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2 Sheets-Sheet 1



FIG. 2.

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REFRIGERATING APPARATUS

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This invention relates to refrigerating apparatus and more particularly to an improved control arrangement for a reverse cycle air conditioning system.

It is an object of this invention to provide an improved reverse cycle refrigerating system which may be used efficiently to supply heat during extreme cold weather.

A further object of this invention is to eliminate the danger of freeze-up of the evaporator of a reverse cycle system when the outside temperature falls below the temperature at which condensate would freeze on the evaporator.

Still another object of this invention is to reduce the size of the refrigerating apparatus required for supplying year-around air conditioning.

Another object of this invention is to provide improved controls for the auxiliary heating means in an air conditioning system.

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 of the drawing diagrammatically shows a preferred embodiment of my invention;

Fig. 2 is a fragmentary view diagrammatically showing the refrigerant flow connections through the reversing valve device during the heating cycle; and

Fig. 3 diagrammatically shows a modified arrangement in which the change-over from heating to cooling is accomplished by the shifting of suitable air dampers.

The desirability of year-around air conditioning utilizing a reverse cycle refrigeration system has long been recognized; but numerous problems have limited the use of reverse cycle air conditioning to relatively few installations. One of the problems in the use of a reverse cycle air conditioning system is that the evaporator of an ordinary reverse cycle system condenses moisture out of the outside air and this moisture freezes on the surface of the evaporator thereby reducing the efficiency of the evaporator to a point that the system becomes ineffective when maximum heating is required. Another disadvantage of the ordinary reverse cycle system is that its capacity decreases as the need for heating increases. Under favorable conditions a reverse cycle system has a high performance factor; but as the out-door temperatures decrease and the need for heating increases the performance fac-

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tor rapidly decreases. I have found that by supplying an adequate amount of auxiliary heat in the outside air stream ahead of the evaporator during the heating cycle it is possible to operate the system with a high performance factor even at the lower outside temperatures.

It is recognized that 100 watts of electrical energy supplied to an electric heater placed in a room will yield approximately 3415 B. t. u.'s of heat whereas the same amount of electrical energy supplied to the compressor of a reverse cycle refrigerating system will yield 15,000 B. t. u.'s of heat or even more so long as the outside air temperature does not drop much below 55° F. From the above it is apparent that the performance factor of a reverse cycle system is very nearly 5 under favorable conditions. However, as the outside air temperature decreases, the performance factor of the reverse cycle system will decrease unless some means is provided for maintaining the temperature of the air flowing over the evaporator substantially constant. In the reverse cycle air conditioning system set forth herein a large variable capacity auxiliary heater is provided for maintaining the temperature of the outside air flowing over the evaporator substantially uniformly at 55° F. even though the outside air temperature falls below this value.

Referring now to Fig. 1 of the drawing wherein I have shown a preferred embodiment of my invention, the enclosure to be conditioned has been designated by the reference numeral 10. Air is withdrawn from the enclosure 10 through the duct 12 and is mixed with fresh air supplied through the fresh air inlet 14 before being discharged into the conditioning chamber 16. A heat exchange unit 18 is disposed within the chamber 16 for either heating or cooling the air as will be explained more fully hereinafter. For purposes of illustration I have shown a fan unit 20 disposed within the air conditioning chamber 16 for circulating air through the chamber 16. The conditioned air is discharged into the closure 10 through the duct 22 in which there is located an auxiliary heater 23 for a purpose explained hereinafter.

An outside air duct 24 is provided within which an air circulating fan unit 26, a conventional motor-compressor unit 28, a heating coil 30 and a heat exchange unit 32 are arranged in the order shown. The heat exchange unit 32 is connected to the motor-compressor unit 28 through the refrigerant line 34 whereas the heat exchange unit 18 is connected to the motor-compressor unit 28 by the refrigerant line 36. A

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changeover valve device 40 is provided as shown, for selectively directing the compressed refrigerant leaving the unit 28 into the heat exchange coil 18 or into the heat exchange coil 32. A fixed restrictor 44 is provided in the refrigerant line 46 which connects the coils 18 and 32. The fixed restrictor serves to control the flow of refrigerant in either direction with the result that either one of the heat exchange units 18 and 32 may be used to evaporate refrigerant and the other may be used to condense refrigerant in accordance with practice which is now well known.

