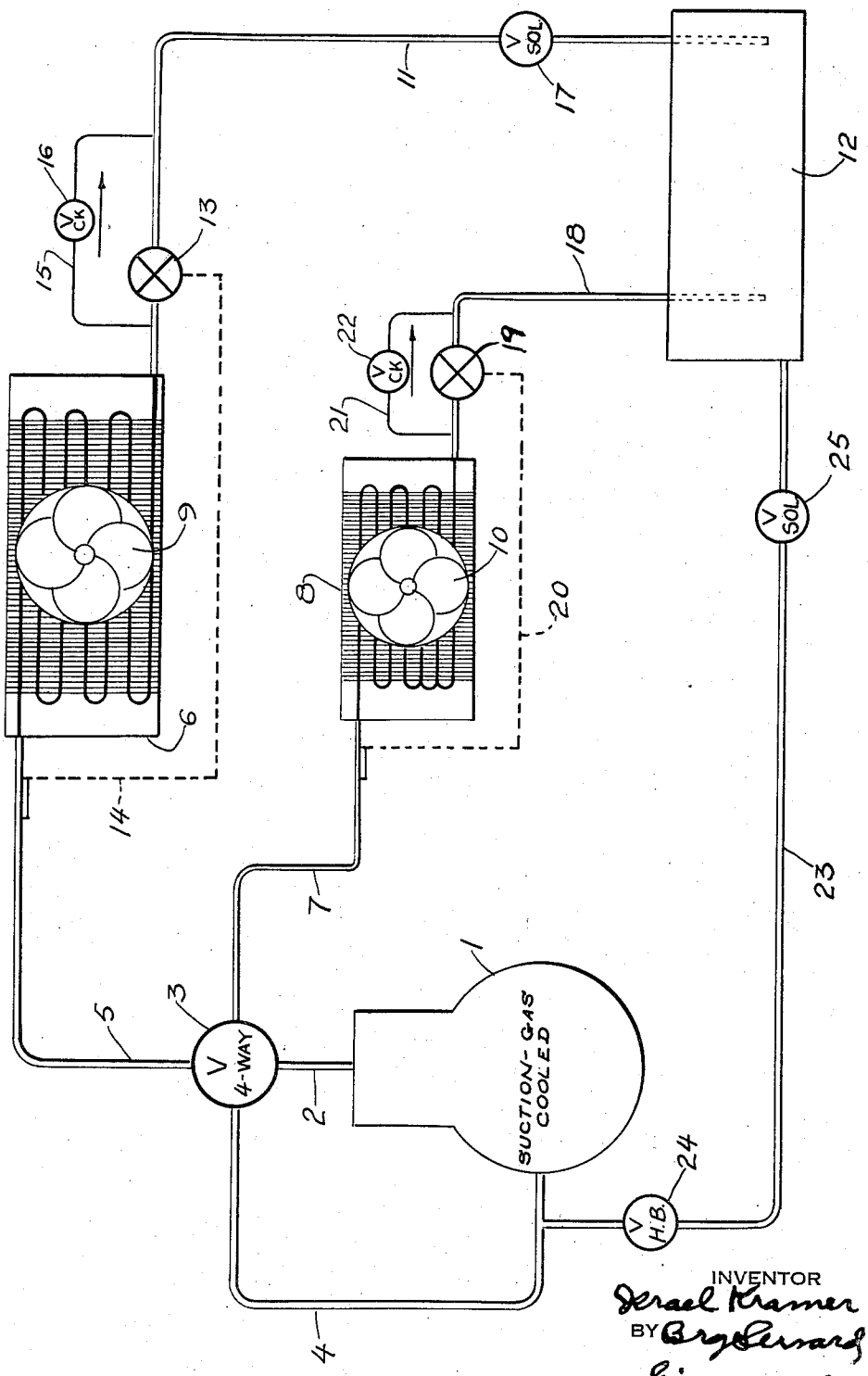
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REVERSIBLE AIR CONDITIONING SYSTEM WITH HOT GAS DEFROSTING MEANS

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REVERSIBLE AIR CONDITIONING SYSTEM WITH HOT GAS DEFROSTING MEANS

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3 Claims. (Cl. 62—278)

This invention relates to a reversible air conditioning system with hot gas defrosting means, and has for an object the provision of such a system embodying indoor and outdoor coils, or the like, and constructed and arranged for defrosting the outdoor coil during cold weather without chilling to an uncomfortable degree the space served by the indoor coil and without the necessity of including heat storage means in the system.

Another object is to provide such a system which employs an hermetically sealed suction-gas cooled compressor wherein heat generated by the motor assembly, e. g. motor windings, can accomplish, in connection with a pressure reducing device, the reevaporation of liquid refrigerant flowing to the compressor during defrosting cycles of the system.

