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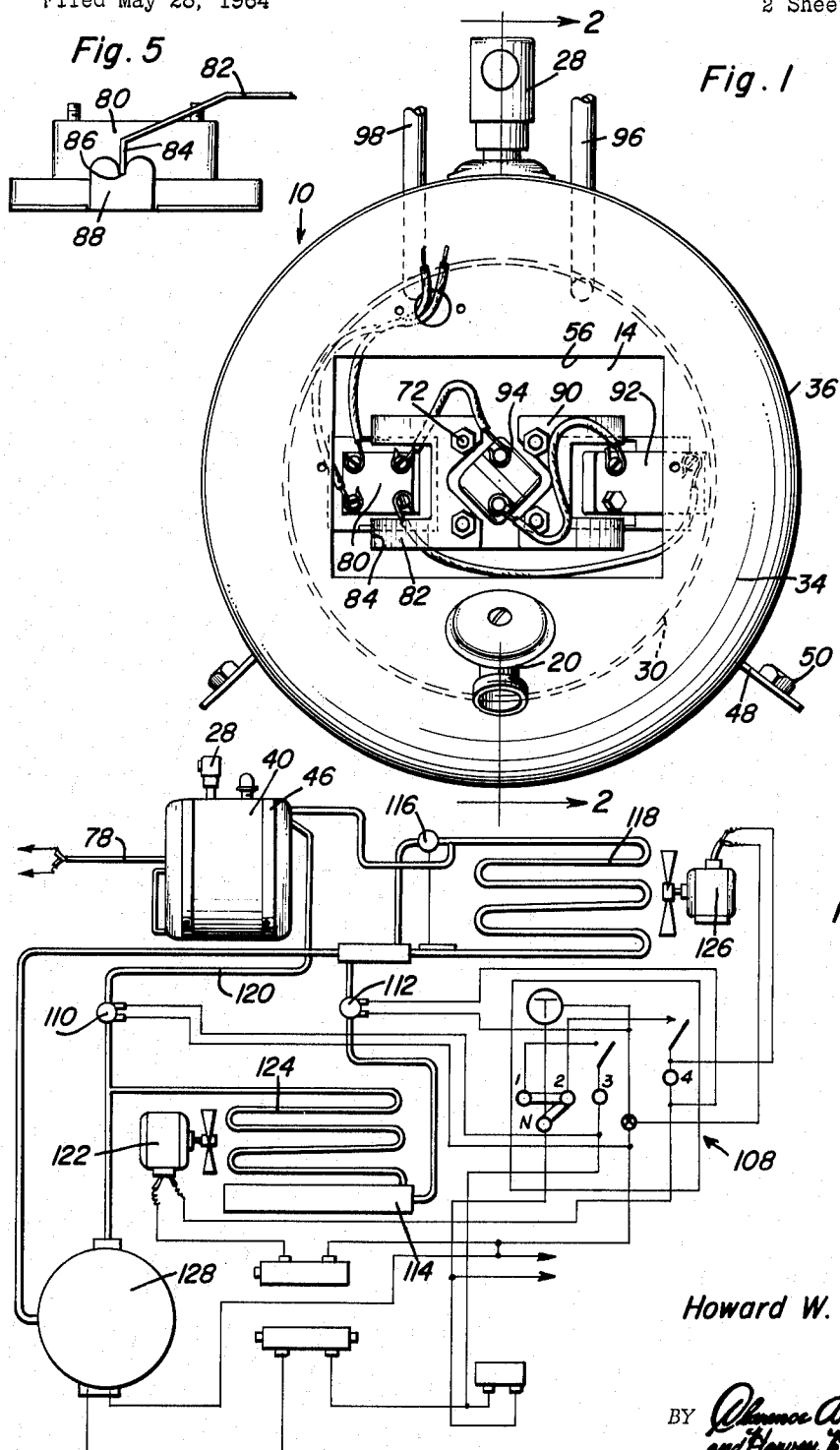
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3,256,708

