

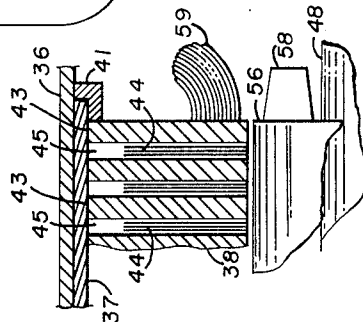
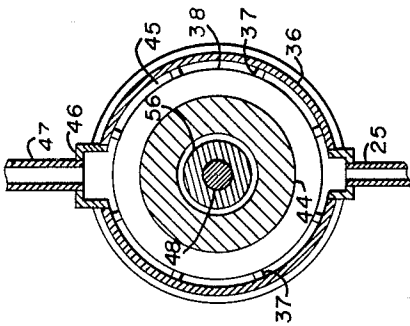
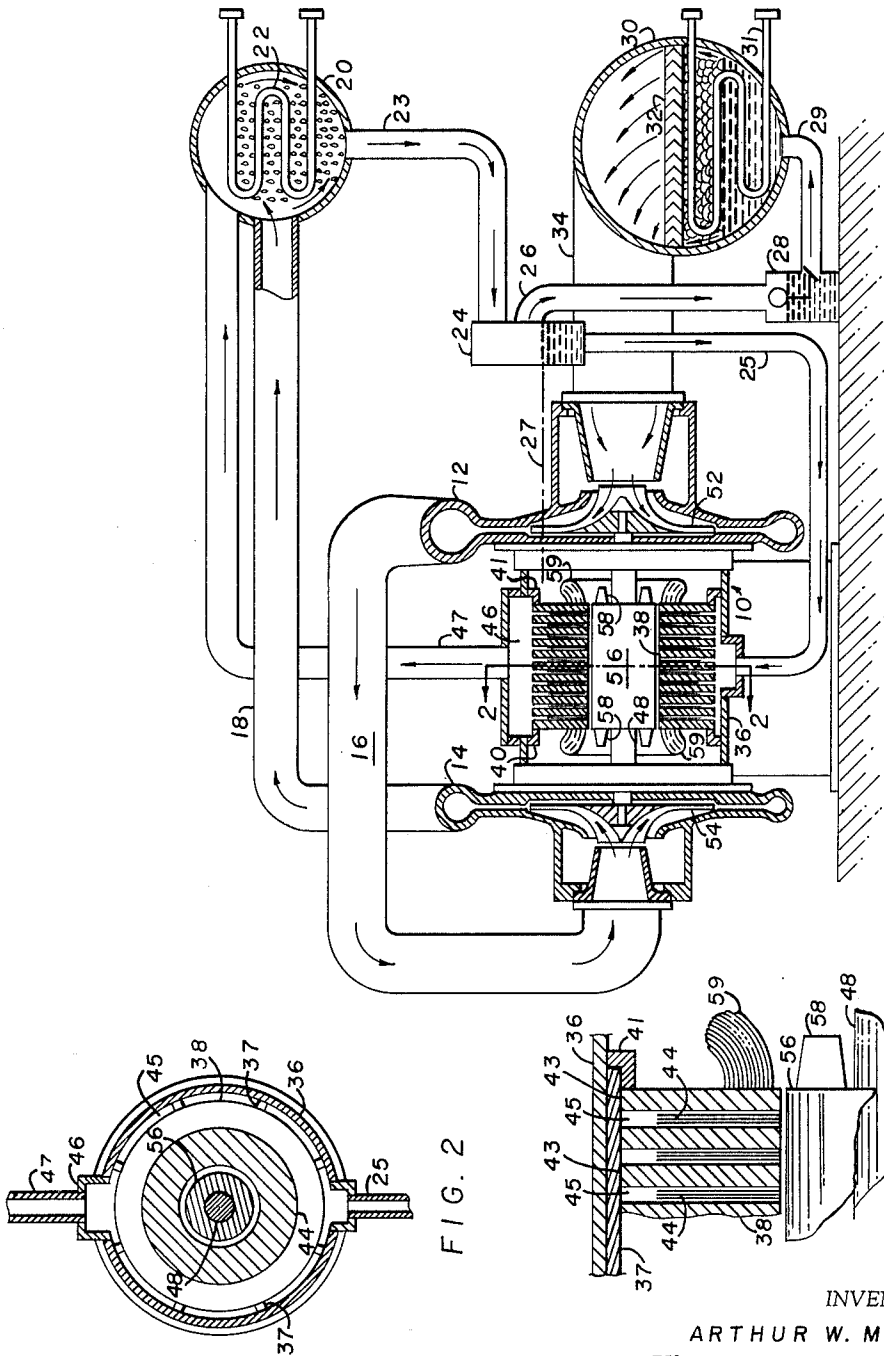
Nov. 23, 1965

