

[54] **REFRIGERANT COOLING SYSTEM
FOR ELECTRIC MOTOR**

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[58] Field of Search62/505

[56] **References Cited**

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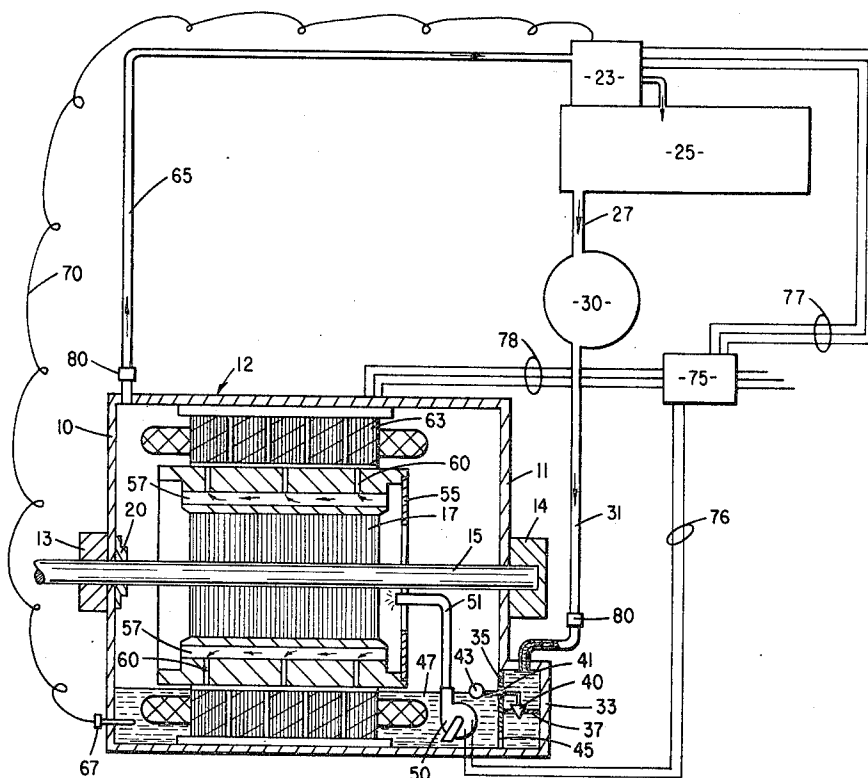
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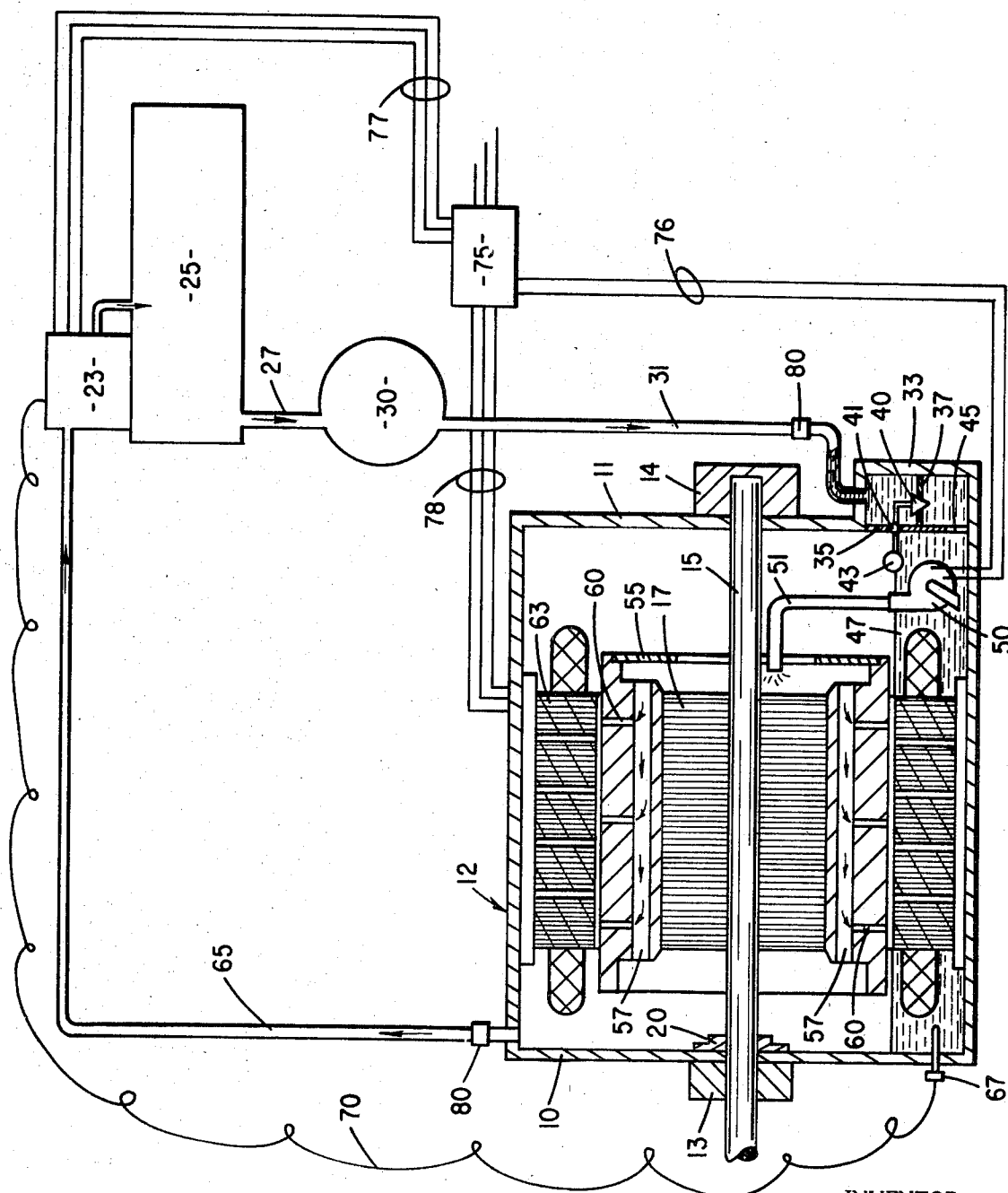
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[57] **ABSTRACT**

