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O'Brien

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[54] **FREEZE-PROOF STEAM TRAP SYSTEM, PACKAGE AND METHOD**

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[52] **U.S. Cl.** **237/67;** 237/80; 55/267; 137/185

[51] **Int. Cl.²** **F24D 1/02**

[58] **Field of Search** 137/185, 192, 62; 237/80, 237/67; 236/52; 55/267; 210/180; 165/110

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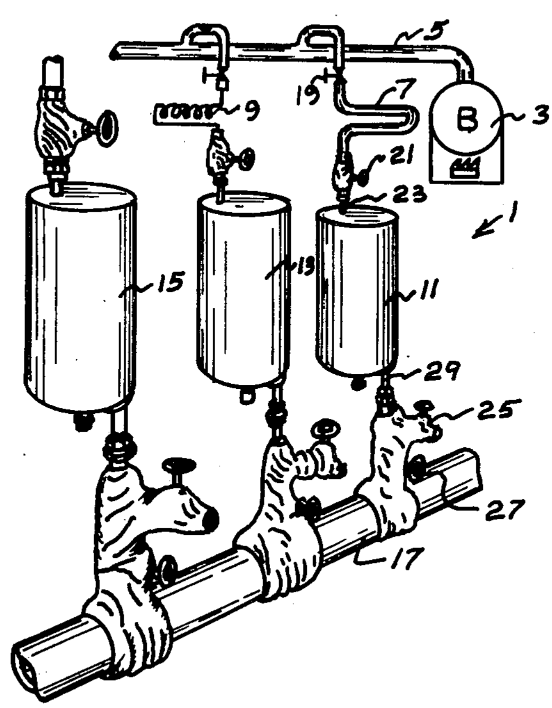
[57] **ABSTRACT**

A freeze-proof mechanical steam trap in a steam heating system includes a vapor filled pipe which draws heat from a discharge manifold and a jacket of foamed polyurethane for protecting the condensate in the trap. The heat pipe in the preferred embodiment is a vertical discharge pipe which utilizes flash steam in the discharge manifold as its working vapor and which transfers its heat to the condensate in an inverted bucket trap and its inlet pipe through a heat exchange arrangement.

29 Claims, 5 Drawing Figures



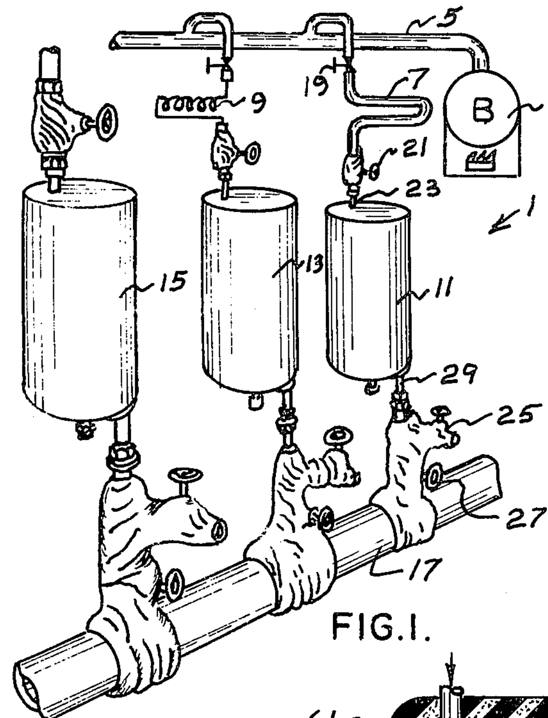


FIG. 1.

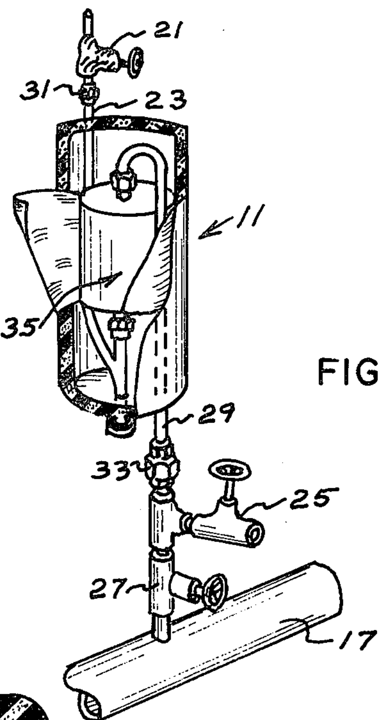


FIG. 2.

