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ASPIRATING TWO-WAY CONTROL VALVE

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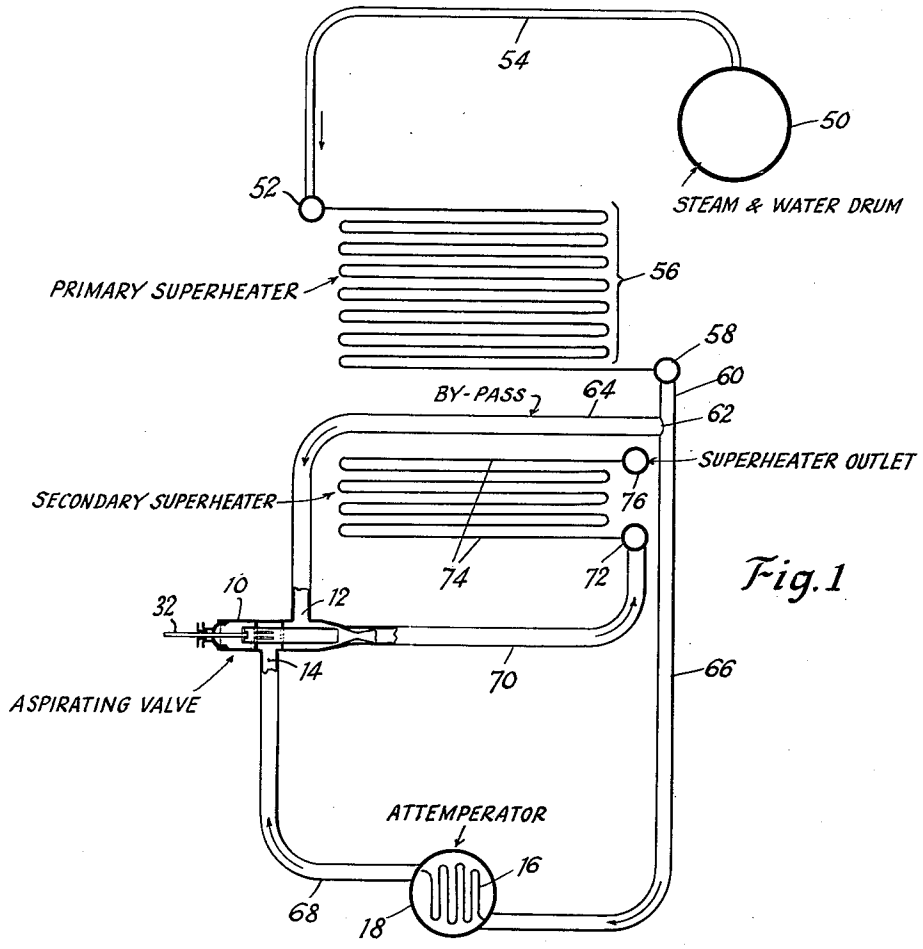

Fig. 1

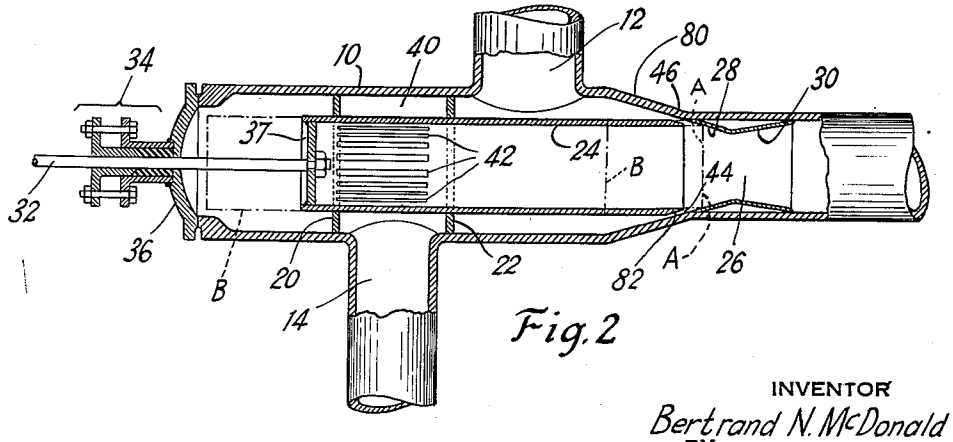

Fig. 2

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ASPIRATING TWO-WAY CONTROL VALVE

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2 Claims. (Cl. 230—112)

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This invention relates to an aspirating two-way control valve adapted for use in the superheated steam line of a steam generator.

The invention provides a unitary construction which constitutes an aspirator or ejector and steam flow proportioning valve, and a steam mixer. It is particularly adapted to receive high pressure steam from a primary superheater at one position, lower pressure steam from an attemperator at another position. The construction operates to control the division of steam flow through the high pressure and low pressure inlets; to adequately mix the attemperated steam and the by-passed steam on the downstream side of the attemperator; and to reduce the overall pressure drop because of the aspirating effect of the by-pass or high pressure steam.

