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N. J. SMITH

2,151,995

REFRIGERATING APPARATUS

Filed March 29, 1935

3 Sheets-Sheet 1

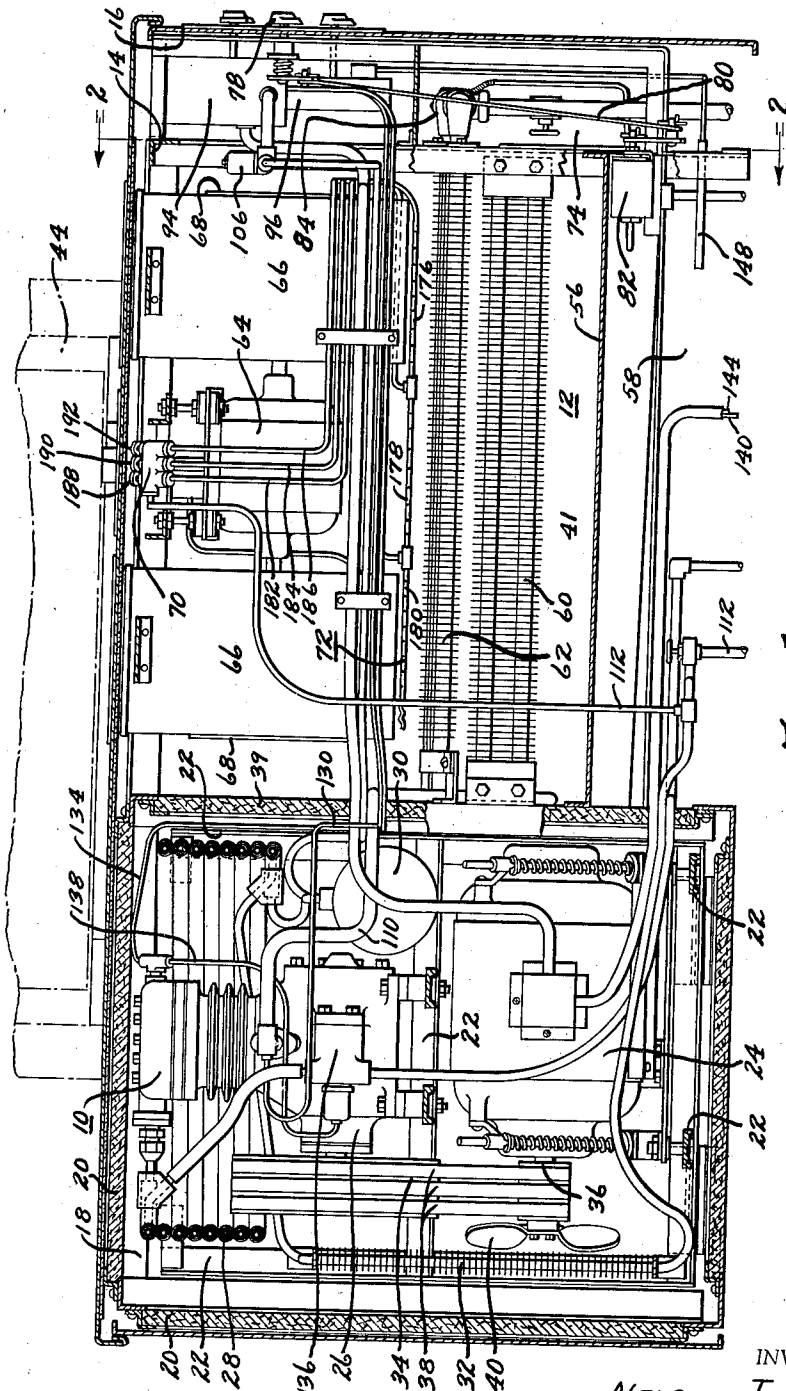


Fig. 1

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3 Sheets-Sheet 2

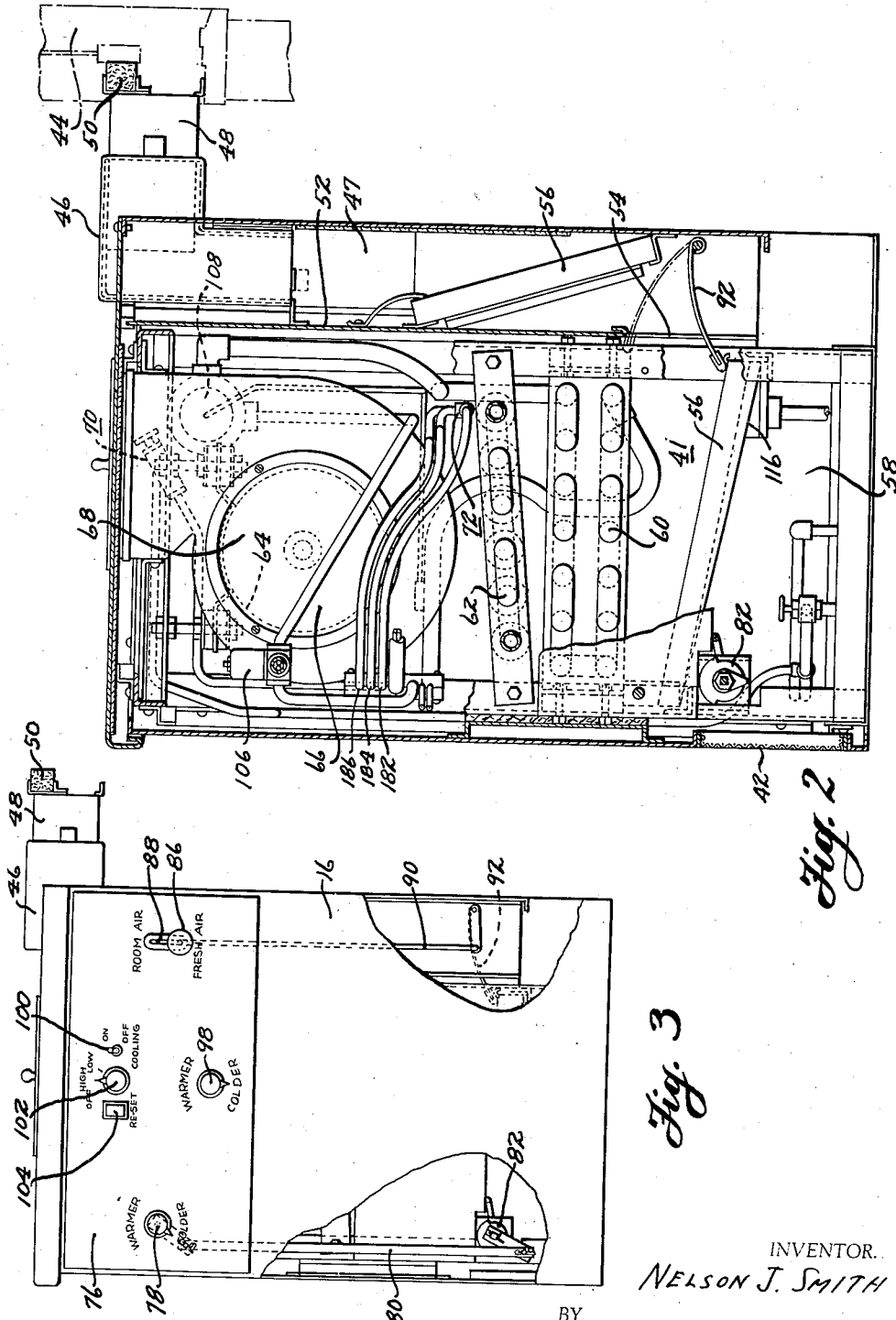


Fig. 2

Fig. 3

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3 Sheets-Sheet 3

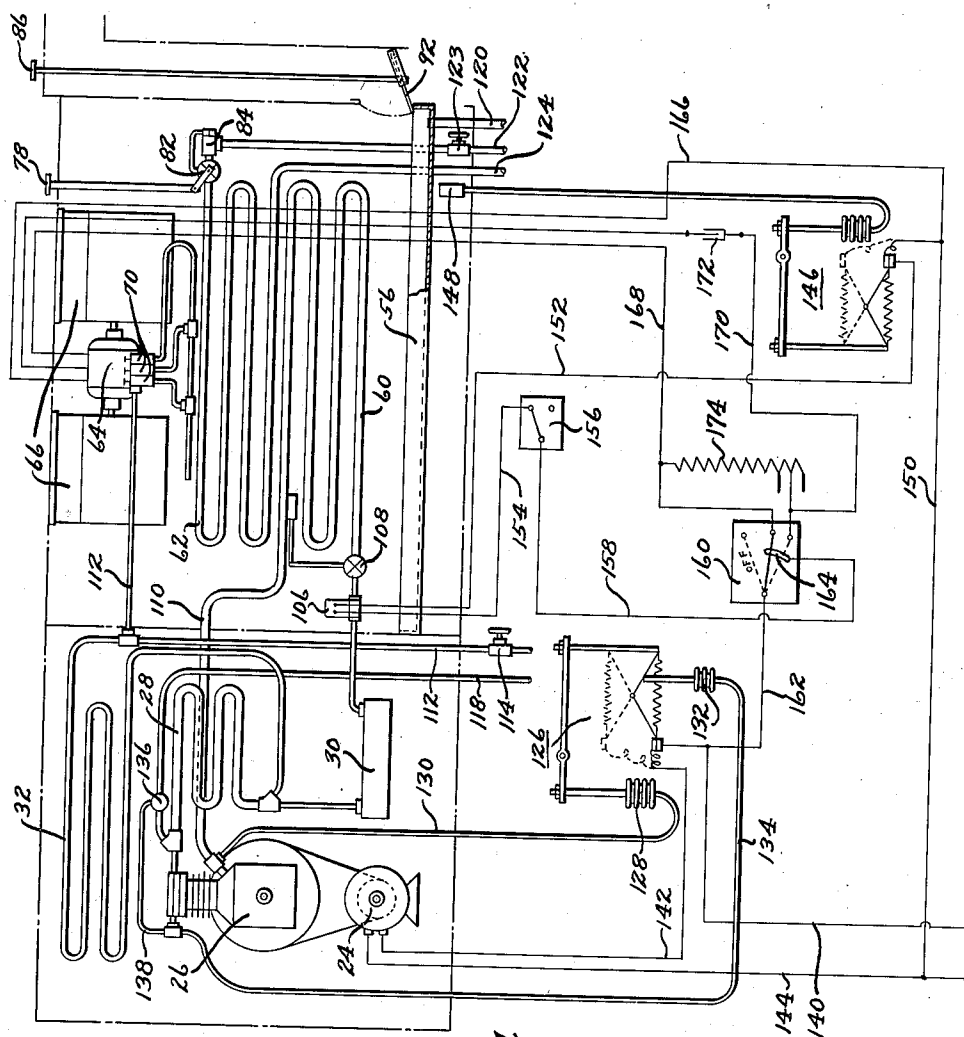


Fig. 4

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UNITED STATES PATENT OFFICE

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REFRIGERATING APPARATUS

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3 Claims. (Cl. 257—3)

This invention relates to refrigerating apparatus and more particularly to a refrigerating apparatus adapted to provide conditioned air within an enclosure.

It is an object of this invention to provide a unitary structure which may be located within a space to be air conditioned and which will perform the functions of cooling, dehumidifying, cleaning and circulating the air within the enclosure in warm weather and will perform the functions of heating, humidifying, cleaning and circulating air within an enclosure in cold weather, and in addition will provide for the introduction of selectively variable amounts of fresh air to the enclosure in either warm or cold weather.

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.

In the drawings:

Fig. 1 is a vertical cross section of a refrigerating apparatus embodying the present invention;

Fig. 2 is a cross section on line 2—2 of Fig. 1;

Fig. 3 is an end view of the device illustrated in Fig. 1, a portion of the apparatus being broken away; and

Fig. 4 is a diagrammatic view showing the connections of the essential elements of the apparatus.

The device illustrated in Figs. 1 to 3 comprises generally a rectangular casing enclosing a refrigerant liquefying unit generally designated as 10, and an air treating unit generally designated as 12. Both units are mounted upon a generally rectangular frame 14 within a casing 16. The unit is adapted to be supported upon the floor of an enclosure to be air conditioned and adjacent one of the side walls thereof, preferably near a window.