Another object is to provide such a system in which the receiver is connected by a conduit with the compressor intake for the flow of refrigerant from the receiver to the compressor during defrosting cycles, and in which a pressure reducing device is positioned in the said conduit.

Another object is to provide such a system which also includes a conduit connecting the receiver with the indoor coil, and in which valves are positioned in the said conduit and in the conduit that connects the receiver with the compressor intake for opening the one conduit and closing the other according to the cycle of operation of the system.

A further object is to provide certain improvements in the form, construction, and arrangement of the several parts, whereby the above named and other objects inherent in the invention may be effectively attained.

In brief summary, the invention comprises an air conditioning system for buildings, the system embodying indoor and outdoor coils, or the like, which function reversibly as evaporator and condenser to cool and heat the interior of the building according to weather conditions; the outdoor coil being exposed to atmosphere. A characteristic of the system resides in the incorporation of means for defrosting the outdoor coil without abstracting heat from the indoor coil, and without the necessity of including heat storage means, by employing a suction-gas cooled compressor and connecting the receiver with the intake thereof through a conduit in which is positioned a pressure reducing device, such as a hold back or automatic expansion valve; means being also provided, as by solenoid valves, for establishing defrosting cycles at desired intervals during which refrigerant flows from compressor discharge to the outdoor coil, hence to the receiver, and thence to compressor intake through the pressure reducing device.

A practical embodiment of the invention is diagrammatically represented in the accompanying drawing.

Referring to the drawing, the compressor is denoted by 1, and is of the suction-gas cooled type, preferably hermetically sealed. Its discharge is connected by a conduit 2 with one port of a four-way reversing valve 3, desirably automatic, that is deemed to require neither structural

depiction nor description since its characteristics are known by engineers in this field and valves of this type are commercially available, e. g. a product known as the Alco Valve. A second port of the valve communicates through suction conduit 4 with the compressor intake; a third port through conduit 5 with the indoor coil 6; and the fourth port through conduit 7 with the outdoor coil 8. The valve construction is such that, in one position thereof, the compressor discharge is open to the indoor coil and the compressor intake is open to the outdoor coil, while, in the other position of the valve, the compressor discharge is open to the outdoor coil and its intake is open to the indoor coil.

The indoor and outdoor coils may be of conventional, or any appropriate, form and construction adapted to serve as evaporators and also as condensers according to the refrigerant flow setting of the system. Each is fitted with the usual fan and motor, marked collectively 9 and 10; and the fan motors should be controlled by some means, preferably automatic, for causing the fans to rotate or remain idle according to the requirements of the then cycle of operation of the system as is well understood in this industry.

A conduit 11 connects the indoor coil with a receiver 12, and a pressure reducing device, such as a thermostatic expansion valve 13 is positioned in the said conduit adjacent the indoor coil, which valve is controlled by the customary feeler bulb and tube denoted collectively by 14. A by-pass 15 spans the valve 13 and is fitted with a check valve 16 that permits flow from the indoor coil toward the receiver but inhibits opposite flow; while an open and shut device, e. g. solenoid valve 17, is located in conduit 11 between the by-pass 15 and the receiver.

Another conduit 18 connects the receiver through a pressure reducing device, such as a thermostatic expansion valve 19, with the outdoor coil, the said valve being controlled by feeler bulb and tube 20; while a by-pass 21 spans the valve 19 and is provided with a check valve 22 which permits flow from the outdoor coil toward the receiver but prevents reverse flow.

Finally, the receiver is connected by a conduit 23 with suction conduit 4 preferably at a point adjacent the compressor intake. This conduit is fitted with a pressure reducing device 24, such as a hold back valve or an automatic expansion valve, that is also preferably positioned adjacent the compressor intake; and also with an open and shut valve 25, e. g. solenoid, which is interposed between the receiver and valve 24.

To operate the system on the heating cycle and warm the interior of the building, the four way valve 3 is set to open communication between the discharge of the compressor 1 and the indoor coil 6 through conduits 2 and 5 and to open communication between the compressor intake and the outdoor coil 8 through conduits 4 and 7. Solenoid valve 17 is open and solenoid valve 25 is closed. The hot refrigerant gas now flows to the indoor coil which functions as a condenser and its fan 9 circulates the surrounding air which is warmed by the coil. The refrigerant which is condensed in the coil travels through by-pass 15, check valve 16, conduit 11, and solenoid valve 17 to the receiver 12. From the latter the flow is through conduit 18 and thermostatic expansion valve 19, which lowers the pressure and temperature of the refrigerant, to the outdoor coil which now functions as an evaporator due to heat obtained from the ambient air that is blown over the coil by its fan 10. The refrigerant thus vaporized thence proceeds through conduits 7 and 4 to the compressor intake for re-compression and re-circulation through the system.

