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REFRIGERATION SYSTEM USING GAS FOR DEFROSTING

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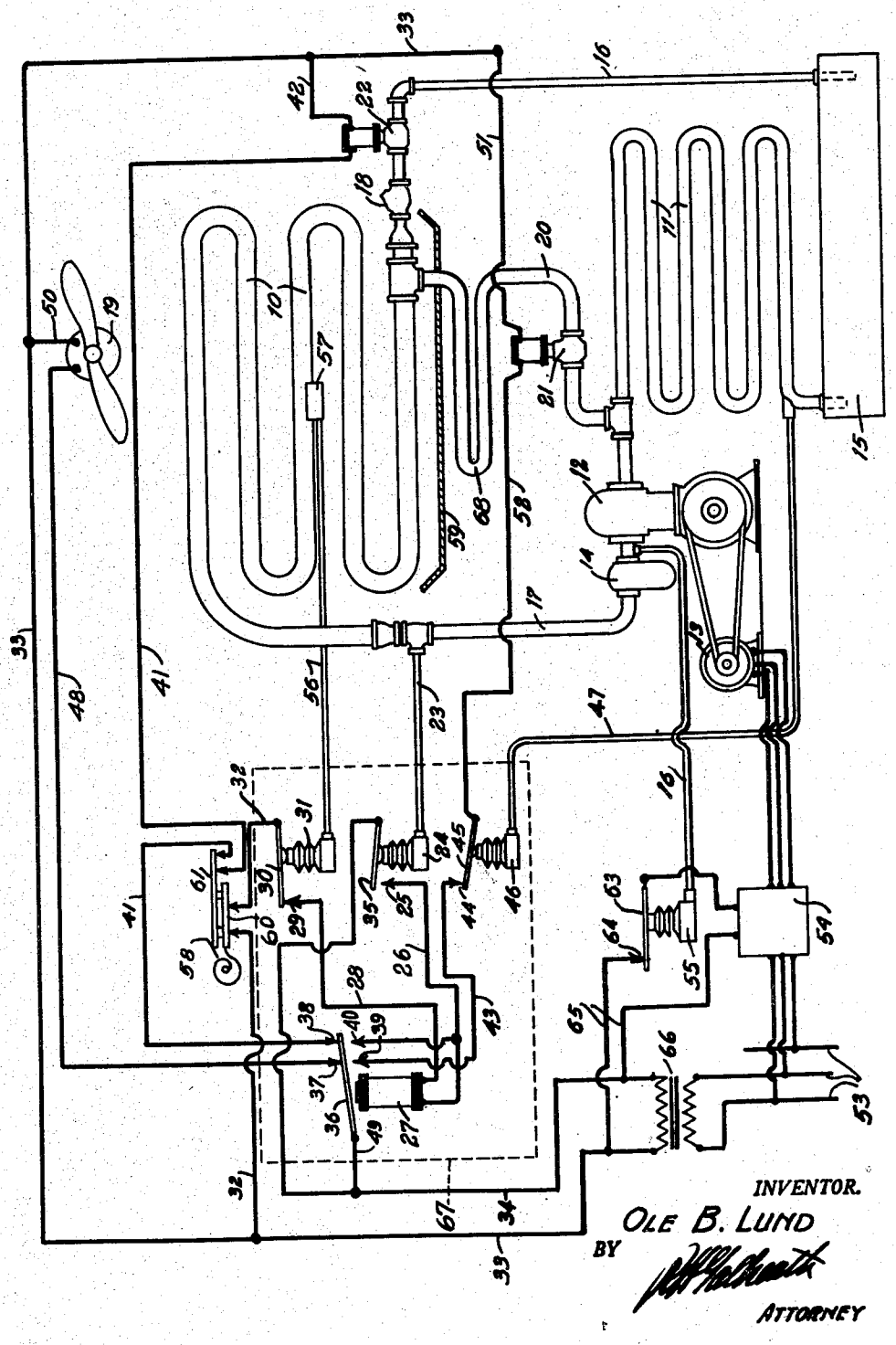

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REFRIGERATION SYSTEM USING GAS FOR DEFROSTING

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This invention relates to an automatic defrosting means for evaporators in coolers and refrigerators operating at below freezing temperatures.

