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REFRIGERATING APPARATUS

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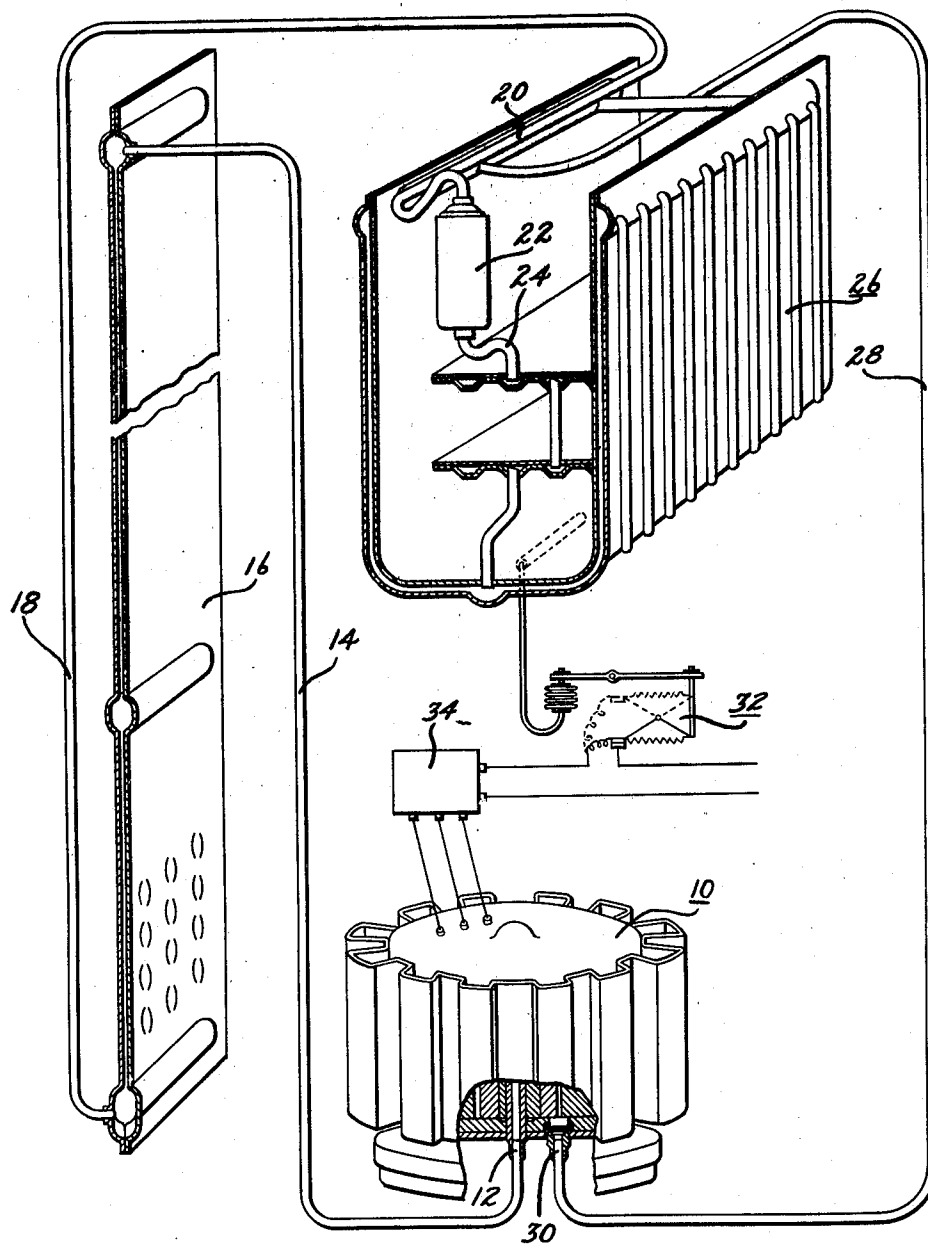


Fig. 1

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## REFRIGERATING APPARATUS

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This invention relates to refrigerating apparatus and more particularly to a novel device for controlling the flow of liquid refrigerant in a refrigerating apparatus.

5 It is an object of the invention to provide a refrigerant flow control device in the form of a fixed restrictor comprising a pair of telescoped cylindrical members having a passage between them of small cross section, but great length.

10 Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

15 In the drawings:

Fig. 1 is a diagrammatic view of a refrigerating apparatus embodying the present invention;

20 Fig. 2 is a cross section of a refrigerant flow control device for use in the system shown in Fig. 1;

Fig. 3 is a cross sectional view of a modified form of refrigerant flow control device for use in the system of Fig. 1;

25 Fig. 4 is a cross sectional view of a further modified form of refrigerant flow control device for use in the system of Fig. 1;

Fig. 5 is a cross sectional view of a further modified form of refrigerant flow control device for use in the system of Fig. 1; and

30 Fig. 6 is a cross sectional view of a further modified form of refrigerant flow control device for use in the system of Fig. 1.

