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AIR CONDITIONING APPARATUS

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FIG. 1.

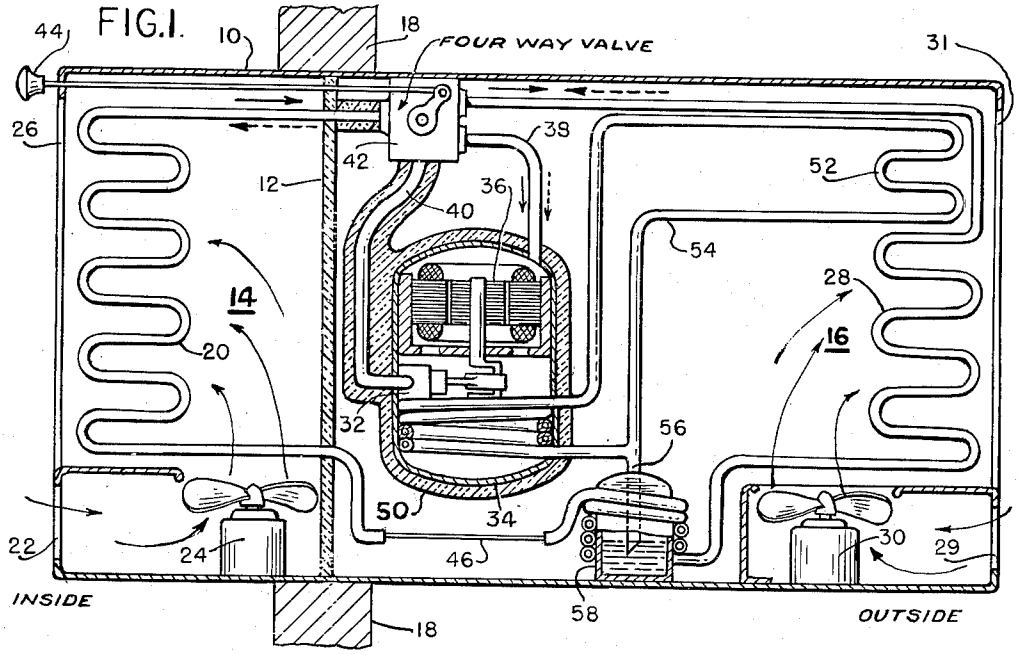
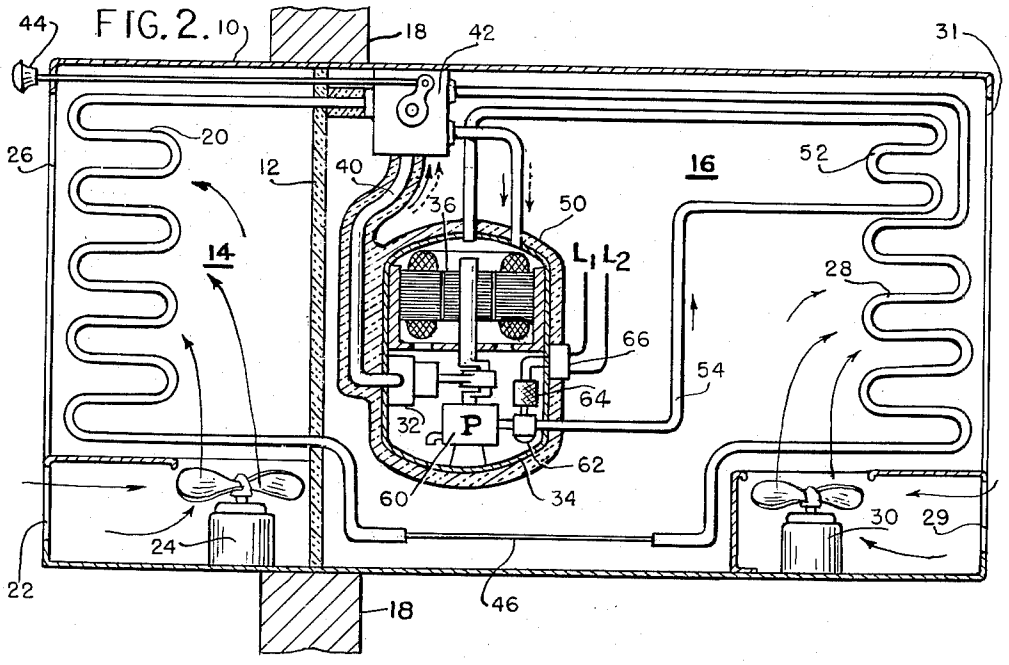