REFRIGERATOR UNIT DEFROSTER WITH AUXILIARY HEATER

Filed May 28, 1964

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 2

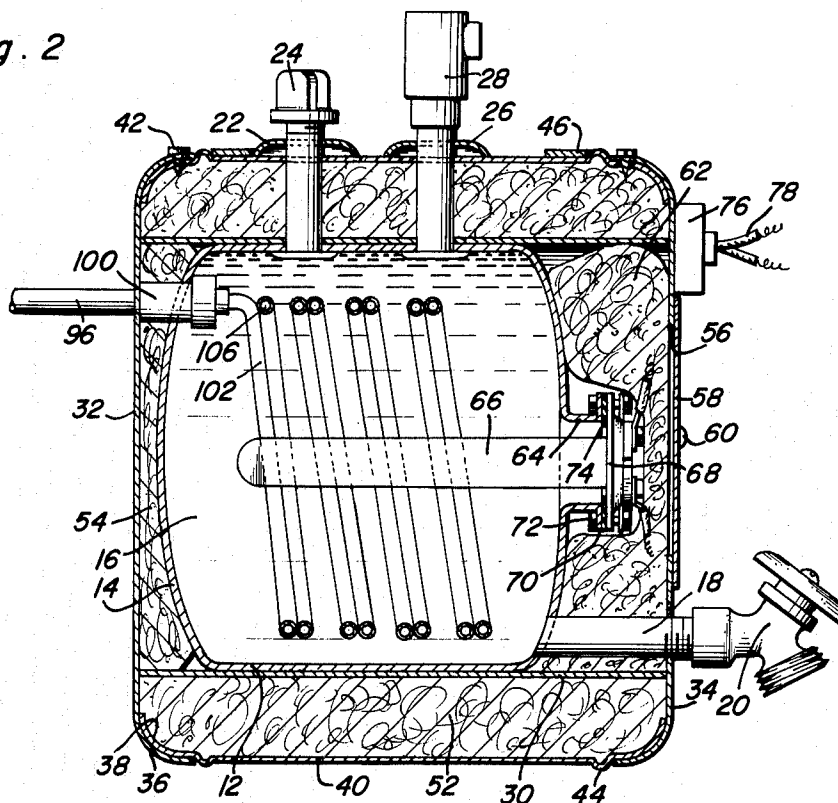
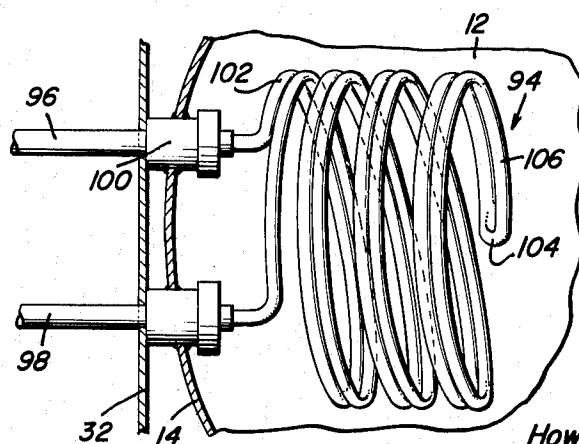


Fig. 3



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1

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REFRIGERATOR UNIT DEFROSTER WITH AUXILIARY HEATER

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5 Claims. (Cl. 62—196)

This application is a continuation-in-part of copending application Serial No. 101,403, for Refrigerating Unit Defroster filed April 7, 1961, now abandoned.

The present invention generally relates to novel improvements in defrosting apparatuses for use in conjunction with a refrigerating unit having a hot gas defrosting system therein for quickly removing ice or frost from the evaporator coils of the refrigerating unit.

A hot gas defrost system is well known in refrigeration systems with the defrosting operation generally being controlled by a suitable time clock so that at regular intervals, the refrigeration system will go into a defrost cycle during which hot gas will be discharged from the compressor directly into the evaporator for raising the temperature of the evaporator coils for melting and removing ice and frost therefrom so that the coils will be clean and in their best heat exchange condition. One of the main problems existent in this type of system is the fact that the compressor quite often will not produce sufficient gaseous discharge at a sufficiently high temperature to rapidly melt the ice or frost. This is especially true when the ambient atmosphere is at a relatively low temperature. There has been some attempt to alleviate this problem by introducing a heating unit into the hot gas defrost lines for the purpose of increasing the temperature of the gaseous refrigerant as it is introduced into the evaporator. For example, in prior Patent No. 2,526,379 to Maseritz, October 17, 1950, there is disclosed a heater for introducing additional heat into the hot gas refrigerant passing through a by-pass conduit. In this previously patented structure, the heater element is energized at the same time as the solenoids for bypassing the flow of hot gas refrigerant from the compressor into the by-pass line so that the heating unit becomes operative only when the defrost cycle begins. In view of the volume of the hot gas refrigerant being passed through the by-pass line and the necessity of maintaining an immediate supply of hot gas refrigerant available for defrosting the evaporator, the structure in Maseritz has not found any commercial acceptance. Another example is in Patent No. 2,770,104 to Sweynor, November 13, 1956 which shows a heating unit having a liquid therein which is heated by an electric heating tube but this patent also fails to specifically disclose an essential element for successful operation and has not found commercial acceptance. This factor not shown in the patent to Sweynor is the specific thermostatically controlled continuously operative heating unit which will maintain the liquid at a continuous preset high temperature sufficient to immediately heat a large volume of hot gas refrigerant to a temperature to quickly raise the temperature of the cooling coil or evaporator coil to a point much above the melting point of ice or frost.

