July 5, 1960

D. D. WILE ET AL

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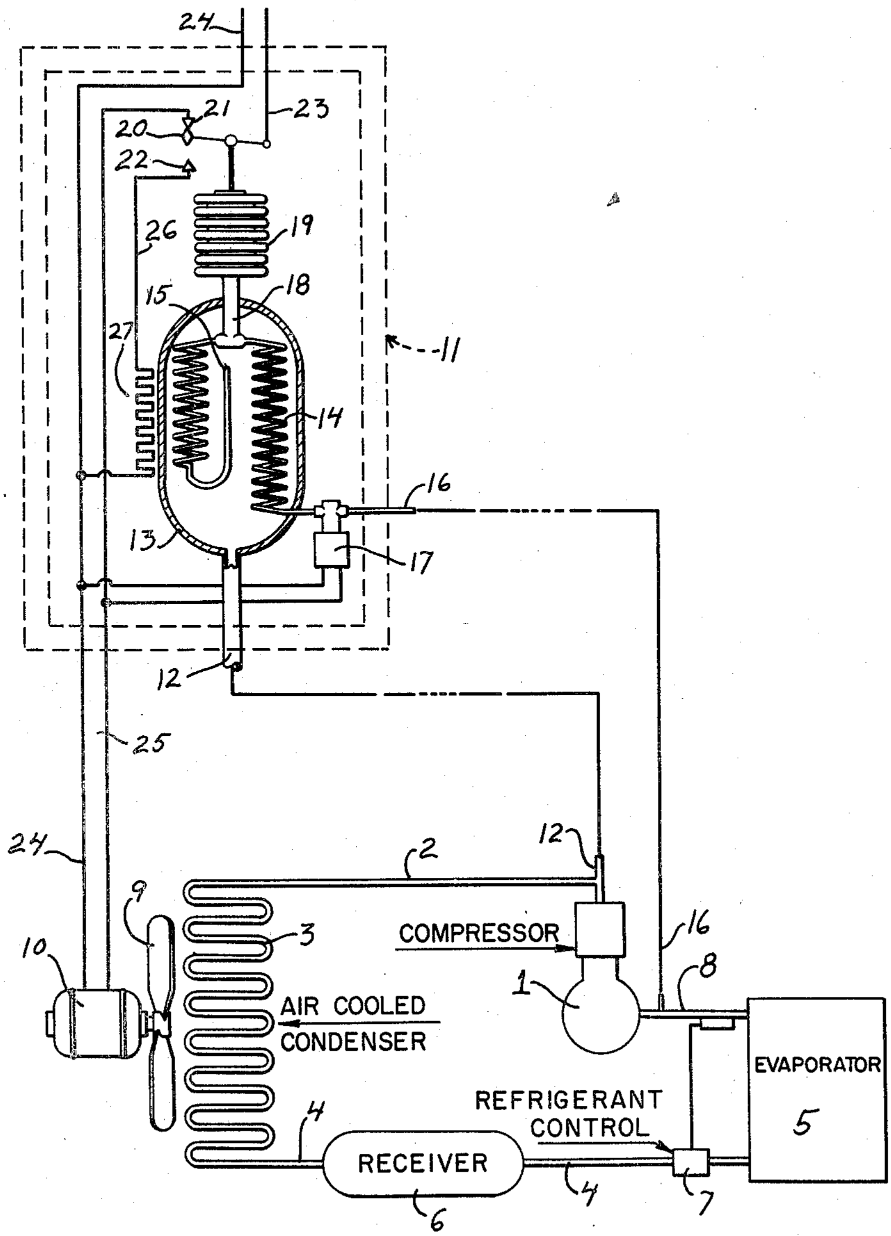
Filed March 11, 1959

2,943,457



DANIEL D WILE
DAVID S. BRAINARD
INVENTORS

BY Lyon & Lyon
ATTORNEYS

United States Patent Office

2,943,457

Patented July 5, 1960

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CONTROL SYSTEM FOR WINTER OPERATION OF AIR-COOLED CONDENSERS

Daniel D. Wile, Whittier, and David S. Brainard, Altadena, Calif., assignors to Recold Corporation, Los Angeles, Calif., a corporation of California

Filed Mar. 13, 1959, Ser. No. 799,317

7 Claims. (Cl. 62—184)

This invention relates to control system for winter operation of air-cooled condensers. Previous attempts have been made to control the condenser of a refrigerating system during cold weather by intermittent operation of the condenser fan motor, the motor being controlled by a pressure-stat sensitive to the pressure in the condenser. This has been unsatisfactory, for the reason that, although the pressure-stat may be sensitive to small changes in condenser pressure, the condenser pressure tends to vary abnormally due to coasting of the fan motor after the electric current has stopped and due to lag in response of the condenser when movement of air over the condenser is restored.

