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STEAM CONVERSION VALVE

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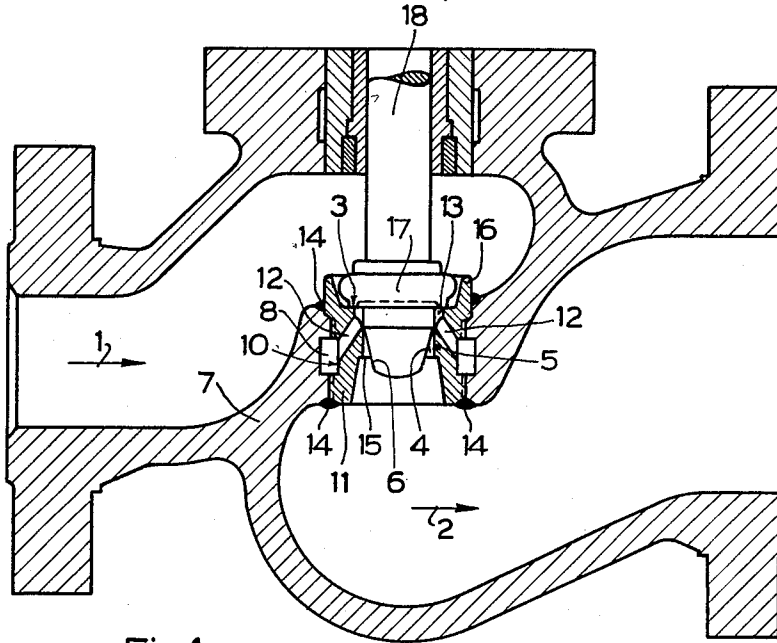


Fig. 1

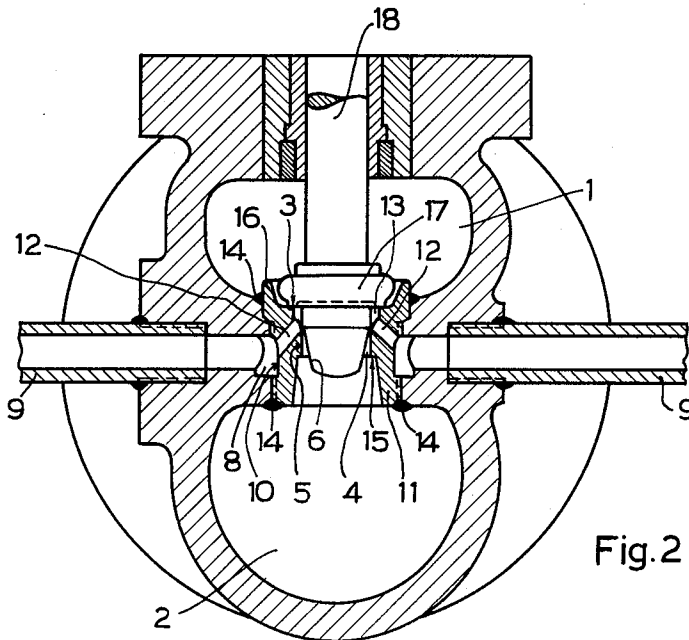


Fig. 2

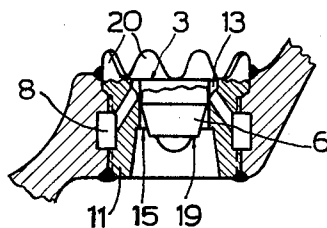


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## STEAM CONVERSION VALVE

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8 Claims. (Cl. 261—62)

My invention relates to steam conversion valves. Such valves serve to simultaneously throttle and cool hot steam.

In the past these two functions, namely pressure reduction and cooling, were assigned to two respective devices: a pressure-reducing valve and a hot-steam cooler (desuper-heater) of the injection or atomizer type. In contrast, a steam conversion valve combines these two functions within a single device in which the cooling water to be injected into the hot steam is supplied to the reducing valve itself in such a manner that an intimate mixture of steam and water in finest distribution is produced within the valve zone of highest flow velocity, that is, within the pressure-reducing zone itself or immediately ahead or behind that zone. This affords the possibility of providing with minimum structural means a supply of steam reduced to the desired pressure and the desired temperature.

It is an object of my invention to improve such steam conversion valves toward greater reliability of operation or an enlarged range of temperature reduction. Another object, related to the one just-mentioned, is to provide a steam conversion valve that secures a reliable operation even if operating under the smallest applicable loads, i. e. when the valve is only slightly open.

According to my invention, I provide a conversion valve with an annular channel around the pressure-reducing portion of the valve, and I join the supply for cooling water with that channel, and connect the channel by ducts with the steam-flow passage of the valve at a flow cross section behind the valve seat. A valve design especially favorable from structural and manufacturing viewpoints is obtained if the supply ducts for the cooling water are machined into a valve-seat bushing inserted into the housing structure of the valve.

