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CONTROLS FOR REFRIGERATION SYSTEMS HAVING AIR COOLED CONDENSERS

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Fig. 1.

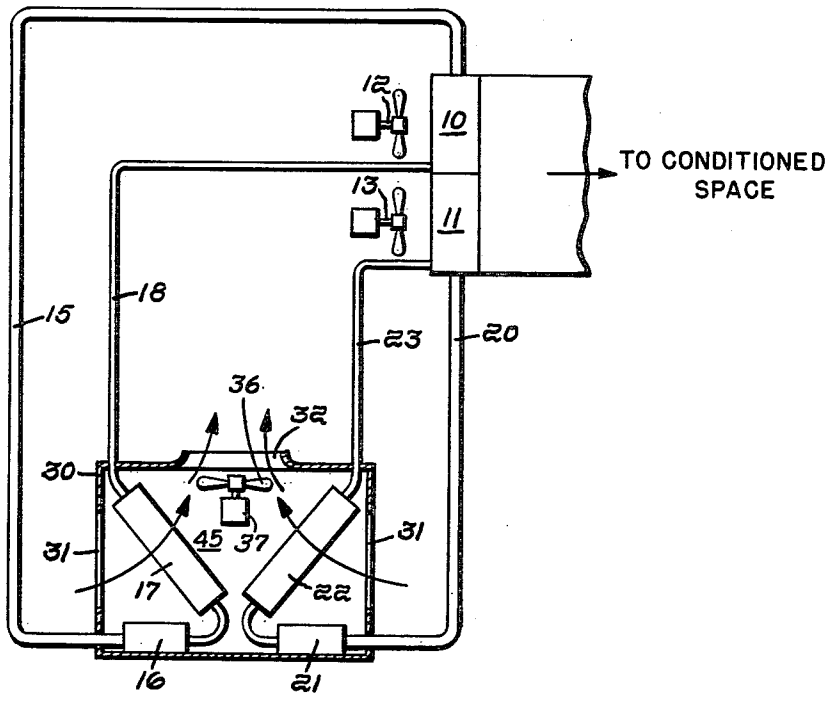
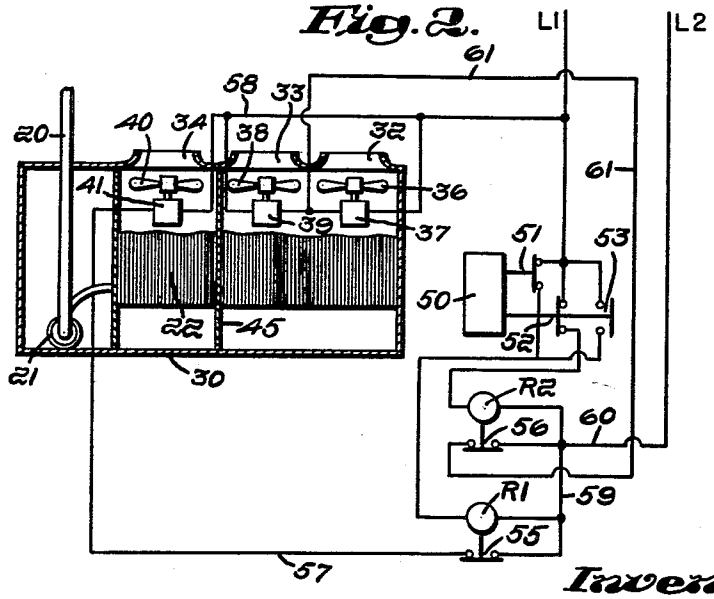


Fig. 2.



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CONTROLS FOR REFRIGERATION SYSTEMS HAVING AIR COOLED CONDENSERS

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This invention relates to controls for refrigeration and air conditioning systems using air cooled condensers.

Due to lack of sufficient water in many locations to cool the condensers of refrigeration and air conditioning systems, and due to the cost of water cooling such condensers in those locations where sufficient water is available, air cooled condensers are widely used. At low outdoor temperatures, the condensing pressure often is too low for there to be sufficient pressure across the expansion devices to operate them properly.