The primary object of this invention is to provide a control system for winter operation of air-cooled condensers wherein control of the condenser fan motor is such that pressure changes in the condenser are anticipated. That is, the fan motor is caused to turn off in anticipation of a drop in pressure within the condenser to compensate for coasting of the motor, and to turn on in anticipation of a rise in pressure within the condenser to compensate for the lag in condenser response to air flow.

A further object is to provide a control system which, when the ambient temperature is above a predetermined value, maintains the condenser fan motor in continuous operation, or, when the ambient temperature is below a predetermined value, maintains the motor in an off condition; thus providing a control system operative within a selected temperature range, but otherwise dormant when not needed.

A further object is to provide a control system which is compact, easily installed, and involves a minimum of moving parts.

With the above and other objects in view, as may appear hereinafter, reference is directed to the accompanying drawing in which:

The figure is a diagrammatical view of a refrigerating system incorporating the invention.

A typical refrigerating system includes a compressor 1 having a discharge side which is connected by a pressure line 2 to the intake end of a condenser 3. The discharge end of the condenser 3 is connected by a line 4 to an evaporator 5. Incorporated in the line 4 is a receiver 6 and a control unit 7. The evaporator 5 is connected by a suction line 8 to the intake end of the compressor 1. If the condenser 3 is an air-cooled type, a fan 9 is provided operated by a fan motor 10 for circulating air over the tubes of the condenser.

In the exercise of this invention, a small insulated housing 11, indicated by broken lines, is provided. A supply tube 12 leads from the pressure line 2 to a small refrigerant chamber 13 located within the housing 11. The refrigerant chamber 13 is located above the pressure line 2, and the supply tube 12 is sufficiently large that any liquid refrigerant will drain back to the pressure line 2 so that the refrigerant chamber 13 is maintained free of liquid refrigerant.

Disposed within the refrigerant chamber 13 is a length of capillary tube 14 which may be coiled. The capillary tube 14 is provided with an open end 15 exposed to the interior of the chamber 13. Leading from the other end of the capillary tube 14 is a return line 16 which is joined to the suction line 8 leading to the intake side of the compressor 1. Interposed in the return line 16 is a normally closed solenoid valve 17.

Intermediate the ends of the coiled capillary tube 14 is a branch line 18 communicating with the interior of a bellows 19 disposed externally of the chamber 13 but within the housing 11. The bellows 19 is adapted to expand and contract with change in the internal pressure and is arranged to actuate a moving contact 20 of a switch having opposed fixed contacts 21 and 22.

The moving contact 20 may be connected to a power supply lead 23, and another lead 24 is connected to a fan motor 10. The fixed contact 21 is connected by a lead 25 to the motor 10. The leads 24 and 25 also connect to the solenoid valve 17. The fixed contact is connected by a lead 26 to a heater element 27, the opposite end of which is connected to the power supply lead 24. While the power leads 23 and 24 are shown as directly connected to the fan motor 10 through the contacts of the switch, it should be understood that a conventional relay system may be employed to minimize the current carried by the switch operated by the bellows 19.

Operation of the control system for winter operation of air-cooled condensers is as follows:

The combination of solenoid valve 17 with switch contacts 21 and 22 together with the action of the capillary tube 14 causes the pressure to intermittently rise and fall in the bellows 19. This intermittent operation of the solenoid valve continues without appreciable change of pressure within the chamber 13 as long as this pressure is within the desired control range. The fan motor starts to operate each time solenoid valve 17 opens but the decrease of pressure within the bellows 19 occurs much more rapidly than the decrease of condensing pressure in the pressure line or conduit 2.

Thus the bellows 19 operates to open the solenoid valve 17 before any appreciable change in pressure occurs in the chamber 13, and this anticipates the change in the condensing pressure. In a similar manner, closing of the valve 17 causes a rise in pressure within the bellows 19 to anticipate a rise in condensing pressure that follows stopping of the fan motor. Thus, without any change in ambient temperature or corresponding change in condensing pressure, the fan motor cycles intermittently.

A rise in ambient temperature within the control range causes the condensing pressure to increase and with it the pressure in chamber 13 increases. This merely changes the rate of discharge from the capillary tube 14 with a corresponding change in ratio between the on and off periods of the fan motor.

At ambient temperatures below the control range, the fan motor remains off continuously. At ambient temperatures above the control range, the fan motor operates continuously. Between these two extremes the fan motor operates intermittently in a manner to maintain a substantially constant condensing pressure.

The heater 27 is utilized to maintain the temperature in the chamber 13 sufficiently high to prevent condensation of refrigerant in the chamber or capillary tube 14, as the presence of liquid refrigerant would cause erratic operation.

