

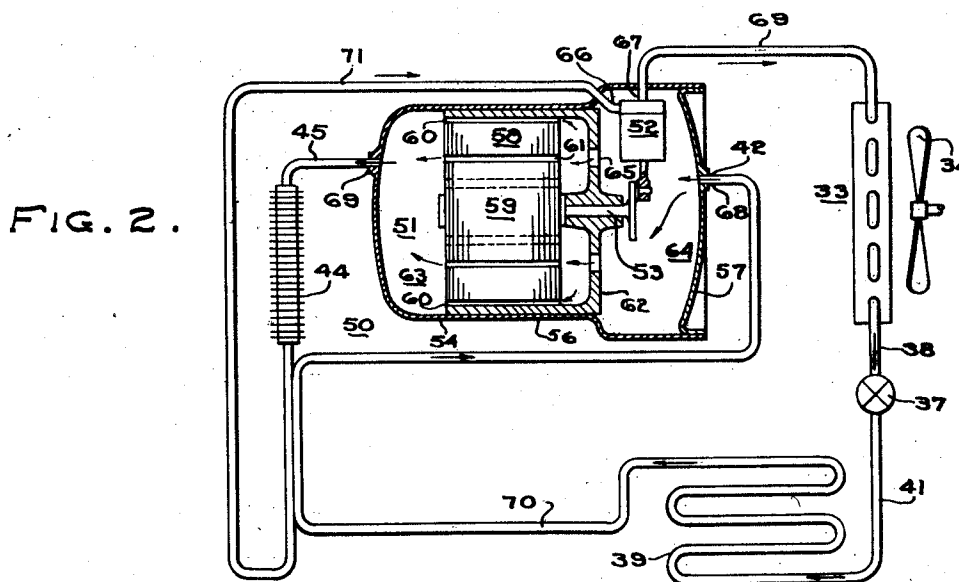
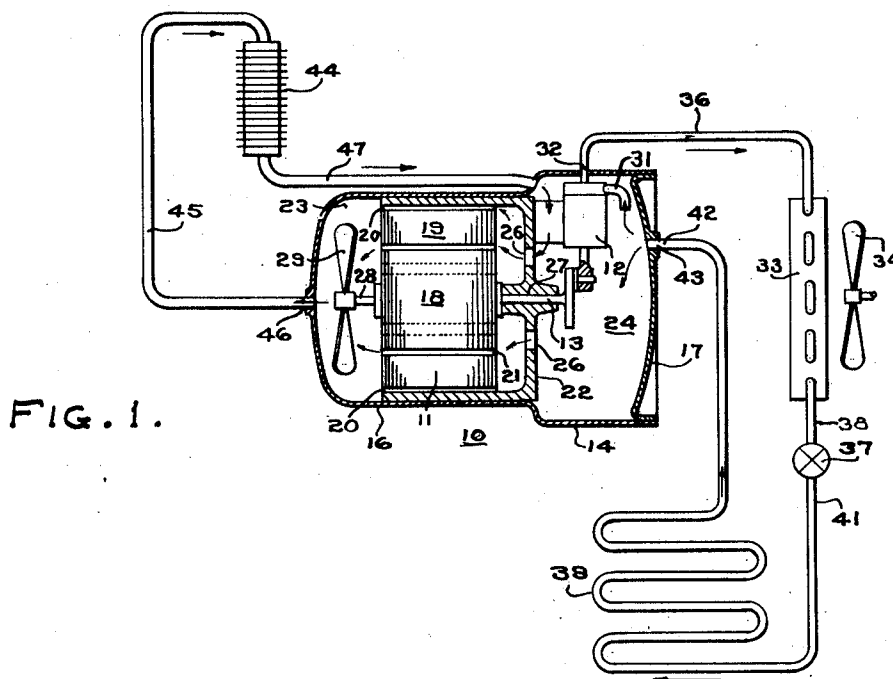
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COOLING APPARATUS FOR COMPRESSORS

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WITNESSES:

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COOLING APPARATUS FOR COMPRESSORS

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My invention relates to refrigeration apparatus and particularly to refrigeration apparatus of the compression type.