The desired functioning of the steam conversion valve is reliably achieved only if steam and cooling water actually mix intimately with each other. This requires not only that the supply of cooling water be distributed as uniformly as possible over the entire periphery of the flow passage, but the steam must also be distributed over the entire periphery with an approximately uniform distribution. With large quantities of flow, these conditions are generally satisfied. With small valve loads, however, the uniform distribution may become disturbed since the steam, like any other flowing medium, seeks the path of least resistance and hence will possibly flow from the inlet side of the valve unilaterally into the pressure-reducing cross section without sufficiently uniform peripheral distribution. According to another feature of my invention, therefore, a collar shaped annular projection is provided in front of the valve seat. The collar acts as an obstacle in the flow path of the steam so that the flow, so to say, is dammed up before it can flow over the obstacle toward the valve seat. This secures a uniform distribution of the steam over the entire valve cross section even with small and smallest valve loads. The flow resistance of the annular collar is so slight that virtually no loss is involved.

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The same effect may also be obtained if instead of a closed annular collar, a number of flow obstacles, similar to guide vanes or turbine-type guide buckets, are distributed around the periphery of the cross section so that the steam flows between these obstacles toward the valve seat. This also affords preventing the steam flow from forming a vortex akin to that observable when water drains out of a tub.

According to another feature of the invention, the flow passage of the valve is given an abrupt enlargement behind the mixing zone of steam and cooling water. The favorable performance of the steam conversion valve is due to the high relative velocity of the steam and water components to be intermixed within or behind the reducing zone of the valve. The abrupt enlargement of the flow passage results in a further increase in the atomizing and evaporating effects because the sudden increase in flow cross section results in a kind of tension-releasing or velocity braking impact upon the flowing media. When the atomized mixture of steam and water is retarded by such a sudden and violent blow, a vigorous whirling effect is obtained, as steam and liquid droplets are subject to the laws of mass inertia and hence react differently to acceleration and retardation. This difference in behavior, as mentioned, augments the atomizing action and hence the evaporation of the water particles by the steam to be cooled.

The same effect, of course, may also be obtained if the diameter of the reducing cone on the valve disc member is abruptly reduced. If desired, a stepwise increase in diameter of the valve flow area may be applied conjointly with a stepwise decrease in diameter of the valve cone.

Embodiments of conversion valves according to the invention are illustrated on the drawing by way of example. Fig. 1 shows a section through the longitudinal center plane of the valve, Fig. 2 shows a cross section taken through the transverse center plane of the same valve, and Fig. 3 is a transverse cross section through the seat portion of a modified valve.

Referring at first to Figs. 1 and 2, the hot steam to be cooled enters into the inlet portion 1 of the valve housing and leaves the outlet portion 2 of the valve housing as indicated in Fig. 1 by arrows. Within the valve housing, the steam passes through the opening of the valve seat 3 and thence through the throttling zone 4 formed by a cylindrical wall 5 and a valve cone 6. Machined into the bridge portion of the valve housing is an annular channel 8 which communicates through lateral bores with pipes 9 for the supply of cooling water. The interior side of channel 8 is bordered by a groove-shaped recess 10 of a valve bushing 11 inserted into the bridge portion 7 of the housing. The bushing 11 has a plurality of bores 12 which open into a space 13 between the valve seat 3 and the throttling zone 4. The bushing 11 is welded to the bridge portion 7 at 14.

A similar arrangement of channel 8 and bores 12 is also applicable in cases where the valve seat and the channel 8 are directly built into the material of the bridge portion. However, this results in a design more difficult to manufacture because then the annular channel 8 and generally also the bores 12 must be molded into the casting of the housing structure.

The flow passage within the bushing 11 is stepped at 15, thus forming an abrupt enlargement of the flow area immediately behind the reducing zone for the purpose of disintegrating the droplets to a maximum degree of fine distribution of the atomized water within the steam. The valve has an annular collar 16 projecting from bushing 11 around the valve seat to secure a uniform distribution of the steam flow over the entire cross section, especially at light valve loads.

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The above-mentioned reducing cone 6 of the valve is joined with, or an integral part of, the valve disc member 17 which is mounted on the valve stem 18 and has an annular seating face to engage the valve seat 3 when the valve is closed. The collar 16 surrounds the disc member 17 with a slight peripheral spacing.

Instead of providing the inner wall surface of bushing 11 with a stepped diameter at 15, an abrupt widening of the flow cross section can also be obtained without such a step, if instead the valve cone 6 is inwardly stepped; or both the valve bushing and the valve cone may be stepped in this manner, the latter design being apparent from the modification shown in Fig. 3.