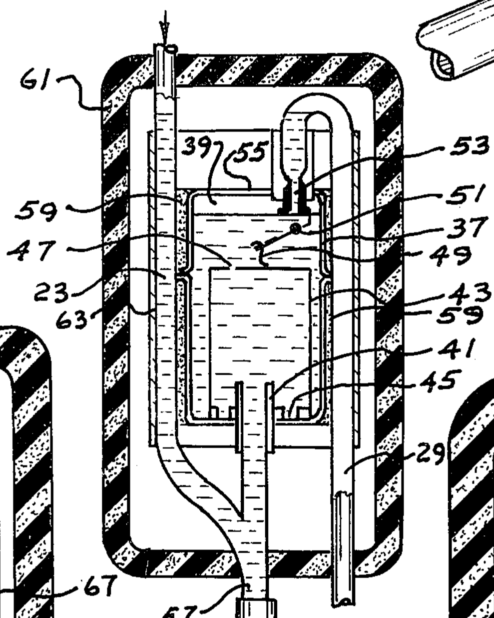


FIG. 3.

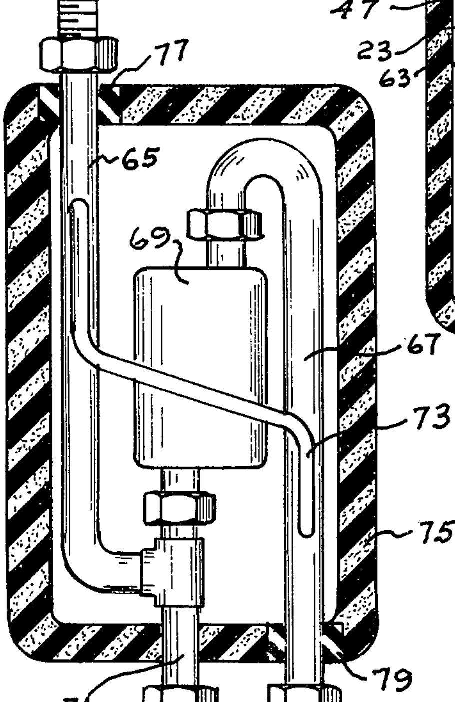


FIG. 4.

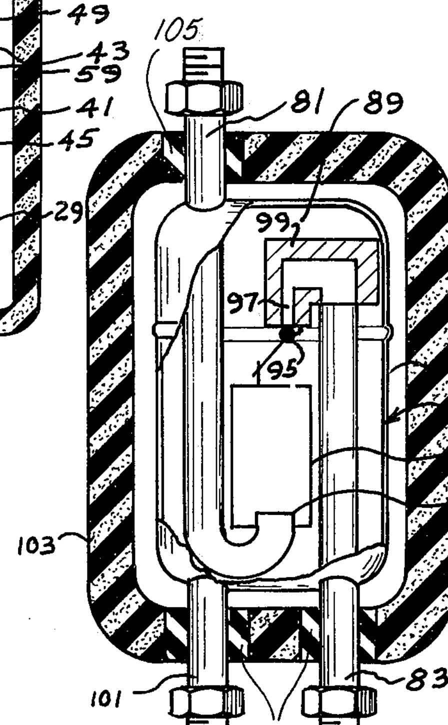


FIG. 5.

FREEZE-PROOF STEAM TRAP SYSTEM, PACKAGE AND METHOD

BACKGROUND OF THE INVENTION

This invention relates to steam traps utilized in steam heating systems, and in particular to means for preventing the freezing of mechanical steam traps in such systems.

Steam heating systems are widely used, for example for heating reactants and products in many industrial processes, for commercial cookers and water heaters, and for space heaters. The present invention relates to such systems which are at least partially located where they are exposed to sub-freezing temperatures. These systems generally include a source of steam under pressure, one or more heat exchangers connected to the steam source, a discharge manifold for receiving condensate from the heat exchanger and a steam trap between the heat exchanger and the discharge manifold for obstructing the passage of steam to the manifold while allowing condensate (as well as air and carbon dioxide) to pass. Steam heating systems generally include more than one heat exchanger connected to a common manifold. Even a system having only a single heat exchanger, however, frequently also includes a bypass line discharging through a steam trap, although a discharge manifold is seldom utilized. The design of steam heating systems with particular emphasis on their steam traps, is discussed in The Armstrong Steam Trap Book (Catalog L-4A), copyright 1971 by Armstrong Machine Works, Three Rivers, Michigan.

The term "discharge manifold" is used broadly herein, and includes any collecting device having more than one inlet through which it receives condensate. Thus, the discharge manifold might be a holding tank, a flash tank, a return line or any of a number of other devices.

Numerous steam traps are presently known. Those classified as mechanical steam traps are generally the simplest, longest-lived and least expensive. They are also adaptable to a wide range of capacities and pressure differentials. Many of the virtues of mechanical steam traps are attributable to their use of a float to control the discharge of condensate, the discharge valve generally being water sealed when closed. The water-sealed valve, however, gives rise to one of the chief disadvantages of mechanical steam traps, their vulnerability to freezing.

The freezing of steam traps is a long-standing and serious unsolved problem. Because no satisfactory means for preventing steam traps from freezing has been known, untold losses are incurred annually in plant down time.