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REFRIGERATING APPARATUS INCLUDING MEANS FOR
COOLING COMPRESSOR MOTOR

3,218,825

Filed Aug. 14, 1962

2 Sheets-Sheet 1



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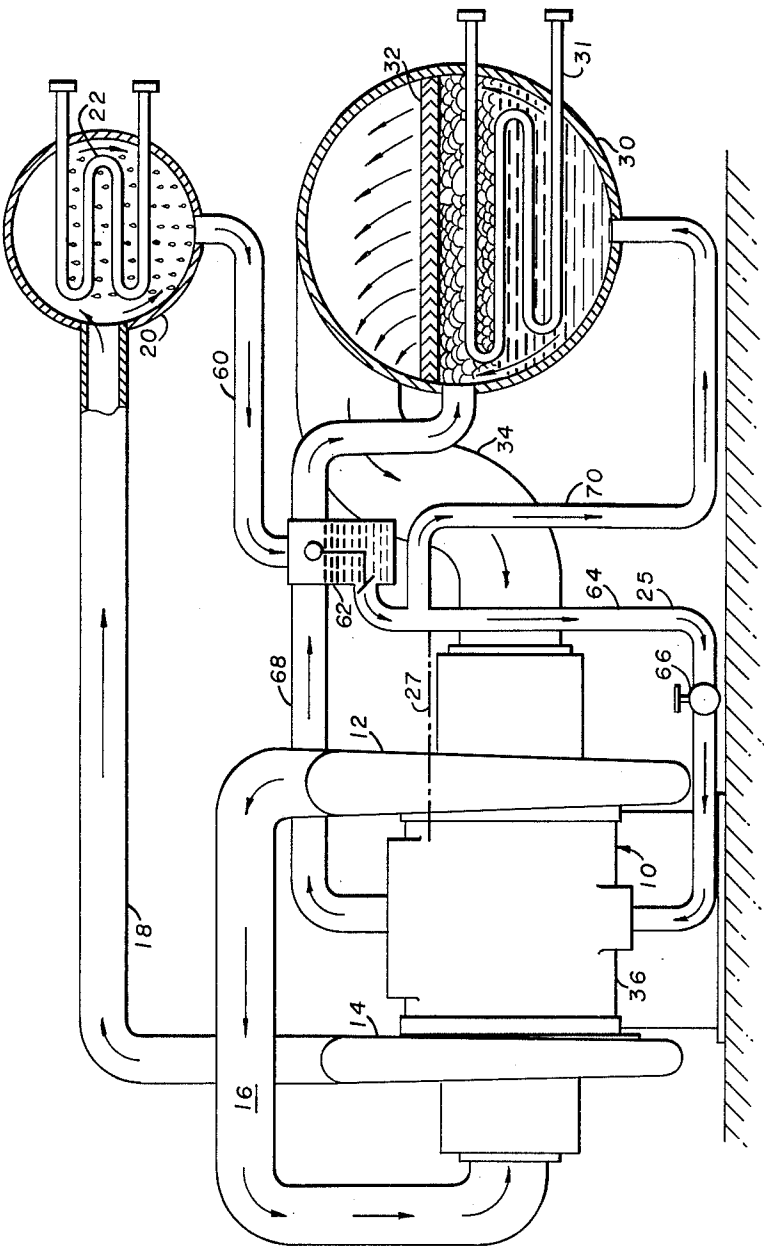


FIG. 4

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REFRIGERATING APPARATUS INCLUDING MEANS FOR COOLING COMPRESSOR MOTOR

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Filed Aug. 14, 1962, Ser. No. 216,842
3 Claims. (Cl. 62—505)

This invention relates to refrigerating apparatus of the type including a motor-compressor assembly, and particularly to apparatus in which the motor and compressor are housed in a sealed unit.

It is an object of this invention to provide improved means for cooling the motor of refrigerating apparatus using the liquid refrigerant of the refrigerating apparatus as a heat exchange medium.

It is another object of this invention to conduct liquid refrigerant through passageways of the motor stator to cool the motor stator by evaporation of refrigerant and to provide means for conducting the vaporized refrigerant to the condenser or to the evaporator.

