

Nov. 13, 1956

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2,770,100

AIR CONDITIONING CONTROL

Filed June 21, 1954

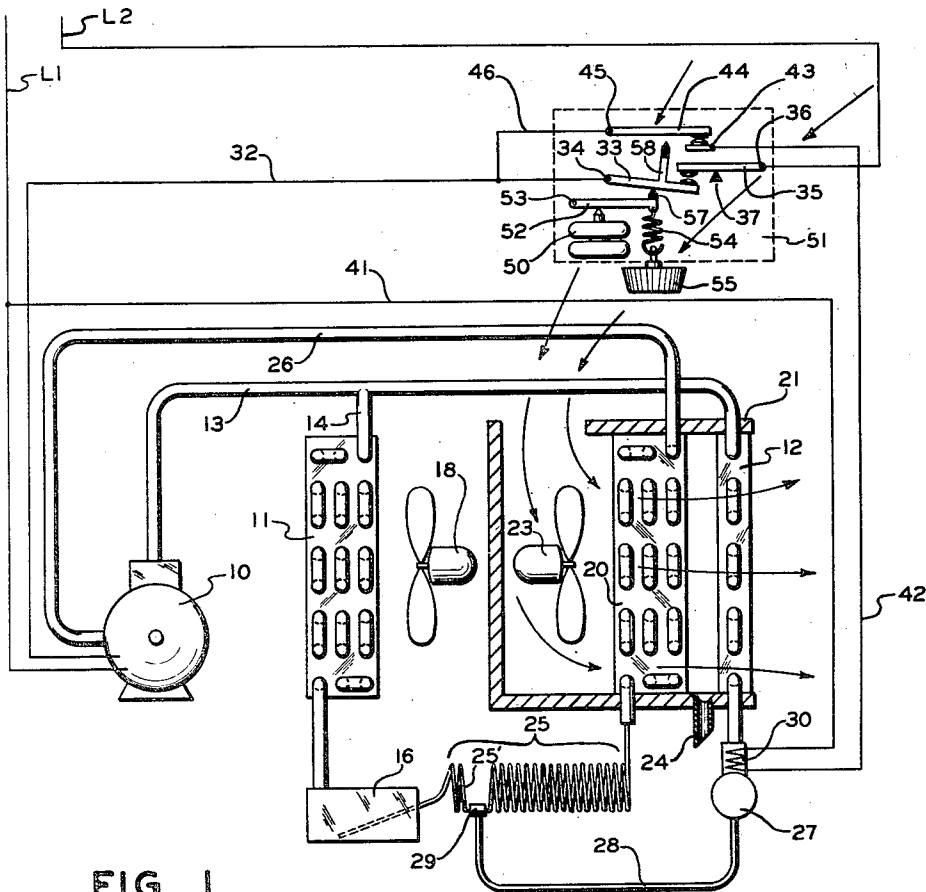


FIG. 1

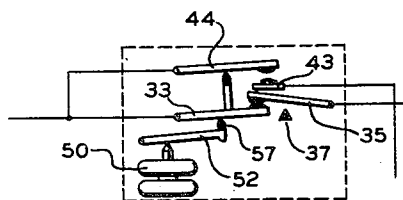


FIG. 2

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AIR CONDITIONING CONTROL

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Application June 21, 1954, Serial No. 437,971

5 Claims. (Cl. 62—4)

The present invention relates to air conditioning systems for rooms, etc., in which air is chilled by passing it in heat exchange relation with an evaporator of a compressor-condenser-expander refrigeration system and which includes a second condenser, which is herein sometimes referred to as an auxiliary condenser, located in the path of the chilled air and is adapted to be selectively activated to reheat the air to avoid reduction of the room air temperature below a comfortable degree while maintaining dehumidification of the air by continued operation of the evaporator.

One object of the invention is the provision of an improved air conditioning system of the general type described in which the refrigerant discharge of the auxiliary condenser is connected into the liquid supply line of the evaporator, and a fixed liquid flow restrictor is provided in the refrigeration circuit between the main condenser refrigerant discharge and the point at which the auxiliary condenser discharges into the evaporator supply line so that the pressure at the outlet of the auxiliary condenser is lower than that of the main condenser whereby by merely opening a valve in the refrigerant lines of the auxiliary condenser refrigerant will flow there-through.