A further object of the present invention is to provide a refrigerant defrost gas heater for maintaining a relatively large volume of liquid at a constant temperature so that during the defrosting cycle hot gas refrigerant will pass through the heater and be immediately heated to an elevated temperature for discharge into the evaporator coils with the present invention being completely free of regulating valves, pressure systems and the like and the device is extremely simple to install by merely in-

2

serting it into the hot gas defrost line between the solenoid operated defrost valve and the evaporator.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIGURE 1 is an end view of the unit of the present invention;

FIGURE 2 is a longitudinal, sectional view taken substantially upon a plane passing along section line 2—2 of FIGURE 1 illustrating the internal structural details of the heater unit;

FIGURE 3 is a detailed fragmental view illustrating the construction of the coil which receives the hot gas refrigerant;

FIGURE 4 is a schematic view of a refrigeration system of the hot gas defrost type with the unit of the present invention incorporated into the hot gas defrost line; and

FIGURE 5 is a detailed view of the mount for the thermostatic switch.

Referring now specifically to the drawings, the numeral 10 generally designates the apparatus of the present invention which includes a generally cylindrical tank 12 having dome-shaped ends 14 for receiving a quantity of liquid such as water 16 therein. Various liquids can be employed including nonfreezable liquids to enable the unit of the present invention to be installed for use outdoors in various temperature conditions so that even during periods of non-use of the refrigeration system, it would not be necessary to remove the water from the tank. Adjacent the bottom at one end of the tank 12, there is provided a drain pipe 18 having a valved faucet 20 connected thereto for enabling the contents of the tank 12 to be drained when desired. At the upper end of the tank 12 there is provided a filler pipe 22 having a screw-threaded removable closure cap 24 thereon for enabling the liquid material such as water 16 to be added into the container 12. Normally, it is only necessary to fill the tank with water but a periodic check could be made in order to insure that the tank remains substantially full of water. Also connected to the top end of the tank 12 is a pipe 26 communicated with the interior of the tank and having a safety valve and fusible plug assembly 28 attached to the upper end thereof. The safety valve is in the form of a pop-off valve so that in the event pressure is formed in the tank 12, the pressure above a certain level would be discharged through the pop-off safety relief valve. As a double safety factor, the fitting 28 is also provided with a fusible plug which will melt and permit discharge of steam or the like in the event the temperature within the tank reaches a predetermined maximum. Thus, with the pop-off safety relief valve and fusible plug assembly 28 incorporated onto the pipe 26 that is communicated with the tank 12, any possibility of explosion or damage to the tank by excessive heating will be avoided.

As illustrated in FIGURE 2 and taking into consideration FIGURES 1 and 3, the tank 12 is generally cylindrical with the longitudinal axis thereof being disposed horizontally. Encircling the cylindrical side wall of the tank is a partition wall 30 that is also cylindrical and which extends beyond the domed ends 14 of the tank 12. Attached to the ends of the circular partition wall 30 is a pair of end plates 32 and 34 which are provided with inwardly curved peripheral edges 36 which match and engage correspondingly inwardly curved end portions 38 on an external peripheral wall 40 spaced concentrically from the cylindrical partition wall 30. The overlapping

3

curved portions 36 and 38 are secured together by suitable fasteners 42 wherein the overlapping portion serves to form a rigid corner construction so that during handling, the tank 12 will not be damaged due to dropping the tank or otherwise striking the tank a blow which sometimes occurs during installation and the like. For further rigidity, the cylindrical wall 40 is provided with an outwardly deformed reinforcing rib 44 disposed circumferentially thereof which serves also to retain mounting straps 46 which partially encircle the unit and have outwardly extending terminal end portions or lugs 48 receiving fastening bolts 50 or the like for supporting the unit from a suitable support.

