

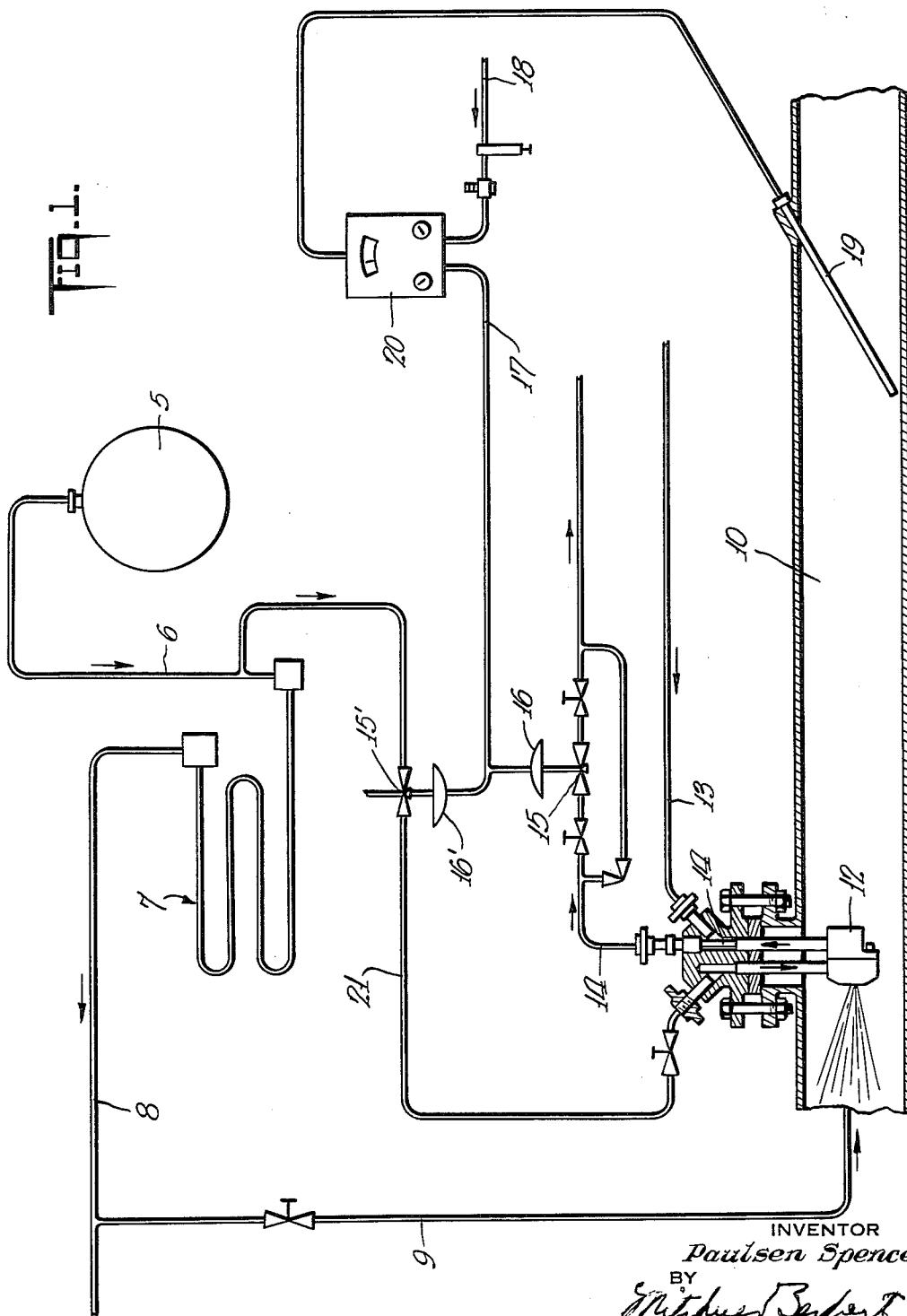
June 4, 1963

P. SPENCE
DESUPERHEATER

3,092,677

Filed Feb. 8. 1957

2 Sheets-Sheet 1



June 4, 1963

P. SPENCE
DESUPERHEATER

3,092,677

Filed Feb. 8, 1957

2 Sheets-Sheet 2

FIG. 2.