Another object of the invention is the provision of a system of the type referred to in which a valve is employed in the discharge line of the auxiliary condenser to control the flow of refrigerant through the latter condenser so that the valve is subjected to low pressure differentials and may be operated by relatively low power.

Another object of the invention is the provision of an improved air conditioning system of the type mentioned in which capillary restrictor means is employed to meter liquid refrigerant to the evaporator from the main condenser as well as from the auxiliary condenser, the refrigerant circuit being arranged so that the capillary provides restriction to cause gaseous refrigerant to be diverted from the main condenser to the auxiliary condenser solely in response to opening the refrigerant circuit of the auxiliary condenser.

A still further object of the invention is to provide an electrically operated valve to control the flow of fluid through the auxiliary condenser and a thermostatic control apparatus comprising switching means to control operation of the compressor and the valve, the switching means being actuated by a single thermally responsive device to initiate operation of the valve and the compressor at a given temperature to cause operation of the auxiliary condenser when moderate temperatures prevail so that the air discharged into the room is dehumidified but only moderately cooled, and upon an increase in temperature, the switch means is actuated by the thermally responsive device to cause the valve to close and render the auxiliary condenser ineffective whereby the air discharged into the room is relatively cooler. This control apparatus provides a reliable and relatively inexpensive automatic means to control the air conditioning system to maintain comfortable room conditions in which humid-

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ity is maintained relatively low not only during periods in which maximum cooling is required but during periods in which modified cooling is desirable.

Other objects and advantages of the invention will be apparent from the following description of a preferred form of the invention, reference being made to the accompanying drawings in which

Fig. 1 is a schematic showing of an air conditioning system for a room which system embodies the invention; and

Fig. 2 is a schematic showing of control apparatus shown in Fig. 1 for controlling operation of the system, certain parts of the apparatus being shown in different positions than in Fig. 1.

For the purposes of illustration the invention is shown embodied in a so-called room air conditioner, but it is to be understood that it could be incorporated in systems for conditioning other spaces. In the form shown the air conditioning system comprises a refrigerant compressor 10 which is the type having an electric motor therefor hermetically sealed within the compressor housing. The compressor discharge is connected with main and auxiliary condensers 11 and 12 respectively, through tubes 13, 14 as shown.

The main condenser 11 may be of any conventional construction and is arranged to discharge condensed refrigerant into a receiver 16, and is cooled by an electric motor driven fan 18 which may be arranged to be operated simultaneously with the operation of the compressor 10 and to blow outside air thereover. The manner in which the fan motor circuit is controlled forms no part of the invention and therefore it is not shown.

An evaporator 20 is disposed in an air duct 21 through which air, at least part of which is from the room to be conditioned, is blown by an electric motor driven fan 23 so that air taken into one end of the duct is forced into heat exchange relation with the evaporator and out of the other end of the duct and into the room, as is indicated by the arrows in Fig. 1.

A funnel formation 24 is provided in the bottom wall of the duct 21 for drawing off moisture condensed out on the evaporator from the air.

The circuit for the motor for the fan 23 may be controlled in any suitable manner, but since such control is not a part of the invention it is not shown.

The auxiliary condenser 12 is likewise disposed in the duct 21 and preferably on the downstream side of the evaporator 20 relative to the air flow through the duct. As is indicated in the drawing the auxiliary condenser 12 has somewhat less refrigerant and heat exchange capacity than the main condenser 11 or the evaporator 20.

Refrigerant is conveyed to the evaporator 20 from the receiver 16 through a capillary restrictor 25, the restrictor functioning to permit relatively free flow of liquid refrigerant to the evaporator while resisting the flow of gas thereto so that liquid refrigerant only is introduced into the lower end of the evaporator. The upper end of the evaporator is connected by a tube 26 to the intake of the compressor 10, as is usual in this type of refrigerating system.

