously described.

Inasmuch as variations may be made in the structure and arrangement of the several parts of the apparatus herein disclosed without departing from the principle of the invention, it will be understood that there is no intention to limit the invention except by the scope of the claims hereto appended.

What is claimed is:

1. A desuperheater comprising a shell, a plurality of tubes in the shell, means for introducing superheated steam into the tubes, means for introducing water into the shell and for bringing

it into contact with the tubes therein, means for withdrawing desuperheated steam from the shell, means responsive to the temperature of the desuperheated steam for controlling the delivery of water to the shell, a by-pass around said controlling means, and means responsive to the temperature of the desuperheated steam for controlling the by-pass, said control for the by-pass being arranged so as to operate at a temperature of the desuperheated steam which is higher than the temperature at which the first mentioned control operates.

2. A desuperheater comprising a shell, a plurality of tubes in the shell, means for introducing superheated steam into the tubes, means for introducing water into the shell and for spraying it over the tubes therein, means for introducing water into the lower portion of the shell, means for withdrawing water from the shell, means for withdrawing desuperheated steam from the shell, and means responsive to the temperature of the desuperheated steam for controlling the delivery of water for spraying the tubes and the delivery of water to the lower portion of the shell.

3. A desuperheater comprising a shell, a plurality of tubes in the shell, means for introducing superheated steam into the tubes, means for introducing water into the shell and for spraying it over the tubes therein, means for introducing water into the lower portion of the shell, means for withdrawing water from the shell, means for withdrawing desuperheated steam from the shell, means responsive to the temperature of the desuperheated steam for controlling the delivery of water for spraying the tubes and the delivery of water to the lower portion of the shell, a by-pass for the means for controlling the delivery of water to the shell for spraying the tubes, and means responsive to the temperature of the desuperheated steam for controlling the by-pass, said by-pass controlling means being arranged to operate at a temperature somewhat higher than the temperature at which the first mentioned controlling means is arranged to operate.

4. A desuperheater comprising a shell, a plurality of tubes in the shell, means for introducing superheated steam into the tubes, means for introducing water into the shell and for spraying it over the tubes therein, means for introducing water into the lower portion of the shell, means for withdrawing water from the shell, means for withdrawing desuperheated steam from the shell, and a thermostat responsive to the temperature of the desuperheated steam for controlling the delivery of water for spraying the tubes and the

delivery of water to the lower portion of the shell.

5. A desuperheater comprising a shell, a plurality of tubes in the shell, means for introducing superheated steam into the tubes, means for introducing water into the shell and for spraying it over the tubes therein, means for introducing water into the lower portion of the shell, means for withdrawing water from the shell, means for withdrawing desuperheated steam from the shell, and means responsive to the temperature of the desuperheated steam for controlling the delivery of water to the lower portion of the shell.

6. A desuperheater comprising a shell, a plurality of tubes in the shell, means for introducing superheated steam into the tubes, means for introducing water into the shell and for spraying it over the tubes therein, means for introducing water into the lower portion of the shell, means for withdrawing water from the shell, means for withdrawing desuperheated steam from the shell, a thermostat responsive to the temperature of the desuperheated steam for controlling the delivery of water for spraying the tubes and the delivery of water to the lower portion of the shell, a by-pass for the means for controlling the delivery of water to the shell for spraying the tubes, and means responsive to the temperature of the desuperheated steam for controlling the by-pass, said by-pass controlling means being arranged to operate at a temperature somewhat higher than the temperature at which the first mentioned controlling means is arranged to operate.

7. A desuperheater comprising a shell, a plurality of tubes in the shell, means for introducing superheated steam into the tubes, means for introducing water into the shell and for spraying it over the tubes therein, means for introducing water into the lower portion of the shell, means for withdrawing water from the shell, means for withdrawing desuperheated steam from the shell, means responsive to the temperature of the desuperheated steam for controlling the delivery of water to the lower portion of the shell, a by-pass for the means for controlling the delivery of water to the shell for spraying the tubes, and means responsive to the temperature of the desuperheated steam for controlling the by-pass, said by-pass controlling means being arranged to operate at a temperature somewhat higher than the temperature at which the first mentioned controlling means is arranged to operate.

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