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CONTROLS FOR REFRIGERATION SYSTEMS
HAVING AIR COOLED CONDENSERS
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Fig. 1.

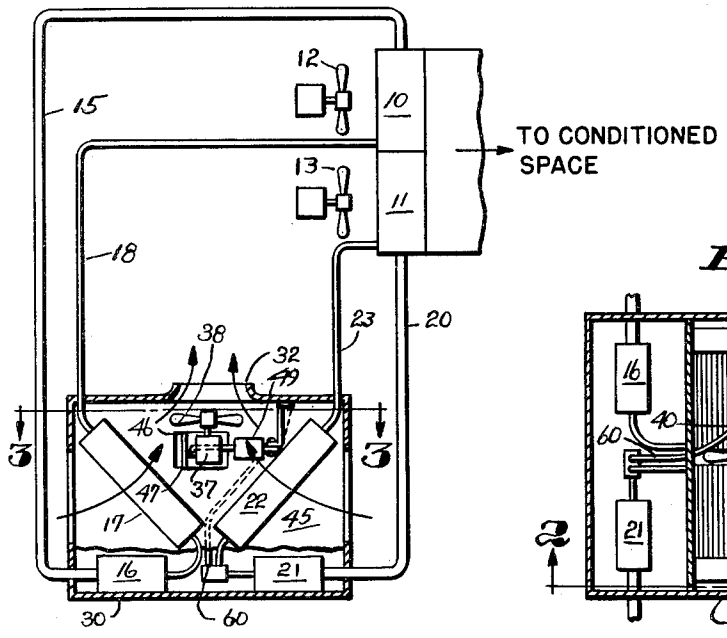


Fig. 3.

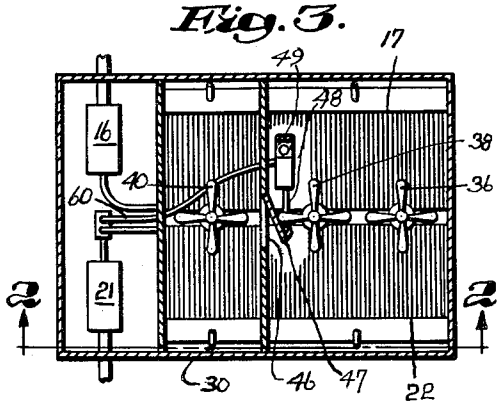
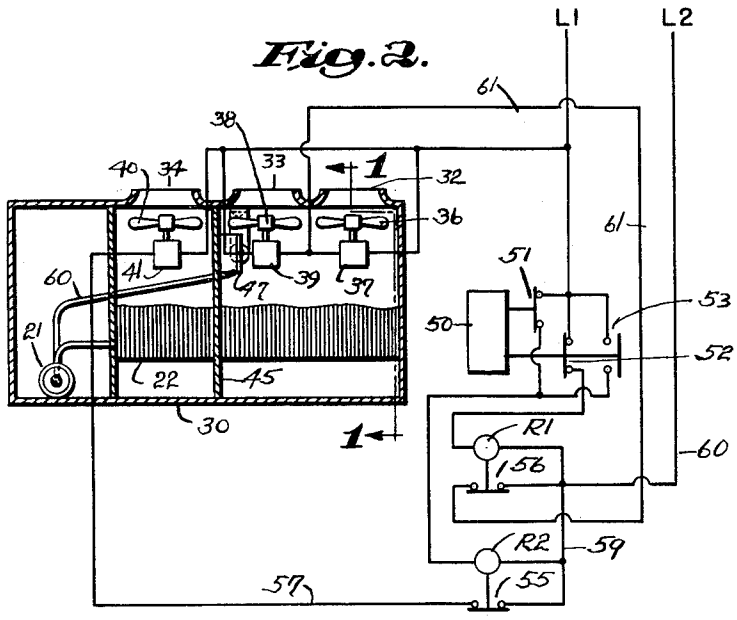


Fig. 2.



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CONTROLS FOR REFRIGERATION SYSTEMS HAVING AIR COOLED CONDENSERS

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This invention relates to controls for refrigeration systems having air-cooled condensers.

Due to the lack of sufficient water in many locations to water 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. For some duties, it is usual to operate air conditioning systems to cool indoor air when the outdoor temperature is low, and when air-cooled condensers are used, the condensing pressure may be insufficient to operate properly the refrigerant expansion devices, requiring the use of additional means to increase the condensing pressure.

The copending application of Robert S. Stewart, Serial No. 183,490, filed March 29, 1962, discloses an air conditioning system having two refrigeration systems with air-cooled condenser coils, the latter being located on the legs of a V-shaped outline within a compartment having outdoor air inlets in its ends and having three spaced-apart, outdoor air outlets in its top. Three fans are located between the condenser coils and the air outlets. The compartment has a vertically extending partition through which the condenser coils extend, and which isolates one fan from the other two fans. Controls responsive to outdoor temperature normally operate all three fans. When the outdoor temperature drops to a predetermined level, two fans are operated. Upon a further drop in outdoor temperature, one fan is operated. Such controls maintain sufficient condensing pressure at full load, but do not maintain sufficient condensing pressure at partial loads.