For efficiently insulating the tank 12, the space between the outer wall 40 and the partition wall 30 is completely filled with insulation material 52 such as a foam plastic such as foamed polystyrene or foamed polyurethane or any equivalent foam insulation which has high insulation characteristics and which may be foamed in place. Also, the space between the end wall 32 and the domed end 14 of the tank 12 is filled with the same insulation material designated by numeral 54. The end wall 34 is provided with an enlarged central opening 56 having an oblong closure plate 58 provided therefor and retained in place by suitable screw-threaded fasteners 60 or the like which enables access to be gained to the interior of the partition wall 30. As illustrated, the pipe 18 extends out through the chamber defined by the domed end wall of the tank 12 and the end wall 34 and this space is normally filled with a removable pad of insulation material 62 which is of the same type as employed in the remainder of the insulation material thereby providing a complete insulation coverage for the tank 12.

The dome-shaped end of the tank 12 adjacent the end wall 34 is provided with a cylindrical neck 64 which receives a heating element 66 therethrough in concentric spaced relation. The heating element 66 extends over a major length of the tank 12 and is disposed centrally therein and is of conventional construction with the head end thereof including a peripheral flange 68 which is secured to an outwardly extending flange 70 on the neck 64 of the tank 12 by a plurality of bolts 72 with a seal ring 74 being employed for retaining the heating unit attached to and sealed in relation to the tank 12.

Connected to the end wall 34 is a juncture box 76 having electric conductors 78 passing therethrough and being connected with a thermostatic switch 80 secured against the dome-shaped wall 12 of the tank by a U-shaped flat spring which has a downturned end 84 received in a groove 86 in a bracket 88 attached to the thermostatic switch 80 for securing the thermostatic switch 80 removably in place. On the opposite side of the heater, a similar spring 90 is provided for securing a limit switch 92 in place with the electrical energy passing through both the thermostatic switch 80 and the limit switch 92 before the heating element 56 is energized by a terminal block 94 connected to the outer end of the heating unit. As illustrated in FIGURE 1, the opening 56 provides for ready access to the electrical conductors, the thermostatic switch 80, the limit switch 92 and also enables easy removal of the heating element if replacement thereof is needed by providing access to the bolts 72.

FIGURE 3 illustrates a double coil 94 disposed in the tank 12 which is connected to an inlet 96 and an outlet 98 each of which is provided with an enlarged portion 100 which may be incorporated into the line where it passes through the dome wall 14 of the tank 12. The line 96 is communicated with a spiral coil 102 which extends in an enclosing relation to the heating element 66 and in concentric inward relationship to the cylindrical peripheral wall 12. At the terminal end of the coil 102, it is reversely bent as at 104 to form a bend and continues as a second coil 106 disposed against the coil 102 as illustrated in FIGURES 2 and 3 thus forming a double

4

coil 94 with the convolutions thereof being arranged in a spiral pattern with the respective convolutions being in juxtaposition insofar as the two coils 102 and 106 are concerned but actually spaced to form an overall spiral double coil. The enlargements 100 in the flow lines serve as means for slowing the velocity of the hot gas passing through the coil assembly 94 so that the gaseous refrigerant will effectively be heated by the hot water or liquid 16.

For controlling operation of the defrosting system of the refrigeration system, a conventional time clock assembly 108 is provided which may be in the form of a Paragon timer model 8015-3. The details of the timer mechanism are immaterial except that it will actuate the solenoid valve 110 and 112 to close the solenoid valve 112 and open the solenoid valve 110 during the defrost cycle which means that refrigerant will no longer pass from the receiver 114 into the expansion valve 116 for passage into the evaporator 118 but will pass through the hot gas defrost line 120 which is in the form of a by-pass which normally leads directly to the evaporator and is connected therewith on the side of the evaporator 118 inwardly of the expansion valve 116. The auxiliary heating unit 10 of the present invention is connected into the by-pass line 120 in a conventional manner in a very simple manner by merely connecting the conduits 96 and 98 thereto.