The danger of freezing a mechanical steam trap is particularly great when the steam supply to the trap is shut off. In sub-zero weather, particularly with a wind, steam traps may freeze in a very few minutes.

Heretofore, when a danger of freezing mechanical steam traps has been recognized, the only safeguards available have been careful sizing and positioning of the parts of the system, particulaly the steam traps, in the original design of the system and then draining the trap manually or automatically whenever the steam supply to those traps is shut off. These safeguards are not always effective. Furthermore, even in a well-designed system, automatic draining requires moving parts which are subject to wear, leakage and failure; draining the trap manually requires the immediate location of all traps affected by the closing of a particular valve, removing their drain plugs to allow the hot water in the system to drain, and replacing the drain plugs before the system is recharged with steam.

Probably the most successful of the mechanical steam traps is the inverted bucket trap. However, it is particularly vulnerable to freezing because its outlet is at the top of its float chamber; therefore, it has a water seal which substantially fills the trap and rises into the inlet conduit to about the level of the top of the trap. Draining an inverted bucket trap is particularly undesirable because when the part of the system served by the trap is reactivated, the trap may blow steam through (remain open) until it is reprimed. The benefits of the present invention are particularly great when the invention is utilized with an inverted bucket trap.

SUMMARY OF THE INVENTION

Accordingly, one of the objects of this invention is to provide means for preventing the freezing of mechanical steam traps in a steam heat exchange system.

Another object is to provide such a means which is simple, reliable and inexpensive.

Other objects will occur to those skilled in the art in the light of the following description and accompanying drawings.

In accordance with this invention, generally stated, steam traps are prevented from freezing by transferring heat energy from their discharge manifold to the condensate in the steam trap through a heat pipe and by insulating the condensate from the ambient sufficiently to provide a thermodynamic balance at a temperature above the freezing point of the condensate when the steam source feeding the steam trap is shut off.

The term "heat pipe" is used herein to mean any device which transfers heat by transporting vapor from an evaporator (vapor source) through a duct, recondensing the vapor at an area remote from the evaporator, and returning the condensate to the evaporator. The return of condensate may be by gravity, by means of a wick or otherwise.

Preferably, the condensate to which the heat energy is transmitted, and which is insulated from the ambient, includes all of the condensate in the vicinity of the steam trap when the steam to the trap is shut off. Thus, if a drip tube is included for collecting dirt and scale from the system, at least a part of it is preferably jacketed with the steam trap. In an inverted bucket trap, the inlet pipe is also preferably jacketed with the steam trap to a level above the float chamber.

The ambient temperatures for which the present invention is adapted may be quite low. For example, experiments show that the preferred embodiment maintains a condensate temperature well in excess of freezing when exposed to −20°F. and 30 mile per hour wind, with a discharge manifold pressure as low as atmospheric pressure. It will be understood that the present invention contemplates protecting steam traps from ambient conditions of at least this order of severity.

The steam heating systems in which the invention is designed to be used typically include a steam source, a heat exchanger connected to the steam source, a discharge manifold which receives hot condensate from the heat exchanger and from at least one other source, and a mechanical steam trap connected between the heat exchanger and the discharge manifold. The steam trap contains condensate which is subject to freezing at least when the steam trap is cut off from the steam source. The improved freeze-proofing means include heat pipe means for transferring heat energy in the form of vapor from the discharge manifold into proximity with the body of the steam trap, heat transfer means for transferring the heat energy from the vapor to the condensate in the steam trap, and insulative means for insulating at least the condensate in the steam trap and the heat transfer means from the ambient. The freeze-proofing means are designed to provide a thermodynamic balance sufficient to prevent the condensate in the steam trap and its inlet conduit from freezing for an indefinite period, due consideration being taken of the most severe expected ambient wind and temperature conditions and of the expected temperature of the condensate in the discharge manifold.

Preferably, the heat pipe means comprise a discharge conduit from the trap to the discharge manifold, the conduit providing an unobstructed vertical heat pipe (i.e., a gravity return heat pipe) for flash steam from the discharge manifold to the heat transfer means. Flash steam is present in the discharge manifold because the pressure in the discharge manifold is less than the pressure at which the condensate was formed. As the flash steam at the upper end of the discharge conduit loses its heat energy to the heat transfer means, it recondenses, thereby forming a partial vacuum and drawing further vapor to the upper end of the discharge conduit. Alternatively, the heat pipe means may be a separate heat pipe. For example, when an unobstructed vertical heat pipe can not be provided, a heat pipe having a wick may be required.