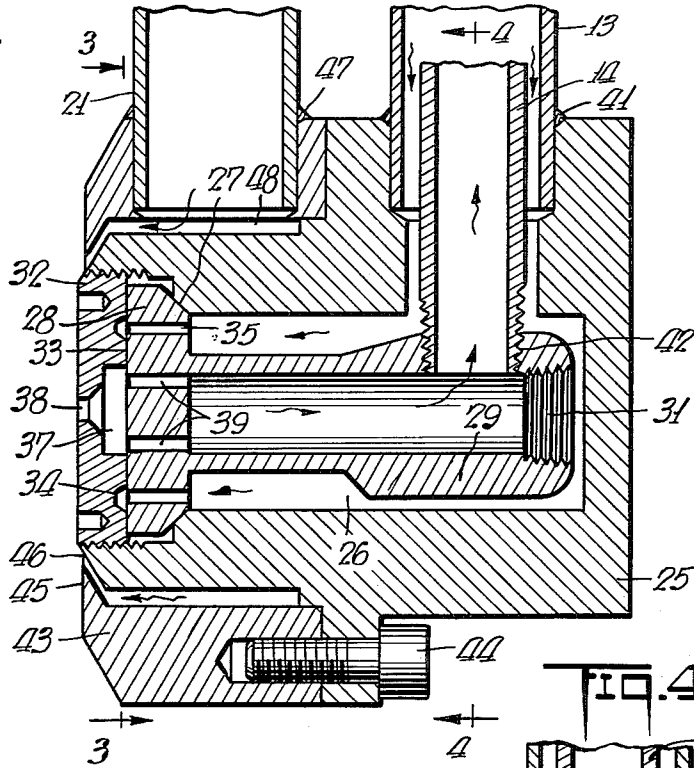


FIG. 3.

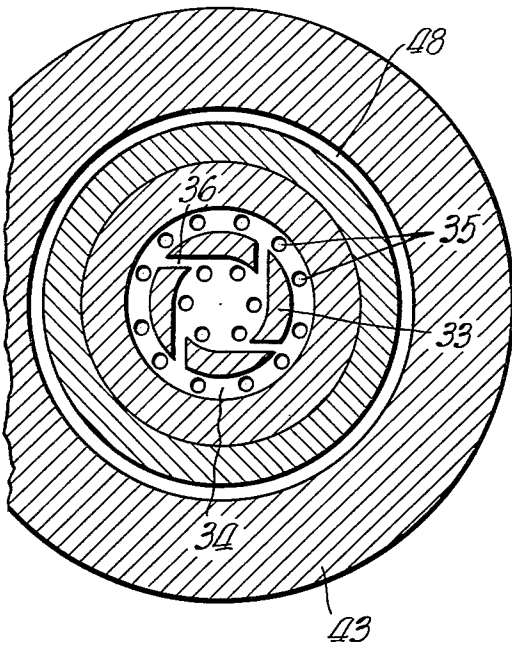
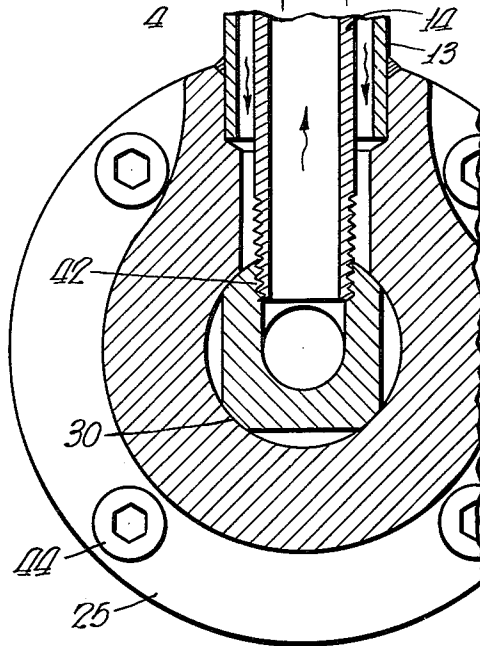


FIG. 4.



