

May 31, 1955

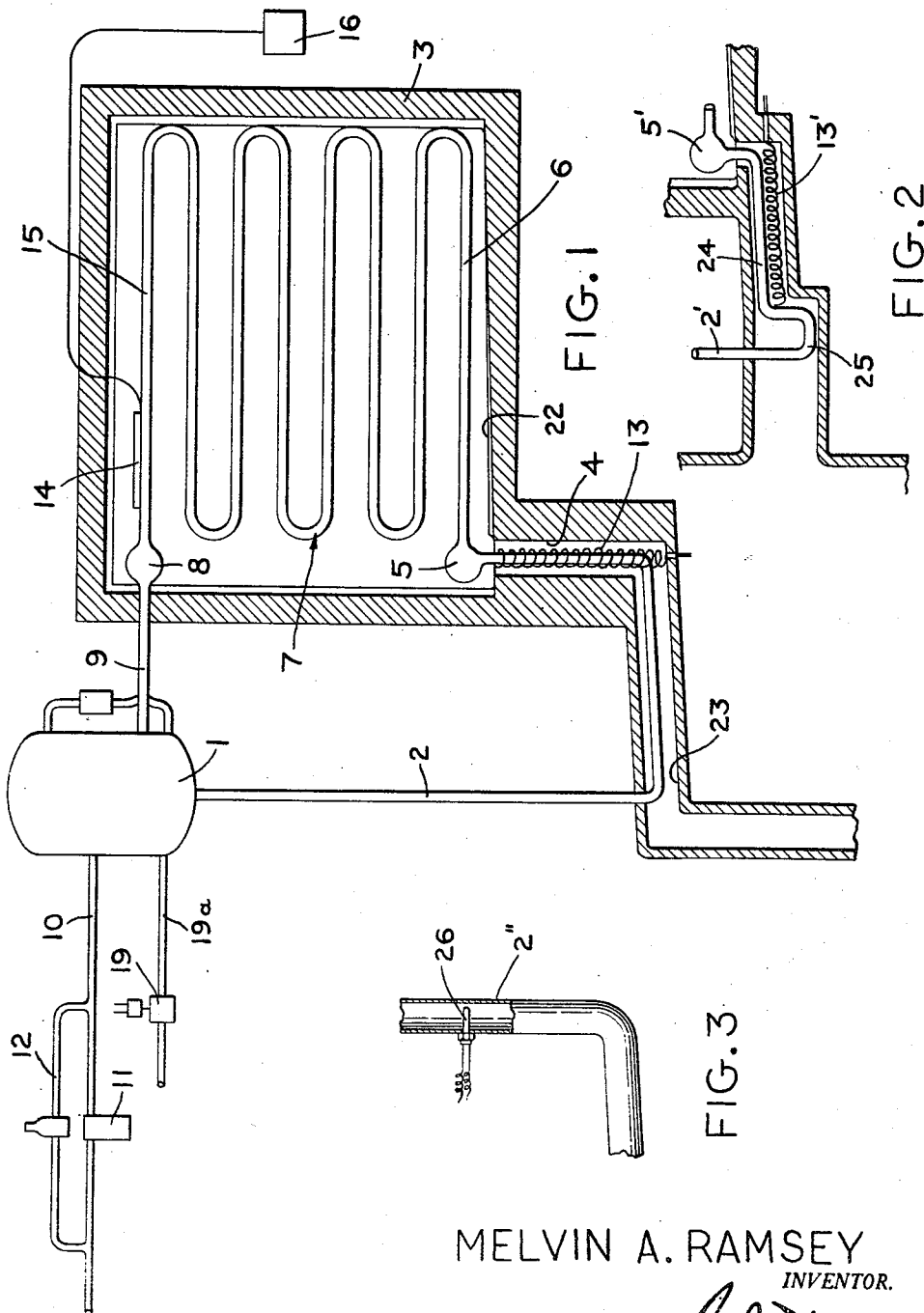
M. A. RAMSEY

2,709,345

METHOD AND APPARATUS FOR DEFROSTING REFRIGERATION COILS

Filed Oct. 4, 1951

3 Sheets-Sheet 1



May 31, 1955