When it is desired to operate the system as a cooling system the heat exchange unit 18 serves as an evaporator and the heat exchange unit 32 serves as a condenser. When it is desired to operate the system as a heating system the changeover valve 40 is shifted from the position in which it is shown in Fig. 1 to the position in which it is shown in Fig. 2, so as to cause the heat exchange unit 18 to serve as a condenser and the heat exchange unit 32 to serve as an evaporator. The capacity of the system is such that when only a small amount of heating is required the reverse cycle system will supply the necessary amount of heat without the addition of any auxiliary heat by either the heating unit 23 or the heating unit 30. As the outside air temperature decreases and the amount of heat required increases it becomes desirable to supply auxiliary heat to the heater 30. For purposes of illustration I have shown the heater 30 in the form of a steam coil whereas the arrangement of the system is such that electric heat, gas heat or any other form of heat may be used to advantage. It will be noted that the arrangement of the ducts is such that outside air only flows over the motor-compressor unit and all of the air which flows over the heating unit 30 is discharged into the outside atmosphere. This arrangement has several advantages. One of the advantages of placing the heater 30 directly in the outside air duct 24 is that the heat can be furnished by the combustion of gas, oil or solid fuel directly in the air stream thereby eliminating the inefficiency of the usual heat transfer medium. The arrangement of the various heat exchange units and the air ducts is such that the duct 24 may be remote from the chamber 16 and the heat exchange unit 18 may be mounted directly in the enclosure to be conditioned, if desired.

In the arrangement shown in Fig. 1 of the drawing the supply of heat to the heating unit 30 is controlled by three valves, 50, 52 and 54, which are arranged as shown. The master valve 50 is controlled by the thermostat 56 located in the space to be conditioned and is adapted to be opened whenever the thermostat 56 calls for either heating or cooling. The thermostat 56 also controls the motor-compressor unit 28 and is adapted to deenergize the motor-compressor unit 28 when neither heating nor cooling is required. This master valve then serves to shut off the heat when the main system is shut down. The valve 54 is controlled by a thermostat 60 placed directly between the heater 30 and the heat exchange unit 32. The thermostat 60 tends to maintain a temperature at approximately 55° at the inlet to the heat exchange coil 32. Thus, as the temperature of the air reaching the coil 32 falls below 55°, the valve 54 tends to open but as the temperature increases above 55° the valve 54 closes. By virtue of this arrangement the valve 54 will remain closed at all times during the summer season when the

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outside temperatures are high and cooling only is required. The valve 52 which is arranged in parallel with the valve 54 is controlled by a thermostat 62 located within the conditioned space. Whenever the temperature in the conditioned space drops considerably below normal thereby indicating that the capacity of the heating system should be increased to take care of an abnormal load, the valve 52 begins to open irrespective of the temperature of the air flowing over the thermostat 60. The valve 52 is primarily useful when the outside temperature is above 55° and it is desired to quickly heat up the enclosure 10 such as when the apparatus is first turned on after a period of non-use. Thus during normal continuous operation of the system the valve 52 may never be called upon to open unless the air temperature within the conditioned space becomes abnormally low. The valves 52 and 54 could be replaced by a single valve controlled jointly by the temperature of the air in the conditioned space and at the inlet to the evaporator.

The refrigeration cycle may be reversed either manually or automatically in accordance with usual practice. For purposes of illustration, I have shown a thermostat 64 located in the conditioned space 10 for operating the diagrammatically shown change-over valve device 40.

The heater 23 located in the conditioned air duct 22 may be of any well known type and may be used either for reheating the air during the cooling season or it may be used for supplying auxiliary heat during the heating season. The heater 23 also may be used to heat air for the space 10 if for any reason the refrigeration system is out of operation and heat is required.

In the modification shown in Fig. 3, the space to be conditioned is designated by the reference numeral 70 and the air conditioning chamber is generally designated by the reference numeral 72. The central section of the chamber 72 is divided into two airflow passages 74 and 76. An evaporator 78 is arranged in the passage 76 whereas a condenser 80 is arranged in the passage 74. The evaporator 78 and the condenser 80 form a part of a refrigerating system which also includes the motor-compressor unit 82 which serves to withdraw refrigerant vapor from the evaporator 78 and to discharge compressed refrigerant into the condenser 80. The refrigerant flows from the condenser 80 to the evaporator 78 through the refrigerant line 84 within which there is provided a conventional refrigerant flow control device 86. The refrigerant flow control device 86 may be of the fixed restrictor type, the thermostatic expansion valve type or of any other type which suitably serves to control the flow of refrigerant from the condenser to the evaporator.

