Feb. 6, 1951 C. C. CARSON 2,540,097

VAPOR SEPARATOR

Filed March 7, 1946

FIG. 1

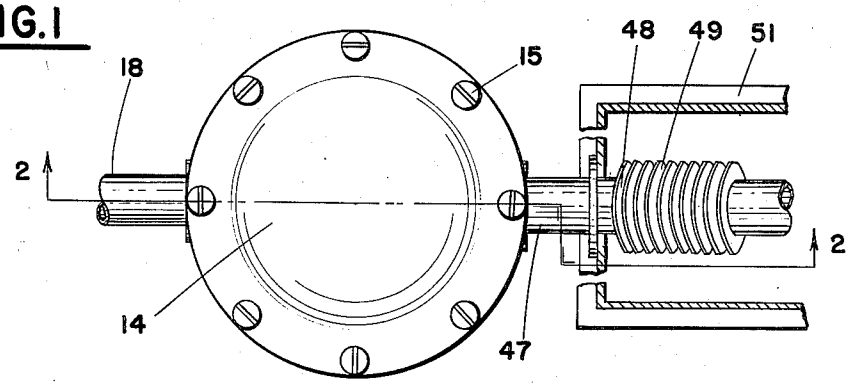
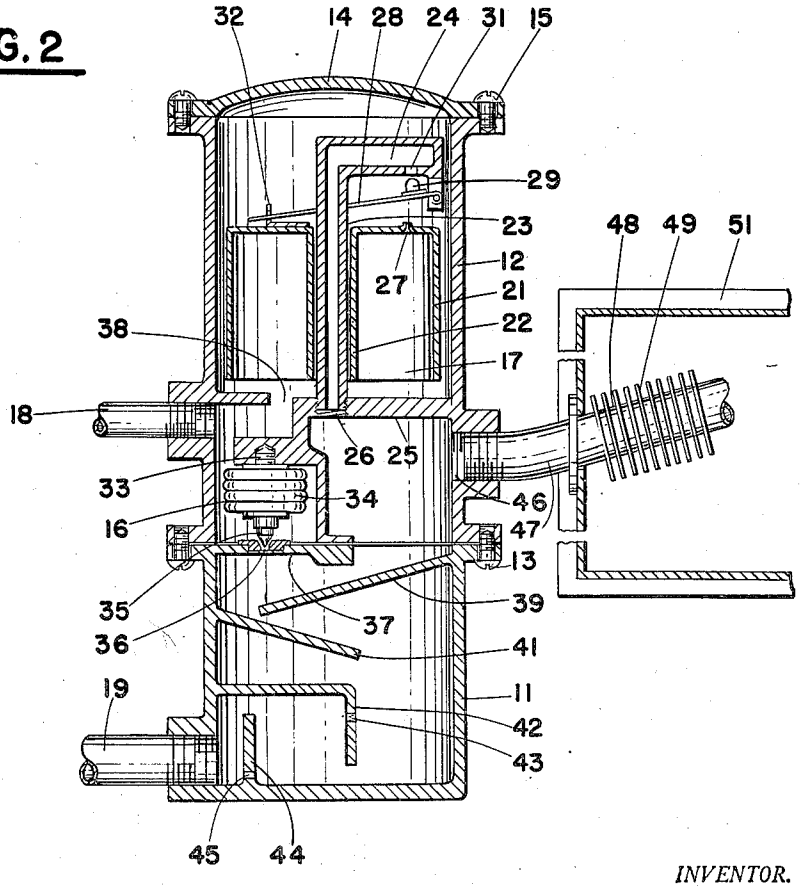


FIG. 2



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VAPOR SEPARATOR

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3 Claims. (Cl. 237—67)

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This invention relates to apparatus suitable for insertion in a steam power system for conveying condensate into exhaust or return lines, and, in particular, relates to a steam trap adapted to be utilized for the handling of condensate received thereby, for condensing flash steam formed from such condensate so received, and for insuring delivery of all of the condensate into the exhaust or return lines. It is an improvement on the steam separator disclosed in applicant's copending application, Serial Number 615,063, filed September 7, 1945, now Patent Number 2,449,055.

Heretofore, experience has shown that by reason of failure to provide a suitable means for insuring a complete condensation of all flash steam formed at the low pressure or exhaust side of a heat exchanger or the like, exhaust handling facilities are, of necessity, of unreasonably great dimensions. The exhaust lines, for example, are usually many times the diameter which would normally be required for handling exhaust condensate alone were there no flash steam present with which to contend. However, operation has shown that even though steam at high pressure is completely condensed so that all of the heat of vaporization available has been utilized, as soon as the condensate is expelled into the low pressure or exhaust side of a heater, flash steam is immediately formed by reason of the fact that at the low pressure, a portion of the condensate returns to steam, thus bringing about complete saturation at the low pressure. If the condensate remaining, plus the flash steam thus formed, are to be exhausted to the return line in the normal fashion, it is readily apparent that piping of unnecessarily large diameter will be required.

