March 19, 1968

D. C. FERDELMAN

CONTROL FOR HEAT PUMP

Filed Sept. 22, 1966

FUNCTION
HEAT-MED. FAN
OFF
LOW FAN
LOW FAN COOL
HI FAN COOL

POSITION
0°
60°
120°
180°
240°

1-5
1-L1
2-N
3-L2
4-6

INVENTOR

Fig. 2

Fig. 3

Fig. 4

INVENTOR:

Donald C. Ferdelman

BY

Carl G. Stickel

ATTORNEY
This invention pertains to a simplified control system for reverse cycle air conditioning systems for heating and cooling.

The controls for reverse cycle air conditioning systems providing heating and cooling have been considerably more expensive than the controls for cooling alone. Particularly, several expensive relays have been required. It is an object of this invention to provide a simple, less expensive control cycle refrigerating system which minimizes the number and the cost of the relays.

These and other objects are attained in the form shown in the drawings in which a multiple selector switch means having a common operating means selects either a heating cycle or a low fan speed without refrigeration or refrigeration with either low or high fan speeds. In addition, a stage type thermostat has a set of double throw contacts which provides thermostatic control of the refrigeration system as well as controls and an electric heater to provide heat when reverse cycle refrigeration is not efficient. The stage type thermostat includes an additional switch which provides for additional electric heat when necessary when the system is used as a heat pump.

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 embodiment is clearly shown.

In the drawings:

FIGURE 1 is a wiring diagram illustrating the control system for a reverse cycle air conditioning system embodying one form of my invention;

FIGURE 2 is a chart showing the closed positions of the selector switch as “on” to perform the desired functions;

FIGURE 3 is a diagrammatic view of the selector switch; and

FIGURE 4 is a diagrammatic view of a reverse cycle air conditioning system.

Referring more particularly to FIGURE 4, there is shown diagrammatically a reverse cycle air conditioning system including a motor compressor unit 20 having its outlet 22 connected to the reversing valve 24 which in the position shown delivers the compressed refrigerant to the outdoor heat transfer coil 26, which transfers heat from the refrigerant to the outdoor air. The refrigerant is condensed in the outdoor coil 26 and is forwarded through the restrictor 28 to the indoor heat transfer coil 30 where the refrigerant evaporates and absorbs heat from the air in the room to be cooled and returns through the reversing valve 24 to the compressor inlet 32. The reversing valve 24 is operated to reverse position by energizing the solenoid 34 which causes the compressor 20 to deliver the compressed refrigerant to the indoor coil 30 where it delivers heat into the room and causes the condensation of the refrigerant which then flows through the restrictor 28 in the opposite direction to the outdoor coil 26 where it evaporates and returns to the compressor. Separate fans, not shown, separately circulate the indoor and outdoor air in heat transfer relation with the indoor and outdoor coils 30 and 26. These are driven by a single fan motor 36 diagrammatically illustrated in FIGURE 1. One example of such a system is illustrated in United States Patent No. 3,186,477, issued June 1, 1965.

In FIGURE 1 there are shown the supply conductors 38 and 40. The supply conductor 38 connects through the branch conductor 41 to the double throw switch 42 of the stationary thermostat 44 which preferably is adjustable and responsive to room temperatures. This stationary thermostat operates in the following manner; it should be set at 70°F, as long as the temperature remains above 70°F, the conductor 41 will be connected through the switch 42 to the terminal 46 and the conductor 48 to the cooling switch 4. If the temperature falls below 70°F, the double throw switch 42 will move downwardly into engagement with the stationary contact 50 connecting through the switch 52 with the heating switch 4. If the room temperature falls further, for example to 68°F, then the secondary stationary switch 54 will be moved downwardly to engage the stationary contact 56 which connects with the conductor 58 connecting with the auxiliary electric heater 62 which is preferably located adjacent the indoor coil 30 and, when energized, heats the air circulated through the indoor coil 30.

The selector switch 64 is controlled by a common operating knob 66 which rotates a shaft 68 provided with a cam 70 which in the zero position closes the switch contacts 4 and 6. The shaft is also provided with a cam 74 which in the zero position moves the contact 3 into engagement with the contact 2 to provide for heating by reverse cycle refrigeration for supplementary heat or by electric heat alone when the reverse cycle refrigeration is not efficient or is insufficient. The shaft 68 is also provided with a cam 72 operating a double throw switch 1 which in the 120° and 180° positions engages the contact 5 to operate the fan motor 36 at a low speed. In the 240° position of the knob the cam 72 moves the double throw switch 1 into engagement with the contact 1 to provide high fan speed. The selector switch is also provided with a cam 76 which is adapted to close the contacts 2 and N when cooling is desired to energize the motor compressor unit 84.

When the contacts 2 and N are closed, the current from the supply conductor 38 flows through the branch conductor 41, the switch member 42, the contact 46, the conductor 48, the switch contacts 2 and N, the conductor 78, the motor protector switch 80, the conductor 82 and the motor 84 of the sealed motor compressor unit which is connected by the branch conductor 86 to the supply conductor 40. This occurs whenever the knob 66 is in either the 180° or the 240° position. In the 180° position the contact member 1 is moved by the cam 72 into engagement with the contact 5 which closes the circuit from the supply conductor 38 through the conductor 88 connecting through the contacts 1 and 5 and the contact 90 with the low speed terminal 92 of the electric motor 36. The cam 72 also holds the contacts 1 and 5 in engagement in the 120° position for low speed fan operation only. In the 240° position the cam 72 moves the contacts 1 and L1 into engagement thereby connecting with the conductor 94 which connects with the high speed terminals 96 of the motor 36. Since the switch contacts L2 and 3 as well as contacts 4 and 6 remain open in the positions of knob 66, the cooling of the room thermostat 44 below the temperature selected will move the switch member 42 away from the stationary contact 46 into engagement with the contact 50 which serves merely as a stop in this selected position of the knob 66 to disconnect the motor 84 from the supply conductor 38. This does not affect the operation of the fan motor 36. The running capacitor 97 is effective for improved phase shift in both starting and running at all speeds and connects to the phase winding terminal 98.