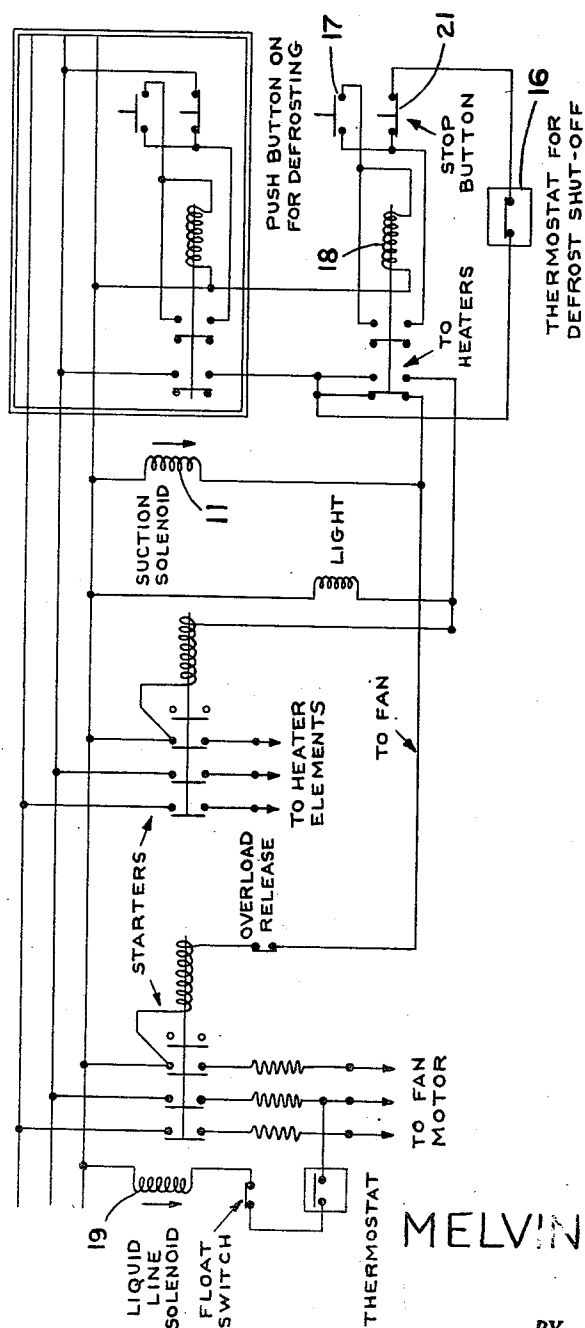
M. A. RAMSEY

2,709,345

METHOD AND APPARATUS FOR DEFROSTING REFRIGERATION COILS

Filed Oct. 4, 1951

3 Sheets-Sheet 2



MELVIN A. RAMSEY
INVENTOR.