In the system illustrated, a fan and motor combination 122 is employed for circulating air over the condenser 124 and a similar fan and motor 126 is provided for circulating air over the evaporator. It is pointed out that other types of cooling devices may be employed for the condenser or the device may be incorporated into a refrigeration system having a cooling tower or any other type of cooling apparatus. Further, the device of the present invention may be incorporated into a refrigeration system that does not employ a fan for circulating air over the evaporator. However, where such fans are employed, the timer which serves to operate the solenoid valve 110 and 112 will also stop the fan motor 126 so that the frost or ice on the evaporator coils will be more expeditiously removed. Of course, operation of the compressor 128 is conventional and operation of the entire system is conventional insofar as the timer and the hot gas defrost cycle is concerned in that when the refrigeration system is operating normally, the solenoid valve 110 in the by-pass line is closed and the solenoid valve 112 is open. During the defrost cycle, the valve 110 is open and the valve 112 is closed. The only difference in operation is that the auxiliary heater unit of the present invention interconnected into the hot gas defrost by-pass line will provide an immediate volume supply of hot gas for discharge directly into the evaporator with the hot gas being retained at a predetermined temperature such as 165° F. for rapidly raising the temperature of the evaporator coils to melt the ice without maintaining them at such an elevated temperature for a relatively long period of time which is necessary when the evaporator coils are not elevated, to a predetermined temperature which sometimes result in unwanted warming of the surrounding atmosphere.

The assembly of the thermostatic switch, limit switch as well as the heating element enables the compact arrangement of components with all of the components being readily accessible for repair or replacement as may be necessary. Further, the complete periphery of the tank is insulated so that very little heat loss occurs thus maintaining the operating cost at low level. The heat element is continuously operative in view of the relatively large quantity of liquid that must be maintained at a desired temperature in order to produce an immediate volume supply of hot gas at a predetermined elevated temperature in relation to the temperature of the hot gas leaving the discharge side of the compressor.

5

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. In a refrigeration system having a compressor unit, a condenser, and an evaporator arranged in serial relation and a hot gas by-pass line normally communicating the discharge of the compressor unit directly with the evaporator during a defrost cycle, that improvement comprising an auxiliary heating unit adapted to be connected serially into the hot gas refrigerant by-pass line, said heater unit including a tank having a quantity of liquid therein, a continuously operative thermostatically controlled heating unit disposed in said liquid for maintaining the liquid at a predetermined elevated temperature, a heat exchange coil disposed in the tank and adapted to be connected in series with the by-pass line for passage of hot gas refrigerant through the coil whereby the liquid enclosing the coil will heat the hot gas refrigerant to a predetermined temperature, the volume of said liquid in the tank being considerably greater than the volume of the coil disposed in the tank, said heat exchange coil being in the form of a spiral coil having double convolutions spaced longitudinally and extending from the inlet to the outlet side of the coil, said inlet and outlet sides of said coil being disposed at the same end of said coil.

2. The structure as defined in claim 1 wherein said tank includes a horizontally disposed cylindrical peripheral wall having dome-shaped ends, a partition encircling said tank, an outer wall encircling the partition in concentric spaced relation thereto, and foam plastic insulation material disposed between the partition and outer wall for insulating the tank thermally and protecting the tank from damage.

3. The structure as defined in claim 3 wherein the heating element extends inwardly of the tank generally along the longitudinal axis thereof centrally of said coil, one end of the tank having a flanged neck thereon with the heating element attached to the flanged neck, bolt means securing the heating element detachably to the flanged neck, a thermostatic switch electrically connected to the heating element and disposed against the end of the tank, and spring means resiliently retaining the thermostatic switch in place against the external surface of the tank.

4. In a refrigeration system having a compressor unit, a condenser, and an evaporator arranged in serial relation and a hot gas bypass line normally communicating the discharge of the compressor unit directly with the evaporator during a defrost cycle, that improvement comprising an auxiliary heating unit adapted to be connected serially into the hot gas refrigerant bypass line, said heater unit including a tank having a quantity of liquid therein, a continuously operative thermostatically controlled heating unit disposed in said liquid for maintaining the liquid at a predetermined elevated temperature, a heat exchange coil disposed in the tank and adapted to be connected in series with the bypass line for passage of hot gas refrigerant through the coil whereby the liquid enclosing the coil will heat the hot gas refrigerant to a predetermined temperature, the volume of said liquid in the tank being considerably greater than the volume of the coil disposed in the tank, said heat exchange coil being in the form of a spiral coil having double convolutions spaced longitudinally and extending from the inlet to the outlet side of the coil, said inlet and outlet sides of said coil being disposed at the same end of said coil, said tank including a horizontally disposed cylindrical peripheral wall having dome-shaped ends, a partition encircling said tank, an outer wall encircling the partition in concentric spaced relation thereto,