The principal object of the invention is to provide means for automatically defrosting the cooling coils which will not require outside heating means, such as heating elements, fans, water, etc., and yet which rapidly and efficiently removes the accumulated ice and frost.

Another object of the invention is to provide a system in which the hot gas from the compressor will be automatically circulated through the cooling coils for rapid defrosting purposes whenever the freezing action becomes inefficient due to frosting conditions and to provide means which will automatically return the system to normal operation when the accumulated ice has been removed and reduced to an efficient operating point.

Other objects and advantages reside in the detail construction of the invention, which is designed for simplicity, economy, and efficiency. These will become more apparent from the following description.

In the following detailed description of the invention, reference is had to the accompanying drawing which forms a part hereof. Like numerals refer to like parts in all views of the drawing and throughout the description.

The drawing illustrates a schematic diagram of the improved automatic defrosting system applied to a conventional refrigerating plant.

In the drawing, the various elements of the usual refrigerating plant are designated by numeral as follows: evaporator piping coil 10, condenser 11, compressor 12, compressor motor 13, accumulator 14, receiver 15, liquid line 16, suction line 17, expansion valve 18, evaporator drain pan 59, circulating fan 19, power mains 53, motor control switch 54 and control circuit mains 33 and 34. The refrigerant circuit is the usual one, that is, the refrigerant is compressed and pumped by the compressor 12 into the condenser 11 where it liquifies and flows to the receiver 15. From the receiver 15 the liquid refrigerant flows through the liquid line 16 to the expansion valve 18 from whence it expands into the evaporator piping coil 10. The evaporated refrigerant is then drawn back through the suction line 17 and accumulator 14 to the compressor 12.

The present invention is designed to melt the accumulated frost and ice from the coil 10 whenever there is sufficient accumulation to interfere with efficient heat exchange.

The invention makes use of the fact that the

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back pressure in the suction line decreases as the rate of heat exchange at the surfaces of the evaporator coil decreases. This variation in back pressure is utilized to control the functioning of the improved defroster system.

The improved system employs a by-pass line 20 connected to the discharge of the compressor 12 ahead of the condensor 11 and extending to the intake extremity of the evaporator 10. The flow through the by-pass line is controlled by means of a first solenoid valve 21. A second solenoid valve 22 controls the flow from the liquid line 16 to the expansion valve 18.

When the second solenoid valve 22 is closed and the first solenoid valve 21 is open, the refrigerant cannot flow through the liquid line 16 and must flow through the by-pass line 20. The gas discharge from the compressor is, of course, under relatively high temperature due to the compression, and this high temperature gas flows directly through the evaporator to raise the temperature thereof and melt the ice therefrom.

The greatest accumulation of frost and ice is, of course, adjacent the expansion valve 18. It will be noted that the gas discharge from the by-pass line 20 has a higher temperature at this point than further along through the evaporator 10. Therefore, the greatest defrosting effect is obtained at the point of greatest ice accumulation.

In order for the system to be automatic, it is necessary that some means be provided to close the second solenoid valve 22 and open the first solenoid valve 21 when the accumulation of ice on the evaporator coils has accumulated to an inefficient extent. It is also necessary to reset the valves 22 and 21 in their normal operating positions when the accumulation of ice has been reduced to the desired point. This is accomplished in the present invention by connecting a pressure tube 23 with the suction line 17 and extending this tube to a first expansible pressurestat 24 which operates to cause a contact blade 35 to close a contact 25 when the back pressure in the suction line reduces to a certain predetermined point.

The blade 35 is connected to the control main 34 and the closing of the contact 25 completes a circuit through a conductor 26 with a relay magnet 27. The circuit through the magnet 27 is completed through a conductor 28 to a contact 29 which is contacted by a contact blade 30 actuated by a thermostat 31 connected by means of a bulb tube 56 with a thermostatic bulb 57 positioned on one of the coils of the evaporator 10.