The outlet of the auxiliary condenser 12 is connected with the capillary restrictor tube 25 through a solenoid operated valve 27 and a tube 28 connected with the outlet of the valve. The tube 28 is connected with the capillary restrictor 25 by a T connection 29 intermediate the ends of the capillary tube so that a portion 25' of the latter is interposed between the receiver 16 and the point of connection of the tube 28 therewith. The connection of the tube 28 into the capillary may be made at any suitable point, and in the form shown it is approximately at a point $\frac{1}{10}$ of the length of the capillary from the receiver.

The solenoid valve 27 is operated by a solenoid 30 and

is arranged to be closed when the solenoid is de-energized and to be opened upon energization of the solenoid.

It will be seen that when the solenoid 30 is de-energized and the compressor 10 is operated, refrigerant will collect and liquify in the auxiliary condenser 12 since the valve 27 is closed and the condenser is cooled by air from the evaporator; therefore the refrigerant discharged from the compressor is then directed into the condenser 11 where it is condensed and flows into the receiver 16. The liquified refrigerant in the receiver 16 then passes through the capillary 25 into the evaporator 20 where it is evaporated and chills the walls of the evaporator in the usual manner well understood in the art. Air blown over the evaporator is chilled and moisture therein is condensed on the surface of the evaporator should the humidity of the air be relatively high. Thus, air discharged from the duct 21 into the room is cooled to the maximum capable of the system and dehumidified.

When the solenoid 30 is energized and valve 27 is opened, the refrigerant condensed in the auxiliary condenser 12 flows through the tube 28, into the capillary 25, and thence to the evaporator. The resistance to the flow of refrigerant offered by the section 25' of the capillary tube 25 causes refrigerant to be diverted from the condenser 11 to the condenser 12. Also, the fact that the condenser 12 is subjected to the chilled air lowers the pressure of the refrigerant therein relative to that in the main condenser. This flow of refrigerant through the auxiliary condenser 12 causes it to be warmed and to transfer heat of the compressed refrigerant into the chilled air passing from the evaporator 20 thereover; therefore, the temperature of the air discharged into the room is higher than the air discharged from the evaporator. Since the operation of the evaporator 20 is unaffected it continues to cool the air and, according to the relative humidity of the air, moisture from the air is condensed on the surface of the evaporator and the air thereby dehumidified. Thus, maximum dehumidification of the air for the room can be effected without the full cooling capacity of the apparatus being effective to chill the room.

Referring now to the control for the air conditioning system, the compressor is energized by current furnished through suitable power lines L1, L2. Line L1 is connected to one terminal of the motor of the compressor and the other motor terminal is connected by wire 32 to a contact arm 33 of a thermostatically operated switching mechanism. The arm 33 is pivoted at 34 and its free end carries a contact which engages a contact on an arm 35 which is pivoted at 36, the weight of the arm causing the arm to rest on a fixed stop 37. The contact arm 35 is connected to L2.

The circuit for the solenoid 30 includes line L1, wire 41, solenoid 30, wire 42, fixed contact 43, movable contact arm 44, which is pivoted at 45, and which arm normally rests on contact 43, wires 46 and 32 to contact arms 33, 35, and L2. It will be seen that although the solenoid circuit is normally closed at 43, 44 it is not de-energized until the compressor control contacts 33, 35 are engaged.

The switch contact arms 33, 34 are arranged to be actuated by a thermally responsive device comprising an expansible bellows 50 and a bellows lever 52 pivoted on a pin 53. The lever 52 is normally urged clockwise about its pivot by a range spring 54 attached thereto and the tension of which spring can be selectively varied by an adjusting screw 55. Expansion of the bellows 50 rotates the lever 52 against tension of the spring 54 and an insulated abutment 57 on the lever is arranged to engage the underside of the contact arm 33 and to cause the latter to engage contact arm 35 upon the attainment of a predetermined temperature, such as 75° F. Thus, the compressor 10 is energized as described, and the solenoid circuit is also completed since contacts 43, 44 are closed. The fans 18 and 23 are suitably energized and

the air cooled by the evaporator 20 is reheated to a certain extent before it passes into the room. Thus, moisture is condensed from the air, but the cooling effect of the air is modified by reheating thereof by the auxiliary condenser.