FIG. 2.



WITNESSES

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AIR CONDITIONING APPARATUS

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This invention relates to air conditioning apparatus, especially those having a reversible refrigerating system.

Conventional apparatus of the class set forth includes a cabinet provided interiorly with indoor and outdoor compartments which communicate, respectively, with air from the conditioned enclosure and the air outdoors. The indoor compartment accommodates an indoor coil or heat exchanger, and the outdoor compartment accommodates an outdoor coil or heat exchanger. Further included is a refrigerant compressor which is located in the outdoor compartment so that compressor heat will not be transmitted to the room air being cooled during summer operation. Instead, compressor heat is given up to the outdoor air circulated through the outdoor compartment. This is disadvantageous in the winter time. And it is, therefore, the principal concern of the present invention to utilize compressor heat for warming enclosure air during winter operation, thereby improving system performance, and to dissipate the same heat during summer operation.

In dealing with this problem, the present invention first provides means for insulating the shell which houses the compressor and its motor. For this purpose, it is preferred to surround the shell with a jacket or enclosure of insulation material. It is also desirable to provide additional means for insulating the compressor discharge line. This arrangement retains compressor heat, as well as heat from motor losses, in the system during winter operation, with the result that this heat will ultimately be carried by the refrigerant to the indoor coil and there rejected to the conditioned room air.

The invention further proposes to take the aforesaid heat out of the compressor and dissipate it to the outdoor air during summer operation by means of a secondary heat transfer system or circuit in which fluid is circulated. This secondary system includes a heat exchanger disposed outside the insulation jacket in heat transfer relationship with the outdoor air, and it further includes a conduit connected to the heat exchanger to define therewith a circuit for the fluid. This system still further includes means for promoting fluid flow through the circuit during summer operation and for retarding fluid flow through the circuit during winter operation.

In one embodiment of the invention the secondary heat transfer system utilizes a volatile refrigerant and includes a refrigerant storage tank. The latter communicates with the secondary system, and it is placed in heat transfer relationship with a component of the main system that operates at low temperature during winter operation, preferably the outdoor coil. Assuming that the outdoor coil and the storage tank are in heat transfer relationship, when the outdoor heat exchanger functions as an evaporator it chills the storage tank and retards flow through the circuit by liquefying the refrigerant, drwing it out of the circuit, and collecting it in the tank. In the same arrangement, when the functions

of the indoor and outdoor heat exchangers are reversed the outdoor heat exchanger then acting as a condenser boils the refrigerant out of the tank and forces it back into the circuit, thereby promoting its circulation through the circuit.

In another embodiment of the invention, fluid, preferabliy lubricating oil, is pumped through the circuit of the secondary system from within the compressor shell through a heat exchanger in the outdoor compartment during summer operation only. The compressor shell, the outdoor coil, and various other parts of the system operate hotter in the summer time than in the winter time, and a control automatically responsive to the temperature of one of these parts, preferably the shell, is employed to direct the fluid through the secondary system when this so-called reference temperature is indicative of the apparatus operating to cool an enclosure. At other times, as during the winter time, the control retards, or discontinues, the flow of fluid in the secondary circuit so that heat otherwise disposed of by the secondary system will warm the refrigerant in the main refrigeration system and be used in heating the enclosure.