The blade 30 is grounded by means of a conductor 32 to the control main 33. A first thermostat blade 60 is in circuit with the conductor 32. The blade 60 is actuated from a room or fixture thermostat control 58.

The relay magnet 27 actuates an armature 36. The armature 36, when attracted, breaks two contacts 37 and 38 and closes two contacts 39 and 40. The contact 38 is connected by means of a conductor 41 with the second solenoid valve 22, from which a ground line 42 leads to the control circuit main 33. A second thermostat blade 61 is in circuit with the conductor 41. This blade is mounted with the first blade 60 so that both act in unison under the influence of the room control 58.

The contact 39 is connected by means of a conductor 43 with a contact 44 which is closed by a switch blade 45 actuated by a second pressurestat 46 connected by means of a pressure tube 47 with the discharge extremity of the condenser 11. The blade 45 is connected to one side of the first solenoid valve 21 by means of a conductor 52.

The relay contact 40 is connected to the conductor 26 leading to the magnet 27. The relay contact 37 is connected by means of a conductor 48 with the circulating fan 19. The relay armature 36 is connected to the circuit control main 34 by means of a conductor 49. The fan 19 is grounded to the control main 33 by means of a ground lead 50, and the first solenoid valve 21 is similarly grounded by means of a ground line 51.

A low pressure pressurestat 55 is provided for actuating the motor control switch 54. The pressurestat 55 is connected by means of tube 62 to the intake of the compressor 12 and actuates a switch member 63 to close a contact 64 upon reduction of pressure in the suction line 17. The pressurestat 55 is set to break its contact at a lower back pressure than will act to break the circuit at the first pressurestat 24. The switch member 63 and the contact 64 are in series with a pilot circuit 65 carrying current from the control mains 33 and 34 to the actuating mechanism of the motor switch control 54.

As illustrated the control circuit mains 33 and 34 are being supplied with current from the power mains 53 through a suitable transformer 66. The type of current and the sources of supply depend upon the sources available at the point of installation and form no part of the present invention.

In the drawing, the various contacts are illustrated in the normal running position. The circuit to the relay magnet 27 is open at the contact 25. The circuit to the fan 19 and the second solenoid valve 22 are closed by means of the relay armature 36. The circuit to the compressor motor 13 is closed at the switch control 54 through the influence of the closed pilot circuit 65. The fan and the compressor are operating and the system is functioning in the usual manner.

Operation

Let us assume that ice begins to form on the evaporator coils 10. This causes a gradual reduction in pressure in the suction line 17 and in the first pressurestat 24. When this pressure has decreased to a preset point, the blade 35 will contact the contact 25 to close the circuit through the relay magnet 27 to attract the armature 36. This immediately breaks the circuits through the conductors 41 and 48 to the second solenoid valve 22 and the fan 19, closing the valve and stopping the fan, and closes the relay contact 39, energizing the first solenoid valve 21 to open the latter.

The hot gas from the compressor 12 now flows through the by-pass line 20 into the evaporator to rapidly raise the temperature thereof and melt the ice and frost therefrom.

The temperature of the evaporator coils rises and, when this temperature reaches a certain predetermined point, the thermostat 31 will expand to open the contact 29, breaking the circuit to the relay magnet 27, allowing the armature 36 to return to normal position. This immediately places the system back in its normal operating condition under the control of the thermostat control 58.

Some means must be provided for maintaining the circuit to the relay magnet 27 closed after the hot gas begins to flow into the evaporator, since the increased gas pressure would immediately expand the first pressurestat 24 to open the contact 25. This is accomplished by connecting the relay contact 40 to the conductor 26 so that the latter contact will hold the circuit to the relay magnet closed after the contact 25 is open.