INVENTOR
Paulsen Spence
BY
Matthew Beutel
ATTORNEYS

1

3,092,677

DESUPERHEATER

Paulsen Spence, Baton Rouge, La.; L. B. Dexter and O. C. Paulsen, co-executors of said Paulsen Spence, deceased
Filed Feb. 8, 1957, Ser. No. 639,150
4 Claims. (Cl. 261-16)

My invention relates to a desuperheater system and an improved desuperheater.

It is often desirable to desuperheat some superheated steam for use in auxiliaries and the like which will not permit or do not require high temperature steam.

During high and normal loads, water sprayed through the desuperheater will be sufficiently atomized to be evaporated in the line and effect the cooling of the superheated steam. During light loads, the amount of cooling water required is small and it is difficult or impossible to self-atomize the same, and it is not properly taken up by the superheated steam to cool the same. Therefore for light loads, there is a supply of atomizing steam to the desuperheater and this steam must, of course, be at a pressure higher than the pressure in the superheated steam line. I have devised a novel means for obtaining atomizing steam at a pressure higher than that normally prevailing in the superheated steam line so that there will always be a sufficient supply of atomizing steam to the desuperheater for light loads.

My invention also contemplates an improved desuperheater, which may be used in my improved or other system.

It is an object of my invention, therefore, to provide an improved desuperheating system, which may be employed without the use of the special pressure reducing valve.

Another object is to provide a desuperheating system wherein the atomizing steam will be turned on when the load drops to a predetermined limit.

Another object is to provide an improved desuperheater.

Still another object is to provide a desuperheater involving means for quite accurately regulating the quantity of water passing into the superheated steam line.

It is another object to provide an exceedingly simple desuperheater, involving parts which may be readily assembled and disassembled, and, in general, the object is to provide an improved desuperheater and desuperheater system.

Other objects and various further features of novelty and invention will be pointed out or will occur to those skilled in the art, from a reading of the following specification in conjunction with the accompanying drawings.

In said drawings, which show, for illustrative purposes only, a preferred form of the invention—

FIG. 1 is a diagrammatic view showing a complete desuperheater system illustrative of the invention;

FIG. 2 is an enlarged, central, vertical, longitudinal sectional view through a desuperheater, illustrating the invention;

FIG. 3 is a sectional view, taken substantially in the plane of the line 3—3 of FIG. 2; and

FIG. 4 is a sectional view, taken substantially in the plane of the line 4—4 of FIG. 2.

Briefly stated, in a preferred form of the invention, the system includes a desuperheater, in a superheated steam line and provided with cooling water and atomizing steam inlets. I provide novel means for providing atomizing steam at a requisite pressure. The steam from the boiler is passed through a superheater and then passes into the superheated steam line. The steam in passing through the superheater of course loses some pressure, and the pressure in the superheated steam line is for that rea-

2

son considerably less than the pressure of the steam entering the superheater. This differential in pressure varies, of course, in accordance with design and conditions of operation, but that differential in pressure would usually be sufficient to atomize the water. Therefore, in order to provide atomizing steam at a pressure higher than the pressure in the superheated steam line and without employing a reducing valve, I take saturated steam from the boiler, or at any point in the steam line ahead of the superheater and conduct that saturated steam to the desuperheater. The pressure of this saturated steam is then higher than that of the superheated steam by about the amount of the pressure loss occurring through the superheater. Desuperheaters of various kinds may be employed in my system, but I prefer to employ a novel desuperheater, which may, of course, be employed in systems other than that heretofore referred to.

In the preferred form, the new desuperheater includes a body having an atomizing steam line connected thereto to provide atomizing steam for the water discharged by the desuperheater. The cooling water is preferably fed at a more or less constant rate to the water nozzle, and a return passage is provided from the water nozzle for return water not ejected through the water nozzle. Thus, with water supplied at a fairly constant rate and withdrawn at a lesser rate, the difference between the water entering the desuperheater and leaving the desuperheater will be ejected through the water nozzle itself. When the desuperheater is working at normal capacity, the nozzle and connections are such that the water will be fairly well atomized and thus evaporated by the superheated steam in the superheated steam line. However, when the load falls to, say, 15% of normal, so little water issues from the water nozzle that it may not be properly atomized, and in that case the atomizing steam is turned on the further atomize the water flowing from the water nozzle.

