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2,654,227

ROOM COOLING AND HEATING SYSTEM

Filed Aug. 20, 1948

2 Sheets-Sheet 1

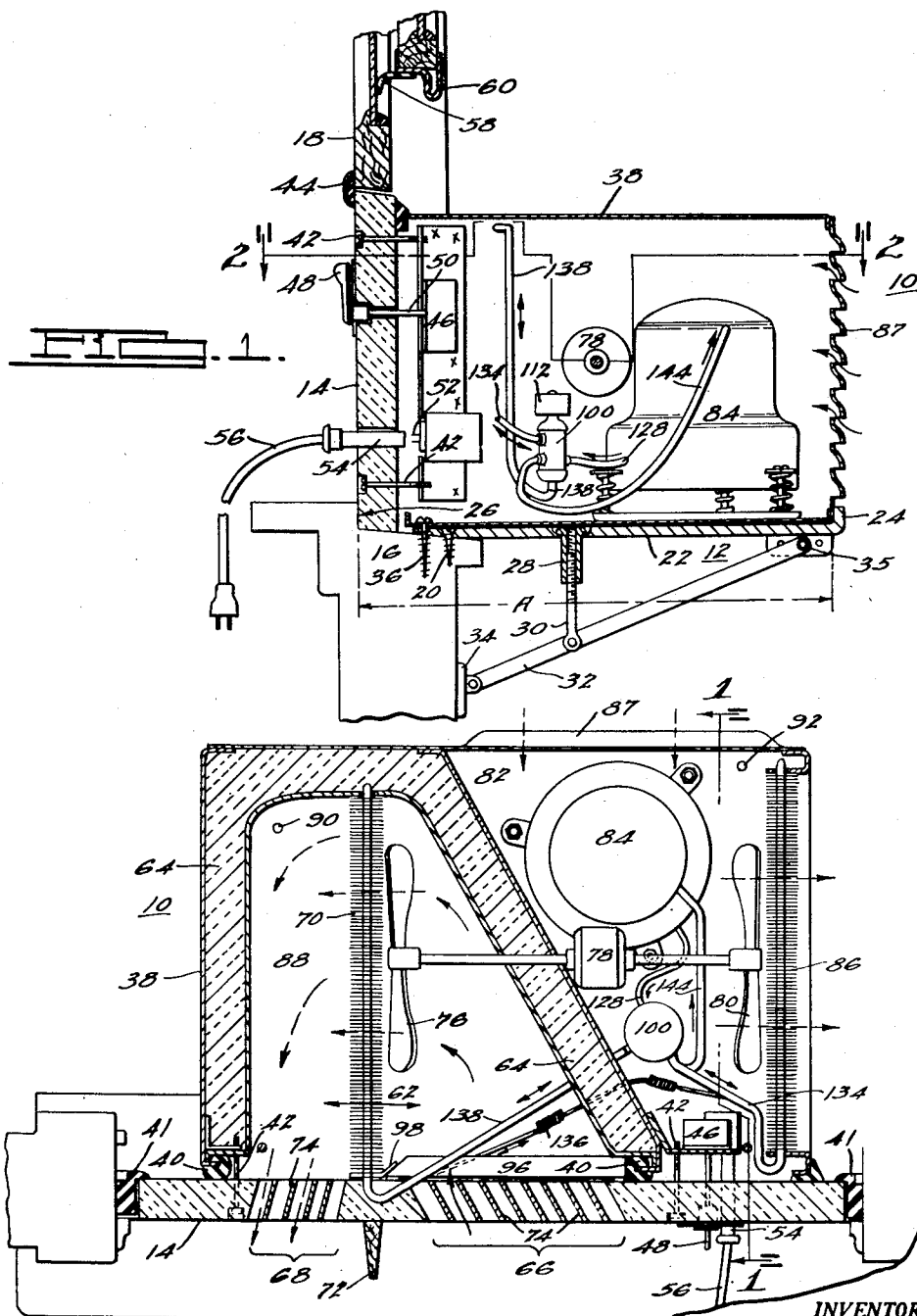


FIG. 2.