It is one object of this invention to provide a means whereby all of the heat which may be available from high pressure steam may be utilized before exhaust of the resulting condensate thereof takes place.

Another object of this invention is to provide a steam trap which will insure complete drainage of condensate from steam power lines.

A further object of this invention is to provide a trap which is adapted to purge from a steam line air which may be entrapped therein.

Still a further object of this invention is to provide a trap which is simple in construction, having relatively few moving parts and which is positive and complete in its operation.

These, as well as the various other novel features and advantages of this invention, will become apparent from a reading of the description and accompanying drawings of which:

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Figure 1 is a plan view of the steam trap associated with a flash steam heat exchanger, and Figure 2 is a sectional view taken at 2—2 of Figure 1.

With reference to the drawings, the steam trap illustrated therein comprises a cylindrical hollow low pressure chamber 11, cylindrical shell or high pressure chamber 12 supported thereby and secured thereto at its flanges by means of suitable screws 13, cover 14 secured to the upper end of chamber 12 at its flanges by means of screws 15, thermostatic valve 16, steam trap cylindrical inverted bucket 17 and inlet and outlet 18 and 19 respectively.

The cylindrical inverted bucket 17, consisting of outer and inner walls 21 and 22, is provided with a central opening 23 through which extends an L-shaped hollow tube 24 adapted to serve as a guide therefor and which, in turn, is secured to a partition 25 at the threaded opening 26. A small vent 27 in the upper portion of the inverted bucket 17 insures the expulsion of any slight amount of air which may be entrapped therein during operation of this device. Pivotally secured to one end of the L-shaped hollow tubular member 24 is a lever 28 having at its pivotal end a ball valve 29 adapted to engage with the seat 31 of the opening in L-shaped tubular member 24. The outward or free end of lever 28 is received for sliding movement in an opening in bracket 32, said bracket being secured to the upper portion of inverted cylindrical bucket 17, so that vertical movement of the bucket will cause the lever 28 to slide in the opening of the bracket swinging upward to cause the ball valve 29 to engage with the seat 31 of the hollow L-shaped tubular member 24. The thermostatic valve 16, secured at one end to the partition 25 by the threads 33 comprises an expansible bellows 34 and a needle valve 35 actuated thereby. A valve seat 36 adapted to be engaged by the needle valve portion is provided in partition 37. An opening 38 in the partition 25 between the cylindrical shell 12 and inlet 18 provides for the passage of steam and relatively high temperature condensate from the heater exhaust through inlet 18 into the chamber 12 and inverted bucket 17. A plurality condensate agitating baffles 39, 41 and 42 are provided in the cylindrical base 11, the lower baffle 42 having a small opening or vent 43 to insure passage there-through of any small amount of air which may be entrapped in the lower portion of the apparatus. Another vertical baffle 44 is secured to the base 11 adjacent to outlet 19, at the bottom portion of which is a

small vent 45 to insure that any condensate entrapped in the lower part of the device will be drained to the exhaust, thus eliminating the danger of damage due to freezing when the apparatus is not in use.

In order that the heat may be extracted from any flash steam which may form in the lower portion of the steam trap, a tubular conductor 47, threadably engaged in threaded opening 46 of the lower portion of the cylindrical shell 12, communicates with and conducts the flash steam to condenser 48. This condenser 48, having fins 49 spaced along its length, is positioned within a rectangular hollow chamber 51 through which air to be heated is passed and brought into contact with the fins 49 of the condenser 48. Conductor 47 is of such a size that the condensate forming within the condenser as a result of extraction of heat from the flash steam received therein, may be returned to the lower portion of the cylindrical member 12 and drained down into base 11 so that eventually it escapes into the exhaust 19. The volume of the space on the side of the baffle 42 adjacent to the exhaust opening 19 is substantially equal to the volume which is occupied by the amount of condensate discharged each time the trap opens to force condensate into the low pressure chamber.