INVENTOR

BY

INVENTOR
Robert Meyer
attorney

attorney

May 31, 1955

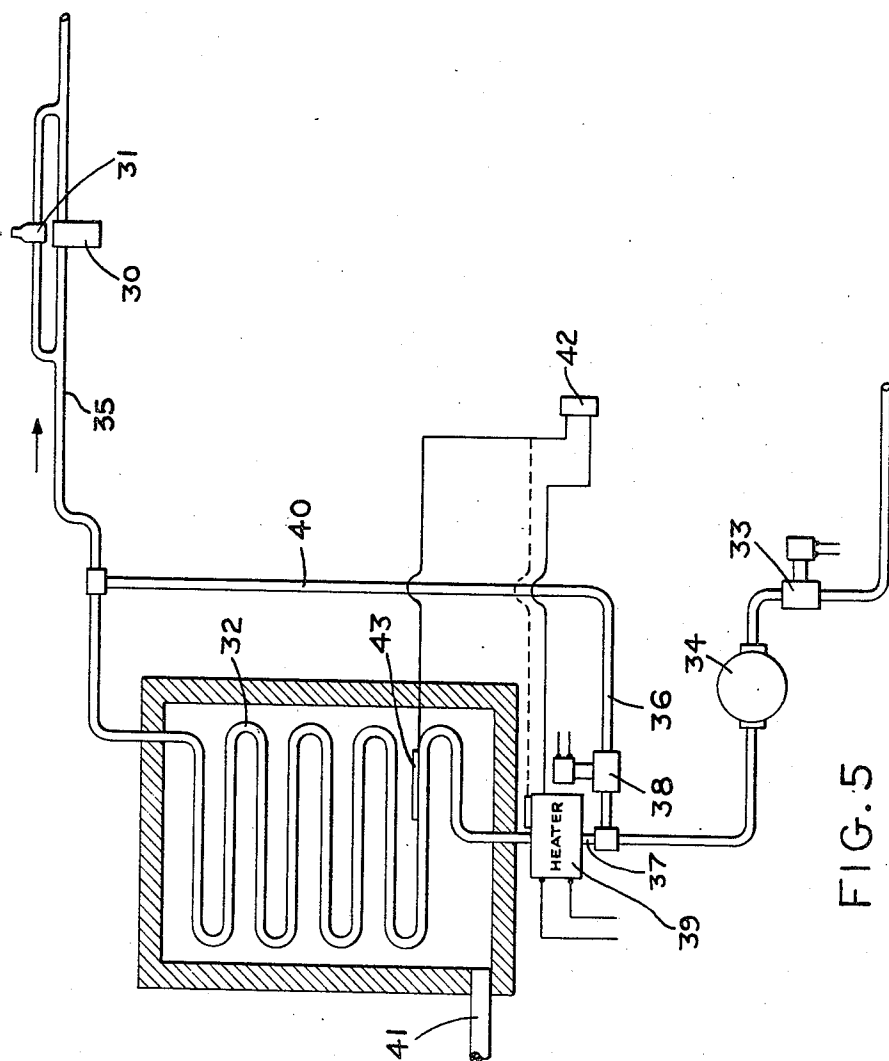
M. A. RAMSEY

2,709,345

METHOD AND APPARATUS FOR DEFROSTING REFRIGERATION COILS

Filed Oct. 4, 1951

3 Sheets-Sheet 3



561

MELVIN A. RAMSEY

INVENTOR.

INVENTOR.
BY *Robert M. Meyer*
attorney

1

2,709,345

METHOD AND APPARATUS FOR DEFROSTING REFRIGERATION COILS

Melvin A. Ramsey, Allendale, N. J., assignor to Worthington Corporation, Harrison, N. J., a corporation of Delaware

Application October 4, 1951, Serial No. 249,647

9 Claims. (Cl. 62-115)

This invention relates to refrigeration and more particularly to the defrosting of refrigeration evaporators employed in commercial coolers for cooling air containing water vapor, below the freezing point of water.

More particularly the invention relates to the defrosting of air cooling evaporator tubes where the surface temperature is below freezing for the purpose of removing accumulated frost or ice which interferes with the heat transfer action of the evaporator and, consequently, with the effectiveness of the cooling of the air.

An object of the present invention is to provide heating means that will apply heat directly to the refrigerant used in the inside of the tubes of the system, in lieu of the hot gas, warm brine, water spray over the outside of the tubes, etc., as is the common present day practice. By applying the heat directly to the refrigerant the heated refrigerant flowing throughout the evaporator will result in the melting of the frost or ice on the evaporator from the inside outwardly providing the desirable feature of less loss of heat to the ambient air. Some of the ice may fall off after its tube side is melted without melting all of the ice.

Another object of the invention is to provide means for preventing clogging of the refrigeration unit by an accumulation of ice on the bottom of the casing or housing of the coil.

With these and other objects in view, as may appear from the accompanying specification, the invention consists of various features of construction and combination of parts, which will be first described in connection with the accompanying drawings, showing a method and apparatus for defrosting refrigeration coils of a preferred form embodying the invention, and the features forming the invention will be specifically pointed out in the claims.

In the drawings:

Figure 1 is a diagrammatic view partly in section of a cooling system of the direct expansion cooling coil type which coils are flooded with ammonia and the system includes a surge drum.

Figure 2 is a detailed section of a modification of the structure shown in Figure 1.

Figure 3 is a detailed sectional view illustrating a different type of heater structure wherein the heater is immersed in the refrigerant flowing through the coils.

Figure 4 is an electrical wiring diagram of the system embodying means for automatically terminating the defrost cycle.

Figure 5 is a diagrammatic view of a different type of refrigerating system embodying the fundamental principles of the present invention.