It is an object of my invention to provide refrigerating apparatus which embodies improved means for cooling the motor of a hermetically sealed motor-compressor unit.

It is another object of my invention to cool the motor of a motor-compressor unit by circulating low pressure refrigerant gas through the motor in contact with the warm rotor and stator elements.

It is a further object of my invention to cool the low pressure refrigerant gas externally of the hermetically sealed casing after the gas has circulated through the motor and before it has been compressed in the compressor.

These and other objects are effected by my invention as will be apparent from the following description and claims taken in connection with the accompanying drawing, forming a part of this application, in which:

Fig. 1 is a diagrammatic view of a refrigerating system showing one embodiment of my invention; and,

Fig. 2 is a diagrammatic view of a refrigerating system showing a second embodiment of my invention.

Referring to Fig. 1 of the drawing for a detailed description of the first embodiment of my invention, numeral 10 designates a hermetically sealed motor-compressor unit comprising a motor 11 and a compressor 12 directly connected to each other in end to end relation by a horizontal drive shaft 13 and enclosed by a hermetically sealed casing 14 having a main portion 16 and a cover portion 17. The motor 11 comprises a rotor element 18 and a stator element 19 with an annular air gap 21 therebetween. The stator element 19 is provided with a plurality of circumferentially spaced longitudinally extending channels 20 on its periphery. A frame structure 22 surrounds the stator element 19 and serves as a support therefor. The frame structure 22 is pressed into the main portion 16 of the casing and divides the interior of the casing into a compartment 23 in which the motor 11 is located and a compartment 24 in which the compressor 12 is disposed. A plurality of openings 26 in the frame structure 22 provides communicating passages between the compartments 23 and 24. The drive shaft 13, to which the rotor element 18 is rigidly secured, is journaled at 27 in the frame structure 22 on the compressor side of the rotor 18 and extends beyond the outer side

of the rotor 18 to provide an extension 28 to which a fan 29 is attached. The compressor 12 is provided with a suction inlet 31 which opens into the compartment 24, and with a discharge outlet 32. A condenser 33, cooled by a fan 34, is connected at one end to the discharge outlet 32 by a conduit 36 and at the other end to an expansion valve 37 by a conduit 38. An evaporator 39, having an inlet 41 and an outlet 42, has the inlet 41 connected to the expansion valve 37 and the outlet 42 connected to an opening 43 in the cover portion 17 of the casing 14. A heat exchanger 44 is disposed externally of the hermetically sealed casing 14 and is connected at one end to the compartment 23 through a conduit 45 and an opening 46 in the casing, while the other end of the heat exchanger 44 communicates with the compartment 24 through a conduit 47.

When the hermetically sealed motor-compressor unit 10 is operated, cold refrigerant vapor is withdrawn from the evaporator 39 and into the compartment 24 by the suction of the compressor 12. Thus an atmosphere of gas at substantially suction pressure prevails within the compartment. A portion of this cold low pressure gas is drawn through the suction inlet 31 into the compressor 12 while another portion is drawn through the openings 26 in the frame structure 22 into the compartment 23 by the suction of the fan 29. From the compressor side of the compartment 23, the low pressure gas is drawn by the suction of the fan 29 through the channels 20 and the air gap 21 in a direction away from the compressor into that portion of the compartment 23 in which the fan 29 is located. In passing through the channels 20 and the air gap 21, the low pressure gas is brought into intimate contact with the warm rotor and stator elements and aids in cooling these parts by absorbing some of the heat generated during their operation. As it is desirable to keep the temperature of the gas entering the compressor 12 as low as possible, the warm gas is forced by the fan 29 out of the compartment 23 through the conduit 45 into the heat exchanger 44, wherein some of the heat of the low pressure gas is dissipated to atmosphere. The cool low pressure gas is returned to the compressor compartment 24 through the conduit 47 where the cooled low pressure gas intermixes with the gas in the compartment 24 to be recirculated through the motor 11 or to be drawn into the compressor 12 through the suction inlet 31. The portion of the low pressure gas which is drawn into the com-

pressor 12 has its pressure raised therein. The gas at a higher pressure is conveyed to the condenser 33 wherein it is liquefied. The pressure of the liquefied refrigerant is reduced in the expansion valve 37 and is conveyed to the evaporator 39 through the inlet 41. Within the evaporator 39, vaporization of the liquid refrigerant is effected and the low pressure gas passes through the outlet 42 into the compartment 24 of the casing 14 to complete the refrigeration cycle.