The various objects, features and advantages of the invention will appear more fully from the detailed description which follows, taken in connection with the accompanying drawing, forming a part hereof, in which:

Fig. 1 is a diagrammatic view of air conditioning apparatus showing one embodiment of the invention; and

Fig. 2 is a diagrammatic view of air conditioning apparatus showing a second embodiment of the invention.

The air conditioning unit embodying the invention includes a casing **10**, having an insulated partition **12** therein that divides the unit into an indoor compartment **14** and an outdoor compartment **16**. The casing **10** is adapted to be mounted within an opening, such as a window, of a building wall **18** in such a manner that the indoor compartment **14** communicates with air to be conditioned in a room or other enclosure. The outdoor compartment **16** communicates with outdoor air, i.e. air outside the conditioned enclosure. The indoor compartment **14** contains an indoor coil, or heat exchanger, **20**. Air to be conditioned enters the indoor compartment **14** of the unit through an inlet opening **22** and is circulated by propelling means, such as a motor-driven propeller fan **24**, over, or through, indoor coil **20**, and then is returned to the conditioned enclosure through an outlet **26**. Moisture that is condensed from the air as a result of cooling is collected and then conveyed from the conditioned enclosure by suitable means (not shown).

Heat is absorbed from and/or dissipated to the outdoor air by an outdoor coil, or heat exchanger, **28** located within outdoor compartment **16** of the unit. Outdoor air is drawn into the casing through inlet **29**, circulated over coil **28** by suitable propelling means, such as a motor-driven propeller fan **30**, and returned outdoors through casing outlet **31**.

The coils, or heat exchangers, **20** and **28** form part of a compression refrigeration system which utilizes a volatile refrigerant, and which includes a compressor **32** located in the outdoor compartment **16** of the unit. The compressor **32**, in accordance with conventional practice, is preferably enclosed within a sealed casing, or shell, **34** which also houses the motor **36** for driving the compressor. The system includes conduit means, a portion of which defines a suction line, or inlet **38** and a discharge line, or outlet, **40** for the compressor **32**. Both lines **38** and **40** are connected to a reversing valve **42**.

The reversing valve **42** is adapted to place the com-

pressor suction line 38 and discharge line 40 in respective communication with indoor coil 20 and outdoor coil 28 for cooling the enclosure, and to reverse the connections and place them in respective communication with the coils 28 and 20 for heating the enclosure. Suitable provision is made for actuating the reversing valve 42, as by a manually movable knob 44. The reversing valve 42 directs the refrigerant from the compressor 32 serially through the coils, first through the outdoor coil 28 for summer operation, or first through the indoor coil 20 for winter operation.

A flow restrictor, which provides pressure reducing or expansion means in either direction of flow, is connected between the indoor coil 20 and the outdoor coil 28. Preferably, the flow restrictor comprises a slender, restricted bore tube 46, commonly referred to in the art as a capillary tube. Tube 46 causes refrigerant to expand in the second coil of the series after leaving the compressor 32, that is, in the coil then functioning as an evaporator. In the drawing, the flow of refrigerant during the cooling cycle is indicated by solid line arrows, and broken line arrows indicate the flow during the heating cycle.

The invention is shown and described herein utilizing room, or enclosure, air as a conditioning medium, and utilizing outside air as a heat source and a heat sink; but the invention is not intended to be so limited, since other fluids, equally effective as air for this purpose, are well known in the refrigeration art.

During winter operation, heat is added to the conditioned enclosure. It is therefore desirable, in the interest of bettering the performance of the apparatus, to retain and utilize in the system heat which heretofore has been lost or rejected to the outdoor air. In carrying out the present invention, the compressor shell 34 is heat insulated, preferably by surrounding it with an enclosure or jacket 50 of insulation material. And, preferably, the portion of the discharge line 40 within compartment 16 is also insulated. The insulation prevents compressor heat, as well as heat from motor losses, from escaping through shell 34 to the outdoor air. Rather, this heat is kept in the system during winter operation, thereby enabling it to be transferred to the refrigerant undergoing compression and later rejected to the room air by the refrigerant as it passes through indoor coil 20. During summer operation, heat is removed from the enclosure and rejected to the outdoor air. Therefore, it is desirable to take out of the system heat which originates in the motor 36 and compressor 32 as a result of mechanical friction, motor losses, etc., so that this heat does not burden the refrigeration system and harm its performance as a cooling unit.