A mixture of return air and fresh air to be conditioned is supplied to the chamber 72 through the air duct 88 which has a return air inlet opening at 90 and a fresh air inlet opening at 92 as shown. A pivoted damper 94 is provided at the outlet of the air duct 88 for directing the air to be conditioned either into the airflow passage 76, in which the evaporator 78 is located, or into the airflow passage 74 in which the condenser 80 is located. A pair of dampers 96 and 98 are provided for directing outside air which enters the chamber 72 at 100 into one or the other of the passages 74 and 76. The dampers 94, 96 and 98 are operated in unison and are so constructed and arranged that they serve to direct the air to be conditioned through one of the airflow passages and the outside air through the other of

the airflow passages. When the dampers 94, 96 and 98 are arranged as shown by the solid lines in Fig. 3, the air leaving the duct 88 is directed over the evaporator 78 and the outside air is directed over the condenser 80. By moving these dampers into their dotted line positions, the incoming air to be conditioned is directed over the condenser 80 so as to be heated and the outside air, which supplies some or all of the heat, is directed over the evaporator 78 and is thereafter discharged into the outside atmosphere. A somewhat similar set of dampers 102, 104 and 106 is provided for directing the air leaving the passages 74 and 76. When the dampers 102, 104 and 106 are arranged as shown by the solid lines in Fig. 3, the cooled air leaving the evaporator 78 is directed into the space 70 and the heated air leaving the condenser 80 is directed to the outside through the outlet 107. These dampers are so constructed and arranged that when the dampers occupy the positions indicated by the dotted lines, the heated air is discharged into the space 70 and the cooled air into the outside atmosphere through the outlet 107. The dampers 94, 96, 98, 102, 104 and 106 are adapted to be operated in unison and may be controlled manually or automatically. In the event that automatic controls are used for operating these dampers, the control would preferably respond to the temperature of the air within the conditioned space, or to the combination of inside and outside air temperatures. A pair of fan units 108 and 110 are provided as shown for propelling the air through the passages 74 and 76 respectively. In order to operate the refrigeration system with a high performance factor and in order to prevent freeze-up of the evaporator 78 during cold weather, I have provided a heating unit 112 which corresponds in function and operation to the heating unit 30 described in connection with the system shown in Figs. 1 and 2. The flow of heating medium to the unit 112 is controlled by a set of valves 150, 152 and 154 which are similar in construction and operation to the corresponding valves 50, 52 and 54 used for controlling the flow of heating medium to the coil 30 in a system of the type shown in Fig. 1. The valve 154 is controlled by the thermostat 160 which serves to maintain a temperature of approximately 55° F. at the inlet to the evaporator 78. The valve 152 is controlled by a thermostat 156 arranged within the enclosure 70 and serves to open the valve 152 when the temperature within the enclosure 70 falls below a predetermined value such as 60° F. The valve 150 and the motor-compressor unit 82 are both controlled by the thermostat 164 located in the space 70. The thermostat 164 is arranged to turn on the motor-compressor unit 82 and to open the valve 150 whenever the temperature within the space 70 falls below or goes above the temperature range sought to be maintained within the space 70.

By virtue of the above described arrangement, none of the air heated by the heating unit 112 is ever discharged into the conditioned space 70. This being the case, it is possible to use any form of direct heat for heating air flowing through the passage 76. A heating unit 123 is provided in the conditioned air duct 105 and is intended to correspond in construction and operation to the corresponding unit 23 provided in the system shown in Fig. 1. The heating unit 123, like the unit 23, may be used for reheating the air during the cooling cycle or it may be used for supplying heat to the air being discharged into the space 70 dur-

ing the heating season. The heating units 23 and 123 may be manually controlled or automatically controlled depending upon the results desired. Thus the heating units 23 and 123 could be automatically controlled in response to either temperature or humidity.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, as may come within the scope of the claims which follow.