Referring now to Fig. 1, there is shown a refrigerating apparatus comprising a motor-compressor unit 10 having an outlet 12 through which compressed refrigerant is delivered by means of a conduit 14 to a condenser 16. Refrigerant liquefied in the condenser 16 is delivered through conduit 18 to a heat interchanger 20, whence it passes to the refrigerant flow control device 22 for delivery by the conduit 24 to the evaporator 26. Refrigerant vaporized in the evaporator is delivered by means of a suction conduit 28 to the inlet 30 of the compressor 10. A suitable thermostatic or other automatic control switch 32 is provided for intermittently operating the motor-compressor unit to provide substantially constant temperatures at the evaporator 26. A starting control switch 34 controls the energization of the proper motor circuits in starting. The system operates in the conventional manner to withdraw heat at the evaporator from a food compartment or other object to be cooled and to dissipate

heat at the condenser to the room air or other cooling medium.

The construction of the refrigerant flow control device or restrictor 22 in its preferred form is illustrated in Fig. 2. This comprises an outer cylindrical member 36 which has a cylindrical bore and is closed at one end except for an outlet connection 38. Telescoped within the member 36 is an inner cylindrical member 40 which likewise has a hollow bore and is closed at the end adjacent the outlet 38, but open at the other end. The surface of one of the two cylindrical members 36 and 40 which lies adjacent the surface of the other member is formed with a helical thread-like groove thereon to provide, when the parts are assembled, a helical passage of small cross section and relatively great length. Preferably, the thread-like groove is formed on the inner member 40 as illustrated in Fig. 2. The open end of the outer cylindrical member 36 is closed by a cap member 42 having an inlet connection 44. To provide a completely closed restrictor except for the inlet and outlet connections 34 and 38 respectively. The cap 42 is sealed to the outer member 36 as by soldering.

25 In order to insure proper operation of the restrictor, the inner and outer members are formed with such relative diameters that they are capable of assembly only when the outer member 36 is at a very much higher temperature than the inner member 40. The cylindrical members are telescoped together by causing the necessary temperature difference between them, either by heating one or cooling the other or both, telescoping them together and then allowing their temperatures to equalize. This results in an extremely tight joint being obtained between the engaging surfaces of the two members 36 and 40 which prevents the passage of refrigerant from the inlet 44 to the outlet 38 by any path other than the one through the helical groove formed on member 40. In order to secure best results in operation, it is preferred to place the restrictor 22 in a vertical position as shown in Fig. 1 with the inlet 44 at the top.

35 In operation, liquid refrigerant is fed from the conduit 18 through the inlet connection 44 at the top of the restrictor. Since this connection is centrally located, and since the bore in the interior of the inner member 40 provides a comparatively large chamber or trap, any sediment which enters through the connection 44 will collect in the sediment chamber in the bottom thereof. Liquid refrigerant is fed to the entrance of

the helical groove at a point near the top of the sediment chamber and at the extreme outside thereof, so that the provision of a filter screen to prevent clogging of the helical passage is unnecessary. The liquid refrigerant under pressure in the helical groove has its pressure reduced to the low pressure prevailing in the evaporator 26 by the great frictional or viscous resistance to the flow of fluid through the helical passage to the restrictor, as is well known in the art. The refrigerant delivered from the end of the helical passage at reduced pressure is conducted through the space between the closed ends of the inner and outer members 40 and 36 to the outlet connection 38 where it is delivered to the conduit 24.

Referring now to Fig. 3, there is illustrated a modified form of restrictor 22A having an outer cylindrical member 46 which has an internal cylindrical bore closed at one end except for the inlet connection 48 and open at the other end. An inner cylindrical member 50 is telescoped within the outer member 46 preferably by a temperature differential shrinkage fit as previously described. A helical refrigerant passage of small cross section and relatively great length is provided between the members 46 and 50 by forming a helical thread-like groove on the surface of one of the members, preferably the member 50, as described in connection with the restrictor 22. The open end of the outer member 46 is closed by a cap 52 having an outlet connection 54, the cap 52 being sealed to the outer member 46. A filter screen 56 is provided in one end of the outer member 46 and is retained therein by a ring 58 to which the screen is secured as by soldering. Retention of the ring 58 in the member 46 is secured preferably by a frictional fit.

In operation of this modified form of the invention, liquid refrigerant is delivered to the inlet connection 48, whence it passes through the filter screen 56 to the helical passage between the inner and outer cylindrical members 50 and 46. Refrigerant at reduced pressure is delivered from the opposite end of the helical groove to the outlet connection 54. The present form of the invention is particularly adapted to refrigerating systems in which it is desirable to locate the inlet connection for the restrictor in a position other than at the top of the device. It is also advantageous where the design of the system as a whole makes it desirable to avoid heat interchange between incoming liquid refrigerant and the outgoing gaseous refrigerant. In such a situation, the inner member 50 may be made of an alloy or other material having a low heat conductivity.