I shall first describe the desuperheater system and thereafter describe specifically the improved desuperheater which may be used in the present or in other desuperheater systems.

As illustrated, there is a boiler 5, conventionally shown, which is connected through the saturated steam main 6 with a superheater 7. The saturated steam is superheated in the superheater and is discharged through the discharge line 8, which may lead to the main turbine, and there may be a branch line 9, which leads to a superheated steam line 10 in which the steam is to be desuperheated for use in auxiliaries or the like requiring steam of a lesser temperature.

The desuperheater 12 is mounted in the superheated steam line 10 and the water nozzle preferably faces upstream. Cooling water enters the desuperheater through the cooling water pipe 13 at a fairly constant rate and preferably comes from the boiler feed pump. There is a water return pipe 14 leading from the desuperheater, which serves to withdraw water from the desuperheater so that only the difference in the water fed to the desuperheater and withdrawn through the line 14 will be discharged from the nozzle, as will be later described. Thus, the amount of water discharged may be accurately governed by controlling the return water line 14. When a greater quantity of cooling water is required, it is only necessary to throttle the flow through the return line 14 and thus force more of the water out into the superheated steam line. When less cooling water is required, the line 14 is not throttled so much and more of the water flows back away from the desuperheater, and thus less water is discharged into the superheated steam line. The throttling of the water line 14 is preferably accomplished by a valve 15, controlled by a diaphragm 16, which is acted on by suitable pressure through the line 17 and inlet pipe 18. A thermostat 19, in the desuperheated

steam line 10, is connected through a controller 20 so as to vary the pressure in the line 17 in accordance with the temperature of the desuperheated steam; that is, after it passes the desuperheater. Thus, if the desuperheated steam falls to too low a temperature, it will mean that less water should be supplied to the desuperheater, and thermostat 19 will act through the controller 20 to open the valve 15 and let further water escape or return from the desuperheater, and thus less will be projected into the superheated steam line. On the other hand, if steam in the superheated steam line is not cooled down to the desired extent, the thermostat 19 will act as heretofore stated, but oppositely, so as to close or throttle the valve 15, thus causing more water to be discharged into the superheated steam line 10.

As has been stated heretofore, as long as there is a normal flow of steam in the superheated steam line, there will be a normal flow of water through the desuperheater 12, and such normal flow will ordinarily be self atomized and thus be evaporated by the superheated steam so as to cool it off. However, when the load falls off to, say, 15% of normal, atomizing steam for the water is required, and this atomizing steam must, of course, be at a higher pressure than the pressure in the superheated steam line. Since there is no normal reducing valve in the superheated steam line, I take saturated steam from the boiler or from any line between the boiler and the superheater, such as the line 21, and that line conducts steam to the desuperheater so as to atomize the small amount of water flowing at the lower ratings. The atomizing steam to the desuperheater is turned on automatically when the load drops to a predetermined level, as 15% of normal. This automatic action is brought about by an atomizing steam valve 15' actuated by a diaphragm 16' connected to the control line 17 to which the diaphragm 16 of the cooling water valve 15 is also connected. Thus when the load in line 10 drops to say 15% of normal little cooling water is required and the control mechanism 20 drops the control pressure in the line 17 so as to open the cooling water return valve 15 to reduce the amount of water issuing from the water nozzle. This drop in pressure in the control line 17 also affects the diaphragm 16' to open the atomizing steam valve 15' and thus provides the necessary atomizing steam to the desuperheater. During normal and high load in the line 10, the pressure in the control line 17 is raised to increase the cooling water supply and this rise in pressure in the line 17 will act through the diaphragm 16' to close the atomizing steam valve 15'.