Referring now to Fig. 2 for a detailed description of the second embodiment of my invention, the refrigerating system embodying the second form of my invention is similar, to the refrigerating system described in connection with the first embodiment of my invention and, for the sake of simplicity, the elements shown in Fig. 2, except for the motor-compressor unit and its refrigerant connections, will be numbered in keeping with the designations given to corresponding parts in Fig. 1.

In Fig. 2, numeral 50 designates a hermetically sealed motor-compressor unit which comprises a motor 51 directly connected in end to end relation with a compressor 52 by a horizontal drive shaft 53 and enclosed by a hermetically sealed casing 54 having a main portion 56 and a cover portion 57. The motor 51 comprises a stator element 58 and a rotor element 59 with an annular air gap 61 therebetween. The stator element 58 is surrounded and supported by a frame structure 62 which is pressed into the main portion 56 of the casing and serves as a partition to divide the interior of the casing into a compartment 63 in which the motor 51 is located and a compartment 64 in which the compressor 52 is disposed. A plurality of circumferentially spaced longitudinal channels 60 are provided on the periphery of the stator element 58 and with the air gap 61 provide communicating passages between the compressor side of the compartment 63 and the outer side of the same compartment. A plurality of openings 65 in the frame structure provide communicating passages between the compartments 63 and 64. The compressor 52 is provided with a suction inlet 66 and a discharge outlet 67. A condenser 33, cooled by a fan 34, is connected, at one end, to the discharge outlet 67 through a conduit 69. The other end of the condenser 33 communicates with an expansion valve 37, through a conduit 38. An evaporator 39 having an inlet 41 and an outlet 42 has the inlet connected to the expansion valve 37, and the outlet 42 connected through a conduit 70 to an opening 68 in the cover portion 57 of the casing. A heat exchanger 44 is disposed externally of the hermetically sealed casing 54 and is connected at one end to the compartment 63 through a conduit 45 and an opening 69 in the casing. The other end of the heat exchanger 44 is connected through a conduit 71, which is arranged in heat exchange relation with the conduit 70, to the suction inlet 66 of the compressor.

When the hermetically sealed motor-compressor unit 50 is operated, cold refrigerant vapor is drawn from the evaporator 39 into the compartment 64. Thus, an atmosphere of gas at substantially suction pressure prevails within the compartment 64. As the motor-compressor unit continues to operate, the cold low pressure gas is drawn through the openings 65 into the compartment 63 by the suction of the compressor 52. From the compressor side of the compartment 63,

the low pressure gas passes in a direction away from the compressor through the channels 60 and the annular passage formed by the air gap 61 into the outer side of the compartment 63. In passing through the channel 60 and the annular passage 61, the low pressure gas is in intimate contact with the warm rotor and stator elements and aids in cooling these parts by absorbing some of the heat generated during their operation. The warm gas is drawn out of the casing through the opening 69 into the heat exchanger 44 wherein it loses some of the heat absorbed by virtue of its contact with the warm motor parts. From the heat exchanger 44, the cooled low pressure gas is drawn, through the conduit 71 and the suction inlet 66 directly into the compressor 52 to be compressed. The conduit 71 is disposed in heat exchange relation with the suction conduit 70 whereby the low pressure gas is further cooled in order to keep the temperature of the gas entering the compressor at a low value. The compressed gas is discharged from the compressor 52 through the outlet 67 and is conveyed through the conduit 69 to the condenser 33 wherein it is liquefied. The pressure of the liquefied refrigerant is reduced in the expansion valve 37 after which it passes through the inlet 41 into the evaporator 39, wherein vaporization of the liquid refrigerant takes place. The vaporized refrigerant is withdrawn from the evaporator 39 and into the compartment 64 by the suction of the compressor 52, thus completing the cycle.