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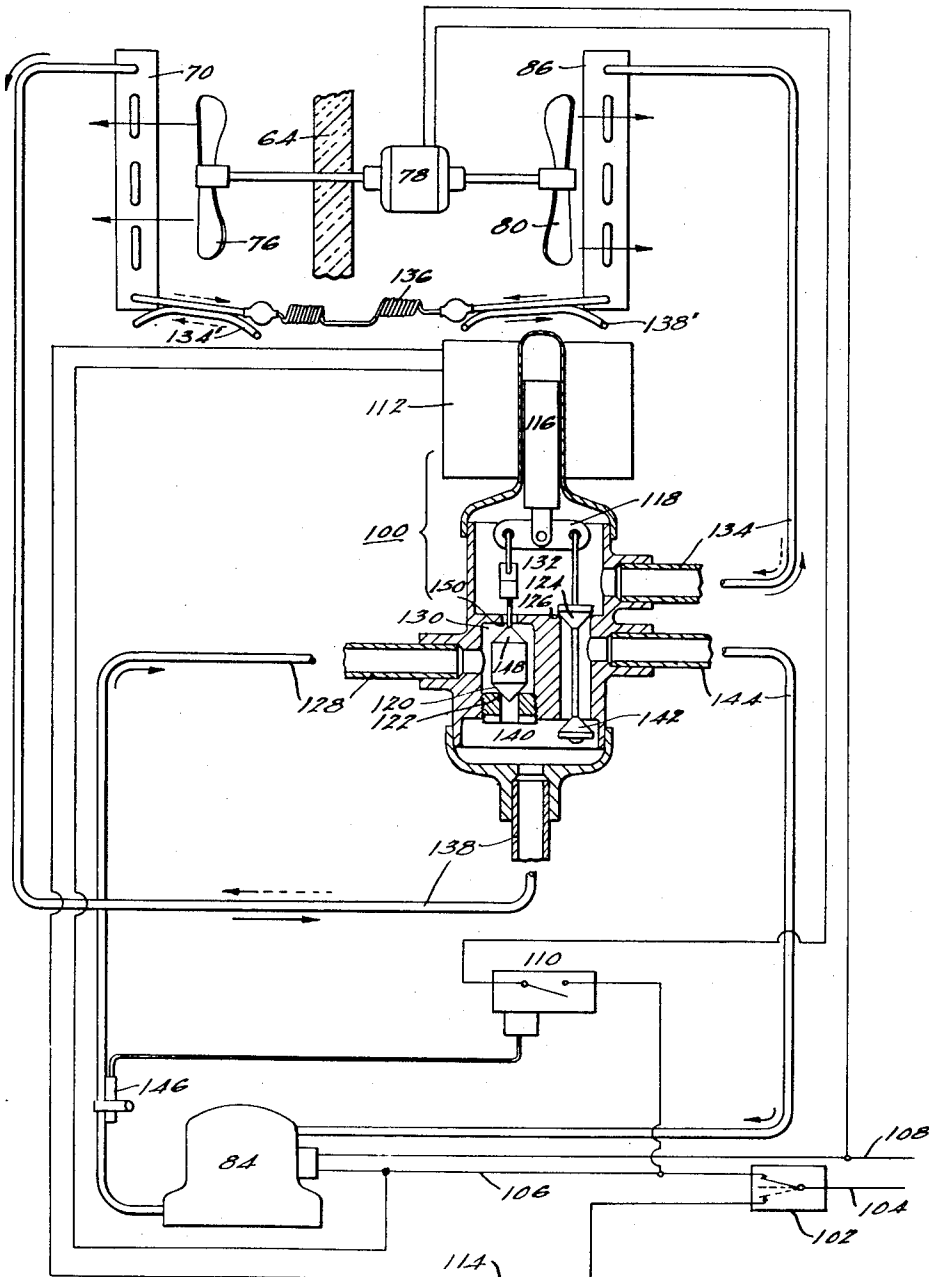


FIG. 3.

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UNITED STATES PATENT OFFICE

2,654,227

ROOM COOLING AND HEATING SYSTEM

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Application August 20, 1948, Serial No. 45,343

21 Claims. (Cl. 62—3)

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This invention has to do with air conditioning systems and particularly with window type room coolers using a reversible refrigerating system, preferably employing a vapor-lock restrictor or "capillary tube" as the refrigerant control device. The reversible use of such a restrictor is disclosed and claimed in my U. S. Patent No. 2,407,794, which issued September 17, 1946.

Among the objects of this invention are these:

To provide a simpler form of reversing valve for a refrigerating system.

To provide a reversing valve mechanism for a heat pump system enclosing the required several valves in one valve body.

To operate all of the valves with one solenoid or other type of motor.

To utilize condenser pressure in holding each of the valves closed when required.

To so locate a room cooler that it takes up none of the space in the room served and even leaves the inside window sill clear of obstruction.

To provide a starting switch for an auxiliary motor or motors responsive to a pressure or temperature condition, which results from the starting of the compressor.

