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TEMPERATURE CONTROL SYSTEM FOR A FLUID UNDER PRESSURE

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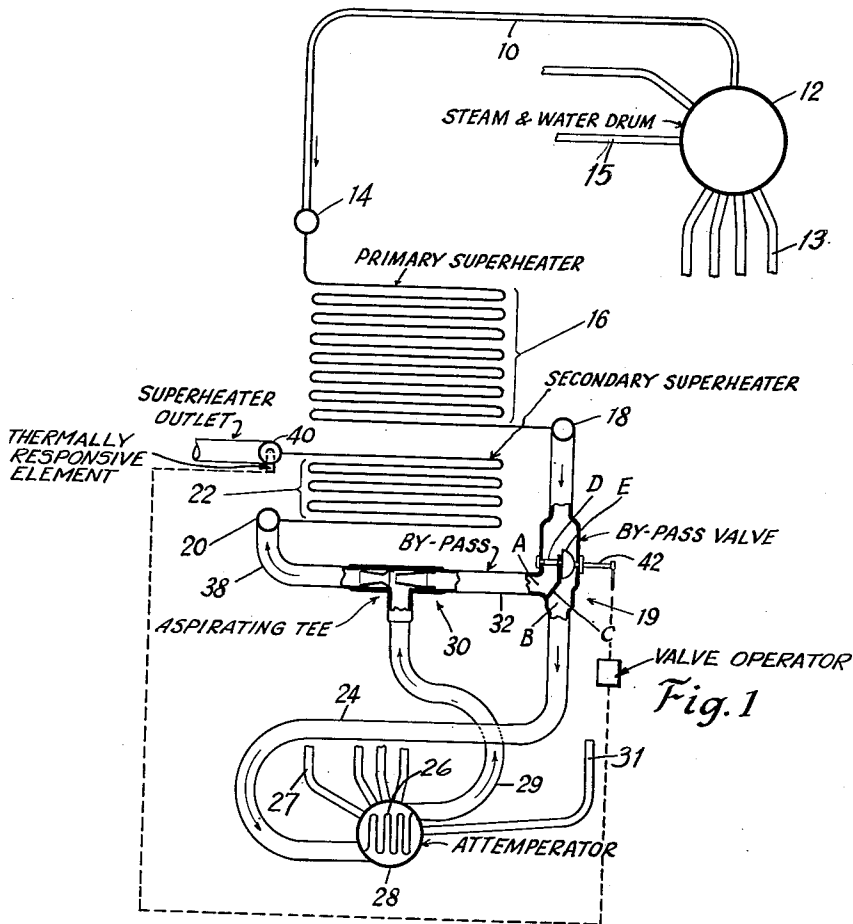
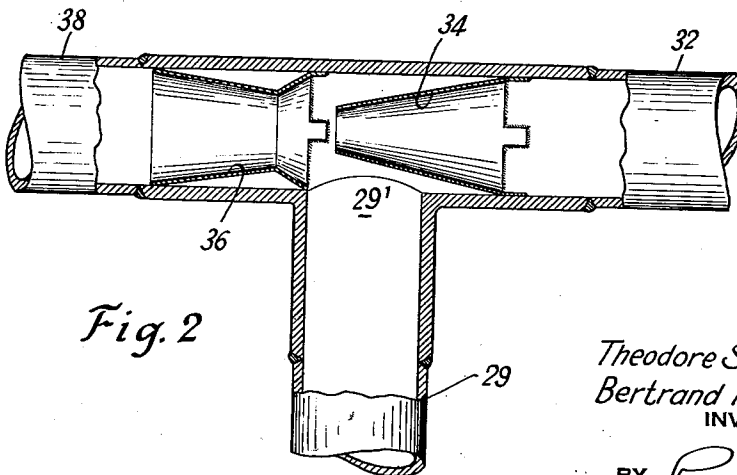


Fig. 2

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TEMPERATURE CONTROL SYSTEM FOR
A FLUID UNDER PRESSURE

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This invention relates to steam generators, and more particularly to a steam generator associated with a superheater, and to the control of superheat in such an installation.

