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OIL AND MOTOR COOLING IN A REFRIGERATION SYSTEM

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FIG. 1.

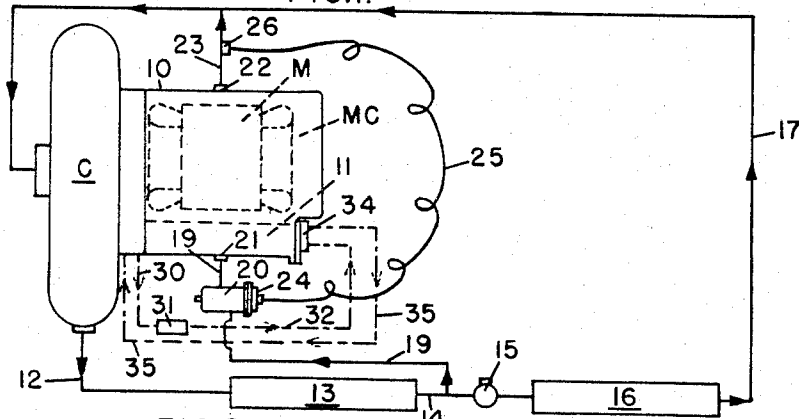
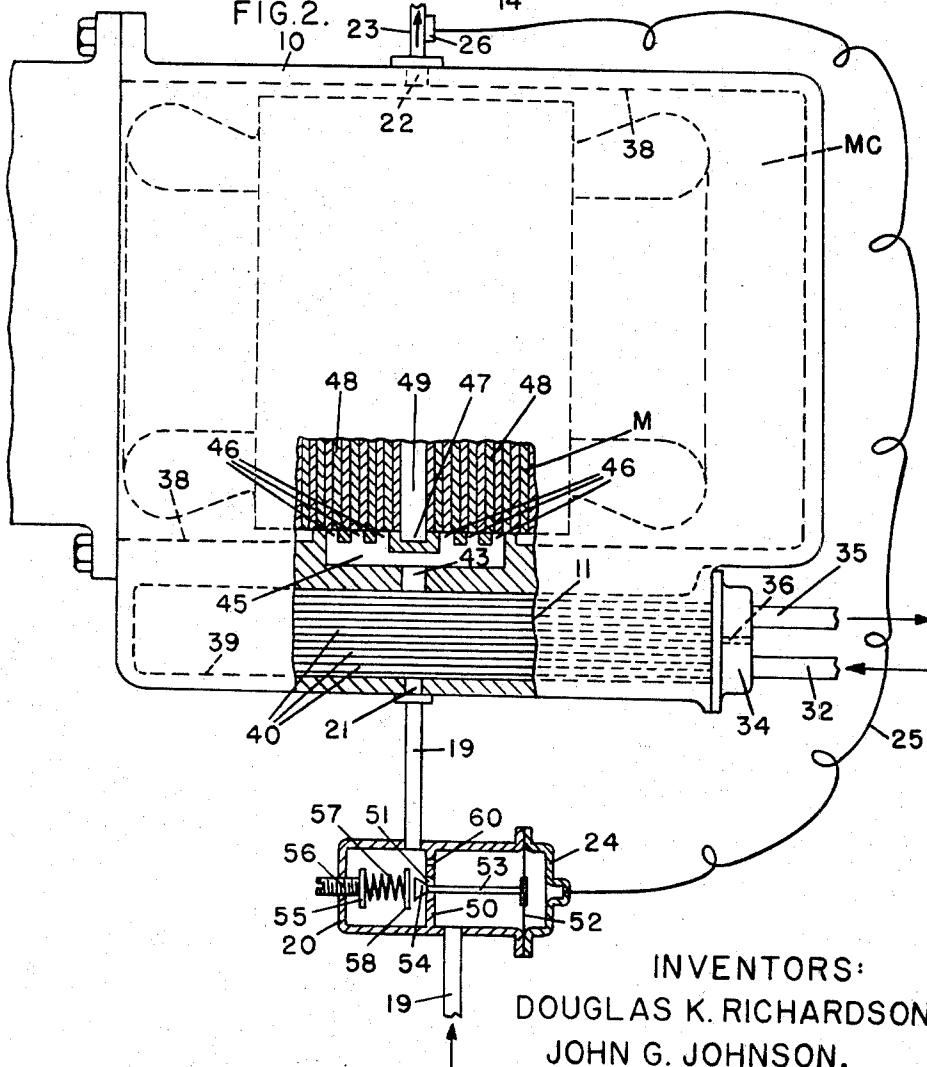


FIG. 2.



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OIL AND MOTOR COOLING IN A REFRIGERATION SYSTEM

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2 Claims. (Cl. 62-197)

ABSTRACT OF THE DISCLOSURE

In a refrigeration system having a refrigerant compressor-motor unit, lubricating oil from the unit is circulated through tubes within an oil cooler compartment in the lower portion of the motor casing. Refrigerant from the condenser of the system is supplied through a thermostatic expansion valve into the oil cooler compartment around the tubes therein, then into the motor compartment around the motor therein, and then through a suction gas tube to the compressor. The diaphragm chamber of the expansion valve is connected to a thermal bulb in contact with the suction gas tube. The expansion valve has a bleed port sized to supply sufficient refrigerant to properly cool the oil regardless of the modulation of the expansion valve caused by varying motor loads.