The heat tranfer means is preferably a substantial area of a heat transfer material extending between the heat pipe means and the condensate in the steam trap. In the preferred inverted bucket steam trap, the heat transfer means also includes means for transferring heat energy from the heat pipe means to the condensate in the inlet conduit to the trap. The heat transfer means include a side wall of the heat pipe means which lies closely adjacent the condensate in the trap. The heat transfer means may also include a heat transmitting solid such as a plastic cement or a metal block between the side wall of the heat pipe and the side wall of the steam trap for conduction of the heat, or it may include a small air gap between these walls if convective conduction of heat is sufficient, or it may include a separate heat pipe. Alternatively, the side wall of the heat pipe may be the sole heat transfer means, as when the upper part of the discharge conduit directly contacts the condensate in the trap. Either an integrally cast conduit or a conduit positioned inside the float chamber will directly contact the condensate. In the preferred inverted bucket trap if the discharge conduit directly contacts the condensate the inlet conduit advantageously also does, the condensate thus acting as a means for transmitting heat energy from the discharge conduit to the inlet conduit.

Effective insulative means are essential to the invention. Protection from both temperature and wind is needed. Preferably, a jacket of a closed porosity foamed plastic is utilized. The closed cell construction eliminates the need for a separate protective layer for guarding against rapid dissipation of heat by the wind, against absorption of water by the jacket (thereby largely destroying its insulative properties), and against

absorption and attack by chemical agents such as hydrocarbons. Insulative means which permit heat losses of less than 1 BTU per hour, square foot, and temperature gradient of 1 degree F. (exclusive of conduction from pipes extending out of the insulative jacket) are desirable, and the preferred embodiment insulative jacket, with a surface of less than 2 square feet, permits hourly heat losses of less than one-half BTU per degree Fahrenheit gradient. Of course, what is necessary is that the heat losses balance the heat energy transferred to the protected condensate by the heat pipe and heat transfer means, at a temperature above the freezing point of the condensate. This is easily determined for any given temperature-wind condition, discharge manifold pressure (hence temperature) and heat transfer configuration. Because the most effective closed porosity foamed plastics presently available are not physically stable at the temperatures reached by some pressurized steam systems, additional high temperature insulation may be provided which spaces the jacket from the heated piping and steam trap.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, FIG. **1** is a partially diagrammatic view in perrspective of a steam heating system of the present invention, employing steam trap packages of the present invention;

FIG. **2** is a view in perspective, partially broken away, of one of the steam trap packages shown in FIG. **1**;

FIG. **3** is a cross-sectional detail of the steam trap package shown in FIG. **2**;

FIG. **4** is a cross-sectional detail, corresponding generally to FIG. **3**, of another embodiment of steam trap package of this invention, for use in the system shown in FIG. **1**; and

FIG. **5** is a cross-sectional detail, corresponding generally to FIGS. **3** and **4**, of another embodiment of steam trap package of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, and in particular to FIGS. **1–3**, reference numeral **1** indicates a steam heating system. The steam heating system **1** includes a source of steam in the form of a boiler **3** and a steam header **5** for distributing steam from the boiler **3**. Heat exchange devices, indicated by reference numerals **7** and **9** are connected to the header for utilizing the latent heat of the steam for heating purposes. The discharge ends of the heat exchange devices **7** and **9** are connected through identical steam trap packages **11** and **13** to a discharge manifold **17**. A third steam trap package **15** is provided for draining condensate from the remote end of the header **5**.

A manual shut-off valve **19** controls the flow of steam from the header **5** to the heat exchange device **7**. Another valve **21** is provided in the line between the heat exchange device **7** and an inlet pipe **23** of the steam trap package **11**. A test valve **25** and shut-off valve **27** are likewise provided between the outlet pipe **29** of the steam trap package **11** and the discharge manifold **17**. Preferably, the unions **31** and **33**, at the ends of the inlet pipe **23** and outlet pipe **29** respectively, are left uninsulated to permit easy removal of the steam trap package **11**. Similar piping, valves and fittings are provided for the steam trap packages **13** and **15**.

The steam trap package **11** includes a standard inverted bucket steam trap **35.** For example, the steam trap may be a ½ inch size "Series Ten-Ten" stainless steel inverted bucket steam trap, commercially available from Armstrong Machine Works, and described in this company's Bulletin No. 122. Briefly, the trap **35** includes a body **37,** which defines a float chamber **39.** Float chamber inlet tube **41,** connected to the inlet pipe **23,** guides the flow of condensate, steam, air and carbon dioxide into an inverted bucket **43.** The lower, open, rim of the bucket **43** is apertured to permit flow between the bucket and the bottom wall **45** of the float chamber **39.** The upper, closed, wall of the inverted bucket **43** includes a carefully sized vent **47** and connecting means **49** for connecting the bucket to a valve **51** which opens and closes an outlet aperture **53** in the top wall **55** of the chamber **39.**

A drip pipe **57** is provided as a vertical leg in the inlet pipe **23** below the float chamber inlet **41.** The drip pipe **57** permits draining of the steam trap **35** and also collects boiler scale and other debris which may be present in the system.