The refrigerant liquefying unit 10 is enclosed within an insulated chamber 18 having insulating walls 20 surrounding the same to prevent the conduction of both heat and noise from the compartment 18 to the enclosure to be air conditioned. The refrigerant liquefying unit is mounted upon a frame 22 supported upon the main frame 14 and includes a motor 24, a compressor 26, a condenser 28, receiver 30 and a heat exchanger 32 for cooling the compartment 18. The compressor 26 is driven by the motor 24 through pulleys 34 and 36 and belts 38. A fan 40 located on the motor shaft circulates the air within the compartment 18 over the heat exchange device 32.

The air treating unit 12 comprises a duct 41

for air to be treated formed by the walls of the casing 16, the wall 52 (see Fig. 2) and the common wall 39 between the units 10 and 12. The air treating duct 41 has two inlets, one of which is formed by the grille 42 for the ingress of recirculated air from the enclosure to be air conditioned and the other of which is situated at the window 44. A sheet metal elbow 46 is positioned in the top of the casing 16 at the rear thereof and may be vertically adjusted to correspond to the height of the sill of the window 44. The rearwardly facing opening of the elbow 46 carries an adjustable sleeve 48 which is movable toward and away from the rear face of the unit so that it may be brought in contact with the window 44. A pad 50 of felt is secured to the sleeve 48 to insure air tight contact between the sleeve 48 and the sash of the window 44. The downwardly facing opening of the elbow 46 communicates with a duct 47 formed between the rear wall of the casing 16 and an intermediate sheet metal wall 52 which terminates in an opening 54 leading into the air treating duct 41. A replaceable filter screen 56 of any suitable construction is positioned diagonally in the duct 47 between the sleeve 46 and the opening 54. A drip pan 56 is positioned in the casing to form the bottom of the duct 41 and the top of the duct 58 which extends from the grille 42 to the opening 54 leading into the duct 41.

Positioned in the duct 41 near the bottom thereof is a refrigerant evaporator 60 of any suitable construction which is maintained at a low temperature by the refrigerant liquefying unit 10. Above the evaporator 60, there is positioned a heating coil 62 which is adapted to be connected with the heating system of the building within which the air conditioning unit is placed. Near the top of the duct 41 there is mounted an air circulating unit comprising a motor 64 which drives a pair of blowers 66 at either end thereof having their inlets 68 opening into the duct 41 and their outlets discharging through the top wall of the casing 16. A humidifying device is also provided in the duct 41 comprising a control manifold 70 which is connected to a water distributing head 72 which overlies the heating coil 62.

At the right hand end of the device as viewed in Fig. 1, a chamber 74 is provided within which are located the control devices for the air conditioning unit. The end wall of the casing 16 is provided with a control panel 76 (see Fig. 3) having located thereon all of the handles by which the various control devices are actuated. Thus,

the knob 78 is connected by means of a lever and link connection 80 to the temperature responsive element 82 positioned within the duct 58 which controls the admission of heating fluid to the coil 62 through the valve 84. The knob 86 which is reciprocable in a slot 88 controls through the medium of a link 90 a damper 92 which is adapted to swing in the opening 54. The electrical controls for the apparatus are mounted within the casings 94 and 96 and are controlled through the medium of knobs 98, 100, 102 and 104 in a manner later to be described.

Referring now to Fig. 4 wherein the elements of the apparatus are illustrated diagrammatically, it will be seen that the evaporating coil 60 has its inlet end connected to the receiver 30 through a solenoid valve 106 and a thermostatic expansion valve 108 while its outlet end is connected to the crank case of the compressor 26 by means of a conduit 110. The heat exchanger 32, the manifold 70 and the condenser 28 are connected to a conduit 112 having a shut-off valve 114 therein which leads from a suitable water supply. The outlet of the condenser 28 and an outlet 116 formed in the drain pan 56 are connected to a suitable drain by conduits 118 and 120 respectively. The heating coil 62 is connected through the valve 84 to a conduit 122 and shut-off valve 123 leading from a source of heating fluid such as steam or hot water while the outlet of the coil 62 is connected to the heating fluid return duct 124.