It will be apparent from the foregoing that I have provided refrigerating apparatus in which the motor of the motor-compressor unit is cooled by circulating low pressure refrigerant gas through the motor to absorb heat therefrom and in which the warm low pressure gas is cooled externally of the casing before being compressed in the compressor.

While I have shown my invention in several forms, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. In refrigerating apparatus, the combination of an evaporator and a condenser for vaporizing and liquefying refrigerant, a compressor for circulating refrigerant through said evaporator and condenser, a motor for driving said compressor, a fluid-tight casing enclosing said motor and compressor, means for conveying refrigerant gas from said evaporator to said fluid-tight casing, whereby an atmosphere of refrigerant gas at substantially suction pressure prevails within the casing, means within said casing for effecting positive circulation of said low pressure gas through said motor and means for cooling the low pressure gas circulated through said motor and for returning at least a portion of the cooled gas to said compressor.

2. In refrigerating apparatus, the combination of an evaporator and a condenser for vaporizing and liquefying refrigerant, a compressor for circulating refrigerant through said evaporator and condenser, a motor for driving said compressor, a fluid-tight casing enclosing said motor and compressor, means for conveying refrigerant gas from said evaporator to said fluid-tight casing, whereby an atmosphere of refrigerant gas at sub-

stantially suction pressure prevails within the casing, means within said casing for effecting circulation of said low pressure gas throughout the length of the motor and means for cooling the low pressure gas circulated through said motor and for returning all the cooled gas to said compressor.

3. In refrigerating apparatus, the combination of an evaporator and a condenser for vaporizing and liquefying refrigerant, a compressor for circulating said refrigerant through said evaporator and condenser, a motor for driving said compressor, a fluid-tight casing enclosing said motor and compressor, means for conveying refrigerant gas from said evaporator to said fluid-tight casing, whereby an atmosphere of refrigerant gas at substantially suction pressure prevails within said casing, means within said casing for effecting circulation of said low pressure gas throughout the length of said motor and means for cooling the low pressure gas circulated through said motor and for returning the cooled gas to the interior of said casing.

4. In refrigerating apparatus, the combination of an evaporator and a condenser for vaporizing and liquefying refrigerant, a compressor for circulating said refrigerant through said evaporator and said condenser, said compressor having an inlet thereto, a motor for driving said compressor, a fluid-tight casing for enclosing the motor and compressor, means for conveying refrigerant gas from said evaporator to said fluid-tight casing, whereby an atmosphere of refrigerant gas at substantially suction pressure prevails within said casing, means within said casing for effecting the circulation of said low pressure gas through said motor and means disposed externally of the fluid-tight casing for cooling the low pressure gas circulated through said motor and for returning the cooled gas directly to the inlet of said compressor.

5. In refrigerating apparatus, the combination of an evaporator and a condenser for vaporizing and liquefying refrigerant, a compressor for circulating refrigerant through said evaporator and said condenser, a motor for driving said compressor, said motor comprising stator and rotor elements with an air gap therebetween and said stator having a plurality of longitudinal channels therethrough, a gas-tight casing enclosing the motor and compressor, means for conveying refrigerant gas from the evaporator to the fluid-tight casing, whereby an atmosphere of refrigerant gas at substantially suction pressure prevails within said casing, means within said casing for effecting the circulation of said low pressure gas through said annular passage and said channels in contact with said stator and rotor elements, and means disposed externally of the gas-tight casing for cooling the low pressure gas circulated through said air gap and said channels and for returning at least a portion of the cooled gas to said compressor.