When the knob 66 is moved to the zero position for heating, the switch contacts L2 and 3 are closed by the cam 76 and the contacts 4 and 6 are closed by the cam 70. The closing of the contacts L2 and 3 connect the sup-
ply conductor 38 with the conductor 121 to energize the solenoid 34 to operate the reversing valve 24 to the reversing position to provide reverse cycle heating in the refrigerant circuit illustrated in FIGURE 4. The solenoid 34 is also connected by the conductor 123 with the supply conductor 40. The closing of the contacts 2 and 3 also energizes the relay 125 through the conductors 127 and 129, the latter of which connects with the supply conductor 40. This closes the relay switch 131 connecting the supply conductor 38 and the branch conductor 133 through the switch 131 and the conductor 135 with the medium speed terminal 137 of the fan 36. When the room temperature drops below the selected temperature such as 70°F the first stage operation of the stationary thermostat 44 will move the movable switch member 42 out of engagement with the stationary contact 46 and into engagement with the stationary contact 50 which connects through the conductor 52, the switch contacts 4 and 6 and the conductor 141 with a thermostatic heat change-over switch 143 which is shown in the normal position. In the normal position this switch 143 connects through the conductor 145 and the auxiliary heater 147 of the thermal overload protector with the conductor 82 so that this provides a connection through the motor 84 for reverse cycle operation when the knob 66 is in the zero position. In this zero position the contacts 2 and 6 are separated so that no operation of the refrigerating system is provided in this position of the selector switch when the switch member 42 is in engagement with the stationary contact 46. The closing of the contacts 2 and 3 also makes it possible to provide auxiliary heating when the stage thermostat efficiently to move the lower stage switch member 54 in engagement with the contact 56 thereby energizing the second auxiliary heater 62 which connects through the temperature safety thermostat 139 with the supply conductor 40 to supplement the heat provided by the reverse cycle refrigeration. The current after flowing through the booster heater 147 flows through the thermal overload protector 80, the contact 82, the motor 84 and the contact 86 to the supply conductor 40 to provide the reverse cycle heating.

The booster heater 147 provides for quicker tripping of the thermal overload protector 80 during reverse cycle refrigeration for better protection under such conditions for the motor 84. The heat change-over switch 143 is preferably located in outdoor temperatures. It is preferably set to trip out of engagement with the contact 149 and is engaged with the contact 151 when the outdoor temperature falls below 45°F. This disconnects the compressor motor 84 thereby preventing frosting of the outdoor coil 26 and energizes the first electric heater 153 which is connected between the contact 151 and the temperature safety thermostat 159 which provides a connection to the supply conductor 40. Upon further lowering of the outdoor temperature, the stage thermostat 44 will close the switch 54 to energize also the second or auxiliary electric heater 62. This arrangement provides for 100% electric resistance heating whenever the refrigeration system is not sufficient in capacity. The electric heaters 153 and 62 are placed in the path of the circulation of the room air which also is passed into heat transfer relationship with the indoor coil 30. This simple control system is substantially less expensive than the systems previously used and provides satisfactory selection of heating and cooling.

While the embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. A reverse cycle refrigerating and control system including indoor and outdoor heat transfer units, a motor compressor unit, a reversing valve for changing the refrigerant connection between the motor compressor unit and the indoor and outdoor heat transfer units, flow control means for controlling refrigerant flow between said indoor and outdoor heat transfer units, a double throw thermostatic switch means having a movable contact terminal and two normally stationary stationary contact terminals, a solenoid for operating said reversing valve to reversing position, a supply conductor connected to the movable contact terminal of said thermostatic switch, a second supply conductor connected to said motor compressor unit, a first selector switch connecting one of the stationary contact terminals with said motor compressor unit, a second selector switch connecting another of said stationary terminals of said thermostatic switch means with the movable contact terminal of said changeover switch, a double throw heat changeover switch having a movable contact terminal and two normally stationary contact terminals, a second selector switch connecting another of said stationary contact terminals of said thermostatic switch means with the movable contact terminal of said changeover switch, a selector switch means connecting one of the stationary terminals of said changeover switch with said motor compressor unit, a third selector switch and conductor means connecting said solenoid with said first and second supply conductors, and an electric heater connected between a second stationary terminal of said changeover switch and said second supply conductor.

2. A system as defined in claim 1 in which a second thermostatic switch means and a second electric heater are connected in series with each other and in parallel circuit with said solenoid.

3. A system as defined in claim 1 in which a second thermostatic switch means and a second electric heater are connected in series with each other and in parallel circuit with said solenoid and said thermostatic switch means are provided with means for stage operation.

4. A system as defined in claim 1 in which fan means are provided for circulating air in heat transfer relation with said indoor unit, a fourth selector switch for controlling said fan means, and common operating means for operating the four selector switches.

5. A system as defined in claim 1 in which fan means are provided for circulating air in heat transfer relation with said indoor unit, and a relay having an operating coil connected in parallel electrical circuit with said solenoid and having contacts connecting said first supply conductor and said fan means.

References Cited

UNITED STATES PATENTS
2,672,734 3/1954 Dieter et al. 165-29
2,173,476 3/1965 McCready 165-29
3,261,395 7/1966 Foster et al. 165-29

ROBERT A. O'LEARY, Primary Examiner.
C. SUKALO, Assistant Examiner.