

[54] **AUTOMOTIVE AIR CONDITIONING SYSTEM**

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[56] **References Cited**

UNITED STATES PATENTS

2,257,785 9/1941 Kendrick 418/82
2,855,761 10/1958 Jacobs 62/243

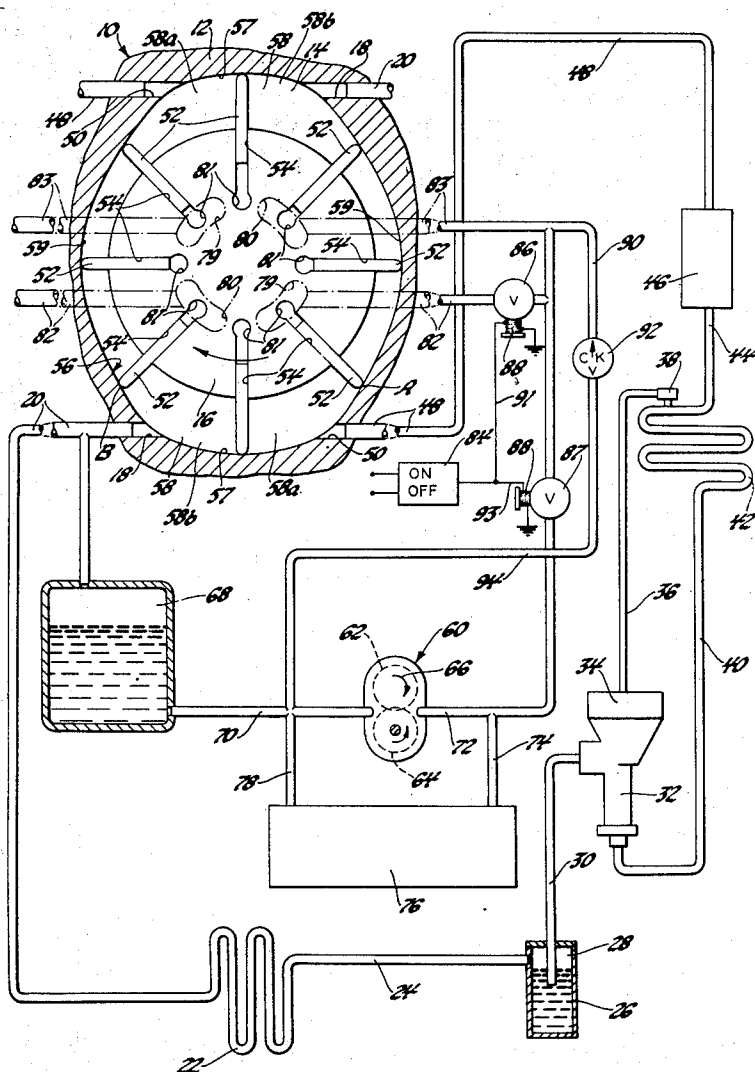
2,910,839 11/1959 Adams 62/323
3,598,510 8/1971 Aoki 418/82