The low- and high-pressure sides of a refrigerant apparatus are connected to the casing of a hermetically enclosed electric motor. Refrigerant control means is provided to maintain a supply of liquid refrigerant in the casing at a predetermined level. A pump functions to dispense the liquid refrigerant from the supply in the motor casing on the components of the motor to cool the same.

2 Claims, 1 Drawing Figure





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REFRIGERANT COOLING SYSTEM FOR ELECTRIC MOTOR

BACKGROUND OF THE INVENTION

The many advantages obtained by using refrigerant to cool electric motors are well known. However, suggested motor-cooling systems employing refrigerant as a cooling medium are not suitable for cooling large hermetically sealed motors used in commercial installations. Such motor-cooling arrangements do not automatically provide efficient cooling of the motor under conditions which change from time to time. Conventionally, such systems function to provide a fixed volume of refrigerant to the motor, regardless of the motor-cooling demand which varies with the load placed on the motor.

Our invention has as an object a motor-cooling system which functions to efficiently provide, at all times, a supply of liquid refrigerant in the motor casing for adequately cooling the motor under all operating conditions.

SUMMARY OF THE INVENTION

The liquid refrigerant output of a refrigerant apparatus is passed to the motor casing through a float operated control valve responsive to the liquid refrigerant supply in the motor casing. The valve functions to limit the refrigerant supply in the motor casing to a predetermined level. To assure that liquid refrigerant is at all times supplied in sufficient volume to maintain the desired level, and the compressor is operated efficiently, the capacity of the compressor is varied by a capacity control operated by a temperature sensor responsive to the temperature of the refrigerant supply in the casing. A small circulating pump, preferably mounted in the motor casing, is employed to dispense liquid refrigerant from the supply and disperse the refrigerant on the motor components. With this arrangement, the cooling requirements of the motor are satisfied under all operating conditions.

BRIEF DESCRIPTION OF THE DRAWING

The drawing is a schematic diagram illustrating our invention in conjunction with a hermetically sealed, horizontally disposed motor.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The end walls 10, 11 of the motor casing 12 are provided with bearings 13, 14. The shaft 15 carrying the rotor 17 is journaled in the bearings 13, 14. The shaft 15 extends outwardly through the bearing 13, and a suitable seal 20 is mounted on the casing end wall 10 to maintain the casing in sealed condition.

In the diagram, 23 designates a refrigeration compressor having the output thereof connected to a condenser 25. A line 27 extends from the condenser to a refrigerant receiver 30 having a discharge line 31 extending to the lower portion of the motor casing.