To provide an improved and simplified valve mechanism for use in connection with a conventional compressor where it is desired to reverse or shift refrigerant flow for any of several purposes such as ice-making, selective heating or cooling, defrosting, or control of a multiple temperature system.

To combine several valves in one assembly, make them substantially leak proof by virtue of their self-closing feature, and insure against damage to the system which might result from failure of one valve to operate at the required time.

To house the working parts of the system in a casing designed to be located outside of the plane of the lower sash of a window, so that the window may be closed while the casing and the working parts remain in place outside of the window.

To provide a bracket or supporting device for attachment to the building outside of the window, such support being adjustable so that it is adaptable to various designs and dimensions of the building.

To provide a front for the cabinet which serves to close the window opening below the raised lower sash, such front being removable separately from the cabinet which contains the main working parts of the system.

To equip the cabinet with an air filter which

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is removable for cleaning or replacement without removing the cabinet from its operating position outside of the window.

To provide switch operating means on the room side of the removable front, said means being removably associated with a main switch mounted in the cabinet so that removal of the electrical cord, the switch dial and the front does not disturb the switch itself.

To utilize substantially the entire front of the cabinet for air inlet and outlet openings which lead from and to the room, these openings being associated with equivalent openings in the removable front and the whole so arranged that two streams of air are directed in a manner to minimize their interference with each other.

To provide for disposal of moisture to outside air from whichever heat exchanger is active as the evaporator, whether that heat exchanger be the one used to cool room air or the one through which outside air is circulated for the purpose of taking heat from it.

To provide a removable front having its two ends composed mainly of thermal insulating material and so constructed that they may be readily sawed off to the required horizontal dimension to fit the window, the sawed ends then being covered by a trim strip which also serves as a gasket or weather strip to insure a substantial air-tight fit with the window casing.

To supply a weather strip adapted to fit between the bottom of the upper sash and a mid-section of the lower sash when the lower sash is raised to the height required by the removable front.

To provide for heat exchange from warm liquid refrigerant to cold suction vapor effective during either cycle of refrigerant flow in a heat pump type of system.

To provide a window type air conditioner arranged to remain in place when the window is closed and to be theft-proof and tamper-proof from outside of the building.

To provide control means for selectively starting the system on either of its modes of operation to transfer heat in the desired direction.

To provide heat exchange as above so arranged that heat is taken from liquid refrigerant while it is still under high pressure.

The valve mechanism here shown is adapted for use in other types of systems and particularly one as shown in my copending U. S. patent application Serial Number 50,101, filed September 20, 1948, which application refers mainly to an automatic ice maker.

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The valve mechanism may be identical for the air conditioning system herein disclosed and the ice-making system disclosed in the above mentioned copending application but the latter employs a different arrangement of controls to provide a novel cyclic operation and to heat the inactive evaporator with the specific heat of liquid instead of with the latent heat of vapor. In other words the valve mechanism herein disclosed is adapted for use in both the reversible "heat-pump" type of system herein disclosed and the liquid defrost type of system used in the ice-maker of the copending application above mentioned, notwithstanding the fact that the two systems are distinct as to purpose and their method of control.

In the accompanying drawings, in which similar reference numbers refer to similar parts:

Figure 1 is a vertical sectional view taken on the line 1—1 of Fig. 2 and showing a room cooler assembly in place outside of a window, the lower sash of which has been raised to accommodate the front panel.

Figure 2 is a horizontal section taken on the line 2—2 of Figure 1.

Figure 3 is a diagrammatic view of the tubular and electrical connections of the system with the valve mechanism shown in enlarged section.

Referring now to Figure 1, it will be seen that the working parts of the system are contained in the assembly 10 which is removably supported by the bracket assembly 12 while the open side of the casing facing the room is engaged by the separately removable panel assembly 14 which fits between window sill 16 and the partly raised lower sash 18.

When installing this apparatus the adjustable bracket assembly 12 is first attached to the window sill by means of screws 20 passing through each of the two horizontal legs 22 which have up-turned outer ends 24 serving as stops for the unit assembly 10. The installer locates the horizontal members 22 so that the dimension A, which is predetermined, allows the required space for the main unit 10 and the front panel 14 between the stops 24 and the vertical ledge 26 of the window sill. The adjusting nut 28 is then turned to pull up on the rod 30 and thereby swing the strut 32 until its hinged pad 34 engages the outside surface of the building wall. This adjustment is so made that the horizontal member 22 is level. The head of this nut has a rounded top and a ball-and-socket seat in horizontal member 22 so that it can swing to the required angle. The pin 35 may, if necessary, be moved to one of the other holes shown in part 22 for a wider adjustment. The main unit assembly 10 is then slid into place thru the window from the inside. Bolts, clamps or screws 36 may be provided for securing the unit to its supporting bracket or to the window sill, but in any event it is held from horizontal movement.