According to Fig. 3, the valve bushing 11 has its inner wall surface stepped at 15, while the valve cone 6 is inwardly stepped at 19 thus providing a more abrupt and greatly enlarged flow area immediately behind the reducing zone of the bushing. In the embodiment of Fig. 3, the valve seat 3 is surrounded by a number of projecting guide structures 20 which are peripherally spaced from each other and serve, much as the collar 16 shown in Figs. 1 and 2, for improving the peripheral distribution of the steam while also retarding the tendency of vortex formation thus securing good atomization of the cooling water even at smallest valve loads.

It should be understood that the abrupt enlargement of the flow passage and the steam-guiding projections around the valve seat are not always necessary so that either or both of these further improvements may be omitted depending upon the operating condition to be met by the particular valve; and it will also be obvious to those skilled in the art, upon a study of this disclosure, that my invention permits of various modifications other than those specifically illustrated and described, without departing from the essence of my invention and within the scope of the claims annexed hereto.

I claim:

1. With a steam conversion valve having a valve seat opening into a chamber and a pressure-reducing zone following said chamber in the flow direction of the steam, the combination of an annular channel surrounding said chamber, supply conduit means for cooling water communicating with said channel, and ducts connecting said channel with said chamber, at a position behind said valve and ahead of said pressure reducing zone.

2. With a steam conversion valve having a valve seat, a chamber, said valve opening into said chamber and a pressure reducing zone following said chamber, the combination of an annular channel surrounding said chamber, supply conduit means for cooling water communicating with said channel, and a plurality of parallel ducts spaced from one another along the periphery of said channel and connecting said channel with peripherally distributed points of said chamber, said points being at positions behind said valve seat and ahead of said pressure reducing zone.

3. A steam conversion valve, comprising a valve housing with a partition, a valve disc, a valve bushing inserted in said partition and forming a seat for said disc, said bushing having a chamber behind said seat and a pressure-reducing flow zone behind said seat and an annular channel surrounding said chamber, and said bushing having a plurality of bores peripherally spaced from each other and connecting said channel with respective points of said chamber near said seat, said points being at positions behind said seat and ahead of said pressure reducing flow zone.

4. A desuperheating reduction valve for hot steam, comprising a valve disc, a valve structure having a flow passage and forming a seat for said disc at one side of said passage, said passage having a chamber behind said seat and a pressure-reducing zone behind said chamber and having a stepwise enlarged flow cross section behind and adjacent to said zone, an annular channel surrounding

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said chamber, supply conduit means for cooling water communicating with said channel, and ducts connecting said channel with said chamber between said zone and said seat, at positions behind said seat but ahead of said pressure reducing zone.

5. A desuperheating reduction valve for hot steam, comprising a stationary seat structure, a movable valve body having a disc member and a cone portion, said seat structure having a first inner wall portion forming a steam flow passage and having a seat for said disc member at one side of said passage, a second wall portion and communicating with said first wall portion surrounding said cone portion and forming together with said cone portion a pressure reducing zone behind said first wall portion, said seat structure having an annular channel concentric to said first wall portion and having ducts connecting said channel with said flow passage at points in said first wall portion between said seat and said zone, cooling-water supply conduit means extending from the outside of the valve to said channel, said cone portion having a stepped shape behind and immediately adjacent to said zone so as to abruptly increase the cross section of said flow passage.

6. A desuperheating reduction valve for hot steam, comprising a valve disc, a valve structure having a flow passage and forming a seat for said disc at one side of said passage, said passage having a chamber behind said seat and a pressure-reducing zone behind said chamber and having an annular channel surrounding said chamber, supply conduit means for cooling water communicating with said channel, and ducts connecting said channel with said chamber between said zone and said seat, and steam guiding structure joined with said valve structure on the side of said seat, said guiding structure projecting away from said seat and being disposed around said disc for peripherally distributing the flow of steam into said passage.

7. A desuperheating reduction valve for hot steam, comprising a valve disc, a valve structure having a flow passage and forming a seat for said disc at one side of said passage, said passage having a chamber behind said seat and a pressure-reducing zone behind said chamber and having an annular channel surrounding said chamber, supply conduit means for cooling water communicating with said channel, and ducts connecting said channel with said chamber between said zone and said seat, and a projecting collar disposed on said valve structure at the side of said seat and projecting from said valve structure around said disc in peripherally spaced relation to said disc.

8. A desuperheating reduction valve for hot steam, comprising a valve disc, a valve structure having a flow passage and forming a seat for said disc at one side of said passage, said passage having a chamber behind said seat and a pressure-reducing zone behind said chamber, an annular channel surrounding said chamber, supply conduit means for cooling water communicating with said said channel, and ducts connecting said channel with said chamber between said zone and said seat, and a plurality of mutually spaced, rounded lugs disposed on said valve structure at the side of said valve seat and projecting from said valve structure around said disc in peripherally spaced relation to said disc.

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