To this end, both embodiments of the invention are provided with a secondary heat transfer system which serves to dissipate compressor and motor heat to the outdoor air during summer operation. The secondary system utilizes a fluid heat transfer medium circulating through a circuit comprising a heat exchanger 52 and conduit 54. Heat exchanger 52 is in heat transfer relationship with the outdoor air, and it is disposed outside the insulation jacket 50, preferably within outdoor compartment 16. Part of conduit 54 extends into the jacket 50 and is placed in heat transfer relationship with the compressor 32.

In the embodiment of the invention shown in Fig. 1, the portion of conduit 54 inside jacket 50 is coiled and placed in heat transfer relationship with the inner surface of shell 34. Refrigerant, such as dichlorodifluoromethane, is used as a fluid heat transfer medium in the secondary system. The fluid vaporizes when heated, and travels to heat exchanger 52 where it gives up heat to the outdoor air, liquefies, and returns to the coiled portion of the conduit 54.

Further provided is an automatic control which selectively renders the heat transfer system effective or ineffective, depending upon whether the unit is operating to cool or heat an enclosure, respectively. The control includes a branch tube 56 which is connected between conduit 54 and a storage tank 58. The latter has sufficient capacity to store all the fluid in the secondary system and is in heat transfer relationship with a portion of the main system which runs hot in summer and cold in winter, preferably outdoor coil 28 a portion of which is shown coiled about tank 58. By this arrangement, tank 58 is heated during summer operation by outdoor coil 28, the refrigerant being boiled out of the tank 58 and kept in circulation for dissipating compressor heat.

When the unit is switched over to heating operation, outdoor coil 28 functions as an evaporator and chills the tank 58, thereby liquefying refrigerant in the circuit and diverting it into the tank for storage. It can be seen that the effect of chilling the tank 58 is to retard flow through the rest of the secondary circuit, thus retaining and utilizing in the system motor and compressor heat previously dissipated during winter operation, with the result that the overall performance of the apparatus is improved.

In the embodiment of Fig. 2, a lubricant pump 60 is driven by motor 36 within the compressor shell; and lubricating oil is used in the secondary system for dissipating compressor heat during summer operation. The lubricating oil enters the shell 34 at the top, flows over the motor 36 and compressor 32, then is drawn into the pump 60 and forced thereby through the circuit.

As in the first embodiment, it is desirable to render the secondary system effective during summer operation and ineffective during winter operation. For this purpose, means are provided, including a flow valve 62. The valve 62 is disposed inside shell 34 and connected in the secondary circuit near the discharge outlet of pump 60. In one position of valve 62, oil is permitted to flow through the secondary circuit and, in its other position, the flow of oil is diverted or otherwise retarded, so that it remains within the shell 34. For operating the valve 62 a solenoid 64 is provided which, when deenergized, holds the valve in position to direct oil through the circuit. When energized, solenoid 64 moves valve 62 so that oil is diverted from the circuit to the shell 34.

Controlling the energization of solenoid 64 is a thermostat 66 placed in heat transfer relationship with one of the refrigerant-conducting components of the system, preferably the shell 34. Characteristic of refrigerant-conducting components of reversible refrigeration systems is that their operating temperature is changed appreciably when the direction of refrigerant flow through the system is reversed, thus providing a reference temperature which indicates whether the system is set for summer or winter operation. Thermostat 66 connects solenoid 64 to electrical power conductors L1 and L2 to effect its energization and prevent oil circulation when the reference temperature indicates that the apparatus is operating to heat an enclosure; as, for example, if the reference temperature is taken at the shell 34 and it is below a predetermined value, such as 150° F. Using the same example, the thermostat contacts remain open above the predetermined temperature value to keep oil circulating.