With the unit thus positioned, the front panel 14 is inserted, first with its lower edge between the window sill ledge 26 and the unit 10, and then tilted into its vertical position so that it engages the casing 38 and the bottom of the upper sash. Gasket 40 on casing 38 provides against air leakage and is compressible enough to allow the front panel 14 to be tilted for insertion and removal.

This front panel is pierced by an opening or openings which match the open front of the unit 10 to provide an air inlet to the unit from the room and an air discharge opening from the

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unit to the room. The panel is otherwise mainly composed of thermal insulating material, preferably of a relatively substantial nature such as a composition board. This material is preferably such that it can be sawed off at one or both ends to the required horizontal dimension to fit the window, allowing for the gasket strips 41 which are used to make tight joints with the window casing, as shown in Figure 2. The front panel 14 may be secured to the unit casing 38 by means of screws 42, thus drawing its gasketed upper flange 44 firmly against the room side of the bottom edge of the lower sash of the window. The switch 46, forming part of the main unit assembly, is manually operable by means of the control lever 48 and the rod 50 which are inserted through the front panel after the panel has been properly located. The main unit assembly also includes a male electrical fitting 52 adapted to engage the long plug 54 which is secured to the electrical cord 56 and removably inserted thru a hole in the front panel. Plug 54 is shown partly withdrawn in Figure 1.

An additional provision for maintaining air tightness of the window after the lower sash has been raised is the gasket 58 of very flexible material such as a sheet of rubber. A channel or series of clips 60 secure it to the lower edge of the upper sash and if the window has vertical mullions the flexible strip 58 may be cut so as to fit around them and make good contact with the glass.

The arrangement of parts within the casing 38 is more readily seen in Figure 2. The left end of the casing comprises a chamber 62 which is surrounded on five sides by insulating material 64 and open at the front to the intake grille 66 and the discharge grille 68. The inlet and discharge portions of this insulated chamber are separated by the heat exchanger 70, which serves as an evaporator for the purpose of cooling the room and as a condenser for the purpose of heating the room. The two grilles may be separated by the vertically extending vane 72 for the purpose of separating the inlet and outlet air streams, but if desired this may be omitted, in which case it is desirable to have the grilles formed of angular vanes or deflectors 74 so that inlet air is drawn from the room mainly from one side and discharge air directed to the room mainly at the other side of the window.

Air is circulated thru the heat exchanger 70 by means of the fan 76 driven by the motor 78 which may have a second fan 80 on the opposite end of its shaft for the purpose of circulating outside air thru the space 82 which encloses the motor-compressor unit 84.

The heat exchanger 70 is preferably of the finned tube type with vertical fins on horizontal tubes. These tubes are usually joined by return bends and in order to confine air circulation to the finned portion of the coil it is proposed that the bare return bends fit into suitable recesses in the insulation 64 and in the front panel 14.

A second heat exchanger 86, which may be identical with the first heat exchanger 70, is arranged to form one of the boundaries of the space 82. Another side of the space 82 is bounded by the louvered portion 87 of the casing 38. The fan 80 circulates air through these louvers and through the heat exchanger 86. This circulation may be in either direction but is here indicated as flowing thru the louvers and then through the heat exchanger. While passing thru the chamber

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82 the outside air also aids in cooling the motor-compressor unit 84.

In the usual operation of this apparatus to cool the room, the heat exchanger 70 serves as an evaporator and the heat exchanger 86 serves as a condenser. Waste heat from the fan motor 78 and the motor-compressor unit 84 is thus dissipated to the outside air along with the heat given off by the condenser 86. During such operation there will normally be moisture deposited upon the heat exchanger 70 which is now serving as an evaporator and being cooled. This moisture drips from the fins of the evaporator or is blown therefrom by the fan 76 into the chamber 88 from which it is free to drip outside of the building through the small hole 90 passing through the insulated bottom wall of the chamber 88. This drip outlet may be provided with a trap to prevent flow of cooler air to the outside of the building or it may be equipped with a drain tube for the purpose of carrying the drip to a desired destination. The latter is not ordinarily necessary.

When the system is reversed, as will hereinafter be explained, the heat exchanger 70 serves as a condenser and the heat exchanger 86 serves as an evaporator. During such operation there may be moisture condensed on the heat exchanger 86. This moisture is either blown into outer air by the fan 80 or it drips to the bottom of the casing 38 which is not insulated in this area. A hole 92 is provided for escape of such drip water.