The refrigerating system diagrammatically illustrated in Figure 1 of the drawings illustrates a method of applying electrical heat to refrigerant in an evaporator or the coils, tubes or pipes of an evaporator which are supplied with evaporating liquid refrigerant and which system includes a surge drum 1 in which a liquid level is maintained and from the bottom of which the refrigerant circulating pipe 2 leads into the insulated casing or housing 3 through

2

a passageway 4 opening into the bottom of the housing. The liquid refrigerant circulating pipe 2 is connected to a header 5 which extends laterally through the housing 3 and connects to the first sections 6 of the evaporator or cooling coil 7 and thus the liquid refrigerant is delivered from the surge drum 1 through the circulating pipe 2 and header 5 into the evaporator 7 where the liquid refrigerant evaporates and from which it emerges through an outlet header 8 into a pipe 9 which returns the vaporized refrigerant to the vapor space of the surge drum 1. Vaporized refrigerant is removed from the surge drum 1 through a suction pipe 10 which has a valve 11 of any suitable type embodied therein and which includes a relief by-pass 12.

An electric heater 13 is shown in Figure 1 as surrounding part of the circulating pipe 2 leading directly to the header 5 and enclosed in the passage 4 and thus when the heating circuit 13 is energized the refrigerant will be heated prior to its entrance into the header 5. A liquid inlet 19A with a valve 19 supplies liquid to the surge drum 1 during normal refrigerating operation, as required to maintain the desired level in the surge drum.

When defrosting is to take place, valves 11 and 19 are closed, isolating the evaporator and surge drum shown, from the remainder of the refrigerant circuit.

This will cause the pressure in the evaporator circuit to rise to that corresponding to the temperature of the ice on it. The heating circuit 13 is energized and the heat from it will change some of the liquid refrigerant at that point, to vapor. The vapor will displace some of the liquid and reduce the total weight of the column through the evaporator without affecting the column in 2, thus causing a circulating in the same direction as normally occurs, in the same manner, during the refrigeration period. The vapor moving through the evaporator 7 and the slightly heated liquid will transmit heat to its interior surface by condensation and convection respectively, thus heating tube metal from the inside resulting in a melting of any frost or ice which has accumulated on the outside of the coils from the inside outwardly. This eliminates much of the heating of the ambient air surrounding the coils, which heating is, of course, undesirable in refrigerating systems of this kind. A thermal element 14 is attached to or rests upon the last or outgoing section 15 of the refrigerating coil and is connected to a thermostat 16 which is connected in the electrical circuit shown in Figure 4 of the drawings to shut off the defrost cycle, that is, cut off the flow of electrical energy to the heating coil 13 when the temperature in the outgoing length 15 of the expansion coil 7 reaches a predetermined degree.

The defrosting cycle is manually started by means of a push button switch 17 shown in Figure 4 of the drawings and when the push button or manually operated switch 17 is operated the relay 18 in the electrical circuit will be energized causing energizing of the heating coil and causing the liquid line solenoid 19 and suction solenoid 11 to operate to close the liquid and suction line magnetic valves (not shown) and at the same time would break the circuit to the fan motor (not shown) to de-energize the same.

When the temperature in the outgoing section 15 of the coil 17 reaches the predetermined temperature the thermal bulb 14 will cause operation of the thermostat 16 to break the circuit through the electric heater 13 and at the same time the relay 18 would return to its normal position resulting in the starting of the fan and operation of the solenoids 19 and 11 to open the solenoid operated valves (not shown). A manually operated switch 21 is employed in the circuit so that the defrosting operation may be manually cut off if desired.

As is shown in Figure 1 of the drawings, the bottom or base 22 of the casing 3 inclines towards the passage

3

4 and this passage communicates with a continuing passage 23 so that the passages 4 and 23 jointly provide means for draining off the melted frost or ice which is removed from the expansion coil 7 during the defrosting operation. Due to the low temperatures involved in refrigerating systems of this type it is highly possible that the drain passages 4 and 23 and interior of the casing 3 will be below freezing at the start at least of the defrosting cycle and it is possible that they would remain below freezing during the defrost cycle. If such were the case some ice would accumulate on the bottom of the casing 3 which might result in the clogging of the drain outlet 4. To prevent such clogging of the drain outlet 4 the header 5 is located directly above the inlet to the drain passage 4 and the bottom 22 inclines downwardly towards this point so that the heated refrigerant in the header 5 would form a cross or collection trough in the casing 3 due to the melting of any ice in proximity thereto, and the lowermost section 6 of the coil 7 would also form a plurality of troughs by melting the ice in close proximity to them, resulting in the formation of a plurality of drain troughs in any ice which might accumulate on the bottom 22 and provide for the draining off of water from the bottom of the casing so as to leave sufficient space about the header 5 and the lowermost section 6 of the coil to provide proper air circulation when the cooling cycle is again started.