Background of the invention

The field of the invention is refrigeration systems having refrigerant compressor-electric motor units, the lubricating oil of which has to be cooled. It is usual to cool the oil and a motor with two refrigerant circuits. This invention cools both in one circuit, with the oil cooler located upstream with respect to refrigerant flow of the motor. A single expansion valve responsive to superheat in the gas leaving the motor compartment controls the refrigerant flow. A feature of this invention is that the expansion valve is provided with a bleed port sized to supply sufficient refrigerant to the oil cooler compartment to properly cool the oil regardless of the modulation of the expansion valve.

Summary of the invention

The electric motor of a refrigerant compressor-electric motor unit has a casing having an upper motor compartment and a lower oil cooler compartment. The bottom wall of the casing forms the bottom of the oil cooler compartment, and has a refrigerant inlet opening therein. The casing has an intermediate wall forming the bottom of the motor compartment and the top of the oil cooler compartment, and has an opening therein for admitting refrigerant leaving the oil cooler compartment into the motor compartment. The casing has a refrigerant outlet in its top wall connected through a suction gas tube to the suction gas inlet of the compressor. The condenser of the system including the compressor is connected through a thermostatic expansion valve to the refrigerant inlet opening with the diaphragm chamber of the expansion valve connected to a thermal bulb in contact with the suction gas tube at the refrigerant outlet of the motor casing. The expansion valve has a bleed port sized to supply sufficient refrigerant to the oil cooler to properly cool the oil regardless of the modulation of the expansion valve caused by varying motor cooling loads.

Brief description of the drawings

FIG. 1 is a diagrammatic view of a refrigeration system embodying this invention, and

FIG. 2 is an enlarged side view, partially in section, of the common casing of the oil cooler and electric motor of

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FIG. 1, and of the thermostatic expansion valve of FIG. 1, the expansion valve being shown in section.

Description of the preferred embodiment

Referring first to FIG. 1 of the drawings, a centrifugal refrigerant compressor C is driven by an electric motor M. A casing 10 extends around an upper motor compartment MC, and around a lower oil cooler compartment 11. The outlet of the compressor C is connected by discharge gas line 12 to the inlet of condenser 13, the outlet of which is connected through liquid line 14 and expansion valve 15 which may be any conventional expansion valve, to the inlet of evaporator 16, the outlet of which is connected by suction gas line 17 to the inlet of the compressor C. The liquid line 14 is also connected by liquid line 19 containing a thermostatic expansion valve 20, to refrigerant inlet 21 of the casing 10. The casing 10 has a refrigerant outlet 22 connected by suction gas line 23 to the suction gas line 17. The expansion valve 20 has a diaphragm chamber 24 connected by capillary tube 25 to thermal bulb 26 in heat exchange contact with the suction line 23.

The oil lines on FIG. 1 are dashed lines. Lubricating oil is drawn from the compressor-motor unit through oil line 30 by pump 31, and is pumped by the latter through oil line 32 to the oil inlet of header 34 of the oil cooler compartment 11. The oil outlet of the header 34 is connected by oil line 35 to the compressor-motor unit.

Referring now to FIG. 2 of the drawings, the casing 10 has a wall 38 extending around the motor M, and has a wall 39 below and connecting with the bottom of the wall 38. The bottom portion of the wall 38, the wall 39 and the header 34 extend around the oil cooler compartment 11. The bottom of the wall 39 has the refrigerant inlet 21 extending therethrough. The top of the wall 38 has the refrigerant outlet 22 extending therethrough. The compartment 11 contains closely spaced, parallel oil cooler tubes 40 having return bends which are not shown, at their left ends, their other (right) ends opening into the header 34. A partition 36 extends horizontally across the interior of the header 34, and separates the oil inlets and outlets of the tubes 40. The usual horizontal and vertical baffles which are not shown, cause the refrigerant entering the inlet 21 to flow over the outer surfaces of the tubes 40 along their entire lengths. The bottom of the wall 38 has, above the refrigerant inlet 21, a refrigerant opening 43 connecting the motor compartment MC with the oil cooler compartment 11. The motor compartment MC, including the motor M, are disclosed in detail in the co-pending application of John G. Johnson, Ser. No. 601,359, filed Dec. 13, 1966. The bottom of the wall 38 has a recess 45 below spaced-apart slots 46 formed in the inner surface of the wall 38, and extending around the motor M on opposite sides of a central annular slot 47 in the inner surface of the wall 38, which slot connects with the refrigerant outlet 22. Stator 48 of the motor M has a central passage 49 aligned with and connecting with the annular slot 47.