The inlet pipe **23** and outlet pipe **29** include long vertical reaches positioned closely adjacent the steam trap body. A heat conducting plastic cement **59** fills the space between the metallic walls of the pipes **23** and **29** and the stainless steel body **37** of the trap **35.** The cement **59** assures efficient transfer of heat energy from the outlet pipe **29** to the condensate in the trap float chamber **39** and in the inlet pipe **23,** as hereinafter described.

The steam trap package **11** also includes an insulative jacket **61** surrounding the inlet pipe **23,** outlet pipe **29,** steam trap **35** and heat transfer medium **59.** The side wall of the jacket **61** is spaced from the inlet pipe **23** and outlet pipe **29** but forms a close fit with the steam trap body **37** on the unobstructed two sides of the steam trap. A wrapping of glass cloth **63** around the pipes **23** and **29** and the steam trap **35** protects the jacket **61** from the deleterious effects of temperatures above about 350°F., which may be reached by the steam trap body **37.** The insulative jacket **61** is preferably formed in halves and is held frictionally by the steam trap body when the two halves are closed. It will be seen that the upper wall of the jacket **61** contacts the inlet pipe **23.** The high temperature polyurethane of which the jacket **61** is made will tend to powder in a small area around the inlet pipe if it is exposed to excessive temperatures, but the performance of the jacket will not be seriously affected.

The jacket **61** is made of a commerically available high temperature rigid foam polyurethane having a closed porosity structure (70 to 75% closed cells). This material is stable to a temperature above 300°F. and starts to powder at about 350°F. It is a very efficient insulator, with a K factor of 0.125 (BTU × inch depth)/(ft^2 × hr × °F.). It is also an efficient wind screen. Its closed cell structure gives it an absorption of less than 0.02 lbs/ft^2, thus insuring that its insulative properties will not be impaired by absorbed water. It has been found that a jacket ¾ inch thick in the form of a cylinder, 12 inches tall and ellipitical in cross section, with a width of 6 inches and a depth of 4 inches is highly satisfactory. This jacket has a surface area of about 1.6 sq. ft., as compared with a surface area of about one sq. ft. for uninsulated piping and steam trap occupying the same vertical space in a conventional steam trap installation. However, the conventional uninsulated steam trap installation has a BTU loss of about 3.4 BTU/hour °F. gradient, as compared with a heat loss of less than 0.3 BTU/hour °F. through the insulative jacket.

Under usual operating conditions, the steam heating system of the present invention operates in precisely the same way as a conventional system. Steam from the steam source **3** passes into the heat exchange device **7,** where it gives up its latent heat to the medium being heated, and condenses. The pressure of the steam in the system forces the condensate into the steam trap **35,** whence it is discharged into the discharge manifold **17.** A steam trap (of whatever type) performs the function of permitting condensate, air and carbon dioxide to pass through it while blocking the flow of steam. The operation of the inverted bucket trap **35,** of the preferred embodiment of this invention is well known. As long as the float chamber **39** and bucket **43** are filled with condensate, the weight of the bucket **43** holds the valve **51** open. When steam reaches the tap, it collects at the top of the bucket **43,** making it buoyant. When the bucket **43** rises, it lifts the valve **51** toward its seat and the flow of condensate snaps the valve shut. Air, carbon dioxide and steam slowly pass through the vent and collect at the top of the float chamber **39.** When entering condensate has raised the level of condensate in the bucket **43** sufficiently to overcome the pressure differential of the water seal on the valve **51,** the bucket sinks and opens the trap valve. Gases and condensate then pass through the trap until sufficient steam has again collected in the bucket.

Heretofore, inverted bucket steam traps have not been insulated at all, because of a general belief that steam vented through the bucket must be permitted to recondense by radiation of its heat through the trap body. See for example, The Armstrong Steam Book, at page 5. However, numerous experiments have shown that the preferred embodiment of this invention operates entirely satisfactorily, without any increased danger of blowing steam through.

When steam is shut off upstream of the trap **35,** as at valve **19,** steam between the shut-off point and the trap discharge condenses and drains through the trap until the outlet siphon is broken and the level of condensate equalizes in the inlet pipe **23** and the float chamber outlet **53.** It will be understood that when vacuum breakers are not provided in the system the level of the condensate in the inlet pipe **23** may be somewhat higher than in the outlet **53** because of the partial vacuum from the condensation of steam in the inlet pipe.