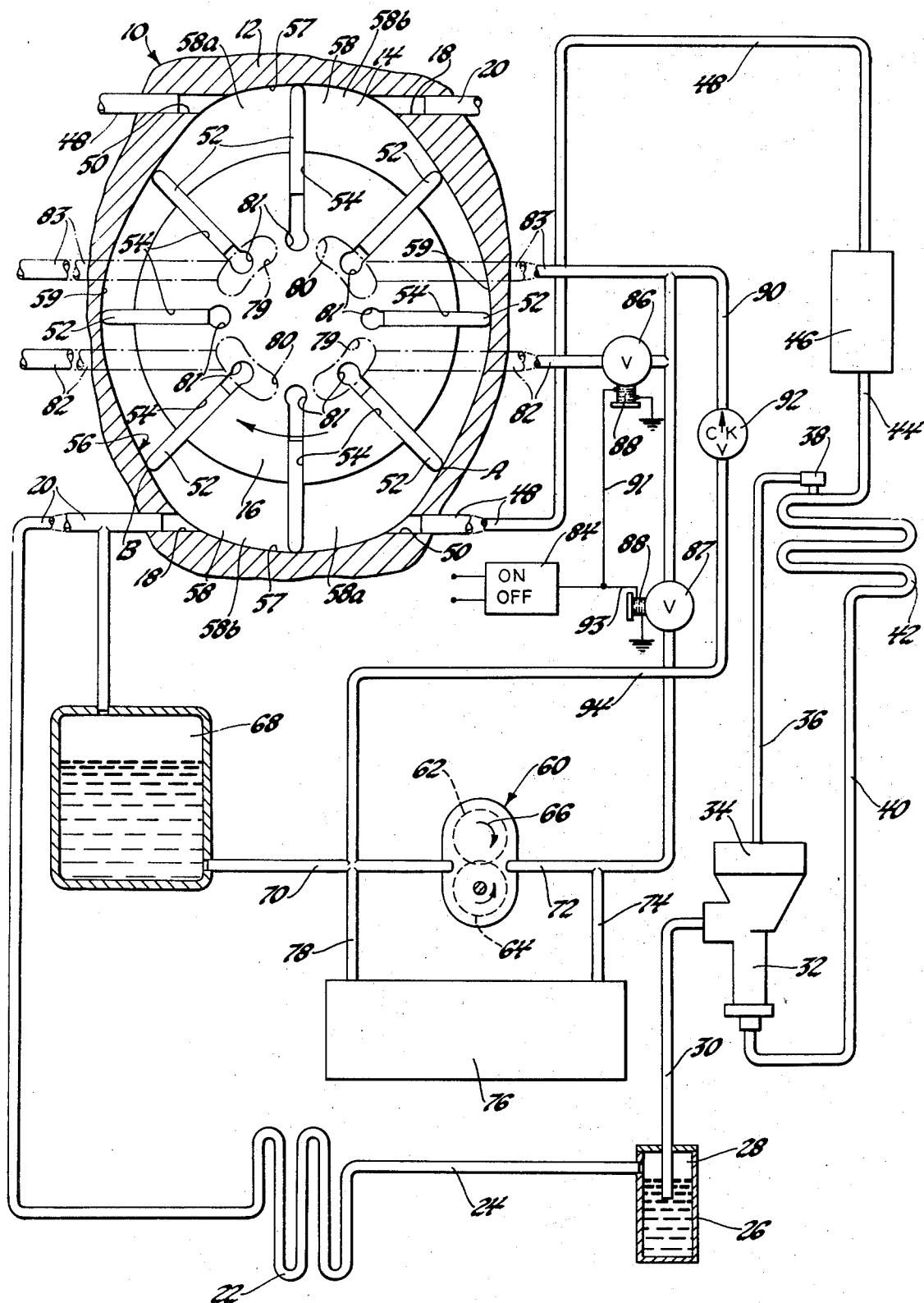
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[57] **ABSTRACT**

An air conditioning system including a condenser, an expansion means, an evaporator and a vane-type refrigerant compressor. The housing of the compressor encloses an oblong chamber in which a rotor member is turned. Radially extending vanes are mounted within slots in the rotor which extend across the radial space between rotor and housing. The vanes are in fluid contact with undervane control chambers. Fluid force in the control chambers is selectively applied to the vanes to press them across the radial space into engagement with the opposite wall of the compressor, whereby compression chambers are formed between adjacent vanes.

3 Claims, 1 Drawing Figure





AUTOMOTIVE AIR CONDITIONING SYSTEM

This invention relates to air conditioning systems having fluid control means to activate and inactivate the refrigerant compressor in response to desired temperature setting for a compartment to be air conditioned.

Prior air conditioning systems for automobile use have utilized electromagnetic clutch means between a drive pulley and the refrigerant compressor for selectively operating the compressor in response to air conditioning needs. The electromagnetic clutch is a relatively costly item and is subject to failure due to wear and tear caused by the continuous stopping and starting of the compressor.