6

and foam plastic insulation material disposed between the partition and outer wall for insulating the tank thermally and protecting the tank from damage, the heating element extending inwardly of the tank generally along the longitudinal axis thereof centrally of said coil, one end of the tank having a flanged neck thereon with the heating element attached to the flanged neck, bolt means securing the heating element detachably to the flanged neck, a thermostatic switch electrically connected to the heating element and disposed against the end of the tank and spring means resiliently retaining the thermostatic switch in place against the external surface of the tank, said spring means being in the form of a spring plate having laterally extending furcations of a resilient nature extending along the side edges of the thermostatic switch and terminating in downturned ends, said thermostatic switch including a base plate having upturned flanges thereon, said flanges having notches receiving the downturned ends of the furcations of the spring plate for resiliently retaining the thermostatic switch mounted against the tank.

5. A heating device for use serially in a hot gas bypass line of a refrigeration system for heating the hot gas to a predetermined temperature comprising a generally cylindrical tank having dome-shaped ends, a quantity of liquid in said tank, said liquid having a freezing point considerably below the normally expected outdoor temperature to prevent freezing of the liquid during periods of non-use, said tank having the longitudinal axis thereof generally horizontally disposed and provided with drain means adjacent the bottom thereof for enabling the liquid in the tank to be drained, filler means communicated with the upper end of the tank for enabling liquid to be added to the tank, a safety pop-off valve and fusible plug assembly connected with the upper end of said tank to prevent build-up of excessive pressure in the tank and prevent the liquid from reaching an excessive temperature, a partition wall encircling the generally cylindrical tank and having end edges projecting beyond the end walls of the tank, end plates connected to the ends of the partition wall and extending beyond the partition wall and terminating in inwardly curved edge portions, an exterior cylindrical peripheral wall spaced concentrically from the partition wall and terminating in inwardly curved edge portions for engagement with the edge portions of the plates, means securing the edges of the plates and the edges of the external wall together with the curved edge portions forming a double thickness at the corners of the assembly to reinforce and rigidify the end plates, partition wall and external wall, said external wall including an outwardly deformed reinforcing rib adjacent each end thereof, a mounting strap partially encircling said external wall and disposed alongside of the ribs and being secured to the wall, expanded foam plastic insulation material filling the space between the partition wall and the external wall and filling the space between the ends of the tank and the end plates for thermally insulating the tank and mechanically protecting the tank from damage due to forces imparted to the external wall and end plates, one end of the partition wall and external wall extending beyond the corresponding end of the tank a greater distance than the other end of the partition wall and external wall, said end plates connected to said one end of the partition wall and cylindrical wall having an enlarged opening therein, the insulation material disposed between the end plate with the opening therein and the end of the tank being removable to expose the end of the tank, said end of the tank having an access opening therein, orientated centrally thereof, an elongated heating element disposed in said tank along the longitudinal axis thereof and extending over a major portion of the length thereof, said heating element being mounted in the opening in the end of the tank for enabling removal thereof through the opening in the end plate, a thermostatic switch mounted against the end of the tank having the opening therein, said switch including a base plate with upturned flanges

thereon, each of said flanges having an upwardly opening notch, a spring member urging the base plate and the thermostatic switch against the end of the tank, said spring member being in the form of a flat leaf spring with extending legs thereon terminating in downturned ends engaged in the notches enabling removal of the thermostatic switch, and a closure plate removably secured in closing relation to the opening in the end plate for enabling access to the thermostatic switch and heating element, a double coil tube disposed in the tank with the coil tube being spirally arranged with a longitudinal axis coincident with the longitudinal axis of the tank and being spaced from the periphery of the tank and being completely immersed in the liquid therein, said coil tube including double tube convolutions with each double tube convolutions being axially spaced, inlet and outlet tubes connected with the coil tube and adapted to be connected serially in the bypass line, enlarged portions in the inlet and outlet of

the coil tube reducing the velocity of gases passing through the tube.

References Cited by the Examiner

UNITED STATES PATENTS

1,912,841	6/1933	Haymond	62—278
2,526,379	10/1950	Maseritz	62—267 X
2,555,161	5/1951	Smith	62—278
2,645,101	7/1953	La Porte	62—278
2,698,522	1/1955	La Porte	62—278
2,724,245	11/1955	Swinburne	62—278
2,770,104	11/1956	Sweynor	62—278 X
2,748,249	5/1956	Collerati	219—326
3,012,415	12/1961	La Porte	62—278

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