As has been stated above, a considerable amount of pressure is lost in the superheater so that the saturated steam pressure is usually higher by five pounds or more as a general thing than the superheated steam pressure, and that differential is sufficient to atomize the water passing through the desuperheater. It will thus be seen that no reducing valve is necessary in order to get a steam pressure high enough to atomize water in the desuperheater, and therefore the cost of the reducing valve is saved and there is no loss of pressure in the superheated steam line.

As has been indicated, various types of desuperheaters may be employed, but I have devised a novel form of desuperheater which is well fitted for operation in the system as described or in any other desuperheater system. The desuperheater, then, as shown in the drawings, includes a body 25, having a rearwardly extending chamber 26 therein closed at the rear and open at the front. This desuperheater has means for conducting cooling water to it and through it, so as to provide the necessary cooling water for desuperheating steam.

In the particular form illustrated, near the end of the chamber 26 is a tapered seat opening 27 and a water conducting head 28 has a corresponding seat so that the head fits the chamber and closes the end quite tightly. This water conducting head has a rearwardly extending tubular portion 29, which may fit within the chamber, as

indicated at 30 (FIG. 4) to steady the rear end of the water conducting head. The rearward extension may be closed as by means of a plug 31, as will be understood. The water conducting head 28 may be held in place by what may be termed a water nozzle plug 32, which is threaded in the end of the body and which bears annularly, as indicated at 33, against the face of the water conducting head. Between the water conducting head 26 and the plug 32, there is an annular channel 34, which in the form shown is principally in the plug 32. The water conducting head has a plurality of openings 35 extending therethrough and communicating with the annular channel 34. The plug 32 has inclined openings 36 therein, which extend into what may be termed a water chamber 37 in the plug and which has a water nozzle 38. The water conducting head 32, furthermore, has openings 39 communicating with the water chamber 37 and the nozzle 38 and opening into the rear tubular extension 29. A water inlet pipe 13 is connected to the body and preferably welded, as indicated at 41. This inlet pipe conducts cooling water into the chamber 26 in the body and the water passes through the openings 35 into the annular channel 34, as heretofore described. A water return pipe 14 is secured by a threaded joint 42 to the tubular extension 29 and serves to return the water passing through the return openings 39. Thus, when water enters through the pipe 13, it enters the annular channel 26 and then passes through the openings 35 into the channel 34. From this channel, the water passes through the inclined channels or passages 36, which give the water a whirling motion as it enters the water chamber 37 and the outlet nozzle 38. Thus, with considerable pressure and a considerable volume flowing through the nozzle, the water will be automatically self sprayed or coned out so as to be easily taken up and evaporated by the superheated steam.

The quantity of cooling water, as stated, is controlled by throttling the return water through the pipe 14. Thus, when it is desired to increase the water flow through the nozzle 38, the pipe 14 is throttled and thus the water in the chamber 37 is forced out of the nozzle instead of passing through the openings 39 and back into the return pipe 14. When less water is required, the return pipe 14 is throttled less, that is, opened wider and more of the water which entered through the water inlet pipe is permitted to return and thus less water will be permitted to escape through the nozzle 38.

In order to provide a steam atomizer for the water passing through the desuperheater, I employ a steam nozzle member 43, which may be secured to a flange on the body, as by means of screws 44 or the like. This nozzle member 43 has an turned lip 45, which cooperates with a coned surface 46 on the desuperheater body, thus forming a nozzle to cone the steam toward the center and thus certainly to atomize whatever water passes through the nozzle 38. Steam enters through the steam pipe 21 heretofore described, which pipe is secured as by welding to the steam-nozzle member 43 as indicated at 47. This steam pipe 21 discharges into the annular space 48 between the inside of the nozzle member 43 and the body 25.

It will be seen then that the quantity of water may be accurately controlled by controlling the passage of water through the return pipe and the water will always be sprayed into the superheated steam line by its own whirling and atomizing motion during normal supply of water and by the atomizing steam during low flow.

While the invention has been described in considerable detail and a preferred form illustrated, it is to be understood that various changes may be made within the scope of the invention as defined in the appended claims.