When weather conditions, such as seasonal change, call for cooling the interior of the building, the four way valve 3 is reversed so as to open communication between

the discharge of the compressor **1** and the outdoor coil through conduits **2** and **7**. Solenoid valve **17** remains open and solenoid valve **25** closed. The hot refrigerant gas thus flows from the compressor to the outdoor coil **8**, which now functions as a condenser to liquefy the gas, which passes through conduit **21** and check valve **22** to the receiver **12**, and thence through conduit **11**, solenoid valve **17**, and thermostatic expansion valve **13**, which reduces pressure and temperature, to the indoor coil **6** that now functions as an evaporator to cool the surrounding air which is circulated by the fan **9**. From the indoor coil the refrigerant, now largely in vapor phase, travels through conduit **5**, four way valve **3**, and conduit **4**, to the compressor intake for re-compression and re-circulation through the system.

During operation on heating cycles, the outdoor coil accumulates frost, especially when the ambient temperature is, say, 40° F. or lower, and efficient performance requires defrosting of the said coil at appropriate intervals. A practice heretofore followed has involved temporary reversal of the system to the cooling cycle in which heat is abstracted from the indoor coil and hot gas is fed to the outdoor coil. Attendant upon such procedure is the marked disadvantage of chilling the indoor space to an uncomfortable, if not intolerable, degree, which has caused resort to offsetting expedients such as the provision of auxiliary heating means which not only complicates the setup, but also adds materially to first cost and maintenance expense including electrical demand charges. The present invention obviates such disadvantage by performing the defrosting in an operating cycle differing from both the heating and cooling cycles, as will now be explained.

A defrosting cycle is initiated by turning the four way valve to its setting for a cooling cycle, closing solenoid valve **17**, and opening solenoid valve **25**. The hot gas from the compressor discharge now travels directly to the outdoor coil and melts the frost thereon. In performing this function the gas is condensed in the coil to its liquid phase and passes through conduit **21** and check valve **22** to the receiver **12**, from which latter the refrigerant returns to the compressor intake by way of conduit **23** with its solenoid valve **25** and hold back valve **24**. The last named valve reduces the pressure of the refrigerant in a manner analogous to the action of an expansion valve and cooperates with the heat of the compressor motor assembly to thoroughly vaporize the refrigerant before it is drawn into the compressor itself. Following completion of defrosting, the four way valve is returned to its setting for the heating cycle, valve **25** is closed, valve **17** is opened, and the heating cycle is reestablished.

From the foregoing it will be observed that, although the advent of a defrosting cycle causes cessation of the flow of hot gas from the compressor to the indoor coil, there is no withdrawal of heat from the latter because solenoid valve **17** is closed, thus avoiding uncomfortable chilling of the indoor space. The indoor coil never requires defrosting because, even when the system is on the cooling cycle, the refrigerant temperature therewithin is above the freezing point.

The solenoid valves **17** and **25**, as well as the motors for the fans **9** and **10**, may be automatically operated by any suitable electrical control arrangement with which engineers skilled in this field are so familiar as to require neither illustration nor detailed description.

It will be understood that various changes may be resorted to in the form, construction, and arrangement of the several parts of the system wiithout departing from the spirit or scope of the invention; and, hence, I do not intend to be limited to details herein shown or described except as the same may be included in the claims or be required by disclosures of the prior art.

What I claim is:

1. A reversible building air conditioning system with hot gas defrosting means comprising, refrigerant compressor, indoor coil, outdoor coil and receiver, together with means for selectively operating the system on three different cycles; a building heating cycle which includes means for causing the refrigerant to flow from the compressor discharge sequentially through the indoor coil, the receiver, and the outdoor coil to the compressor intake; a building cooling cycle which includes means for causing the refrigerant to flow from the compressor discharge sequentially through the outdoor coil, the receiver, and the indoor coil to the compressor intake; an outdoor coil defrosting cycle which includes means for causing the refrigerant to flow from the compressor discharge sequentially through the outdoor coil and the receiver to the compressor intake; and refrigerant pressure reducing means interposed between the outdoor coil and the receiver to function during building heating cycles, and another refrigerant pressure reducing means interposed between the indoor coil and the receiver to function during building cooling cycles.

2. A system as defined in claim 2, which includes bypass means associated with both said refrigerant pressure reducing means fitted with means for permitting refrigerant flow from the indoor and outdoor coils to the receiver and inhibiting reverse flow therethrough.

3. A system as defined in claim 3, which also includes means for closing communication between the receiver and the compressor intake during building heating and cooling cycles, and means for closing the communication between the receiver and the indoor coil during the outdoor coil defrosting cycle.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,878,654

March 24, 1959

Israel Kramer

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 38, for the claim reference numeral "2" read -- 1 --; line 43, for the claim reference numeral "3" read -- 2 --.

Signed and sealed this 25th day of August 1959.

(SEAL)

Attest:

KARL H. AXLINE
Attesting Officer

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Commissioner of Patents