The air filter 96 is located just inside of the room air intake grills 66, where it bears against one end of the diagonal insulated wall and against an angular stop 98, being held in place by the removable front 14. This filter is removable for cleaning or replacement upon removal of the front 14. It is preferably held in firm contact with its inner stops, to minimize air leakage around it, and spaced slightly from the front 14 to allow distribution of air over it after passing through the grille 66.

Figure 3 shows the wiring and tubular connections which are partly omitted in Figures 1 and 2 because they would be hard to trace in those views. This figure also illustrates the valve assembly 100 on an enlarged scale relative to the balance of the figure. As shown the valve mechanism is in the position for cooling of the room with 70 acting as the evaporator and 86 acting as the condenser. The system is shown in the condition immediately after manual closing of the line switch 102 so that current is carried from the line 104 by the wire 106 to the motor 84 and returns to the opposite side of the line 108. It will be seen that this would also energize the motor 78 if it were not for the fact that switch 110 is open. This switch will soon close to start the motor 78 as hereinafter explained.

The solenoid 112 of the valve mechanism 100 is not energized since the conductor 114 is not connected with the line conductor 104. When the solenoid is not energized its armature 116 drops, its weight being supported by the equalizing member 118 which in turn rests upon the two valve members, holding the valve 120 against its seat 122 and the valve 124 against its seat 126. High pressure refrigerant vapor leaving the compressor through tube 128 enters the chamber 130 thus additionally urging the valve 120 against its seat. The high pressure vapor is free to flow into chamber 132 where it increases the pressure of valve 124 upon its seat. The high pressure vapor exits from the chamber 132 through the tube 134, which leads to the heat exchanger 86 in

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which the refrigerant is now condensed. As fast as liquid refrigerant collects in the bottom of 86 it is forced thru the vapor-lock restrictor tube 136 into the lower tube of the heat exchanger 70 in which the liquid is evaporated.

Low pressure refrigerant vapor flowing thru the tube 138 enters the chamber 140 and then flows past the open valve 142 to exit thru tube 144 which leads to the suction side of the compressor. It will be noted that this low pressure refrigerant vapor will not unseat valve 120 nor valve 124 against the higher vapor pressure which is holding them closed.

As soon as the compressor has started the tube 128 will rise in temperature due to the temperature of the compressed vapor flowing through it. As soon as evaporation starts in the heat exchanger 70, there will be cold vapor flowing thru the tube 138 to the valve assembly and thru the tube 144 to the suction side of the compressor.

Referring now to the fan switch 110 we trace the means by which it is closed thermostatically in response to a rise of temperature of its bulb 148. This bulb is clamped to the discharge tube 128 of the compressor 84 and the switch setting is such that it will be closed to start the motor 78 as soon as the discharge tube rises to a temperature enough higher than ambient to insure that the switch does not close when the system is idle. The switch closes in response to starting of the compressor either to cool the room or to heat the room as the hot discharge vapor always flows thru the tube 128. When the switch 102 is opened both motors stop and soon thereafter the switch 110 will open because of the bulb 148 falling nearer to ambient temperature.

Assuming now that it is desired to heat the room instead of cool it, the switch 102 is closed to connect the line 104 with the conductor 114 which leads to the solenoid 112. Current flows thru the solenoid in series with the motor 84 and as before the motor 78 will soon be started by the closing of the switch 110. It will be understood that the switch 102 may have an additional contact for connecting the solenoid 112 and the motor of 84 in parallel if it is desired to employ a solenoid winding with a higher resistance or to avoid putting any additional resistance in series with the compressor motor. Such an arrangement is seen in Fig. 4 of my copending application, Serial No. 50,101, filed September 20, 1948. It will also be understood that the switch 102 may be automatically operated by a room thermostat, outside thermostat or other suitable means.

Now that the compressor has been started with the solenoid 112 energized its armature 116 will be lifted, raising the valve members thru the medium of the equalizing bar 118. While the armature is still being urged upward the valve 148 engages its seat 150 and the valve 142 engages its seat. This shifts the path of refrigerant flow so that high pressure vapor entering the chamber 130 from the tube 128 now flows downwardly into the chamber 140 and out thru the tube 138 to the heat exchanger 70 which now acts as a condenser. Liquid refrigerant flows in the opposite direction to its previous flow thru the restrictor 136 and enters the heat exchanger 86 at the bottom. Refrigerant vapor leaving this heat exchanger flows thru the tube 134 to the chamber 132 of the valve mechanism. Due to the fact that valve 124 is open and valve 148 is closed, this suction vapor now flows past the valve 124 and into the suction tube 144 which leads back to the compressor. This path of flow for heating the room is indi-

cated by dotted arrows whereas the path of flow for cooling the room is indicated by solid arrows.