The invention will be described by reference to the accompanying drawings which illustrate a preferred embodiment.

In the drawings:

Fig. 1 is a diagrammatic view illustrating a superheat control system receiving steam from a steam and water drum of a steam generator, and including a surface attemperator, in association with the unitary structure which includes the steam proportioning valve and the aspirator; and

Fig. 2 is a detailed view of the unitary steam aspirator and valve structure, in longitudinal section.

The unitary steam aspirator and steam proportioning valve shown in the drawings includes a tubular body 10 having a lateral inlet 12 for superheated steam, and a second lateral inlet 14 (usually of smaller flow area) leading from a surface attemperator, the tubes of which may be advantageously disposed in a submerged water drum 18 of the steam generator.

At spaced positions in tubular body 10 and at opposite sides of the inlet 14, there are transverse metallic diaphragms 20 and 22. These diaphragms are fixed within the tubular body in the positions shown and are formed with axially aligned openings which form bearings for the sliding movements of the hollow cylindrical member 24, the opposite sliding movements of which conversely vary the proportions of superheated steam and attemperated steam entering the valve body 10 and proceeding to a mixing zone 26 provided by a Venturi-like construction having a contracting entrance portion 28 and an expanding exit portion 30. The contracting entrance portion 28 of the Venturi insert member 30 is formed as an extension of the conical converging wall 80 of the body 10.

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The hollow cylindrical valve member or valve plunger 24 is moved longitudinally relative to the tubular body 10 by means of a valve stem 32 extending through a stuffing box construction 34 secured to a closure member 36, which in turn is fixed to the left hand end of the body 10. The valve stem 32 has its right hand end secured to an end diaphragm or closure member 37 secured to the member 24.

Fig. 2 shows the valve member or plunger 24 in an intermediate operating position slightly retracted from its fully advanced position indicated by dot-dash lines A—A; the fully retracted position is indicated by the dot-dash indication B. In the position shown by Fig. 2, the annular steam flow area of the opening 44 at position 46 in the conical portion 80 of the body permits the flow of bypass steam, while steam flow from the attemperator through inlet into the central space of the plunger is permitted through the ports 42 which are for the major portion of their length in the space 40 between diaphragms 20 and 22.

When the valve member 24 is retractively moved to the left from the position in which it is shown in Fig. 2 (toward the position B) the flow of attemperated steam through the inlet 14 into the annular chamber 40 and then into the valve member 24 is decreased by reason of the decreased flow area of the communicating openings provided by the circular series of parallel slots (or slot shaped ports) 42 formed in the wall of the valve member 24 at its right hand end. This same movement increases the flow area of the opening 44 between the right hand end of the valve member 24 and the conical wall portion 28 at the position 46, to increase the flow of superheated steam through the mixing zone 26.

The converging conical body portion 80 provides a rapidly increasing flow area 44 with progressive retractive movement so that a flow area of minimum restriction leading from inlet 12 to the outlet end of the body is provided. When the plunger is so retracted the ports 42 will lie to the left of diaphragm 20 and there will be no communicating flow passages into the central portion of the plunger from space 40.

With the longitudinally arranged ports 42 communicating fully with annular chamber 40, a free flow area of greater extent than that of the inlet 14 is conventiently provided to minimize the pressure drop therethrough. Static pressure conditions relative to the plunger are such at all positions that the force necessary to move it is small, making the valve readily adaptable for automatic regulation.

The retractive movement of the valve member 24 referred to above would be accomplished when the temperature of the superheated steam at a point of use beyond the zone 26 is such that a decreasing amount of attemperation is necessary. Conversely an advancing movement of the plunger 24 toward the position AA would be accomplished when the superheat is higher than desired and it is desired to attemperate a greater proportion of the total steam flow.

The steam pressure and flow conditions under the arrangement indicated in Fig. 2 of the drawings, as well as under the condition wherein the valve member 24 is moved slightly to the left, include an aspirating action by the bypassed steam flowing from the inlet 12 through the opening 44 at the end of the valve member 24. The pressure of the superheated steam entering through the inlet 12 is greater than the pressure of the steam entering through the inlet 14, and the velocity head of the superheated steam flowing through the inlet 12 is increased as the steam flows through the annular opening 44. This increase in velocity head is accompanied by a decrease in static pressure to thereby create a pressure condition which provides for increased flow through the attemperator, the inlet 14, the annular chamber 40, and the interior of the valve member 24 to the position of the opening 44.

The steam flowing at high velocity through the annular opening 44 is, because of the conformation of the surrounding body wall and the entrance portion 28, directed inwardly in aspirating and mixing relationship with the steam flowing axially from the open end of the valve plunger 24. The gradually diverging portion of the Venturi construction contributes to the efficient recovery of velocity energy to pressure energy as the velocity of the mixed stream is reduced.