The subject air conditioning system utilizes a vane-type compressor in which vanes are supported within axial slots in a rotor and extend radially across the space between the rotor and a surrounding housing of the compressor. At the base of the slots an undervane pressure control passage extends to fluidly engage one edge of the vane. When pressurized fluid is introduced into the undervane passage, the resultant radial force on the vane causes it to be extended across the radial space and contact the opposite chamber wall. As the rotor turns in the housing, the vane is pressed into engagement with the inner surface of the housing to compress refrigerant trapped within compression chambers formed between adjacent vanes.

Solenoid actuated valves are electrically connected to a thermostat in the compartment to be air conditioned to control the pressurization of undervane passages at the base of the vanes. When the temperature in the compartment rises above a predetermined value, the thermostat energizes the solenoid valves and causes them to open thus introducing pressurized fluid to the undervane passages to cause the vanes to extend radially across the space between the rotor and the housing. This produces refrigerant compression and resultant cooling. When the temperature in the compartment falls below a predetermined desired value, the thermostat deenergizes the solenoid coil and the valves are closed to depressurize the undervane passage and permit the vanes to retract into the slots of the rotor thus discontinuing compression of refrigerant.

A convenient source of pressurized undervane fluid is the oil which is normally mixed with refrigerant in an air conditioning system for lubricating bearings and seals of the compressor. Most refrigerant compressors include small gear-type oil pumps to pressurize and circulate the oil and cause it to flow through the bearings and against the seal surfaces. The addition of passages from the outlet of the oil pump extending to the undervane passages permits the vanes to be moved by oil pressure radially against the opposite surface of the housing during operation of the compressor.

Therefore, an object of the present invention is to provide an auxiliary fluid pressurizing means in a vane-type compressor to selectively apply fluid pressure to edge portions of the compressor vanes to cause the vanes to move into contact with the opposite portion of the housing to form compression chambers therebetween.

A further object of the present invention is to provide a vane-type compressor which has radially extending vanes mounted within axial slots of a rotor with undervane fluid control passages formed along the base of

the slots which permit the introduction of pressurized fluid to force the vane to move radially through the space between the rotor and the housing to form compression chambers therebetween.

A still further object of the present invention is to provide simple and economical automatic control of a refrigerant compressor by utilizing pressurized hydraulic fluid which is selectively transmitted to the compressor by thermostatically controlled electric solenoid valves.

A particular advantage of the fluid pressure controlled system is that it permits the oil pump of a refrigerant compressor to be run continuously whenever the car engine is running, thus insuring a supply of oil for the compressor's shaft seals and bearings at all times. Particularly during prolonged shutdown, such as in wintertime, it is desirable to supply the seal with oil to prevent it from "drying out." When it "drys out" it may fail in the summer after the initial start up.

Further objects and advantages of the present invention will be more readily apparent from the following detailed description, reference being had to the accompanying drawings in which a preferred embodiment is shown.

In the single FIGURE of the drawings, a somewhat schematic view of an air conditioning system with a desired vane-type air compressor is illustrated.

A refrigerant compressor 10 is illustrated having a housing 12 which encloses an interior space 14. A rotor 16 is supported within space 14 for rotation by means of a pulley and belt powered by the automobile engine. Outlet port means 18 is connected by a refrigerant conduit 20 to a condenser 22 which is normally installed in front of the automobile radiator in the airstream through the grille. The condenser 22 is connected by conduit 24 to a receiver 26 whose housing encloses a chamber 28 in which liquid refrigerant is separated from vaporous refrigerant. A conduit 30 extends downward into the interior 28 toward the bottom of the receiver 26 to draw off only liquid refrigerant and transmit it to expansion valve means 32.

Valve means 32 reduces the relatively high pressure refrigerant to a lower pressure. Opening and closing of the valve means 32 is controlled by pressure exerted against a diaphragm (not visible) within the upper portion 34 of the valve means. A space on one side of the diaphragm is connected by a capillary line 36 to a temperature sensor 38 to develop control pressure proportional to refrigerant temperature at the location of sensor 38. The resultant pressure is transmitted through the capillary line 36 to the expansion valve means 32.