It is another object of the invention to provide means for conducting liquid refrigerant from the condenser to the evaporator only when the motor has a predetermined supply of refrigerant liquid for cooling.

Other objects and advantages of the invention will appear as the specification proceeds to describe the invention with reference to the accompanying drawings in which:

FIGURE 1 is a partly diagrammatic view in elevation of the refrigerating apparatus with portions sectioned to more clearly show the interior construction;

FIGURE 2 is a cross-sectional view taken on line 2—2 of FIGURE 1;

FIGURE 3 is an enlarged sectional view taken on an axial plane through one of the stator supporting bars and showing a portion of the interior of the motor; and

FIGURE 4 is a partly diagrammatic view in elevation of a modification of the refrigerating apparatus with portions sectioned to more clearly show the interior construction.

Referring now to FIGURE 1, an electric motor 10 has at one end a first stage compressor 12 and at the other end a second stage compressor 14. A cross-over pipe 16 conducts gas from the discharge of the first stage 12 to the inlet of the second stage 14.

The gas discharged from the second stage 14 flows through a pipe 18 to a condenser 20. The condenser 20 may be of the shell-and-tube type in which cooling water flows through the tubing 22 and the refrigerant is in the shell outside the tubes. Refrigerant liquid condensed in condenser 20 flows by gravity through pipe 23 to a reservoir 24. A conduit 25 is in fluid flow communication with the bottom of reservoir 24 and conducts liquid refrigerant to the motor 10.

A conduit 26 is connected to the reservoir 24 at a point above its bottom to conduct overflow liquid refrigerant when the liquid rises to level 27. A properly sized float valve 28 maintains a liquid level in the chamber of the valve. Conduit 29 conducts the liquid and flash gas to evaporator 30 which is also of the shell-and-tube type in which the secondary refrigerant liquid such as water or brine flows through the tubing 31 and the refrigerant is in the shell outside the tubing.

The secondary refrigerant liquid circulates between the evaporator 30 and the cooling load served by the refrigeration apparatus to transfer heat from the load to the evaporator 30. In removing heat from the secondary refrigerant, the refrigerant in the evaporator 30 boils forming vapor which passes through the liquid eliminator

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32 and thence into the suction pipe 34 of the evaporator 30 to the inlet of the first stage compressor 12.

The motor 10 has a fluid tight casing 36 secured in fluid sealing relationship to the housings of compressors 12 and 14. Bars 37 are secured to the casing 36 and to a motor stator 38 to support the motor stator 38 in the casing 36. As more clearly shown in FIGURE 3, the stator 38 comprises large diameter laminations 43 and smaller diameter laminations 44 thus providing annular spaces 45 between the stator 38 and the casing 36 for the flow of refrigerant. The refrigerant flowing in annular spaces 45 contacts and cools large surface areas of the stator 38, the bars 37, and the casing 36. Rings 40 and 41 are secured to the casing 36 to provide additional support for the stator 38 and bars 37, and to seal the annular spaces 45 from the interior of the motor. A manifold 46 collects the vaporized refrigerant for flow into conduit 47 and thence to condenser 20.

A shaft 48 is rotatably supported in the casing 36 by bearings (not shown) and extends at one end into compressor 12 and has a centrifugal impeller 52 secured thereto. The other end of shaft 48 extends into compressor 14 and has a centrifugal impeller 54 secured thereto. A motor rotor 56 is secured to the shaft 48 and has fan blades 58 for circulating the refrigerant vapor over the surfaces of the shaft 48, the rotor 56, the stator 38, and the ends of the stator windings 59. This circulation of refrigerant vapor transfers heat from these parts to the cooled parts of the motor. The spaces surrounding the rotor 56 and the spaces surrounding the end turns of the windings 59 are filled with refrigerant vapor because of the pressures and temperatures existing in these spaces.

Under certain temperature conditions which might occur after a shut down of the apparatus, there can be little or no liquid refrigerant in the casing 36, the conduit 25, and the reservoir 24. When the apparatus is started under such conditions, the refrigerant condensate first produced by condenser 20 flows directly through conduit 25 to the motor casing 36 for motor cooling. Refrigerant liquid does not flow through conduit 26 to the evaporator 30 until the liquid in reservoir 24 rises to the level 27 which is opposite the bottom of the entrance to conduit 26.