This invention adds a damper within an opening in the fan isolating partition of the system of the Stewart application, which is opened and closed by means responsive to discharge gas from one of the refrigerant compressors. Upon a predetermined decrease in discharge gas pressure, the damper is opened, permitting air to be recirculated through the outdoor air outlets, by-passing the condenser coils, reducing their cooling by the outdoor air, and increasing the condensing pressure.

An object of this invention is to decrease the cooling of an air cooled condenser coil of a refrigeration system when the pressure within the system decreases.

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, with the compartment containing its condenser coils and fans shown in section, the section being along the line 1—1 of FIG. 2;

FIG. 2 is a side section of the compartment, the section being along the lines 2—2 of FIG. 3, and shows also the electrical controls of the system, and

FIG. 3 is a section along the lines 3—3 of FIG. 1.

The air conditioning system illustrated has evaporator coils 10 and 11 used for cooling indoor air moved by fans 12 and 13 respectively. The 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 end 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 into the evaporator coils 10 and 11 respectively.

The condenser coils 17 and 22 are arranged on the legs of a V-shaped outline within a compartment 30 having outdoor 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 across the interior of the compartment 30 between the fans 38 and 40, and prevents air moved by the fans 36 and 38 when the fan 40 is not operating, from being recirculated through the outlets 33 and 34, and prevents air when the fan 40 is operating alone from being recirculated through the same outlets, which air if so recirculated, would by-pass the condenser coils 17 and 22. The partition 45 has an opening 46 therein which is adapted to be opened and closed by a damper 47 pivoted to the partition. The damper 47 is connected to piston rod 48 of cylinder 49, the interior of which is connected by tube 60 to the discharge side of the compressor 21. The cylinder 49 is pivoted to the partition 45. A decrease in discharge gas pressure to, for example 220 p.s.i., causes a piston which is not shown, in the cylinder 49, to start to open the damper 47 which would be fully opened when the discharge pressure, for example, decreases to 180 p.s.i.

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 electric supply lines L1 and L2. The switch 52 is connected in series with relay R2 and the supply lines. The switch 53 is connected across the switch 51.

The relay R2 has a switch 55 connected by wires 57 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 R1 has a switch 56 connected by wires 60 and 61 in series with the parallel connected motors 37 and 39 and the supply lines.

Operation

In operation, at outdoor temperatures high enough for the pressures across the capillary tubes 18 and 23 to be sufficient for the latter to operate properly as expansion means, the switches 51 and 52 are closed, energizing the relays R1 and R2, the switches 55 and 56 of which close and energize the fan motors 37, 39 and 41 so that all three fans 36, 38 and 40 operate to move outdoor air over the condenser coils 17 and 22. The damper 47 is closed.

Upon a drop in outdoor temperature to a predetermined 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 fans 36 and 38 remain in operation, reducing the volume of outdoor air which cools the condenser 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 which 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 the relay R1 back on which turns the fan motor 41 back on so that there is the one fan 40

in operation, further reducing the volume of outdoor air which cools the condenser coils.

At full load, the operation of the one fan **40** may be sufficient for maintaining the condensing pressure at the proper level at the lowest outdoor temperature at which the system is expected to operate to cool indoor air. At partial loads, the fan **40** moves too large a volume of outdoor air over the condenser coils for maintaining the proper condensing pressure. When the discharge pressure at the compressor **21** drops to, for example 220 p.s.i., the damper **47** starts to open, permitting some of the air moved by the fan **40** to by-pass the condenser coils, reducing their cooling for increasing the pressure therein. When the discharge pressure drops to 180 p.s.i., for example, the damper **47** is fully opened, further reducing the cooling of the condenser coils.

When the load on the system increases, or the outdoor temperature increases, the damper **47** closes for returning the system to the control of the thermostatic means **50**.

What is claimed is:

1. In a refrigeration system having a refrigerant compressor, a condenser compartment, a partition extending across the interior of said compartment, an air-cooled condenser coil within said compartment and extending through said partition and connected to the discharge side of said compressor, said compartment having an air inlet and an air outlet opening on one side of said partition, a fan within said compartment between said openings for moving air through said inlet opening, over the portion of said coil that is on said one side of said partition, and out said outlet opening, said compartment having a second air inlet opening and a second air outlet opening on the other side of said partition, a second fan within said compartment between said second openings for moving air through said second inlet opening, over the portion of said coil that is on said other side of said partition, and out said second outlet opening, said partition having an air by-pass opening therein, a damper normally closing said by-pass opening, and means including means responsive to refrigerant pressure within said system and produced by said compressor for adjusting said damper to open said by-pass opening.

2. The invention claimed in claim 1 in which said means responsive to refrigerant pressure is connected to said discharge side of said compressor.

3. The invention claimed in claim 2 in which said means responsive to refrigerant pressure comprises a cylinder having its interior connected to said discharge side of said compressor, and having a piston rod connected to said damper.

References Cited in the file of this patent

UNITED STATES PATENTS

2,214,933	Nelson	Sept. 17, 1940
2,958,208	Braden	Nov. 1, 1960
3,004,402	Dart	Oct. 17, 1961
3,073,132	Crider	Jan. 15, 1963