Control of the liquefying unit 10 is provided by means of the customary low pressure control switch 126 which is mounted within the casing 94. The principal actuating bellows 128 of the switch 126 is connected by a conduit 130 to the suction line 110 while a high pressure cut-out bellows 132 is connected by means of a conduit 134 to the discharge side of the compressor. Suitable overload circuit breaking means (not shown) may be incorporated in the switch 126 and may be reset by the knob 104 shown in Fig. 3. A water control valve 136 is provided in the outlet conduit 118 and is controlled by head pressure through a conduit 138 communicating with the discharge side of the compressor. The switch 126 is connected in series with the motor 24 by conductors 140, 142, and 144 leading from a suitable source of electric current.

The electrical control of the air treating unit 12 includes a thermostatic switch 146 located in casing 96 and having a temperature responsive element 148 positioned within the duct 58. The knob 98 is connected to the switch 146 in a manner to adjust the mechanism thereof to vary the temperature at which the switch responds. Switch 146 is connected to the conductor 144 by a conductor 150 and is connected to the solenoid valve 106 by a conductor 152. The return line from the solenoid valve 106 includes the conductor 154, the on-off switch 156 which is controlled by the knob 100, the conductor 158, the blower switch 160 which is controlled by the knob 102, and the conductor 162. The blower switch 160 has three positions, namely: off, high speed and low speed, reading downwardly in Fig. 4 and is provided with a conducting segment 164 by which a circuit is established between the conductors 158 and 162 in the high and low speed positions of switch 160. The motor 64 which drives the blowers 66 is connected to the conductor 150 by means of a conductor 166 and has its main winding also connected by means of a conductor 168 to the high speed position contact

of the switch 160. The phase winding of the motor 64 is connected by means of a conductor 170 having a capacitor 172 connected in series therein with the low speed position contact of the switch 160. A resistor 174 is connected between the conductors 168 and 170. Thus, whenever the knob 102 is moved to the "off" position, the circuit to both the solenoid valve 106 and the motor 64 is interrupted. In the high speed position of the knob 102, illustrated by the full line in Fig. 4, the circuit to the solenoid valve 106 is established through the segment 164 and the main winding to the motor 64 is supplied with the full voltage of the current supply, while the phase winding of the motor 64 is connected to the conductor 162 through the capacitor 172 and through the resistor 174. In the low speed position of the knob 102, the solenoid valve 106 is in circuit as before, while the main winding of the motor 64 is connected to the conductor 162 through the resistor 174 and the phase winding has impressed thereon the full voltage of the current supply in series with the capacitor 172. It will thus be seen that the solenoid valve 106 can be energized only when the motor 64 is energized for either high or low speed, thus preventing the delivery of refrigerant to the coil 60 whenever the motor 64 is turned off. The switch 156 may be used to open the circuit of the solenoid valve 106 and thus cut off refrigeration without the necessity of also turning off the blower motor 64.

Whenever the switch 156 is in the "on" position and the switch 160 is in either the high or low speed position, the solenoid valve 106 is then subject to the control of the thermostatic switch 146 which acts to control the delivery of liquid refrigerant to the coil 60 in accordance with the demand therefor as indicated by the temperature of the air flowing through the duct 58. The operation of the liquefying unit 10 is indirectly subject to control by thermostatic switch 146 in the following manner. Whenever the switch 146 is open and the solenoid valve 106 is closed, the liquefying unit will run until the pressure within the evaporator 60 is reduced to the cut-out point of the switch 126. Thereafter the liquefying unit will remain idle until sometime after the switch 146 has again closed and the solenoid valve 106 has opened. It will be understood, of course, that the control mechanism heretofore described exercises control only during such times as it is desired to cool the air within the space to be air conditioned, as during summer weather.

In winter weather, when it is necessary to heat the space to be conditioned, the switch 156 will be opened and the switch 160 utilized solely as a control for the blower motor 64. Under these conditions, control of the heating of the air within the duct 41 is provided by the thermostatic valve 84 previously described. During both winter and summer conditions, the relation between the amount of recirculated air drawn in through the duct 58 and the amount of fresh air drawn in through the duct 47 may be varied by means of the knob 86 which controls the damper 92.