With the liquid refrigerant at level 27 in the reservoir 24, the stator 38 is substantially submerged in liquid, because the liquid level in the annular passageways 45 is also substantially at level 27. With this arrangement, substantially all of the outer surface area of laminations 43 and 44 and substantially all of the surface areas of laminations 43 defining annular spaces 45 are wetted with liquid refrigerant. Very effective cooling of the stator is therefore obtained.

Referring now to FIGURE 4 which shows a modification of the apparatus of FIGURE 1 and in which corresponding parts have like numerals, the refrigerant liquid flows from condenser 20 through conduit 60 to a float valve 62 which maintains a liquid level in the chamber of the valve. Conduit 64 conducts liquid refrigerant to the motor casing 36. A valve 66 is positioned in the conduit 64 to control the flow therethrough.

A conduit 68 conducts vaporized refrigerant from the manifold 46 of the motor casing 36 to the evaporator 30 at a point below the eliminator 32.

A conduit 70 receives refrigerant liquid which overflows from conduit 64 and conducts such refrigerant liquid to evaporator 30.

The operation of the apparatus of FIGURE 4 is similar to that of FIGURE 1 in that on initiating operation the refrigerant liquid first produced by the condenser 20 flows directly through conduit 64 to the motor casing 36 for motor cooling.

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Refrigerant liquid does not flow through conduit 70 until liquid in conduit 64 rises to the outlet to conduit 70. At this condition, the liquid refrigerant in the casing 36 is substantially at the same level as the liquid refrigerant in conduit 70 and the desired effective motor cooling is obtained as explained more fully with reference to FIGURE 1.

Although a two-stage compressor has been shown, it should be understood that the apparatus is also applicable to an apparatus in which the motor drives a single stage compressor.

While I have described the foregoing preferred embodiment of my invention, I contemplate that many changes may be made without departing from the scope or spirit of my invention and I desire to be limited only by the claims.

I claim:

1. In refrigerating apparatus, the combination of an evaporator for vaporizing refrigerant, a condenser for liquefying refrigerant, a compressor for circulating refrigerant through said condenser and evaporator, a casing, an electric motor stator mounted in said casing and having grooves in its periphery, means providing an annular space between said electric motor stator and said casing, means for conducting refrigerant liquid from said condenser to the annular space between said electric motor stator and said casing to cool said electric motor stator and said casing, means for conducting refrigerant vapor from said casing, a rotor and shaft assembly rotatably mounted in said casing, fan means mounted on said rotor and shaft assembly for circulating refrigerant vapor over the surfaces of said shaft and rotor assembly, said stator and said casing to transfer heat from said shaft and rotor assembly and said stator to said casing, and means for additionally conducting refrigerant liquid from said condenser to said evaporator when the level of refrigerant liquid in said casing exceeds a predetermined point.

2. In refrigerating apparatus, the combination of an evaporator for vaporizing refrigerant, a condenser for liquefying refrigerant, a compressor for circulating refrigerant through said condenser and evaporator, a casing, an electric motor stator mounted in said casing and having grooves in its periphery, means providing an annular space between said electric motor stator and said casing, means for conducting refrigerant liquid from said condenser to the annular space between said electric

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motor stator and said casing to cool said electric motor stator and said casing, means for conducting refrigerant vapor from the annular space to said condenser, a rotor and shaft assembly rotatably mounted in said casing, fan means mounted on said rotor and shaft assembly for circulating refrigerant vapor over the surfaces of said shaft and rotor assembly, said stator and said casing to transfer heat from said shaft and rotor assembly and said stator to said casing, and means for additionally conducting refrigerant liquid from said condenser to said evaporator when the level of refrigerant liquid in said casing exceeds a predetermined point.

3. In refrigerating apparatus, the combination of an evaporator for vaporizing refrigerant, a condenser for liquefying refrigerant, a compressor for circulating refrigerant through said condenser and evaporator, a casing, an electric motor stator mounted in said casing and having grooves in its periphery, means providing an annular space between said electric motor stator and said casing, means for conducting refrigerant liquid from said condenser to the annular space between said electric motor stator and said casing to cool said electric motor stator and said casing, means for conducting refrigerant vapor from the annular space to said evaporator, a rotor and shaft assembly rotatably mounted in said casing, fan means mounted on said rotor and shaft assembly for circulating refrigerant vapor over the surfaces of said shaft and rotor assembly, said stator and said casing to transfer heat from said shaft and rotor assembly and said stator to said casing, and means for additionally conducting refrigerant liquid from said condenser to said evaporator when the level of refrigerant liquid in said casing exceeds a predetermined point.

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