From the above it will be appreciated that considerable advantage accrues in the use of the described valve assembly in regulating the proportioning of the steam directed through an attemperator with respect to that directed about an attemperator in that the velocity conditions resulting from the throttling of the bypassed steam are utilized in overcoming flow restrictive pressure loss conditions in the attemperator flow path.

Fig. 1 of the drawings indicates the steam and water drum 50 of a steam generator. Such a generator may have steam heat absorbing steam generating tubes with their upper ends connected to the drum 50 and their lower ends connected to the submerged drum 18.

From the steam space of the drum 50, steam flow is to the superheater inlet header 52, through circulators such as that shown at 54. From the header 52, the steam flows through a bank 56 of series connected return bend tubes which extend across a gas pass. From these tubes, the steam enters an intermediate superheater header 58 and then flows through a tube such as that shown at 60 to a position 62 at which the steam flow is divided between the bypass 64 leading to the inlet 12, and the conduit 66 leading to the attemperator 16, this proportioning being dependent upon the axial position of the valve member 24 within the valve body 10.

The flow of attemperated steam from the attemperator 16 to the inlet 14 takes place through the tubular connection 68. From the mixing zone 26 of the combined steam flow proportioning valve and steam aspirator, the steam flow continues through the tubular connection 70 to

a header 72 for a secondary superheater 74 consisting of a bank of tubes similar to the tubes of the bank 56 and similarly disposed transversely of the gas pass. From this bank of tubes steam flows through the superheater outlet header 76 and then through appropriate connections to a point of use.

The illustrative aspirating valve construction provides for the maximum of steam attemperation by movement of the hollow needle or valve member 24 to the right from a position in which it is shown in Fig. 2. When this movement is continued to the maximum extent, the beveled end 82 of the member 24 fits closely within the entrance of the contracting section 28 of the mixing zone or within the tapered section 82 near the right hand end of the valve body 10, thus closing the bypass 64 and forcing all of the steam from the superheater 56 to flow through the attemperator 16.

While in accordance with the provisions of the statutes I have illustrated and described herein the best form of my invention now known to me, those skilled in the art will understand that changes may be made in the form of the apparatus disclosed without departing from the spirit of the invention covered by my claims, and that certain features of my invention may sometimes be used to advantage without a corresponding use of other features.

What is claimed is:

1. In a combined mixing and aspirating valve construction, a tubular valve body having a Venturi fluid mixing section and associated wall portions, a hollow tubular valve member closed at one end and having its open end arranged to contact the wall of the contracting entrance to the Venturi section when the valve member is moved in one of its directions of movement, portions of the valve body having aligned openings and acting as slidable mounting means slidably receiving the valve member and holding it in position coaxial with the venturi, said last mentioned portions coacting with wall portions of the valve body to form two separated inlet chambers normally subjected to different fluid pressures, the inlet chamber nearest the venturi being in direct communication with the inlet of the venturi when the valve member is moved in one of its directions of movement, the interior of the valve member being in free communication with the other inlet chamber through openings in a wall part of the valve member and the interior of the valve member also being in free communication with the Venturi mixing section, said last mentioned openings also extending longitudinally of the valve member so as to reduce the flow of fluid through the last mentioned inlet chamber to the Venturi mixing section when the valve member is moved to increase the flow from the remaining inlet chamber to the venturi, corresponding ends of adjacent longitudinally extended openings being adjacent said slidable mounting means when the valve member is at one end of its path of movement and substantial parts of the openings being shrouded or rendered inoperative by the mounting means when the valve member has reached a position intermediate its path of movement, and means whereby the valve member may be moved longitudinally of the valve body and toward or from the venturi to reversely throttle the flows from the two separate inlet chambers to the venturi.

2. In a combined mixing and aspirating valve construction, a tubular body having wall portions

and a Venturi-like section at one end and two axially spaced separate fluid inlets at the same side of said section, said inlets being normally subject to different fluid pressures, a tubular inner valve member, means within the valve body for slidably mounting the tubular inner valve member so that it is movable toward or from the contracting entrance of the Venturi section to control the fluid flow from said inlets to the Venturi section, said means combining with wall parts of the valve body to form separate inlet chambers separately in communication with said inlets, the end of the valve member remote from the venturi having longitudinally extending openings therein in communication with the other of said inlet chambers and adapted to reduce the flow of fluid from the other inlet through the Venturi section as the valve is moved to increase the flow from the first inlet through the Venturi section, corresponding ends of adjacent longitudinally extended openings being adjacent said slidable mounting means when the valve member is at one end of its path of movement and substantial parts of the openings being shrouded

or rendered inoperative by the mounting means when the valve member has reached a position intermediate its path of movement, the interior of said valve member normally in free communication with the Venturi section, and means whereby the valve member may be moved to reversely throttle the fluid flows from the separate inlets to the Venturi section solely by movement of the valve member in one direction.

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