What is claimed is as follows:

1. Apparatus for heating air for an enclosure comprising in combination, a first heat exchange unit, a second heat exchange unit, means for transferring heat from one of said units to the other of said units, means for flowing a first stream of air in thermal exchange with said first heat exchange unit and for discharging said stream of air into said enclosure, means for flowing a second stream of air in thermal exchange with said second heat exchange unit and for discharging said second stream of air into the outside atmosphere, heating means for supplying heat to said second stream of air before said second stream of air flows in thermal exchange with said second heat exchange unit, and means responsive to the requirements for heat in said enclosure for energizing said heating means.

2. Apparatus for either heating or cooling air for an enclosure comprising in combination, a first heat exchange unit, a second heat exchange unit, means for transferring heat from one of said units to the other of said units, means for flowing a first stream of air in thermal exchange with said first heat exchange unit and for discharging said stream of air into said enclosure, means for flowing a second stream of air in thermal exchange with said second heat exchange unit and for discharging said second stream of air to the outside atmosphere, heating means for supplying heat to said second stream of air before said second stream of air flows in thermal exchange with said second heat exchange unit, means responsive to the requirements for heat in said enclosure for energizing said heating means, said first and second heat exchange units forming a part of a volatile refrigerant system including a compressor, means for reversing the flow of refrigerant through said first and second heat exchange units, and means for controlling the flow of refrigerant between said heat exchange units.

3. In an air conditioning unit for an enclosure, a condenser, an evaporator, means to transfer heat from said evaporator to said condenser, means for flowing air to be conditioned in thermal exchange with said condenser so as to heat said air, means for discharging the heated air into said enclosure, means for flowing air in thermal exchange with said evaporator, means for discharging said last named air into the outside atmosphere, means for heating said last named air before said air is used for heating said evaporator, and means responsive to the temperature of the air in said enclosure for controlling said last named means.

4. In an air conditioning system of the reverse cycle type, a volatile refrigerant system having a heat absorbing element and a heat dissipating element, means for flowing a first stream of air in thermal exchange with said heat absorbing element, means for flowing a second stream of air in thermal exchange with said heat dissipating element, means for heating said first stream

of air prior to its contact with said heat absorbing element, and means responsive to the temperature of the air leaving said heating means for controlling the operation of said heating means.

5. In combination, means forming a first air duct, means forming a second air duct, a refrigerating system having a condenser in said first air duct and an evaporator in said second air duct, means for circulating outside air in through said second air duct and over the evaporator, said second duct being so constructed and arranged as to discharge the air flowing therethrough into the outside atmosphere, means for circulating air to be conditioned in over said condenser and out into the space to be conditioned, a first heating means in said second duct arranged to heat the air flowing in said second duct before contacting the evaporator, and a second heating means arranged in said first duct at a point beyond said condenser for heating air leaving said condenser.

6. In combination, means forming a first air duct, means forming a second air duct, a refrigerating system having a condenser in said first air duct and an evaporator in said second air duct, means for circulating outside air in through said second air duct and over the evaporator, said second duct being so constructed and arranged as to discharge the air flowing therethrough into the outside atmosphere, means for circulating air to be conditioned in over said condenser and out into the space to be conditioned, a first heating means in said second duct arranged to heat the air flowing in said second duct before contacting the evaporator, and a second heating means arranged in said first duct at a point beyond said condenser for heating air leaving said condenser, said refrigerating system including a compressor mounted in said second air duct so as to be cooled by the air flowing through said second air duct.

7. In combination, means forming a first air duct, means forming a second air duct, a refrigerating system having a condenser in said first air duct and an evaporator in said second air duct, means for circulating outside air in through said second air duct and over the evaporator, said second duct being so constructed and arranged as to discharge the air flowing therethrough into the outside atmosphere, means for circulating air to be conditioned in over said condenser and out into the space to be conditioned, a first heating means in said second duct arranged to heat the air flowing in said second duct before contacting the evaporator, and a second heating means arranged in said first duct at a point beyond said condenser for heating air leaving said condenser, said refrigerating system including a compressor mounted adjacent the inlet of said second air duct for partially heating the air flowing in thermal exchange with said evaporator.