A conduit 40 transmits the low liquid refrigerant from valve 32 to evaporator means 42 which is located so that air passing into a passenger compartment flows over its exterior cooling surfaces. The refrigerant within the evaporator 42 is vaporized therein by the extraction of heat from the air flowing over the evaporator. The refrigerant then flows through a conduit 44 and into a throttling valve 46.

The throttling valve is a pressure operated device which maintains evaporator pressure above a level which corresponds to a 32° F temperature of the refrigerant. By restricting or throttling the outlet of the evaporator to maintain refrigerant within the evaporator, the refrigerant pressure is maintained above the aforementioned freezing level. This prevents moisture which

condenses on the outer surfaces of the evaporator from freezing thereon and eventually blocking air flow through the evaporator. Refrigerant then flows from the throttling valve 46 through a suction line 48 to inlet port means 50 of the compressor.

The compressor 10 has radially outwardly extending vanes 52 which are supported within axially directed slots 54 within rotor 16. When the refrigerant compressor is in an active mode of operation, the vanes 52 extend across the radial distance or space between the rotor 16 and the housing 12 and contact the inner peripheral wall 56 of housing 12. The inner peripheral wall 56 of housing 12 defines an oblong space in which the rotor 16 is mounted for rotation. Portions 57 of wall 56 opposite one another are spaced from rotor 16 a greater distance than portions 59 which are between portions 57. The radial distance between rotor 16 and wall 56 varies as the rotor turns clockwise to produce variable volume compression chambers 58 between adjacent vanes 52.

Refrigerant is drawn through inlet port means 50 into expanding compression chambers 58a and is discharged through outlet port means 18 from a contracting compression chamber 58b. It should be noted that the compressor illustrated is a two rise compressor with two inlets and two outlets which are adapted to be connected to lines 48 and 20, respectively. A single rise or three, four rise compressor could also be used.

The compressor 10 includes a small gear-type oil pump 60 shown in the drawing detached from the compressor 10. Actually, the oil pump 60 is located adjacent one end of the rotor 16 within housing 12 but is shown in a detached view only for clarity. The oil pump includes a driven gear member 62 and an idler gear member 64. The gear member 62 is operably connected to the rotor 16 to turn with it in the direction shown by arrow 66.

The oil pump 60 draws oil from a sump region 68 of compressor 10 (shown symbolically) through a passage 70 and discharges the oil into passage 72. The pressurized oil then flows through passage means 74 to bearings and seals of the compressor shown schematically by box 76 of the compressor 10. Here again, the bearings and seals are a portion of compressor 10, but are shown schematically and detached from the compressor only for clarity. After engaging the bearings and seals, the oil passes through passage means 78 back to inlet passage 70 or to sump 68. Thus, whenever the rotor 16 of the compressor 10 is rotated, as is the case as long as the automobile engine is operative, oil is fed by oil pump 60 to the bearings and seals. There will be no prolonged period of time for the seals to "dry-out" as long as the automobile engine is operated periodically.

As described so far, the system would desirably cool a passenger compartment of an automobile. However, there will be times when the temperature of ambient or the compartment will fall below a comfortable temperature and air conditioning will, therefore, no longer be desirable. In fact, when ambient temperature falls below about 45° there most likely will be insufficient heat transfer from the air in the compartment to warm the evaporator 42 sufficiently to prevent frost from forming on its exterior surfaces. Further, the system will be uneconomical due to excessive operation of the compressor when not needed.

The present air conditioning system utilizes a compressor which is simply and easily deactivated to selectively prevent the pressurization of refrigerant therein even as the rotor 16 continues to be turned. Fluid filled control chambers 79 and 80 in the end of compressor housing 12 are aligned with undervane control passage means 81 in the rotor as it turns. Control passages 79, 80 are positioned in the end of housing 12 to progressively be fluidly connected with the undervane passage 81 at the start of the pumping stroke and the end of a pumping stroke, respectively. Passages 81 are selectively supplied with pressurized oil from passages 79, 80 and pump 60 to cause the rotors 52 to be forced radially outward against the surface 56 of housing 12 when compressing action is desired. Control chambers 79, 80 are connected by fluid passage means 82, 83 to the outlet 72 of oil pump 60.