Such components as the outdoor coil 28 and the compressor shell 34 run hotter (usually above 150° F.) during summer operation than during winter operation (usually below 150° F.). Conversely, the indoor coil 20 runs cooler during summer operation than during winter operation. A reference temperature value will differ in various systems, and for their various components, depending on the application. Therefore, it will suffice to say that the embodiment of Fig. 2 carries out the invention by retarding the flow of heat transfer fluid

in the secondary system when the reference temperature is above a predetermined value.

It is a feature of the present invention that the insulation surrounding the shell 34 also serves to muffle noise emanating therefrom.

In both embodiments, the flow of fluid through the heat dissipating system is promoted when the conditioning medium is being cooled, and retarded, or diverted, when the conditioning medium is being heated.

While the invention has been shown 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.

What is claimed is:

1. Air conditioning apparatus including a reversible, compression refrigeration system utilizing a volatile refrigerant for heating or cooling a conditioning medium and comprising: a cabinet provided interiorly with first and second compartments; a first heat exchanger disposed in said first compartment and means for supplying outside air thereto; a second heat exchanger disposed in said second compartment, and means for supplying the conditioning medium thereto; compression means for the volatile refrigerant disposed in said first compartment, and means surrounding said compression means providing heat insulation therefor; means for serially directing the refrigerant from said compression means through said heat exchangers, first through said first heat exchanger when cooling said conditioning medium or first through said second heat exchanger when heating said conditioning medium; means for expanding the refrigerant in the second heat exchanger of the series; and means utilizing a fluid for dissipating heat from said compression means when said apparatus is cooling said conditioning medium and comprising: a third heat exchanger disposed outside said insulation means in heat transfer relationship with the outside air, a conduit having a portion thereof in heat transfer relationship with said compression means and connected to said third heat exchanger to define therewith a circuit for said fluid, and means promoting the circulation of said fluid through the circuit when the conditioning medium is being cooled, and retarding the circulation of said fluid through the circuit when the conditioning medium is being heated.

2. Air conditioning apparatus including a reversible, compression refrigeration system utilizing a volatile refrigerant for heating or cooling a conditioning medium and comprising: a cabinet, a partition in said cabinet dividing the interior thereof into first and second compartments; a first heat exchanger disposed in said first compartment and means for supplying outside air to said first compartment; a second heat exchanger disposed in said second comparment and means for supplying the conditioning medium thereto; compression means for the volatile refrigerant disposed in said first compartment, and means surrounding said compression means providing heat insulation therefor; means for serially directing the refrigerant from said compression means through said heat exchangers, first through said first heat exchanger when cooling said conditioning medium or first through said second heat exchanger when heating said conditioning medium; means for expanding the refrigerant in the second heat exchanger of the series; and means utilizing a fluid for dissipating heat from said compression means when said apparatus is cooling said conditioning medium and comprising: a third heat exchanger disposed outside said insulation means in heat transfer relationship with the outside air, a conduit connected to said third heat exchanger to define therewith a circuit for said fluid, said conduit having a portion thereof inside said insulation means in heat transfer relationship with said compression means, means connected in said circuit selectively operable to promote or retard the flow of said fluid through said circuit, and control means for said last-named means effecting its promotion of fluid flow through said circuit incident to the flow of refrigerant from said compression means first through said first heat exchanger.