8. In an air conditioning system of the reverse cycle type, a volatile refrigerant system having a heat absorbing element and a heat dissipating element, means for flowing a first stream of air in thermal exchange with said heat absorbing element, means for flowing a second stream of air in thermal exchange with said heat dissipating element, means for heating said first stream of air prior to its contact with said heat absorbing element, means responsive to the temperature of the air leaving said heating means for controlling the operation of said heating means, and means for selectively directing either of said air streams into a space to be conditioned

and the other of said air streams into the outside atmosphere.

9. Apparatus for either heating or cooling air for an enclosure comprising in combination, a first heat exchange unit, a second heat exchange unit, means for transferring heat from one of said units to the other of said units, means for flowing a first stream of air in thermal exchange with said first heat exchange unit and for discharging said stream of air into said enclosure, means for flowing a second stream of air in thermal exchange with said second heat exchange unit and for discharging said second stream of air into the outside atmosphere, heating means for supplying heat to said second stream of air before said second stream of air flows in thermal exchange with said second heat exchange unit, and means responsive to the requirements for heat in said enclosure for energizing said heating means, said first and second heat exchange units comprising parts of a reverse cycle refrigerating system having means for causing either one of said units to operate as a condenser and the other to operate as an evaporator.

10. In an air conditioning system, a first heat exchange unit, a second heat exchange unit, a refrigerant compressor, refrigerant flow connections between said heat exchange units and said compressor, said heat exchange units, compressor and refrigerant flow connections forming a heat transfer system, means for flowing a first stream of air in thermal exchange with said first heat exchange unit, means for flowing a second stream of outside air in thermal exchange with said second heat exchange unit, means for discharging said first stream into an enclosure to be conditioned, means for discharging said second stream into the outside atmosphere, means for supplying heat to said second air stream before contacting said second heat exchange unit whereby said heat is transferred by said heat transfer system into said first air stream, and means responsive to the temperature within said enclosure for controlling said means for supplying heat.

11. In an air conditioning system, a first heat exchange unit, a second heat exchange unit, a refrigerant compressor, refrigerant flow connections between said heat exchange units and said compressor, said heat exchange units, compressor and refrigerant flow connections forming a heat transfer system, means for flowing a first stream of air in thermal exchange with said first heat exchange unit, means for flowing a second stream of outside air in thermal exchange with said second heat exchange unit, means for discharging said first stream into an enclosure to be conditioned, means for discharging said second stream into the outside atmosphere, means for supplying heat to said second air stream before contacting said second heat exchange unit whereby said heat is transferred by said heat transfer system into said first air stream, means responsive to the temperature within said enclosure for controlling said means for supplying heat, and means for reversing the flow of refrigerant through said heat exchange units so as to change the system from a heating system to a cooling system.

12. In an air conditioning system, a first heat exchange unit, a second heat exchange unit, a refrigerant compressor, refrigerant flow connections between said heat exchange units and said compressor, said heat exchange units, compressor and refrigerant flow connections forming a

heat transfer system, means for flowing a first stream of air in thermal exchange with said first heat exchange unit, means for flowing a second stream of outside air in thermal exchange with said second heat exchange unit, means for discharging said first stream into an enclosure to be conditioned, means for discharging said second stream into the outside atmosphere, means for supplying heat to said second air stream before contacting said second heat exchange unit whereby said heat is transferred by said heat transfer system into said first air stream, means responsive to the temperature within said enclosure for controlling said means for supplying heat, and means for reversing the flow of refrigerant through said heat exchange units so as to change the system from a heating system to a cooling system, said temperature responsive means including means for preventing the heat supplying means from heating said second stream of air when cooling is required in said enclosure.

13. In an air conditioning system, a first heat exchange unit, a second heat exchange unit, a refrigerant compressor, refrigerant flow connections between said heat exchange units and said compressor, said heat exchange units, compressor and refrigerant flow connections forming a heat transfer system, means for flowing a first stream of air in thermal exchange with said first heat exchange unit, means for flowing a second stream of outside air in thermal exchange with said second heat exchange unit, means for discharging said first stream into an enclosure to be conditioned, means for discharging said second stream into the outside atmosphere, means for supplying heat to said second air stream before contacting said second heat exchange unit whereby said heat is transferred by said heat transfer system into said first air stream, means responsive to the temperature within said enclosure for controlling said means for supplying heat, and means for discharging said first stream of air into the outside atmosphere and said second stream into said enclosure when cooling is required in said enclosure.