In Figure 2 of the drawings a slight modification of the system shown in Figure 1 is illustrated. In this form the section 24 of the inlet pipe 2' which leads directly to the header 5' is in a substantially horizontal position and the electrical heater 13' is placed in close proximity to the section 24 of the inlet pipe 2' so as to apply its heat to the section 24 to heat the refrigerant immediately prior to its entrance into the header 5'. In this modified form where the section 24 is substantially horizontal a trap 25 is incorporated in the inlet piping 2' so as to prevent a reverse circulation of the refrigerant during the defrosting cycle.

Figure 3 of the drawings shows a slight modification of the embodiment of the invention shown in Figures 1 and 2. In this form an electrical heater 26 of a different type is inserted into the inlet pipe 2' so that it is immersed in the refrigerant liquid. Electric heaters of both types, that is, enclosed immersion and external resistance heaters, are commercially available and are well known in the art and may be purchased readily upon the open market.

Figure 5 shows a further modification of the invention. In this form the refrigerant liquid enters the evaporator 32 through a valve 33, and an expansion valve 34 and line 37 and the vapor leaves through pipe 35 controlled by valve 30 (or relief valve 31 in case of excessive pressure in the evaporator). Heater 39 is applied to line 37 in such a way as to deliver heat to it when the heater is energized. An auxiliary line 40 controlled by valve 38, permits a circulation from the outlet of the evaporator 32 back to its inlet, immediately below heater 39.

When it is desired to defrost the evaporator 32, the valves 33 and 30 are closed and valve 38 is opened. The pressure in the evaporator will then rise to that corresponding to the temperature of the ice on its surface. The heater 39 is now energized and some of the liquid refrigerant will vaporize. The vapor will bubble up through the liquid in evaporator 32 and condense as it transfers heat to the evaporator. It may be that the rate of vapor formation and the size of the evaporator tubes will be such as to result in the vapor displacing the liquid in the evaporator and pushing it ahead instead of bubbling through it. In that case, the liquid so displaced will return through line 40 and valve 38 to heater 39. Any suitable means such as the drain indicated at 41 may be provided for draining off the melted frost or ice from the coil 32. A thermostat 42 may be connected to the heater 39 and by means of a thermal bulb 43 to

4

the lowermost section of the coil 32 or line 37, immediately above the heater, so that when a predetermined temperature is reached deenergizing of the heater 39 will automatically take place and the valves 33 and 30 will be opened and the valve 38 closed recycling the system of refrigeration.

Valves 19, 11, 33, 30 and 38 may be manual or automatic (solenoid or other type). Valves 30 and 11 may be eliminated if the compressor maintaining the suction pressure can be stopped during the defrosting.

It will be understood that the invention is not to be limited to the specific construction or arrangement of parts shown, but that they may be widely modified within the invention defined by the claims.

What is claimed is:

1. In a refrigerating system including an evaporator through which refrigerant flows, a heater for heating the refrigerant prior to its entrance into the evaporator to cause heating of the evaporator from the inside outwardly to melt accumulated frost from the evaporator, a housing enclosing said evaporator and having an outlet for the liquid resulting from the melting of the frost from the evaporator, said heater located in advance of said outlet to prevent clogging of the outlet by refrozen frost from the coils the lowermost portion of said evaporator and the base of said casing being inclined and located in close proximity so that the heated refrigerant will melt troughs in any ice accumulation on the base of the casing.

2. In a refrigerating system including an evaporator through which refrigerant flows, a header pipe at the inlet of said evaporator, a refrigerant inlet pipe leading into said header, and an electric current operated heater for heating the refrigerant as it flows through said inlet pipe to said header, a housing enclosing said evaporator and having an outlet for the liquid resulting from the melting of frost from the coil, said heater and evaporator located relative to said outlet to cause melting of ice at the entrance to the outlet and prevent clogging of the outlet by refrozen frost from the coils.