During the operation of the defrosting system the pressure in the condenser 11 naturally falls. To prevent the pressure in the condenser from dropping to a point where it might freeze the condenser, the second pressurestat 46 is employed. The drop in pressure in the condenser is immediately communicated to the pressurestat 46, and when this pressure reaches a low point of, say 50 p. s. i., the switch blade 45 will open the contact 44, closing the second solenoid valve 21 and forcing the hot gas to flow through the condenser until the pressure therein has raised to a pre-set point of, say 135 p. s. i., at which time the second pressurestat 46 will cause the switch blade 45 to contact the contact 44 and again close the circuit to open the valve 21.

The room thermostat control 58 functions in the usual manner, that is, when the temperature in the room or fixture falls below a preset point the circuits controlled thereby are opened. In the improved defrosting system this thermostat simultaneously opens two circuits, one through the conductor 32 and one through the conductor 41, when the proper room temperature is reached. When the circuit through the conductor 41 is opened, the second solenoid valve 22 closes allowing the pressure in the suction line 17 to reduce sufficiently to actuate the low pressurestat 55 to break contact at 63–64 stopping the compressor and the system. This also actuates the first pressurestat 24 but since the circuit through the conductor 32 is open at the thermostat control 58 the current supply to the defrosting relay magnet 27 is cut off during idle periods of the condensing unit.

Ice loosened by the defroster may fall to the drain pan 59. In order to prevent this ice from freezing to the pan, the by-pass line 20 is conducted beneath the pan in contact therewith, as indicated at 68, so that the temperature of the pan 59 will be raised when the temperature of the evaporator is raised so as to melt the ice in the pan.

The relay and the various pressurestats and thermostats may be mounted on a control board located at a suitable point and indicated in broken line at 67. The motor control switch 54 and the room thermostat control 58 may be mounted in the customary manner.

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

1. In a refrigerating system having a gas com-

pressor, a suction line leading from said evaporator to said compressor, a condenser receiving the gas from the compressor, and a liquid line carrying the liquid gas from the condenser to the evaporator, means for defrosting the evaporator comprising: a by-pass line extending from the discharge of the compressor to the intake of the evaporator; an electrically controlled valve in said by-pass line; a second electrically controlled valve in said liquid line; a pressure-operated switch connected to the suction line; electric contacts controlled by said switch, said contacts being arranged to open the first valve and close the second valve when the pressure in the suction line has decreased to a pre-determined point; and means for closing the first valve when the pressure in the condenser has decreased to a certain pre-determined point.

2. In a refrigerating system having a gas compressor, a suction line leading from said evaporator to said compressor, a condenser receiving the gas from the compressor, and a liquid line carrying the liquid gas from the condenser to the evaporator, means for defrosting the evaporator comprising: a by-pass line extending from the discharge of the compressor to the intake of the evaporator; an electrically controlled valve in said by-pass line; a second electrically controlled valve in said liquid line; a pressure-operated switch connected to the suction line; electric contacts controlled by said switch, said contacts being arranged to open the first valve and close the second valve when the pressure in the suction line has decreased to a pre-determined point; a second pressure-operated switch; and means for conducting pressure to said second switch from the condenser, said second switch being in circuit

with said first valve to close the latter when the pressure in the condenser has lowered to a pre-determined point.

3. In a refrigerating system having a gas compressor, a suction line leading from said evaporator to said compressor, a condenser receiving the gas from the compressor, and a liquid line carrying the liquid gas from the condenser to the evaporator, means for defrosting the evaporator comprising: a by-pass line extending from the discharge of the compressor to the intake of the evaporator; an electrically controlled valve in said by-pass line; a second electrically controlled valve in said liquid line; a pressure-operated switch connected to the suction line; a relay controlled by said switch; means for conducting pressure from the suction line to operate said switch when the pressure in the suction line decreases to a pre-determined point; a first contact closed by the operation of said relay said first contact being in circuit with said first valve; and a second contact broken by the operation of said relay, said second contact being in circuit with said second valve; and means for opening the circuit controlling said relay when the temperature of the evaporator rises to a pre-determined point.

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