The thermostatic expansion valve 20 has a partition 50 with a valve opening 51 in its center, extending across its interior. Diaphragm 52 within the diaphragm chamber 24 is attached at its center to one end of piston rod 53 which extends through the opening 51, and has a valve piston 54 on its other end. A circular plate 55 on the inner end of adjusting screw 56 threaded into the end of the valve 20 opposite its diaphragm chamber 24. A coiled spring 57 is attached at one end to the plate 55, and at its other end to a circular plate 58 similar to and aligned with the plate 55, and aligned with the piston 54. The partition 50 has a bleed port 60 extending therethrough and operating as a by-pass around the valve opening 51. The valve 20, except for the bleed port 60, is that disclosed on pp. 301-302 of "Principles of Refrigeration"

by R. J. Dossat, published in 1961 by John Wiley & Sons. The bleed port 60 is sized to provide sufficient refrigerant to cool the oil flowing through the oil cooler tubes 40 sufficiently regardless of the modulation of the expansion valve 20 caused by variations of the cooling load of the motor M.

Operation

Referring first to FIG. 1 of the drawings, discharge gas from the compressor C flows through the line 12 into the condenser 13. Liquid flows from the latter through the liquid line 14 and the expansion valve 15 into the evaporator 16. Gas from the latter flows through the suction gas line 17 to the suction side of the compressor C. Liquid refrigerant also flows from the liquid line 14 through the liquid line 19 and the expansion valve 20 into the refrigerant inlet 21 of the casing 10. Gas flows from the interior of the casing 10 through the suction gas tubes 23 and 17 to the suction side of the compressor C. Lubricating oil is drawn through the oil line 30 from the compressor-motor unit by the pump 31, and is forced by the latter through the oil line 32 into the header 34 of the oil cooler compartment 11, and from the header 34 through the oil line 35 back to the compressor-motor unit.

Referring now to FIG. 2 of the drawings, refrigerant from the expansion valve 20 flows through the refrigerant inlet 21 into the oil cooler compartment 11 around the outer surfaces of the oil cooler tubes 40, and then through the opening 43 in the casing wall 38 into the recess 45 within the wall 38. The refrigerant then flows from the recess 45 through the slots 46, and cools the motor M as described in the previously mentioned Johnson application. Gas flows through the passage 49 into the annular slot 47, and from the latter through the refrigerant outlet 22 into the suction gas tube 23. The oil entering the header 34 flows through the tubes 40, then from the header 34 through the oil line 35 to the compressor-motor unit.

The oil cooler load is not reduced in accordance with reductions in the compressor load as is the motor cooling load so that the thermostat 20 can be adjusted by its response to superheat in the gas leaving the motor compartment to so near closed position that the oil flowing through the oil cooler tubes 40 is not adequately cooled. The bleed port 60 prevents this, it supplying in a by-pass around the adjustable valve opening of the valve 20, sufficient refrigerant into the oil cooler compartment to adequately cool the oil at all times.

By cooling the oil and the motor in a single refrigeration circuit, the tubing and tubing connections are simplified, and their cost is reduced. Adequate cooling of the oil is accomplished by placing the oil cooler upstream with respect to refrigerant flow, of the motor, and by providing the bleed port 60. Further simplification of structure, and reduction of cost are accomplished by forming the oil cooler compartment in the motor casing.

We claim:

1. In a refrigeration system including a compressor, a condenser, a discharge gas line connecting said compressor to said condenser, expansion means, a first liquid line connecting said condenser to said expansion means, an evaporator, a third line connecting said expansion means to said evaporator, and a first suction gas line connecting said evaporator to said compressor; said compressor having an electric driving motor and being connected with said motor in a compressor-motor unit; said motor having a casing with a wall extending around said motor and forming a motor compartment; said unit having an oil cooler compartment with a refrigerant inlet and a refrigerant outlet, and having means for circulating the lubricating oil of said unit through said cooler compartment in heat exchange with refrigerant flowing between said inlet and outlet; the improvement comprising a second liquid line containing a thermostatic expansion valve connected to said first liquid line and to said inlet of said cooler compartment; means connecting said outlet of said cooler compartment to the interior of said motor compartment, and a second suction gas line connected to said interior of said motor compartment and to said first suction gas line, said expansion valve having a refrigerant metering opening, and having means including means responsive to superheat in the gas flowing through said second suction line for variably opening and closing said opening, said expansion valve having a bleed port by-passing said metering opening, said bleed port being sized to supply a substantial quantity of refrigerant to said cooler compartment sufficient to adequately cool the oil flowing therethrough when said metering opening is closed.

2. The invention claimed in claim 1 in which said cooler compartment has a header, in which said casing has a second wall forming with a portion of said first mentioned wall and said header said cooler compartment, in which said inlet of said cooler compartment is an opening in said second wall, in which said outlet of said cooler compartment and said means connecting said outlet of said cooler compartment to said interior of said motor compartment is an opening in said portion of said first mentioned wall, in which said cooler compartment has a plurality of tubes therein connecting with said header, and in which said means for circulating oil through said cooler compartment includes said tubes, and includes an oil inlet opening and an oil outlet opening in said header.

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MEYER PERLIN, *Primary Examiner*.