It is to be noted that the auxiliary condenser 12, being of less heat exchange capacity than either the main condenser 11 or evaporator 20, modifies the temperature thereof so that the resultant cooling effect is somewhat less than the maximum cooling effect obtained when the auxiliary condenser is inoperative.

Assuming now that the temperature in the room continues to rise, the bellows 50 expands and moves contact arm 33 upwardly, and an insulated post 58 on the contact arm then engages contact arm 44 and causes the latter to move from contact 43 and thereby break the circuit to the solenoid 30 as is shown in Fig. 2. This causes the valve 27 to close and block the flow of refrigerant through the auxiliary condenser so that the full cooling effect of the air discharged from the evaporator is obtained in the room since the auxiliary condenser is no longer effective to reheat the air.

As the temperature in the room reduces, the bellows 50 tends to collapse and contact arm 44 again re-engages contact 43 while contact arm 33 continues to engage contact arm 35. In this condition the compressor 10 is maintained in operation but the valve 27 is opened by the solenoid 30 to again establish the flow of refrigerant through the auxiliary condenser 12 thus modifying the temperature of the air discharged from the duct 21 into the room.

Should the temperature in the room continue to fall, the bellows 50 collapses to a point at which contact arm 33 moves from contact arm 35 thereby breaking the circuit to the compressor and the solenoid 30.

It is evident that by my invention I have provided a relatively simple air cooling system having control means to modify the cooling effect thereof while at the same time maintaining the dehumidification of the air whereby a more comfortable temperature in a room may be had by relatively simple control.

It is to be understood that other forms, modifications and adaptations of the invention could be employed than that shown and described. For example, the switches for controlling the compressor and solenoid circuits could be of different structure than that shown but of equivalent function, such as snap switch mechanisms. It is to be understood that any such changes in form, or modifications fall within the scope of the claims which follow.

I claim:

1. A conditioning system comprising a refrigerant compressor, a main refrigerant condenser connected with the refrigerant discharge of the compressor, an evaporator, a liquid supply line from the condenser to the evaporator including a fluid passage restricted relative to the remainder of said supply line, an auxiliary condenser connected with the refrigerant discharge of the compressor and having the refrigerant discharge thereof connected in said supply line at a point at which at least a portion of said restricted fluid passage lies between said main condenser and said point, and means to control the flow of fluid through said auxiliary condenser.

2. A conditioning system comprising a refrigerant compressor, a main refrigerant condenser connected with the refrigerant discharge of the compressor, an evaporator, a liquid supply line from the condenser to the evaporator including a fluid passage restricted relative to the remainder of said supply line, an auxiliary condenser connected with the refrigerant discharge of the compressor and having the refrigerant discharge thereof connected in said supply line at a point at which at least a portion of said restricted fluid passage lies between said main condenser and said point, and a single valve to control the flow of fluid through said auxiliary condenser.

3. A conditioning system comprising a refrigerant com-

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pressor, a main refrigerant condenser connected with the refrigerant discharge of the compressor, an evaporator, a liquid supply line from the condenser to the evaporator including a fluid passage restricted relative to the remainder of said supply line, an auxiliary condenser connected with the refrigerant discharge of the compressor and having the refrigerant discharge thereof connected in said supply line at a point at which at least a portion of said restricted fluid passage lies between said main condenser and said point, and a valve between the refrigerant discharge of said auxiliary condenser and said point to control the flow of fluid through said auxiliary condenser.

4. In an air conditioning system having a compressor, and an evaporator comprising a refrigerating circuit, electrically controlled means to control operation of the compressor, electrically controlled means to reheat air chilled by the evaporator, control means for both said electrically controlled means comprising two switches to control the first and second electrically controlled means, and a thermally responsive element to actuate said switches sequentially.

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5. In an air conditioning system having a compressor, and an evaporator comprising a refrigerating circuit, electrically controlled means to control operation of the compressor, electrically controlled means to reheat air chilled by the evaporator, control means for both said electrically controlled means comprising two movable switch members movable to control the first and second electrically controlled means respectively, and a thermally responsive expansible element adapted to move one of said switch members upon a predetermined expansion thereof and to move the other of said switch members upon a predetermined greater expansion.

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