When air conditioning of the compartment is desired, pressurized oil from pump 60 is transmitted through the passage means 82, 83 to the control chambers 79, 80 which causes the vanes 52 to be moved radially in slots 54 against the surface 56 of casing 12. This separates and seals adjacent compression chambers 58 from one another and results in pressurization of refrigerant as the vanes move from inlet 50 to outlet 18.

When a compartment to be air conditioned is cooler than a desired temperature, thermostatic switch means 84 located in the compartment will cause valves 86, 87 to close. The valves 86, 87 are positioned in passage means 82, 83 to control oil pressurization of control chambers 79, 80. Solenoid coils 88 actuate valves 86, 87 by energization through wires 91, 93 from thermostat 84. When the valves 86, 87 close, the supply of pressurized oil is blocked to control passages 79, 80 and trapped fluid therein is discharged to relief line 90 to permit the vanes 52 to retract within slots 54 and away from surface 56. In this position, refrigerant will not be compressed during rotation of the rotor 16. When the valves 86, 87 are again opened, a small amount of pressurized oil is necessary to again pressurize the chambers 79, 80, 81 and provide sufficient undervane pressure to cause the vanes to extend radially against the surface 56.

Should any line blockage occur during a compressing mode of operation when valves 86, 87 are open, a higher than normal pressure may develop in the chambers 79, 80, 81. To relieve this excess pressure, a relief passage 90 is provided which has a check valve 92 therein which is normally closed. When pressure exceeds the predetermined opening of the check valve 92, the oil may flow past the check valve 92 and through a passage 94 back to the inlet 70 of the oil pump 60 thus relieving the pressure.

At the start of a compressing mode of operation, the valves 86, 87 are opened. Pressurized oil flows through valve 86 and passage means 82 to cause pressurization of the undervane passages 81 which are aligned with control chambers 79. As the vane rotates from a position A at the start of a pumping cycle to a position B at the end of a pumping cycle, the pressurization of the undervane chamber 81 keeps the vane against wall 57. As the vane rotates past position B to its "retracted position," the oil displaced from the undervane passage 81 is transmitted to passage 82 and control chamber 79 through the open valve 86. Thus on startup once the leakage is made-up, very little additional oil is needed for the control and undervane passages.

When compressing action is no longer needed and valves 86 and 87 are closed, the retraction of vanes 52 in slots 54 displace the oil from passages 81 and control chambers 80 to relief line 90 and past valve 92. Pressurized oil is prevented from being transferred from control chamber 80 to control chamber 79 by the closed valve 86. Since no additional oil is supplied to chambers 79, the vanes 52 remain retracted and no compressing occurs.

Although the embodiment illustrated is a preferred embodiment, other minor variations could be provided without falling outside the scope of the following claims which define the invention.

What is claimed is as follows:

1. In an automobile air conditioning system for a compartment including a condenser, an expansion means and an evaporator, a simple temperature control system comprising:

a refrigerant compressor having a rotor supported for continuous rotation by an automobile engine in a chamber defined by a compressor housing;
said chamber and said rotor being configured with rises to produce alternating larger and smaller radial distances therebetween;

radially projecting vanes supported in generally axial slots of said rotor for rotation therewith forming compression chambers between adjacent vane members;

inlet and outlet means in said housing positioned downstream and upstream respectively from said rises for introducing and discharging refrigerant from said compression chambers;

said rotor having undervane passage means adjacent the inner edge of each vane to permit a radial force to be applied to the vanes by fluid pressure therein;

pressure control passage means formed in the end of said compressor housing and angularly located with respect to the beginning and termination of said rises to make fluid connection with said undervane passage means when said vanes are rotated into alignment therewith and pass the beginning and termination of each of said rises;

auxiliary fluid pressurization means connected to said rotor for rotation therewith and being fluidly connected to said pressure control passage means to pressurize said undervane passage means and press said vanes radially outward against said housing thereby compressing fluid in said compression chambers formed thereby;

thermostatically controlled means for controlling the pressurization of said undervane passages in response to changes in the temperature of a compartment to be cooled.