This invention uses three fans to move outdoor air over an air cooled condenser and in response to a predetermined, low temperature turns off one fan so as to decrease the cooling of the condenser and thereby increase the condensing pressure, and in response to a predetermined low outdoor temperature turns off the other two fans. A single, two-step thermostat and two relays are used to control the three fans so that one fan, two fans or three fans operate depending upon outdoor temperature.

An object of this invention is to vary the cooling of an air cooled condenser in steps in response to variations in outdoor temperature.

Another object of this invention is to control three fans for cooling an air cooled condenser in response to outdoor temperatures so that one fan, two fans or three fans will operate depending upon outdoor temperatures.

This invention will now be described with reference to the annexed drawings, of which:

FIG. 1 is a diagrammatic view of an air conditioning system embodying this invention, including an end view, in section, of a compartment containing two refrigerant compressors, two air-cooled condensers connected to the compressors, and cooled through the movement of outdoor air by three fans, one of which is shown by FIG. 1, and

FIG. 2 is a side section of the condenser compartment of FIG. 1, with an upper portion of one of the condenser coils removed to show the three fans and their motors, and shows the control circuits of the fans. FIG. 2 also shows one of the compressors, and the lower portion of a pipe connecting that compressor to one of the evaporator coils of FIG. 1.

The air conditioning system illustrated has two evaporator coils 10 and 11 used for cooling air moved by fans 12 and 13 respectively. The evaporator coil 10 is connected by tubing 15 to the suction side of refrigerant compressor 16, the discharge side of which is connected to the inlet end of condenser coil 17, the outlet side of which is connected by capillary tube 18 to the coil 10. The evaporator coil 11 is connected by tubing 20 to the suction side of refrigerant compressor 21, the discharge side of which is connected to the inlet end of condenser coil 22, the outlet end of which is connected by capillary tube 23 to the coil 11. The capillary tubes 18 and 23 serve to expand liquid refrigerant from the condenser coils 17 and 22 respectively, into the evaporator coils 10 and 11 respectively.

The condenser coils 17 and 22 are arranged on the legs of a V within a compartment 30 having air inlets 31 in its ends, and having air outlets 32, 33, and 34 in its top. The compressors 16 and 21 are on the floor of the compartment 30 between the inlets 31 and the bottoms of the coils 17 and 22.

A fan 36 driven by electric motor 37 is supported below the outlet 32. A second fan 38 driven by electric motor 39 is supported below the outlet 33. A third fan 40 driven by electric motor 41 is supported below the outlet 34. A partition 45 extends vertically between the fans 40 and 38. The fans are operated to draw outdoor air into the compartment 30 through the inlets 31 over the condenser coils 17 and 22 and to blow the air from the compartment through the outlets 32, 33 and 34.

A two-step, outdoor thermostatic means 50 opens switch 51 at a predetermined low outdoor temperature, and closes switch 53 and opens switch 52 at a predetermined outdoor temperature lower than the temperature at which the switch 51 is opened. The switch 51 is connected in series with control relay R1 and the electric supply lines L1 and L2. The switch 52 is connected in series with relay R2 and the electric supply lines L1 and L2. The switch 53 is connected across the switch 51.

The relay R1 has a switch 55 connected by wires 57, 58 and 59 in series with the fan motor 41 and the supply lines L1 and L2. The fan motors 37 and 39 are connected in parallel. The relay R2 has a switch 56 connected by wires 60 and 61 in series with the motors 37 and 39 and the electric supply lines L1 and L2.

Operation

In operation, at outdoor temperatures high enough for the pressures across the capillary tubes 18 and 23 to be sufficient or proper operation, the switches 51 and 52 are closed, energizing the relays R1 and R2, the switches 55 and 56 of which energize the three fan motors to operate the three fans. Upon a predetermined reduction in outdoor temperature, the switch 51 opens, deenergizing the relay R1 which opens its switch 55, deenergizing the fan motor 41 and turning off the fan 40 so that only the two fans 36 and 38 remain in operation. The decreased cooling of the condenser coils by the turning off of the fan 40 causes the condensing pressure to rise sufficiently for proper expansion in the evaporator coils.