When the steam power system, with which the apparatus is associated, is operated for heating purposes or the like, air as well as a slight amount of water is first expelled from the steam power line and into the radiator from which it escapes to the trap through inlet opening 18. The air and low temperature water pass from the inlet opening 18 down through the space around the thermostatic valve 35, over the baffles 39, 41 and 42 and finally out the exhaust 19. However, as soon as live steam enters the trap, the thermostatic valve 16 closes immediately by reason of its high sensitivity to other than ordinary low temperatures so that any steam subsequently entering the trap is caused to pass into the upper portion thereof through opening 38 and into the bucket 17. Any small amount of steam which passes through vent 27 is condensed before it reaches the opening 31, the loss of heat from the body of the apparatus being sufficient to offset the latent heat of the small amount of steam which escapes through said opening. As the steam condenses, the level of the condensate in shell 12 will rise to such a point as to cause the bucket 17, by reason of steam contained therein, to become buoyant and rise to such a level as to force the ball valve member 29 into engagement with the seat 31 thus closing the passage between the high pressure and low pressure chambers. As soon as condensation of the steam thus entrapped is effected, the bucket 17 drops, opening the valve between the high and low pressure chambers to permit a quantity of the condensate to be forced, by reason of the difference in pressure, through the L-shaped tubular member 24 to the low pressure chamber 11. Upon reaching this low pressure area, however, the condensate or a portion thereof immediately flashes into steam. The steam thus created can be utilized for furnishing considerable heat for an air heating system by permitting it to pass into the condenser 48 through the tubular conductor 47 where it condenses, losing its latent heat of vaporization to the condenser and air passing over fins 49. The condensate thus formed will drain back into the bottom portion of cylindrical shell 12 and into the lower portion of the low pressure chamber 11. The condensate entrapped at the bottom of the chamber 11 is caused to be expelled to the exhaust at each instance that the trap opens by reason of the fact that the high pressure on the high pressure side will momentarily be in communication with the low pressure chamber so that the water is forced out as a result of the pulsating action.

Since the thermostatic valve 16 is located in a position lower than the inlet opening 18, complete drainage of the power system is insured at all times for as the condensate, which is normally present when the device is not in operation, is of a low temperature, the thermostatic valve 16 remains open insuring complete drainage of condensate by gravity to the exhaust 19. Thus, no condensate can be retained in the high pressure chamber of the trap to freeze and cause damage to the apparatus when the device is not in use.

As an aid to rapid flashing when the condensate reaches the low pressure chamber, the baffles 39, 41 and 42 are so arranged to cause the flow of condensate to be restricted and to bring about agitation thereof to insure that a portion of the heat contained therein will be utilized in the formation of flash steam.

It will be understood that the above description and accompanying drawings comprehend only the general and preferred embodiment of the invention and that various changes in construction, proportion and arrangement of the parts may be made within the scope of the appended claims without sacrificing any of the advantages of the invention.

The invention herein described and claimed may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

I claim:

1. Apparatus for extracting heat from a heat transmitting medium issuing from a power system comprising a high pressure chamber into which air, condensate and vapor may be introduced from said power system, a low pressure chamber beneath and communicating with said high pressure chamber by means of two independent passages, a thermostatic valve beneath said high pressure chamber adapted to close one of said passages and a mechanically operable valve adapted to close the other of said passages, buoyant means for actuating said last-mentioned valve, a plurality of baffles arranged within said low pressure chamber to break up said condensate and for reversing the flow of condensate received therein from said high pressure chamber, a heat exchanger associated with said low pressure chamber, and an exhaust so located with respect to said pressure chambers as to automatically insure complete drainage of all condensate from said apparatus when the apparatus is cut of operation.

2. Apparatus for extracting heat from a heat transmitting medium issuing from a steam power system comprising an inlet, a high pressure chamber into which air, condensate and vapor may be introduced from said power system, a low pressure chamber beneath and communicating with said high pressure chamber, a passage adjacent to said inlet and between said chambers, a thermostatic valve within said passage and beneath said high pressure chamber adapted to permit air and a relatively low

temperature condensate to pass directly into said low pressure chamber, a second passage between said high and low pressure chambers, a mechanically operable valve within said second passage, buoyant means for actuating said last-mentioned valve, a plurality of baffles arranged within said low pressure chamber to break up said condensate and for reversing the flow of condensate received therein from said high pressure chamber, a heat exchanger associated with said low pressure chamber, and an exhaust so located with respect to said pressure chambers as to automatically insure complete drainage of all condensate from said apparatus when the apparatus is out of operation.

3. Apparatus for extracting heat from a heat transmitting medium issuing from a steam power system comprising an inlet, a high pressure chamber into which air, condensate and vapor may be introduced from said power system, a low pressure chamber beneath and communicating with said high pressure chamber, a passage adjacent said inlet and between said chambers, a thermostatic valve within said passage and beneath said high pressure chamber adapted to permit air and a relatively low temperature condensate to pass directly into said low pressure chamber, a second passage between said high

and low pressure chambers, a mechanically operable valve within said second passage, buoyant means for actuating said last mentioned valve, condensate flow restricting means in said low pressure chamber to insure completion of flashing of condensate received therein, a heat exchanger associated with said low pressure chamber, and an exhaust so located with respect to said pressure chambers as to automatically insure complete drainage of all condensate from said apparatus when the apparatus is out of operation.

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