So long as any steam trap feeding the discharge manifold **17** is connected to the steam source, the condensate which it discharges provides a source of flash steam which rises in the outlet pipe **29** of the steam trap package **11.** At this upper riser portion of the outlet pipe **29** adjacent the trap body **37,** the flash steam transmits its latent heat through the heat transmitting cement **59** and the body **37** of the steam trap to the condensate in the steam trap. The heat transmitting cement **59** between the inlet pipe **23** and the trap body **37** also insures that heat energy carried by steam in the outlet pipe **29** is transmitted to condensate in the inlet pipe **23.** Convective heating is sufficient to protect the condensate in the lower part of the inlet pipe **23** and in the drip tube **57.** As the steam in the outlet pipe **29** gives up its latent heat and recondenses, a partial vacuum is produced at the upper riser part of the outlet pipe 29 which draws more steam into this heat exchange portion of the pipe. The condensate formed returns by gravity to the discharge manifold. Thus, the outlet pipe 29 acts as a heat pipe which transfers large amounts of heat energy from the discharge manifold to the condensate jacketed in the package 11. Even a small temperature differential between the condensate in the discharge manifold 17 and the condensate in the trap 35 is sufficient to induce the heat pipe action.

A system in accordance with the preferred embodiment was constructed and tested in a chamber where the temperature was held at or below −20°F. and a steady 30 mile per hour air flow across the system was maintained. With the discharge manifold vented to atmospheric pressure and a thermocouple attached to the union 31, one of two steam trap packages was shut off. The temperature at the union 31 stabilized above 40°F. Under the same conditions, but with a guage pressure of 5 lbs. per sq. inch on the discharge manifold, the temperature of the union 31 stabilized at 60°F. or higher. In a conventional system not utilizing the freeze-proofing method of the present invention, the steam trap freezes within minutes.

The steam trap package and system of this invention have thus far been described as means for carrying out a method of freeze-proofing the steam traps of a heating system having multiple heat exchange devices conventionally connected to a discharge manifold. The package and system may also be utilized in applications which do not conventionally include a discharge manifold. For example, a steam heating system having a single remote heat exchange device generally does not discharge into a manifold, although a bypass steam trap is generally provided in the steam main. When steam to the heat exchange device is shut off, the bypass steam tap discharges condensate as it is formed, to protect the main from the corrosive effects of standing condensate. By replacing the conventional steam trap draining the heat exchange device with a steam trap package of the present invention and connecting the steam trap package and the bypass trap to a common manifold, the steam trap draining the heat exchange device is protected from freezing. The freeze-proofing method in such a system works in precisely the same way as in the multiple heat exchange device system.

It may also be noted that when an enitre steam heating system is shut down (as may be occasioned by a disaster, for example), the system described will freeze more slowly than a conventional system, thereby providing a somewhat longer time before the steam traps freeze. More importantly, the present invention permits the traps to be thawed or protected from freezing by the simple expedient of running steam into the discharge manifold from a outside source. In a typical industrial installation involving thousands of steam traps, this method of protecting or thawing steam traps is an immense side benefit of the system.

Numerous variations in the package, system and method of this invention, within the scope of the appended claims, will occur to those skilled in the art, in the light of the foregoing disclosure. Numerous exemplary variations are discussed in the "Summary of the Invention" above. The variations of FIGS. 4 and 5 are merely by way of example.

In FIG. 4 a steam trap package is illustrated having an inlet pipe 65, outlet pipe 67, steam trap 69 and drip tube 71, all corresponding to similar elements in the embodiment of FIGS. 1–3. This embodiment, however, utilizes as its means for transmitting heat from the outlet pipe to the condensate, a separate heat pipe 73 having its side wall in contact with the outlet pipe 67, steam trap 69 and inlet pipe 65. The heat pipe 73 may contain Freon-22 as its working fluid. The internal pressure of the heat pipe 73 is chosen to provide vaporization and recondensation at a desired temperature. Because of the orientation of the heat pipe 73, an internal wick is not required for its operation. However, other configurations requiring wicking for the return of condensate to the "evaporator" end of the heat pipe may be used. The polyurethane foam insulative jacket 75 of this embodiment is spaced from the hot piping and from the steam trap by means of insulative sleeves or spacers 77 and 79 on the inlet pipe 65 and outlet pipe 67. The spacers are made of an insulative material which is stable at higher temperatures than the polyurethane jacket. For example, they may be formed of calcium silicate treated with a water-proofing material.

The embodiment of steam trap package shown in FIG. 5 includes an inlet pipe 81, outlet pipe 83 and inverted bucket trap 85. The casing 87 of the trap 85 encloses both the lower end of the inlet pipe 81 and the upper riser part of the outlet pipe 83 in the float chamber 89. An upwardly bent end 91 of the inlet pipe 81 forms the inlet to the float chamber 89, below an inverted bucket 93. The bucket 93 controls a valve 95 which opens and closes an outlet orifice 97 in a block 99 secured to the interior of the casing 87. The upper end of the outlet pipe 83 is secured to the block 99 and communicates through a passage in the block with the orifice 97. A drain pipe 101 connects directly through the casing 87 with the float chamber 89. An insulative jacket 103 and spacers 105 may be identical with those of FIG. 4. It will be seen that in this embodiment the means for transferring heat from steam in the outlet pipe 83 to the condensate comprise the entire surface area of the riser part of discharge pipe 83 within the condensate in the float chamber. The condensate in the float chamber transfers heat to the side wall of the inlet pipe 81, to heat the condensate in it.