Figure 3 also illustrates diagrammatically a method of obtaining heat exchange between the cold suction vapor and the hot refrigerant liquid just prior to entering the restrictor 136 for either direction of flow. Tube 138' represents a section of tube 138 in heat exchange with liquid leaving the bottom of 86 when it is acting as the condenser. A section of tube 134 is represented by the numeral 134' which shows the location and direction of flow when 70 is acting as the condenser. While heat exchange between suction vapor and high pressure liquid may be employed for both the cooling and heating cycles it may be desired to employ it for the cooling cycle only since this will probably represent more hours of usage.

The valve mechanism here disclosed is an improvement over previous valve mechanisms used in the so-called "reverse cycle" or "heat pump" systems. It is also a simpler and lower-cost device than those shown in my issued Patents Nos. 2,145,773 and 2,145,774. In the air conditioning apparatus here shown it is not necessary to stop liquid flow prior to the shifting of the suction vapor connection because the heat exchanger just finishing its operation as a condenser will have a minimum of liquid in it and no harm to the compressor will result from the shift of the suction connection at the same instant that the high pressure valve operates, particularly when the compressor employed is in a sealed unit where suction vapor enters the casing before going to the inlet port of the compressor.

I claim:

1. In a refrigerating system, a compressor for circulating a volatile refrigerant through said system, a first heat exchanger which serves to dissipate heat, a second heat exchanger which serves to absorb heat, means for producing a change in the circulation of said refrigerant and thereby effecting an exchange of functions between said heat exchangers to cause the said first heat exchanger to absorb heat and the said second heat exchanger to dissipate heat, a motor for driving said compressor, an auxiliary device for circulating a heat exchange fluid associated with said system, a motor for driving said device, means for causing said compressor to circulate said refrigerant in either of the two manners above defined, and means responsive to the operation of said compressor while said heat exchangers operate in either of the two manners for starting the second said motor.

2. In a refrigerating system of the reversible type, a pair of heat exchange units including one which serves to dissipate heat and one which serves to pick up heat, a pressure imposing element adapted to circulate a volatile refrigerant through the system, means forming a pair of conduits each of which is connected with one of said heat exchange units, one of said conduits carrying warm high pressure refrigerant and the other carrying the low pressure vapor of said refrigerant, control means for reversing the operation of said system and thereby exchanging the functions of said heat exchangers and those of said conduits, an auxiliary motor associated with said system to operate a fluid circulating device, switch means for starting said motor, and temperature responsive means for actuating said switch, said temperature responsive means being actuated by a change of temperature related at one time to

one of said conduits and at another time to the other of said conduits.

3. A room cooler, a cabinet enclosing said cooler, a removable side of said cabinet, a control on said cooler enclosed by said cabinet adjacent said removable side, an electrical fitting on said cooler enclosed by said cabinet adjacent said removable side, and plug type connecting means for connecting said electrical fitting with an extension cord and said control with external means for manually operating it, said connecting means extending through said removable side when the cooler is assembled in operating condition.

4. In a refrigerating system, a pressure imposing element, a pair of heat exchangers connected in said system for series flow of refrigerant there-through, means connected in series between said heat exchangers for reducing the pressure of refrigerant flowing from either one to the other thereof, a unitary valve mechanism including a body member comprising four chambers of which a first one is in open communication with one of said heat exchangers, a second one with the other said heat exchanger, a third one with an inlet port of said pressure imposing element, and the fourth one with a high pressure refrigerant supply conduit, a port connecting the first chamber with the third, a port connecting the second chamber with the fourth, a port connecting the first chamber with the fourth, and a port connecting the second chamber with the third, and valve means arranged to close the first two said ports at one time and the second two said ports at another time, said valve means acting in each case to hold each port of the two closed with the aid of fluid pressure exerted on its valve from the higher pressure side thereof, and means for actuating all of said valve means simultaneously to open two and close the other two of said ports.

5. In a refrigerating system adapted to circulate a volatile refrigerant, a pressure imposing element arranged to move said refrigerant from the low side to the high side of said system, a pair of heat exchangers of which one serves as a high side part of said system to dissipate heat and the other a low side part of said system to absorb heat during one period of operation and which are adapted to exchange these functions during another period of operation, valve means operable to control said exchange of functions, said valve means being contained within a single gas-tight housing and including a pair of valves urged by the high-side pressure of said refrigerant in their closing directions and a pair of valves held open against the direction of flow of said refrigerant during each of said periods of operation, and means operable from outside of said housing for selectively starting said system with said heat exchangers operating in either manner.