If the outdoor temperature falls to a predetermined temperature below the temperature at which the switch 51 opens, the switch 52 opens and the switch 53 closes. The opening of the switch 52 deenergizes the relay R2 which opens its switch 56 and deenergizes the fan motors 37 and 39, turning off the fans 36 and 38 respectively. The closing of the switch 53 connected in parallel with the switch 51 turns relay R1 and the fan motor 41 and its fan 40 back on so that there is one fan in operation.

The partition 45 prevents leakage through the inactive fan or fans.

The two compressors 16 and 21 would be controlled by a two-step indoor thermostat which is not shown.

By placing the condenser coils 17 and 22 on the legs of a V, and by using common fans for moving outdoor air over both condenser coils, space and expense are saved.

What is claimed is:

1. In a refrigeration system, a compartment having an outdoor air inlet opening and an outdoor air outlet opening, a heat exchange coil within said compartment between said openings, a partition extending across the interior of said compartment between said openings, said coil extending through said partition, a first fan within said compartment on one side of said partition, a first motor within said compartment for driving said fan, second and third, spaced-apart fans within said compartment on the other side of said partition second and third motors within said compartment for driving said second and third fans respectively, said fans being arranged to draw outdoor air through said inlet opening and to move the

outdoor air over said coil and out said outlet opening, thermostatic means responsive to outdoor temperatures, a first switch closed by said means when the outdoor temperature is at or above a first predetermined temperature and opened by said means when the outdoor temperature falls below said first temperature, means including said first switch, when closed, for energizing said first motor, a second switch closed and a third switch opened by said thermostatic means when the outdoor temperature is at or above a second predetermined temperature lower than said first temperature, said second switch being opened and said third switch being closed when the outdoor temperature falls below said second temperature, means including said second switch, when closed, for energizing said second and third motors, and means connecting said third switch across said first switch so that when said third switch is closed, said first motor is energized by said means included with said first switch.

2. The invention claimed in claim 1 in which said means included with said first switch comprises a first relay which is energized when said first switch is closed and a switch closed by said relay when said relay is energized, and in which said means included with said second switch comprises a second relay which is energized and a switch closed by said second relay when said second relay is energized.

3. In a refrigeration system, a rectangular compartment having outdoor air inlet openings in its opposite sides, and having first, second and third, aligned, spaced-apart outlet openings in its top, a partition extending across the interior of said compartment between said first and second outlet openings, a pair of slanted, spaced-apart, heat exchange coils located on the legs of a V-shaped outline below said outlet openings, said coils extending through said partition, first, second and third fans between the tops of said coils below and in alignment with said first, second and third outlet openings respectively, a first motor within said compartment for driving said first fan, second and third motors within said compartment for driving said second and third fans respectively, said fans being arranged to draw outdoor air through said inlet openings and to move the outdoor air over said coils and out said outlet openings, thermostatic means responsive to outdoor temperatures, a first switch closed by said means when the outdoor temperature is at or above a first predetermined temperature and opened by said means when the outdoor temperature falls below said first temperature, means including said first switch, when closed, for energizing said first motor, a second switch closed and a third switch opened by said thermostatic means when the outdoor temperature is at or above a second predetermined temperature lower than said first temperature, said second switch being opened and said third switch being closed when the outdoor temperature falls below said second temperature, means including said second switch, when closed, for energizing said second and third motors, and means connecting said third switch across said first switch so that when said third switch is closed, said first motor is energized by said means included with said first switch.

4. The invention claimed in claim 3 in which said means included with said first switch comprises a first relay which is energized when said first swtich is closed and a switch closed by said relay when said relay is energized, and in which said means included with said second switch comprises a second relay and a switch closed by said second relay when said second relay is energized.

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