6. In refrigerating apparatus, the combination of a condenser for liquefying refrigerant vapor, an evaporator for vaporizing refrigerant liquid, a compressor for withdrawing vaporized refrigerant from the evaporator and for discharging compressed refrigerant vapor to the condenser, a motor disposed at one side of the compressor for driving the latter, said driving motor embodying a rotor and a stator with an air gap therebetween, and means for conveying vaporized refrigerant from the evaporator through the gap in the motor in a direction away from the com-

pressor, whereby heat is absorbed from the motor, and means for conveying refrigerant gas circulated through the air gap of the motor to the inlet of the compressor.

7. In refrigerating apparatus, the combination of a sealed casing, a motor and a refrigerant vapor compressor in said casing, said motor driving said compressor, an inlet and an outlet on said compressor, a refrigerant condenser connected with said outlet, a refrigerant evaporator connected with said condenser, a suction conduit connecting said refrigerant evaporator and said casing, a second conduit in heat exchange relationship with said suction conduit connecting said casing and the inlet of said compressor, the suction conduit and the second conduit being connected to the casing in a manner to draw the cooling vapors issuing from the suction conduit across the motor to cool the same.

8. In refrigerating apparatus, the combination of a sealed casing, a motor and a refrigerant vapor compressor in said casing, said motor driving said compressor, an inlet and an outlet on said compressor, a refrigerant condenser connected with said outlet, a refrigerant evaporator connected with said condenser, a suction tube connecting said evaporator with the compressor side of said casing, means within said casing for effecting circulation of the refrigerant vapor therein from the compressor side through said motor to cool the same, and means for returning at least a portion of the circulated gas to the inlet of the compressor.

9. In refrigerating apparatus, the combination of a sealed casing, a motor and a refrigerant vapor compressor in said casing, said motor driving said compressor, an inlet and an outlet on said compressor, a refrigerant condenser connected with said outlet, a refrigerant evaporator connected with said condenser, a suction tube connecting said evaporator with the compressor side of said casing, means within said casing for effecting circulation of the refrigerant vapor therein from the compressor side through said motor to cool the same, and means for cooling the low pressure gas circulated through said motor and returning at least a portion of the circulated gas to the inlet of the compressor.

10. In refrigerating apparatus, the combination of an evaporator, a condenser, a compressor for circulating refrigerant through said evaporator and condenser, a motor for driving the compressor, a fluid-tight casing for enclosing the motor and compressor, said compressor being provided with an inlet in substantially unrestricted communication with the interior of said fluid-tight casing, first refrigerant conveying means for conveying refrigerant gas from said evaporator and having an inlet connecting with the interior of said fluid-tight casing, whereby an atmosphere of refrigerant gas at substantially suction pressure prevails within said casing and is in contact with said motor, and second refrigerant conveying means disposed in heat exchange relation with said first refrigerant conveying means externally of the fluid-tight casing, said second refrigerant conveying means being arranged to convey low pressure gas from the interior of the sealed casing to said compressor inlet after the low pressure gas has been in contact with said motor.

11. In refrigerating apparatus, the combination of an evaporator, a condenser, a compressor for circulating refrigerant through said evaporator and condenser, a motor for driving said

compressor, a fluid-tight casing for enclosing the motor and compressor, said compressor having an inlet in communication with said fluid-tight casing, means for conveying refrigerant gas from the evaporator and having an inlet in communication with the fluid-tight casing, whereby an atmosphere of refrigerant gas at substantially suction pressure prevails within said casing, a fan within said casing actuated by said motor for effecting the circulation of low pressure gas through said motor and means disposed externally of the fluid-tight casing for cooling the low pressure gas circulated through said motor and for returning the gas to said compressor.

12. In refrigerating apparatus, the combination of a condenser, an evaporator, a fluid-tight casing, and a motor compressor unit separate from and disposed in said casing, said unit com-

prising a motor and a compressor directly connected in end-to-end relation, the motor including a stator element and a rotor element, a motor frame structure surrounding and supporting the stator element, said frame structure being pressed into said casing and serving as a partition to divide the interior of the casing into a motor compartment and a compressor compartment, the parts being constructed and arranged so that said compressor compartment contains refrigerant gas at suction pressure and so that refrigerant gas in said compressor compartment must flow through said frame structure in contact with said stator element and said rotor element to cool the same before it enters said compressor.

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