6. In a refrigerating system of the reversible heat pump type, first and second conduits serving alternately to conduct high pressure liquid refrigerant therethrough under substantially the pressure at which it was condensed, third and fourth conduits serving alternately to conduct low pressure refrigerant vapor, and heat exchange means serving at one time to cool liquid in the first conduit by transfer of heat to vapor in the third conduit and at another time to cool liquid in the second conduit by transfer of heat to vapor in the fourth conduit.

7. In a room cooling and heating unit, double throw switch means for starting said unit, and valve means for shifting the operation of said unit

between cooling and heating cycles, one throw of said switch being arranged to energize both said unit and said valve means for one cycle of operation and the other throw being arranged to energize said unit only for the other cycle of operation.

8. In a reversible heat pump system, a pair of heat exchangers each serving alternately to absorb heat by evaporation of a refrigerant therein and to dissipate heat by condensation of refrigerant therein, restrictor of vapor-lock type arranged in series between said heat exchangers, a pair of refrigerant conduits connecting opposite ends of said restrictor with said heat exchangers, and a pair of conduits of which one is connected with one of said heat exchangers and the other of which is connected with the other of said heat exchangers, each of said last named conduits being connected on the side of said exchanger to which it is connected opposite from the connection of said exchanger with said restrictor, said first named pair of conduits being in heat exchange association with said last named pair of conduits whereby vapor in the one of said conduits that is serving as a suction conduit is heated by liquid flowing through the one of said conduits in which liquid is flowing to said restrictor.

9. In a control assembly for reversing the flow of a volatile refrigerant in a refrigerating system of the reversible heat transfer type, a housing structure adapted to be connected into such system, a pair of mechanically interconnected valves actuated by magnetic means of which all moving parts are entirely enclosed within said housing structure, each of said valves being adapted to be held closed by a refrigerant pressure difference between portions of said housing structure during operation of such system in one direction of heat transfer and held open by another pressure difference between portions of said housing structure during operation of such system in its reverse direction of heat transfer.

10. In a control valve assembly for reversing a heat pump system of the type having high and low pressure sides, a housing adapted to be connected into and form a part of such system, four valves in said housing and arranged to cause said refrigerant to reverse its flow in a part of such system, each of said valves when closed being urged in its closing direction by pressure of such high side, and valve actuating mechanism including a single motor for exerting a force independently of the pressure in said housing and having its moving parts sealed within said housing for actuating said valves in one direction to open two of them and close the other two, said mechanism further including means biasing said valves in the opposite direction.

11. In a control valve assembly for use in a refrigerating system charged with a volatile refrigerant, four valves arranged to cause said refrigerant to reverse its direction of flow through a portion of said system, electromagnetic means energizable independently of refrigerant pressure for moving said four valves to cause two of them to open and the other two to close, and linkage means for transmitting movement from said electromagnetic means to said valves, said linkage means acting to balance the force applied to said valves whereby when two of said valves are closed said closed two valves are definitely seated to close tightly.

12. In a reversing valve assembly for use in a refrigerating system of the reversible heat pump type employing a charge of volatile refrigerant, a housing adapted to be connected into and to

form a part of such system, two pairs of mechanically interconnected valves of which one pair is arranged to control the flow of said refrigerant from a high pressure portion of such system and the other pair is arranged to control the flow of said refrigerant to a low pressure portion of such system, a single motor operable to exert a force independently of forces exerted by fluid controlled thereby for operating all four valves, and mechanical means entirely enclosed within said housing for transmitting movement from said motor to said valves, said mechanical means being so constructed and arranged that one pair of said valves is moved in advance of the other pair of said valves.

13. In a reversing valve assembly for a refrigerating system having high and low pressure sections through which a volatile refrigerant is circulated, a chamber having a constantly open port through which it receives high pressure refrigerant, a pair of outlet ports for said chamber, a pair of valves within said chamber for closing said outlet ports one at a time, a pair of chambers of which each is connected with one of said outlet ports, a chamber having a constantly open outlet port for low pressure refrigerant, a pair of ports leading to the last said chamber, one from each of said pair of chambers, a pair of valves of which one is located in each of said pair of chambers and arranged to close at last said ports one at a time, and motor means controllable independently of fluid flow through said ports and having its moving parts sealed within one of said chambers and connected to transmit positive movement to all four of said valves whereby two of said valves are opened and the other two of said valves are closed to cause reversal of refrigerant flow in a portion of said system.