The motor casing is formed with a sump compartment 33, to the upper portion of which the line 31 is connected. A partition 35 serves to separate the sump 33 from the main motor compartment. A horizontal partition plate 37 serves to separate the sump into upper and lower compartments. The plate 37 is formed with an aperture to receive a valve 40 carried on an arm having a pivot connection 41 in the partition 35. The valve arm extends into the main motor compartment; and at its free end, it is provided with a float 43. The partition wall 35 is formed in its lower portion with an aperture 45.

With this arrangement, liquid refrigerant is passed from the receiver 30 to the sump 33 and is metered into the motor casing by valve 40 operated by float 43. The valve arrangement is such that the valve is moved to closed position by the float 43 when the liquid refrigerant reaches the level indicated by the line 47. This level is shown slightly below the periphery of the motor rotor 17.

A refrigerant circulating pump 50, preferably mounted in the motor casing, functions to pump the liquid refrigerant

from the supply and dispense the same through outlet tube 51. The discharge tube 51 terminates in confronting relation to one end of the motor rotor 17. An annular member 55 is fixed to this end of the rotor. The rotor is formed with passages 57 extending in a direction axially of the rotor. The rotor is also formed with passages 60 extending radially outwardly from the passages 57.

The liquid refrigerant discharged from tube 51 is collected by centrifugal force between the dam or annular member 55 and the contiguous end of the rotor and is moved through the passages 57 and outwardly through the passages 60 for discharge in the gap between the rotor 17 and the motor stator 63.

A suction line 65, communicating with the upper portion of the motor casing, extends therefrom to the compressor 23 and serves during operation of the compressor for the withdrawal of refrigerant vapor from the motor casing.

It will be appreciated the heat load to be extracted from the motor is in relation to the load placed on the motor. As the load on the motor is increased, more heat is developed in the motor components with an accompanied temperature rise and increase in vaporization of the refrigerant.

To make certain that the output from compressor 23 is sufficient at all times to maintain the refrigerant supply in the motor casing at the level 47, and also to prevent unnecessary loading of the compressor, the compressor 23 is provided with a capacity control mechanism such as a conventional step unloader. Such a mechanism is disclosed in U.S. Pat. No. 2,626,099, to Carlyle M. Ashley, Jan. 20, 1953. The unloader is operated by a temperature sensor 67 mounted in the motor casing and responsive to the temperature of the refrigerant supply. The sensor 67 is connected by line 70 to the compressor capacity control mechanism. As previously pointed out, the temperature of the refrigerant supply is in relation to the heat developed in the motor which, in turn, is comparable to the load placed on the motor.

The compressor 23 is selected to have a maximum capacity to provide sufficient refrigerant to effectively cool the motor when the same is operating at top design load. As the load on the motor decreases, the temperature of the refrigerant supply will also decrease; and the sensor 67 will operate to unload the compressor 23 accordingly. With this arrangement, an adequate supply of liquid refrigerant is continuously maintained in the lower portion of the motor casing to satisfy the motor cooling demand.

In order that the cooling of the motor becomes effective immediately upon startup following a prolonged shutdown period, the compressor 23 and the motor-operating the refrigerant-circulating pump 50 are connected to the starter 75 for energizing the main motor. A line 76 extends from the starter 75 to the pump motor 50; and a line 77 extends to the compressor 23 or the starting equipment therefor. The line 78 extends from the starter 75 to the stator windings of the main motor. Accordingly, the refrigerant-circulating pump 50 and the compressor are energized simultaneously with the main motor to effect cooling thereof on startup.

Employing the system of our invention, the motor may be fabricated and shipped as a compact structure embodying all components except the refrigeration apparatus. Upon installation of the motor, it is only necessary to connect the refrigerant lines 31, 65 by couplings 80, the capacity control line 70, and the electric lines to the starter 75.

We claim:

1. A liquid refrigerant cooling system for an electric motor comprising a hermetically sealed casing containing the motor components including a stator having windings and a rotor, the axis of said rotor being disposed horizontally, refrigeration apparatus operable when energized to supply liquid refrigerant to said casing and extract refrigerant vapor therefrom, passage means extending from said apparatus to said casing for the transfer of the liquid refrigerant thereto, refrigerant control means operable to maintain a supply of liquid refrigerant in said motor casing in contact with a por-

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tion of the windings of said stator and at a level below and in close proximity to said rotor, and pump means operable to dispense liquid refrigerant from said supply onto said motor components.
2. A system as set forth in claim 1 wherein said compressor includes capacity control mechanism operable to vary the out-

put capacity of said compressor according to the temperature of said liquid refrigerant supply in said motor casing, and a temperature sensor disposed to sense the temperature of said supply, said temperature sensor being operatively connected to said compressor capacity control mechanism.

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