3. In a refrigerating system including an evaporator through which refrigerant flows, a heater for heating the refrigerant prior to its entrance into the evaporator to cause heating of the evaporator from the inside outwardly to melt accumulated frost from the evaporator, a housing enclosing said evaporator having a drain passageway for the melted frost from the evaporator, said heater disposed in said drain passageway to prevent clogging thereof by re-freezing of the melted frost from the evaporator.

4. In a refrigerating system including an evaporator through which refrigerant flows, a heater for heating the refrigerant prior to its entrance into the evaporator to cause heating of the evaporator from the inside outwardly to melt accumulated frost from the evaporator, a housing encircling said evaporator, said housing inclined at its lowermost portion for communication with a drain passageway, the lowermost portion of said evaporator located in close proximity to said inclined portion of the housing so that the heated refrigerant in the lowermost portion of the evaporator will form troughs in any ice accumulation on the lowermost portion of the housing, and said heater disposed in said drain passageway to prevent clogging thereof by re-freezing of the melted frost from the evaporator.

5. In a refrigerating system including an evaporator through which refrigerant flows, a heater for heating the refrigerant prior to its entrance into the evaporator to cause heating of the evaporator from the inside outwardly to melt accumulated frost from the evaporator, a housing enclosing said evaporator, said housing inclined at its lowermost portion for communication with the opening of a drain passageway, said evaporator including a header disposed adjacent the opening of said drain passageway in said housing, said header and the lower-

5

most portion of said evaporator located in close proximity to said inclined portion of the housing so that the heated refrigerant in the lowermost portion of the header and the evaporator will form troughs in any ice accumulated on the inclined portion of the housing, and said heater disposed in said drain passageway to prevent clogging thereof by re-freezing of the melted frost from the evaporator.

6. In a refrigerating system, a housing having a drain passageway for melted frost communicating with the lowermost portion thereof, an evaporator in said housing to receive refrigerant from said system through a circulating inlet pipe extending into the housing through said drain passageway, a return pipe connected to said evaporator and extending through said housing to return refrigerant fluid to said system, a heater for heating the refrigerant prior to its entrance into the evaporator to cause heating of the evaporator from the inside outwardly to melt accumulated frost from the evaporator, said heater disposed in said drain passageway to prevent clogging thereof by re-freezing of the melted frost from the evaporator.

7. In a refrigerating system, a housing having a drain passageway for melted frost communicating with the lowermost portion thereof, an evaporator in said housing to receive refrigerant from said system through a circulating inlet pipe extending into the housing through said drain passageway, a return pipe connected to said evaporator and extending through said housing to return refrigerant fluid to said system, a heater for heating the refrigerant prior to its entrance into the evaporator to cause heating of the evaporator from the inside outwardly to melt accumulated frost from the evaporator, the lowermost portion of said evaporator located in close proximity to said inclined portion of the housing so that the heated refrigerant in the lowermost portion of the evaporator will form troughs in any ice accumulated on the inclined portion of the housing, and said heater

6

disposed in said drain passageway to prevent clogging thereof by re-freezing of the melted frost from the evaporator.

8. In a refrigerating system, a housing having a drain passageway for melted frost for communicating with the lowermost portion thereof said water portion being inclined, an evaporator in said housing to receive refrigerant from said system through a circulating inlet pipe extending into the housing through said drain passageway, a return pipe connected to said evaporator and extending through said housing to return refrigerant fluid to said system, a heater for heating the refrigerant prior to its entrance into the evaporator to cause heating of the evaporator from the inside outwardly to melt accumulated frost from the evaporator, said evaporator including a header disposed adjacent the drain passageway in said housing, said header and the lowermost portion of said evaporator located in close proximity to said inclined portion of the housing so that the heated refrigerant in the lowermost portion of the evaporator will form troughs in any ice accumulation on the inclined portion of the housing, and said heater disposed in said drain passageway to prevent clogging thereof by re-freezing of the melted frost from the evaporator.

9. In the refrigerant system as claimed in claim 8 wherein said heater is disposed to coact with said circulating inlet pipe.

References Cited in the file of this patent

UNITED STATES PATENTS

Re. 19,988	Swezey	May 26, 1936
1,970,340	Ruff	Aug. 14, 1934
2,452,102	Cocanour	Oct. 26, 1945
2,459,173	McCloy	Jan. 18, 1949
2,511,419	Smith	June 13, 1950
2,526,379	Maseritz	Oct. 17, 1950
2,554,848	Warren	May 29, 1951