I claim:

1. In a desuperheater, a desuperheater body having a cylindrical chamber open at one end, a water-conducting head fitting within the end of said chamber and having a tubular extension extending back into said chamber, the rear portion of said tubular extension being relatively

5

square to be supported within said cylindrical chamber at each corner thereof, a water nozzle plug threaded in the front end of said chamber and holding said water-conducting head in place, said water-conducting head and plug having a water chamber between them and a water nozzle extending outwardly therefrom, said plug and said water-conducting head having an annular groove between them, said water-conducting head having a plurality of openings communicating said cylindrical chamber with said groove, water inlet means to said desuperheater body and outside said water-conducting head extension, said plug and water-conducting head having spiral grooves between them communicating with said annular groove and connecting the latter with said water chamber and nozzle, said water inlet means being connected to said cylindrical chamber for conducting water through said opening and into said annular groove, said water-conducting head having a plurality of circularly spaced apart openings connecting the interior of said tubular extension with said water chamber, a water return pipe connected to said tubular extension, a steam nozzle member secured to said body about said water nozzle plug and providing an annular chamber about the outside of said body and terminating in a narrow annular steam atomizing space between said body and said steam nozzle member, and a steam pipe connected to said steam nozzle member and said annular chamber aforesaid.

2. In a desuperheater system,

a main steam line,

a desuperheater in said line,

cooling-water-conducting means for conducting cooling water to and discharging a fraction of the flow of the same through said desuperheater into the main line,

said last-defined means including an exhaust connection external of the main line for conducting undischarged liquid cooling water away from said desuperheater and thus determining the amount of water discharged at said desuperheater,

means including a saturated-steam connection for conducting saturated atomizing steam to and spraying the same from said desuperheater into said main line to atomize the cooling water,

means for controlling the supply of cooling water sprayed from the desuperheater and including throttling means in said exhaust connection,

another throttling means for controlling the supply of saturated atomizing steam to said desuperheater, and coordinated control means for said respective throttling means to throttle the supply of atomizing steam to said desuperheater when the quantity of cooling water sprayed from said desuperheater increases,

said control means being set to shut off said steam when the cooling water discharge flow exceeds a predetermined limit.

3. In a desuperheater system
a source of superheated steam,
a source of cooling water,
a source of saturated steam,

6

a main line connected to said source of superheated steam,

cooling means coupled to said source of cooling water for discharging part of the flow of cooling water flowing from said source of cooling water, including intake means substantially external of said main line connected to said source of cooling water,

flow means coupled to said intake means for discharging a part of the flow of said cooling water into said main line and

exhaust means substantially external of said main line coupled to said intake and discharge means for conducting the undischarged part of the flow of cooling water away from said main line,

atomizing means coupled to said source of saturated steam for discharging atomized saturated steam into said main line to atomize the cooling water,

first control means coupled to said exhaust means to throttle the flow of undischarged cooling water thereby controlling the amount of cooling water discharged into said main line,

second control means coupled between said atomizing means and said source of saturated steam to throttle the flow of saturated steam to said atomizing means, and coordinating control means coupled to said first and second control means and responsive to the temperature of said superheated steam flowing in said main line at a position downstream of said cooling and atomizing means to throttle the flow of saturated steam when the throttling of said first control means increases,

said coordinating control means fully throttling said second control means to shut off said saturated steam when said first control means is at a predetermined position, whereby said saturated steam is shut off from said main line when the cooling water discharge flow exceeds a predetermined limit.

4. In the desuperheater system of claim 3, said coordinating control means is coupled to said first and second control means by a pressure line and said coordinating control means varies the pressure in said pressure line in response to the said temperature at said downstream position.

References Cited in the file of this patent

UNITED STATES PATENTS

1,582,080	Peabody	Apr. 27, 1926
2,155,986	Wheaton	Apr. 25, 1939
2,222,348	Gorrie	Nov. 19, 1940
2,276,055	Mastenbrook	Mar. 10, 1942
2,293,314	Spence	Aug. 18, 1942
2,373,707	Peabody	Apr. 17, 1945
2,550,683	Fletcher et al.	May 1, 1951
2,610,837	Puster	Sept. 16, 1952

FOREIGN PATENTS

482,901	Great Britain	Apr. 7, 1938
649,970	Great Britain	Feb. 7, 1951