In operation of the unit as a whole under summer weather conditions, the compressor 26 is driven by the motor 24 to withdraw gaseous refrigerant from the evaporator 60 and to deliver compressed refrigerant to the condenser 28 where it is liquefied by the cooling water supplied through the conduit 112 and subsequently collected in the receiver 30. Whenever the solenoid valve 106 is open, liquid refrigerant is delivered

to the expansion valve 108 where it is expanded into the evaporator 60 to reduce the temperature thereof in a well known manner. The fan 40 circulates the air within the compartment 18 over the heat exchanger 32 to withdraw the heat of the motor and the heat of the compressor from the air in the compartment 18. The blowers 66 cause the withdrawal of air into the ducts 47 and 58 through the opening 54 and through the duct 41 where the air is cooled by the evaporator 60 or heated by the heating coil 62 depending upon which one of them is in operation and delivers the treated air through the outlets in the top of the casing 16.

During winter operation, humidification of the air being conditioned is desirable and is provided by means of the water distributing head 72. The head 72 is divided into three sections 176, 178 and 180, each of which is out of communication with the other except through the manifold 70. Separate conduits 182, 184 and 186 lead from the manifold 70 to the separate portions of the head 72. Individual valves 188, 190 and 192 control the admission of water from the conduit 112 to the conduits 182, 184 and 186 respectively. Thus, if a small amount of humidification is desired, only one of the valves in the manifold will be opened, thus delivering water to only one-third of the distributing head 72. The humidifying water is, therefore, distributed over only a small portion of the heating coil 62 and the amount of moisture added to the air passing to the conduit 41 is limited. If more humidification is desired, two or three of the valves in the manifold 70 may be opened, thus increasing the area on the coil 62 over which humidifying water is distributed. It will be understood that very little control over the rate of humidification may be obtained by varying the amount of opening of any one of the valves in the manifold 70. This is due to the fact that substantially the smallest practical opening of any one of the valves admits enough water to the distributing head 72 to completely cover or wet the surface of the coil 62 immediately below that portion of the head 72 to which water is delivered. Any greater opening of the valve will merely increase the amount of water which flows over that portion of the heater coil 62 without increasing the amount of wetted surface thereof. Inasmuch as the rate of humidification is dependent upon the amount of wetted surface, it will be seen that the provision of separately controllable distributors for different portions of the surface of the coil 62 provides a reliable means for varying the rate of humidification of the air passing over the coil 62. The drip pan 56 collects the surplus water

delivered from the distributing head 72 and delivers it to the drain during winter operation, while during summer operation, the cooling coil 60 collects water of condensation from the air being cooled thereby which is also collected in the drip pan 56 and delivered to the drain.

While the form of embodiment of the present invention as herein disclosed constitutes a preferred form, it is to 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. Self-contained air conditioning apparatus comprising in combination, a liquefying unit, means forming an insulated compartment therefor, a refrigerant evaporator connected to said liquefying unit, means forming an air duct enclosing said evaporator and having an outlet communicating with a space to be air conditioned, an inlet communicating with said space, 15 and a second inlet communicating with a fresh air supply, means for circulating air through said duct, heating means in said duct, means for varying the ratio between the quantities of air withdrawn through said inlets, and sectional 25 sprays for supplying moisture to said heating means.

2. In combination, a refrigerant liquefying unit, a refrigerant evaporator in refrigerant flow relationship with said liquefying unit, means 30 forming an air duct enclosing said evaporator and having an outlet communicating with a space to be air conditioned, an inlet communicating with said space, a second inlet communicating with a fresh air supply, means for circulating air through said duct, heating means in said duct, means for varying the ratio between the quantities of air drawn through said inlets, and sectional sprays for supplying moisture to said heating means. 40

3. In combination, a refrigerant liquefying unit, a refrigerant evaporator in refrigerant flow relationship with said liquefying unit, means 45 forming an air duct enclosing said evaporator and having an outlet communicating with a space to be air conditioned, an inlet communicating with said space, a second inlet communicating with a fresh air supply, means for circulating air through said duct, heating means in said duct, means for varying the ratio between the quantities of air drawn through said inlets, sectional sprays for supplying moisture to said heating means, a solenoid valve between the liquefying unit and the evaporator, and temperature responsive means for operating said 55 valve.

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