Numerous other variations will be apparent to those skilled in the art.

Having thus described the invention, what is claimed and desired to be secured by Letters Patent is:

1. A freeze-proof mechanical steam trap package adapted to be attached in a steam heating system between a steam source and a discharge manifold below said package, said package comprising a steam trap body having a top and a bottom; a float chamber in said trap body; an inlet into said float chamber; an outlet from said float chamber; float means in said float chamber for opening and closing said outlet; an inlet conduit in fluid communication with said inlet into said float chamber; an outlet conduit in fluid communication with said outlet from said float chamber, said outlet conduit including a riser portion of substantial length; heat transfer means for transferring heat from said riser portion of said outlet conduit to said steam trap body; and a jacket of insulative material enclosing at least said trap body, said inlet conduit, said heat transfer means and said riser portion of said outlet conduit; said inlet conduit extending from said jacket at a height above said outlet from said float chamber for connection into said steam heating system, and said outlet con-

duit extending downward from said jacket for connection into said steam heating system, whereby heat energy in the form of vapor from the discharge manifold may be transferred through said outlet conduit to said float chamber and said inlet conduit within said jacket.

2. The package of claim **1** wherein said insulative jacket is a rigid foamed material and further including spacer means having substantially less thermal conductivity than said steam trap body and having greater thermal stability than said jacket for mantaining said jacket spaced from said steam trap body.

3. The package of claim **2** wherein said spacer means comprise a first insulative sleeve between said jacket and said inlet conduit and a second insulative sleeve between said jacket and said outlet conduit.

4. The package of claim **1** wherein said insulative jacket permits hourly heat losses through the jacket of less than one BTU per degree Fahrenheit gradient.

5. The package of claim **1** wherein said riser portion of said outlet conduit extends a substantial distance adjacent a side wall of said steam trap body, said heat transfer means comprising a substance between said outlet conduit and said side wall of said trap body.

6. The package of claim **1** including a drain conduit in fluid communication with said inlet conduit, said drain conduit being positioned entirely below said float chamber, said drain conduit extending through said insulative jacket for removing particulate matter and for draining said inlet conduit and said float chamber without removing said insulative jacket.

7. A freeze-proof inverted bucket steam trap package adapted to be attached in a steam heating system between a steam source and a discharge manifold below said package, said package comprising an inverted bucket steam trap having a top and a bottom, a float chamber in said trap, an inlet at the bottom of said float chamber, a outlet at the top of said float chamber, and an inverted bucket float positioned in said float chamber above said inlet for controlling opening and closing of said outlet; an inlet conduit in fluid communication with said float chamber inlet; an outlet conduit in fluid communication with said float chamber outlet, said outlet conduit including a riser portion of substantial length; heat transfer means for transferring heat energy from said riser portion of said outlet conduit to condensate in said steam trap and to said inlet conduit; and an insulative jacket enclosing said steam trap, said inlet conduit, said riser portion of said outlet conduit and said heat transfer means, said insulative jacket extending above said float chamber outlet and extending below said float chamber inlet; said inlet conduit extending from said jacket at a height above said float chamber outlet for connection into said steam heating system, and said outlet conduit extending downward from said jacket for connection into said steam heating system, whereby heat energy in the form of vapor from the discharge manifold may be transferred through said outlet conduit to said float chamber and said inlet conduit within said jacket.

8. The package of claim **7** wherein said insulative jacket permits hourly heat losses through the jacket of less than one-half BTU per degree Fahrenheit.

9. The package of claim **7** wherein said riser portion of said outlet conduit extends a substantial distance adjacent a side wall of said steam trap body, said heat transfer means comprising a side wall of said riser portion and a thermally conductive substance between said riser portion and said side wall of said trap body.

10. The package of claim **9** wherein said riser portion of said outlet conduit is exterior of said steam trap body, said thermally conductive substance comprising a thermally conductive solid in intimate contact with said riser portion of said outlet conduit and with said side wall of said steam trap body.

11. The package of claim **9** wherein said riser portion of said outlet conduit is interior of said float chamber, said heat transfer means comprising condensate within said float chamber.

12. The package of claim **7** including a drain conduit in fluid communication with said inlet conduit, said drain conduit being positioned entirely below said float chamber, said drain conduit extending through said insulative jacket for removing particulate matter and for draining said inlet conduit and said float chamber without removing said insulative jacket.