One method of controlling the superheat of high pressure superheated steam involves the absorption of excess superheat by heat transfer directly to a fluid of lower temperature in a direct contact attemperor wherein a spray of water is introduced into the steam. Another method involves a closed surface type of heat exchanger in which the superheated steam and the cooling liquid are separated by metallic walls. The use of the latter type of attemperor is advantageous in that it avoids the possibility of introducing contaminants into the steam, but it is subject to the disadvantage of inherent and substantial steam flow resistance which reduces the pressure at which the steam is delivered at a point of use. This is particularly true in large capacity installations handling large volumes of steam. Such steam flow resistance is a very substantial factor where the attemperor heat transfer surface elements are of limited extent, as where they are placed in a water space of a steam generator.

It is an object of the invention to provide a superheated steam attemperor of the surface type associated with a steam generator by such steam flow connections and provisions that there is a counterbalancing or compensatory effect on the steam pressure drop incurred as a result of the steam flow resistance of the attemperor.

More specifically the invention involves the association of a steam jet aspirator in the regulating bypass conduit of an attemperor to reduce the static pressure at the steam outlet connection of the attemperor.

In one practice of the invention a portion of the steam from a first superheater section is conducted through the attemperor and then to a combined aspirator and mixing T forming a juncture with a bypass line in which the remainder of the superheated steam from the first superheater section is conducted directly to a second superheater section. In this T the bypassing steam passes through a Venturi-like section at high velocity, the attempered steam having its velocity increased by the effect of the bypassing steam. The attempered steam enters the T forwardly of the Venturi-like section and is mixed with the bypassed steam.

The invention will be described with reference to an embodiment shown in accompanying drawing, in which:

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Fig. 1 is a diagrammatic view showing the illustrative superheat control system in its association with upper and lower drums of a steam generator; and

Fig. 2 is a longitudinal section showing the combined steam aspirator and mixing T involved in the Fig. 1 system.

In the system shown in Fig. 1, saturated steam passes through the line 10 from the steam and water drum 12 of a steam generator to the inlet header 14 of a primary superheater section 16. This section involves a bank of spaced tubes disposed transversely of a gas pass and connected for series flow of steam therethrough to the header 18.

The superheated steam from header 18 is divided and proportioned by a bypass valve 19 between two flow paths leading to the inlet header 20 of the secondary superheater section 22. One of these flow paths includes a conduit 24 leading to the inlet of an attemperor 26 which is advantageously disposed in the submerged drum or header 28 of the steam generator. From the outlet of the attemperor the steam cooled thereby is conducted by a conduit 29 to a combined steam aspirator and mixing T indicated generally at 30.

The remainder of the steam from the bypass valve 19 is conducted through the bypass conduit 32 directly to the aspirator and mixing T 30 where the bypassed steam is mixed with the attempered steam entering through the conduit 29.

The bypassing steam flowing in conduit 32 is directed through nozzle 34 fixed within the T at its upstream end and having its discharge end in the zone of the lateral port 29' connected to the conduit 29. The nozzle increases the velocity of the steam with the result that the static pressure thereof at the position of high velocity is substantially reduced from that in conduit 32. The reduced static pressure thereby developed in the zone surrounding the nozzle outlet thus reduces the back pressure related to the port 29' of conduit 29. As the flow through the steam carrying tubes of the attemperor and its conduit connections is a direct function of the difference in pressures existing at the valve end of conduit 24 and the T port 29', the reduction of pressure at the zone of the port 29' effects a higher flow of steam.

Immediately downstream from the lateral connection or port 29' of the T 30 with the conduit 29 is a Venturi-like tubular section 36, secured as by welding, within the T in alignment with

3 the nozzle 34 and acting to thoroughly merge the attemperated and bypassed steam while the diverging portion of the Venturi tube effects a gradual reduction of steam velocity with an efficient recovery of static pressure.