3. Air conditioning apparatus including a reversible refrigeration system utilizing a volatile refrigerant for heating or cooling air from an indoor enclosure and comprising a cabinet, a partition in said cabinet dividing the interior thereof into outdoor and indoor compartments; an outdoor heat exchanger disposed in said outdoor compartment and fan means for supplying outside air thereto; an indoor heat exchanger disposed in said indoor compartment and fan means for supplying enclosure air thereto; compression means for the volatile refrigerant disposed in said outdoor compartment including a hermetically sealed shell, and means surrounding said shell providing heat insulation therefor; means including an element for serially directing the refrigerant from said compression means through said heat exchangers, first through said outdoor heat exchanger when cooling said enclosure air or first through said indoor heat exchanger when heating said enclosure air; means for expanding the refrigerant in the second heat exchanger of the series; and means utilizing a volatile fluid for dissipating heat from said compression means when said apparatus is cooling said enclosure air and comprising: a third heat exchanger disposed outside said insulation, means in heat transfer relationship with the outside air, a conduit having a portion thereof in heat transfer relationship with said compression means and connected to said third heat exchanger to define therewith a circuit for said fluid, a fluid storage tank communicating with said conduit and in heat transfer relationship with either of said outdoor heat exchanger or said directing means between said element and said expanding means, the latter said heat transfer relationship providing heating or cooling of said tank whereby the circulation of fluid through said circuit is promoted when said system cools said enclosure and heats said tank, and the circulation of fluid through said circuit is retarded by said fluid being received in said tank when said system heats said enclosure and cools said tank.

4. Air conditioning apparatus comprising a cabinet provided interiorly thereof with outdoor and indoor compartments, and a reversible refrigeration system utilizing a volatile refrigerant for heating or cooling air from an indoor enclosure; said reversible refrigeration system including outdoor heat exchange means disposed in said outdoor compartment and a fan for supplying outside air thereto; indoor heat exchange means disposed in said indoor compartment and a fan for supplying enclosure air thereto; compression means for the volatile refrigerant disposed in said outdoor compartment and including a hermetically sealed shell; an insulated enclosure surrounding said shell; means for serially directing the refrigerant from said compression means through said heat exchange means, first through said outdoor heat exchange means when cooling said enclosure air or first through said indoor heat exchange means when heating said enclosure air; means for expanding the refrigerant in the second heat exchange means of the series; and a system utilizing a fluid for dissipating heat from said compression means when said apparatus is cooling said enclosure air and comprising: a third heat exchanger disposed outside said insulated enclosure in heat transfer relation with the outside air, a conduit having a portion thereof inside said enclosure and defining with said third heat exchanger a circuit for said fluid; and a control responsive to the temperature of one of said means for retarding the flow of fluid through said circuit when said apparatus is heating said enclosure air, or for promoting the flow of fluid through said circuit when said apparatus is cooling said enclosure air.

5. Air conditioning apparatus comprising a cabinet, a partition in said cabinet dividing the interior thereof into

outdoor and indoor compartments, and a reversible refrigeration system utilizing a volatile refrigerant for heating or cooling air from an indoor enclosure; said reversible refrigeration system including outdoor heat exchange means disposed in said outdoor compartment and a fan for supplying outside air thereto; indoor heat exchange means disposed in said indoor compartment and a fan for supplying enclosure air thereto; compression means for the volatile refrigerant disposed in said outdoor compartment and including a hermetically sealed shell and a lubrication system for said compression means utilizing a lubricating fluid; an insulated enclosure surrounding said shell; means for serially directing the refrigerant from said compression means through said heat exchange means, first through said outdoor heat exchange means when cooling said enclosure air or first through said indoor heat exchange means when heating said enclosure air; means for expanding the refrigerant in the second heat exchange means of the series; and a system utilizing

said lubricating fluid for dissipating heat from said compression means when said apparatus is cooling said enclosure air and comprising: a third heat exchanger disposed outside said insulated enclosure in heat transfer relation with the outside air, a conduit connecting said lubrication system to said third heat exchanger and defining therewith a circuit for said lubricating fluid; and a control responsive to the temperature of one of said means for retarding the flow of lubricating fluid through said circuit when said apparatus is heating said enclosure air, or for promoting the flow of lubricating fluid through said circuit when said apparatus is cooling said enclosure air.

References Cited in the file of this patent

UNITED STATES PATENTS

2,247,950	Kucher	July 1, 1941
2,300,005	Philipp	Oct. 27, 1943
2,342,566	Wolfert	Feb. 22, 1944