While a particular embodiment of this invention has been shown and described, it is not intended to limit the same to the exact details of the construction set forth, and it embraces such changes, modifications, and equivalents of the parts and their formation and arrangement as come within the purview of the appended claims.

What is claimed is:

1. In a refrigerating system involving a compressor having an intake and a discharge side, an air-cooled condenser connected with the discharge side of the compressor, a fan for forcing air through said condenser, and a motor for driving the fan, the combination of: a gaseous coolant-receiving chamber communicating with the discharge side of said compresor; a capillary tube within said chamber having a receiving end exposed within said chamber and a discharge end communicating with the intake end of said compressor; a valve for controlling discharge from said capillary tube; a pressure switch communicating with said capillary tube intermediate the ends thereof responsive to a preselected lower pressure in said capillary tube to close said valve and stop said fan motor, and responsive to a predetermined higher pressure in said capillary tube to open said valve and start said fan motor.

2. In a refrigerating system involving a compressor having an intake and a discharge side, an air-cooled condenser connected with the discharge side of the compressor, a fan for forcing air through said condenser, and a motor for driving the fan, the combination of: a gaseous coolant-receiving chamber comunicating with the discharge side of said compressor; a capillary tube within said chamber having a receiving end exposed within said chamber and a discharge end communicating with the intake end of said compressor; a valve for controlling discharge from said capillary tube; a pressure switch communicating with said capillary tube intermediate the ends thereof responsive to a preselected lower pressure in said capillary tube to close said valve and stop said fan motor, and responsive to a predetermined higher pressure in said capillary tube to open said valve and start said fan motor; and means for heating said chamber, said heating means being activated when said fan motor is stopped to prevent condensation of liquid refrigerant in said chamber.

3. In a refrigerating system involving a compressor having an intake and a discharge side, an air-cooled condenser connected with the discharge side of the compressor, a fan for forcing air through said condenser, and a motor for driving the fan, the combination of: a bypass line from the discharge end to the intake end of said compressor; flow-resistance means interposed in said bypass line; a valve for controlling discharge from said flow-resistance means; a pressure switch communicating with said flow-resistance means intermediate the ends thereof; said pressure switch responsive to a predetermined minimum pressure to stop said fan motor and close said valve, and responsive to a predetermined maximum pressure to start said fan motor and open said valve.

4. In a refrigerating system involving a compressor having an intake and a discharge side, an air-cooled condenser connected with the discharge side of the compressor, a fan for forcing air through said condenser, and a motor for driving the fan, the combination of: a bypass line from the discharge end to the intake end of said compressor; flow-resistance means interposed in said bypass line; a valve for controlling discharge from said flow-resistance means; a pressure switch communicating with said flow-resistance means intermediate the ends thereof; said pressure switch responsive to a predetermined minimum pressure to stop said fan motor and close said valve, and responsive to a predetermined maximum pressure to start said fan motor and open said valve; a chamber for gaseous refrigerant interposed in said bypass line upstream of said flow-resistance means; and a heater for said chamber operable by said switch to prevent condensation of refrigerant therein when said fan motor is stopped.

5. In a refrigerating system involving a compressor having an intake and a discharge side, an air-cooled condenser connected with the discharge side of the compressor, a fan for forcing air through said condenser, and a motor for driving the fan, the combination of: an insulated housing; a chamber within said housing having an inlet communicating with the discharge side of said compressor; a flow-resisting coil within said chamber having an inlet communicating with the interior thereof and an outlet communicating with the intake side of said compressor; a valve for controlling flow from said coil; a pressure switch communicating with said coil intermediate the ends thereof arranged to stop said fan motor and close said valve in response to a minimum pressure in said coil, and arranged to start said fan motor and open said valve in response to a maximum pressure in said coil.

6. A fan motor control for refrigerating systems having a hot compressed refrigerant line and a cold expanded refrigerant line, comprising: a bypass line between said lines; a flow-resisting means interposed in said bypass line tending to establish a pressure gradient therethrough; and a pressure switch communicating with said flow-resistant means intermediate the ends thereof for stoping said fan motor when the pressure in said region reaches a predetermined minimum, and to start said fan motor when the pressure in said region reaches a predetermined maximum.

7. A fan motor control for refrigerating systems having a hot compressed refrigerant line and a cold expanded refrigerant line, comprising: a bypass line between said lines, a flow-resisting means interposed in said bypass line tending to establish a pressure gradient therethrough; a valve controlling flow from said flow-resistant means; and a pressure switch communicating with said flow-resistant means intermediate the ends thereof for stopping said fan motor and closing said valve when the pressure in said region reaches a predetermined minimum, and to start said fan motor and open said valve when the pressure in said region reaches a predetermined maximum value.

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