14. In combination with a volatile refrigerant system having a pair of complementary heat exchange coils, means for flowing a first stream of air in thermal exchange with one of said coils, means for flowing a second stream of air in thermal exchange with the other of said coils, means for discharging one of said streams into a space to be conditioned, a heating unit for heating one of said streams of air prior to its contact with one of said coils, a supply line for supplying a heating medium to said heating unit, a first valve in said supply line, a second valve in said supply line, means for by-passing said second valve, a third valve controlling the flow through said by-passing means, means responsive to the temperature within said space for controlling said first valve, means responsive to the temperature within said space for controlling said second valve, and means responsive to the temperature of the air leaving said heating unit controlling said heating unit.

15. In combination with a volatile refrigerant system having a pair of complementary heat exchange coils, means for flowing a first stream of air in thermal exchange with one of said coils, means for flowing a second stream of air in thermal exchange with the other of said coils, means for discharging one of said streams into a space to be conditioned, a heating unit for heating one of said streams of air prior to its contact with

one of said coils, a supply line for supplying a heating medium to said heating unit, a first valve in said supply line, a second valve in said supply line, means for by-passing said second valve, a third valve controlling the flow through said by-passing means, means responsive to the temperature within said space for controlling said first valve, means responsive to the temperature within said space for controlling said second valve, and means responsive to the temperature of the air leaving said heating unit controlling said heating unit, one of said temperature responsive means including means for controlling said refrigerant system.

16. In combination with a volatile refrigerant system having a pair of complementary heat exchange coils, means for flowing a first stream of air in thermal exchange with one of said coils, means for flowing a second stream of air in thermal exchange with the other of said coils, means for discharging one of said streams into a space to be conditioned, a heating unit for heating one of said streams of air prior to its contact with one of said coils, a supply line for supplying a heating medium to said heating unit, a first valve in said supply line, a second valve in said supply line, means for by-passing said second valve, a third valve controlling the flow through said by-passing means, means responsive to the temperature within said space for controlling said first valve, means responsive to the temperature within said space for controlling said second valve, means responsive to the temperature of the air leaving said heating unit controlling said heating unit, and change-over means for causing either one of said heat exchange coils to reject heat picked up by the other of said heat exchange coils.

17. In combination with a volatile refrigerant system having a pair of complementary heat exchange coils, means for flowing a first stream of air in thermal exchange with one of said coils, means for flowing a second stream of air in thermal exchange with the other of said coils, means for discharging one of said streams into a space to be conditioned, a heating unit for heating one of said streams of air prior to its contact with one of said coils, a supply line for supplying a heating medium to said heating unit, a first valve in said supply line, a second valve in said supply line, means for by-passing said second valve, a third valve controlling the flow through said by-passing means, means responsive to the temperature within said space for controlling said first valve, means responsive to the temperature within said space for controlling said second valve, means responsive to the temperature of the air leaving said heating unit controlling said heating unit, and change-over means for causing either one of said air streams to be discharged into said space.

18. In an air conditioning system for an enclosure, a first heat transfer unit and means for transferring heat between said heat transfer unit and said enclosure, a second heat transfer unit, a heating unit, means for flowing air first into heat exchange relationship with said heating unit and then in heat exchange relation with said second heat transfer unit and then discharging the air outside said enclosure, means for evaporating a volatile liquid in said second heat transfer unit and condensing the evaporated volatile liquid in said first heat transfer unit and returning the condensed volatile liquid to the second heat transfer unit for re-evaporation, and means for rendering effective said heating unit to heat the flow-

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ing air while said means for evaporating is operative for producing evaporation in said second heat transfer unit.

19. In combination, means forming a first air duct, means forming a second air duct, a refrigerating system having a condenser in said first air duct and an evaporator in said second air duct, means for circulating outside air in through said second air duct and over the evaporator, said second duct being so constructed and arranged as to discharge the air flowing therethrough into the outside atmosphere, means for circulating air to be conditioned over said condenser and out into the space to be conditioned, and heating means in said second duct arranged to heat the air flowing in said second duct before contacting the

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evaporator, said refrigerating system including a compressor mounted in said second air duct in advance of the evaporator so as to heat the air before contacting the evaporator.

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