14. In a refrigerant flow reversing device for a refrigerating system charged with a volatile refrigerant, two pairs of valves, means mechanically connecting the two valves of each pair whereby the opening of one valve of a pair causes the other valve of that pair to move in its closing direction, a single electric motor for moving said pairs of valves to open one and close the other of each pair, and equalizing means between said motor and said valves whereby the valve which opens in response to the application of the lesser force opens first and the two valves moving in their closing direction will each complete its closing movement independently of the closing of other of said two valves.

15. In a reversible refrigerating system charged with an evaporative refrigerant, an evaporator, a condenser, a pressure imposing element having high and low pressure portions, refrigerant conveying means connecting said evaporator and said condenser, a high pressure chamber communicatively connected with said high pressure portion of said element and having two outlet ports closable one at a time by a pair of oppositely facing valves movable within said chamber, a low pressure chamber communicatively connected with said low pressure portion of said element and having two inlet ports closable one at a time by a pair of facing valves connected by a stem passing through said inlet ports, conduit means connecting a first pair of said ports with said condenser and a second pair of said ports with said evaporator, and means for moving all of said valves in one direction to open two and close the other two of said ports whereby said refrigerant is tempo-

rarily caused to condense in said evaporator and to evaporate in said condenser.

16. In a valve mechanism for use in a refrigerating system charged with a volatile refrigerant, a condensing unit having high and low pressure portions, a pair of heat exchangers, each exchanger being adapted to serve either as an evaporator or as a condenser, fluid flow means interconnecting said exchangers and interconnecting said exchangers with said unit and including means for modifying the flow of said refrigerant to cause said heat exchangers to reverse their functions, said means comprising two pairs of valves, one pair controlling flow of refrigerant from said unit high pressure portion and the other pair controlling flow of refrigerant to said unit low pressure portion, a single motor arranged to actuate both said pairs of valves, and a rocker for transmitting power from said motor to all of said valves whereby one pair of valves is started to move before the other pair and one valve is closed later than another.

17. In a refrigerating system of the reversible heat transfer type, means forming a closed circuit for circulation of a volatile refrigerant, a pair of mechanically interconnected valves actuated by means entirely enclosed within said circuit, each of said valves being held closed by a refrigerant pressure difference between portions of said circuit during operation of said system in one direction of heat transfer and held open by another pressure difference between portions of said circuit during operation of said system in its reverse direction of heat transfer.

18. In a refrigerating system charged with a volatile refrigerant, four valves arranged to cause said refrigerant to reverse its direction of flow through a portion of said system, electromagnetic means for moving said four valves to cause two of them to open and the other two to close, and linkage means for transmitting movement from said electromagnetic means to said valves, said linkage means further acting to balance the force applied to said valves whereby both of the valves being closed are definitely seated to close tightly.

19. In a refrigerating system having high and low pressure sections through which a volatile refrigerant is circulated, a chamber having a constantly open port through which it receives high pressure refrigerant, a pair of outlet ports for said chamber, a pair of valves within said chamber for closing said outlet ports one at a time, a pair of chambers of which each is connected with one of said outlet ports, a chamber having a constantly open outlet port for low pressure refrigerant, a pair of ports leading to the last said chamber, one from each of said pair of chambers, a pair of valves of which one is located in each of said pair of chambers and arranged to close the last said ports one at a

time, and motor means having its moving parts sealed within one of said chambers and connected to transmit positive movement to all four of said valves whereby two of said valves are opened and the other two of said valves are closed to cause reversal of refrigerant flow in a portion of said system.

20. In a refrigerating system charged with a volatile refrigerant, two pairs of valves for reversing refrigerant flow in a part of said system, means mechanically connecting the two valves of each pair whereby the opening of one valve of a pair causes the other valve of that pair to move in its closing direction, a single electric motor for moving said pairs of valves to open one and close the other of each pair, and equalizing means between said motor and said valves whereby the valve which opens in response to the application of the lesser force opens first and the two valves moving in their closing direction will each complete its closing movement independently of the closing of other of said two valves.

21. In a refrigerating system of the reversible heat pump type, two valves controlling flow of high pressure refrigerant, two valves controlling flow of low pressure refrigerant, and a single motor means for actuating all of said valves to effect reversal of operation of said system, said means being so constructed and arranged as to cause operation of a high pressure valve in advance of the operation of a low pressure valve.

GLENN MUFFLY.

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