2. In an automobile air conditioning system for a compartment including a condenser, an expansion means and an evaporator, a simple temperature control system comprising:

a refrigerant compressor having a rotor supported for continuous rotation by an automobile engine in a chamber defined by a compressor housing;

said chamber and said rotor being configured with rises to produce alternating larger and smaller radial distances therebetween;

radially projecting vanes supported in generally axial slots of said rotor for rotation therewith forming

compression chambers between adjacent vane members;

inlet and outlet means in said housing positioned downstream and upstream respectively from said rises for introducing and discharging refrigerant from said compression chambers;

said rotor having undervane passage means adjacent the inner edge of each vane to permit a radial force to be applied to the vanes by fluid pressure therein;

pressure control passage means formed in the end of said compressor housing and angularly located with respect to the beginning and termination of said rises to make fluid connection with said undervane passage means when said vanes are rotated into alignment therewith and pass the beginning and termination of each of said rises;

auxiliary fluid pressurization means connected to said rotor for rotation therewith and being fluidly connected to said pressure control passage means to pressurize said undervane passage means and press said vanes radially outward against said housing thereby compressing fluid in said compression chambers formed thereby;

means extending from the outlet of said fluid pressurization means to said control passage means in said compressor housing for transmitting pressure to said undervane passage means aligned therewith;

selectively activated valve means in said pressure transmitting means for controlling the pressurization of said control passage means and undervane passage means;

thermostatically controlled means selectively actuating said valve means to permit pressurization of said undervane passage means at compartment temperatures above a desired temperature.

3. In an automobile air conditioning system for a compartment including a condenser, an expansion means and an evaporator, a simple temperature control system comprising:

a refrigerant compressor having a rotor supported for continuous rotation by an automobile engine in a chamber defined by a compressor housing;

said chamber and said rotor being configured with rises to produce alternating larger and smaller radial distances therebetween;

radially projecting vanes supported in generally axial slots of said rotor for rotation therewith forming compression chambers between adjacent vane members;

inlet and outlet means in said housing positioned downstream and upstream respectively from said rises for introducing and discharging refrigerant from said compression chambers;

said rotor having undervane passage means adjacent the inner edge of each vane to permit a radial force to be applied to the vanes by fluid pressure therein;

pressure control passage means formed in the end of said compressor housing and angularly located with respect to the beginning and termination of said rises to make fluid connection with said undervane passage means when said vanes are rotated into alignment therewith and pass the beginning and termination of each of said rises;

auxiliary fluid pressurization means connected to said rotor for rotation therewith and being fluidly

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connected to said pressure control passage means to pressurize said undervane passage means and press said vanes radially outward against said housing thereby compressing fluid in said compression chambers formed thereby;

first pressure transmitting means connected to said control passage means located adjacent the termination of each rise for pressurizing said control passage means and undervane passage means aligned therewith;

second pressure transmitting means connected to said control passage means located adjacent the beginning of each rise for pressurizing said control passage means and undervane passage means aligned therewith;

first valve means controlling the pressurization of said first control passage means for permitting the selective pressurization or depressurization thereof;

second valve means controlling the pressurization of

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both first and second control passage means for permitting the selective pressurization or depressurization thereof;

means including solenoid valve actuators associated with said first and second valve means and a thermally responsive member in the compartment for opening said valve means when the compartment temperature is above a desired preselected temperature and for closing said valve means when it is below said temperature thereby controlling the compressing action of said compressor by pressurizing or depressurizing said undervane passage means;

pressure relief means connected between said first and second valve means thereby relieving the pressure in said undervane passage means as they are aligned with said second control chamber means whenever said valve means are closed.

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