13. A method of protecting the steam trap of a steam heating system, said system including a steam source, a discharge manifold and a plurality of steam traps connected between the steam source and the discharge manifold, wherein steam may be shut off between the steam source and at least one steam trap without shutting off steam to all the steam traps, and wherein shutting off steam to said one steam trap results in the collection of condensate in said one steam trap, said method comprising maintaining a thermodynamically stable temperature gradient between the condensate and the ambient at a condensate temperature above the freezing point of water, by enclosing said steam trap in an insulative jacket and transferring heat energy from said discharge manifold to said condensate through at least one heat pipe extending within said insulative jacket in heat transferring relationship with said condensate.

14. The method of claim **13** wherein said temperature gradient is at least 50°F.

15. The method of claim **14** wherein said insulative jacket permits hourly heat losses through it of less than 1 BTU per degree Fahrenheit gradient.

16. In a steam heating system including a steam source, a heat exchange device connected to the steam source, a discharge manifold for receiving hot condensate from the heat exchange device and from at least one other source, and a steam trap connected between the heat exchange device and the discharge manifold, the steam trap containing condensate which is subject to freezing at least when the steam trap is cut off from the steam source, the improvement comprising protective means for protecting said steam trap from ambient temperatures substantially below the freezing point of the condensate in it, said protective means comprising heat pipe means for transferring heat energy, in the form of vapor, from the discharge manifold into proximity with the body of the steam trap, heat transfer means for transferring the latent heat of the vapor to the condensate in the steam trap, and insulative means for insulating the heat transfer means and the condensate in the steam trap from the ambient.

17. The improvement of claim **16** wherein the heat pipe means comprise an outlet conduit between the steam trap and the discharge manifold, the vapor comprises flash steam formed by hot condensate delivered into said discharge manifold by said other source, and the heat transfer means comprise a substantial length of a side wall of the outlet conduit.

18. The improvement of claim **17** wherein the steam trap is an inverted bucket trap having a float chamber with an inlet at its bottom and an outlet at its top and an inverted bucket float in the chamber controlling opening and closing of the outlet, wherein the system also includes a steam trap inlet conduit extending from the heat exchange device to the float chamber inlet, and wherein the insulative means comprise a jacket of insulative material enclosing the trap, portions of the outlet conduit adjacent the steam trap, and those portions of the inlet conduit below the float chamber outlet.

19. The improvement of claim **18** wherein the insulative material is a rigid, foamed, closed porosity plastic of sufficient thickness to transfer heat at a rate of less than 0.25 BTU per hour per degree Fahrenheit gradient per square foot.

20. The improvement of claim **16** wherein the steam trap includes a float chamber, an inlet conduit communicating with said float chamber, an outlet from said float chamber, a valve seat in said outlet, and float means in said float chamber, said float means being cooperable with said valve seat for controlling communication between said float chamber and said outlet.

21. The improvement of claim **20** wherein said heat pipe means comprise duct means for carrying to said heat transfer means flash steam formed by hot condensate delivered into said discharge manifold by said other source.

22. The improvement of claim **21** wherein the steam trap is an inverted bucket trap.

23. The improvement of claim **22** wherein said insulative means comprise an insulative jacket which permits hourly heat losses through it of less than 1 BTU per degree Fahrenheit gradient.

24. The improvement of claim **21** wherein said heat pipe means comprise an outlet duct connected between said float chamber outlet and said discharge manifold.

25. The improvement of claim **21** wherein said insulative means comprise a jacket of insulative mateial which permits hourly heat losses through the jacket of less than 1 BTU per degree Fahrenheit gradient.

26. The package of claim **25** wherein said insulative material is a rigid, foamed, closed porosity plastic of sufficient thickness to transfer heat at a rate of less than 0.25 BTU per hour per degree Fahrenheit gradient per square foot.

27. A freeze-proof mechanical steam trap package adapted to be attached in a steam heating system between a steam source and a discharge manifold below said package, said package having a top and a bottom, said package comprising:

a float chamber;

an inlet conduit communicating with said float chamber;

an outlet conduit communicating with said float chamber;

a valve seat in said float chamber;

float means in said chamber, said float means being cooperable with said valve seat for controlling communication between said float chamber and said outlet conduit;

means for transferring heat energy, in the form of vapor from the discharge manifold, to said float chamber and said inlet conduit;

a jacket of insulative material enclosing said float chamber, said inlet conduit, said outlet conduit, and said means for transferring heat energy,

said inlet conduit extending from said jacket at a height above said valve seat for connection into said steam heating system, and

said means for transferring heat energy comprising a conduit extending downward from said jacket for connection with said discharge manifold.

28. The package of claim **27** wherein said means for transferring heat energy comprise a substantial length of a side wall of a riser portion of said outlet conduit extending a substantial distance adjacent a side wall of said float chamber, and a heat conducting substance between said riser portion and said side wall of said float chamber.

29. The package of claim **27** wherein the insulative material is a rigid foamed plastic of sufficient thickness to transfer heat at a rate of less than 0.25 BTU per hour per degree Fahrenheit gradient per square foot.

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