The mixed steam is conducted from the T 30 through conduit 38 to header 20 for the second superheater section. This section is formed by a bank of spaced tubes similar to that of section 16, the tubes being series connected to discharge steam at final superheat to a superheater outlet header 40.

The recovery of static pressure is such that the overall steam pressure drop incurred between headers 18 and 20 is less than if the bypassed and attemperated steam streams were merged in a junction fitting without the development of the aspirating effect by the jet action of the bypassed stream.

The bypass valve 19 includes a single valve stem or shaft 42 turnably mounted in the valve walls and in a diaphragm C between branches A and B which lead respectively to the bypass 32 and the attemperator conduit 24. Secured to the valve shaft 42 in the branches A and B are the valve members D and E. They are set 90° apart so that when steam flow is increased through bypass 32, it is decreased through the attemperator, and vice versa. Such proportioning of steam flows is preferably automatically controlled in response to slight variations of final steam temperature from a predetermined value.

In the operation of a steam boiler of the type indicated, the maximum correction of superheating steam temperature by attemperation will be carried out at maximum load at which time the maximum flow of steam through the superheater section will occur, but with the division of steam between conduits 24 and 32 accomplished by valve 19 to direct such an amount through the former conduit that the desired steam temperature at a position following the T 30 results. At low ratings when no attemperation of the low steam flow is desired, the valve 19 will be operated to close off the inlet to conduit 24 and thereby bypass all of the steam through the nozzle 34.

As the pressure drop from inlet header 14 to outlet header 40 is greatest at high loads, it will be appreciated that the aspirating T is effective in the load range where the pressure drop is most important.

By way of further indication of the steam generator, the drawing shows the lower ends 27 of steam generating tubes which are in communication with the steam and water drum 12 by the circulators 15 and any necessary interposed header. Fig. 1 also indicates downcomers 13 leading from the water space of the drum 12. The lower ends of these downcomers are connected to the water drum 28, as indicated at 31.

What is claimed is:

1. In a steam generator-superheater installation, a steam and water drum, a primary superheater section receiving saturated steam from the drum, a second superheater section receiving

ing steam from the primary section through two flow paths arranged in parallel, a water drum, an indirect type of attemperator in one of said flow paths, the liquid containing portion of said attemperator being the water drum, tubular means connecting said drums into the circulatory system of the generator, the other flow path bypassing the attemperator, valve means variably proportioning the steam flows through said flow paths in response to variations in total steam temperature from a predetermined value, and an aspirator at the downstream juncture of the bypass and the other flow path utilizing the higher pressure of the bypassing steam to increase the effective steam pressure drop through the attemperator

2. In a steam generator-superheater installation, a steam and water drum, a gas heated primary superheater section receiving steam from the drum, a second superheater section receiving steam through two flow paths from the primary superheater section, a water drum of the generator, a steam attemperator in said water drum forming a part of one of said flow paths, the liquid containing portion of said attemperator being the water drum, the other flow path bypassing the attemperator, valve means variably proportioning the steam flows through said paths to maintain a predetermined final steam temperature, and a combined aspirator and mixing T joining said flow paths at a position downstream from the attemperator, said T having a bypass steam nozzle discharging into a Venturi-type mixer and having a connection with the flow path leading from the attemperator

3. In a steam generator-superheater installation, a steam and water drum, a primary superheater section receiving saturated steam from the drum, a second superheater section receiving steam from the primary section through two flow paths arranged in parallel, a water drum, an indirect type of attemperator in one of said flow paths, the liquid containing portion of said attemperator being the water drum, tubular means connecting said drums into the circulatory system of the generator, the other flow path bypassing the attemperator, valve means variably proportioning the steam flows through said flow paths to control steam temperature, and an aspirator at the downstream juncture of the by-pass and the other flow path utilizing the higher pressure of the by-passing steam to increase the effective steam pressure drop through the attemperator.

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