Referring now to Fig. 4, there is illustrated a further modified form of restrictor 22B which is much like the restrictor 22, except that the closed end of the inner cylindrical member 41 is situated adjacent the inlet connection 44. Inasmuch as this construction eliminates the sediment trap provided by the form illustrated in Fig. 2, a filter screen 58 is provided which is soldered or otherwise sealed to the inner end of the cap member 42. Its operation is substantially the same as that of the form of Fig. 3, except that the interior bore of the inner member 40 provides a body of cold low pressure refrigerant in heat exchange with the refrigerant flowing through the helical passage.

Referring now to Fig. 5, a further modified form of restrictor 22C is illustrated including an outer cylindrical member 60 having an internal bore which is closed at one end except for a central

inlet conduit 62 and an outlet conduit 64 laterally spaced therefrom. In this modification, the inner cylindrical member 66 is formed and assembled to the outer member substantially as in the modification of Fig. 4, except that the inlet conduit 62 extends inwardly through the closed end of the inner member 66 to feed liquid refrigerant into the interior of that member. The open end of the inner member 66 carries a filter screen 68 which is retained in position by a retaining member 70. The open end of the outer cylindrical member 60 is closed by a sealing cap 72 soldered or otherwise sealed to the member 60. The operation of this modification is substantially the same as has been described previously with the exception of the fact that the low pressure refrigerant is withdrawn from the device at the same end that the high pressure liquid refrigerant is delivered to the device.

The modification illustrated in Fig. 6 comprises a restrictor 22D somewhat similar in construction to the restrictor 22C except that the inner member 74 is closed at the end remote from the outlet connection 64. The inlet conduit 62 extends centrally through substantially the entire length of the restrictor to pass through the closed end of the inner member 74 and deliver the liquid refrigerant to the space between that and the end cap 72. A filter screen 76 is located on the end of the inner member 74 and is sealed to the same by a retaining ring 78 pressed into a groove 80 formed on the end of the inner member 74. The operation of this modification is substantially the same as that of the modification of Fig. 5, with the exception of the fact that the interior of the inner member 74 is exposed to low pressure refrigerant rather than to high pressure refrigerant as is the case in the previous modifications.

It will thus be seen that the present invention provides several specific constructions of refrigerant flow control devices or restrictors which are well suited for use as the sole means for regulating the flow of liquid refrigerant from the high pressure side to the low pressure side of a refrigerating apparatus, as well as for use in conjunction with other control devices.

While the form of embodiment of the present invention as herein disclosed constitutes a preferred form, it will be understood that other forms might be adopted all coming within the scope of the claims which follow.

What is claimed is as follows:

1. In a refrigerating system, a restrictor for controlling the flow of refrigerant from the high side to the low side comprising an outer cylindrical member, an inner cylindrical member, one of said members having a groove adjacent a surface of the other of said members and forming therewith a passage of small cross-sectional area and relatively great length, means forming a wall in said inner member to block communication through said member between its ends, and inlet and outlet conduits in one end of said outer member, one of said conduits extending through said wall forming means.

2. In a refrigerating system, a restrictor for controlling the flow of refrigerant from the high side to the low side comprising an outer cylindrical member, an inner cylindrical member, one of said members having a groove adjacent a surface of the other of said members and forming therewith a passage of small cross-sectional area and relatively great length, means forming a wall in said inner member to block communication

through said member between its ends, and inlet and outlet conduits in one end of said outer member, one of said conduits extending through said wall forming means and being coaxial with said cylindrical members.

3. In a refrigerating system, a restrictor for controlling the flow of refrigerant from the high side to the low side comprising an outer cylindrical member, an inner cylindrical member, one of said members having a groove adjacent a surface of the other of said members and forming therewith a passage of small cross-sectional area and relatively great length, said inner member being hollow and open at one end and closed at the other end, said outer member being hollow and closed at both ends, and inlet and outlet conduits at one end of the outer member, one of said conduits extending through the closed end of said inner member.

4. In a refrigerating system, a restrictor for controlling the flow of refrigerant from the high side to the low side comprising an outer cylindrical member, an inner cylindrical member, one of said members having a groove adjacent a surface of the other of said members and forming therewith a passage of small cross-sectional area and relatively great length, said inner member being hollow and open at one end and closed at the other end, said outer member being hollow and closed at both ends, and inlet and outlet conduits at one end of the outer member, one of said conduits ex-

tending through the closed end of said inner member, and filter means positioned to filter the refrigerant before entering said passage.

5. In a refrigerating system, a restrictor for controlling the flow of refrigerant from the high side to the low side of said system comprising an outer cylindrical member, an inner cylindrical member enclosed in the outer member, said outer member being provided with refrigerant inlet and outlet connections, one of said members having a groove adjacent a surface of the other of said members, said outer member being held on said inner member by pressure substantially equivalent to that derived from temperature change shrinkage and the ends of said inner member being solid and imperforate.

6. In a refrigerating system, a restrictor for controlling the flow of refrigerant from the high side to the low side of said system comprising an outer cylindrical member, an inner cylindrical member enclosed in the outer member, said outer member being provided with refrigerant inlet and outlet connections, one of said members having a helical groove adjacent a surface of the other of said members, said members being telescoped together and retained by a bond sufficiently tight to preclude relative movement after assembly, and the ends of said inner member being solid and imperforate.

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