March 10, 1964 W. LUKAS ETAL 3,123,986

COMBINED REFRIGERATOR, AIR CONDITIONER AND CONTROLS

Filed Nov. 28, 1962 2 Sheets-Sheet 1

FIG. 1

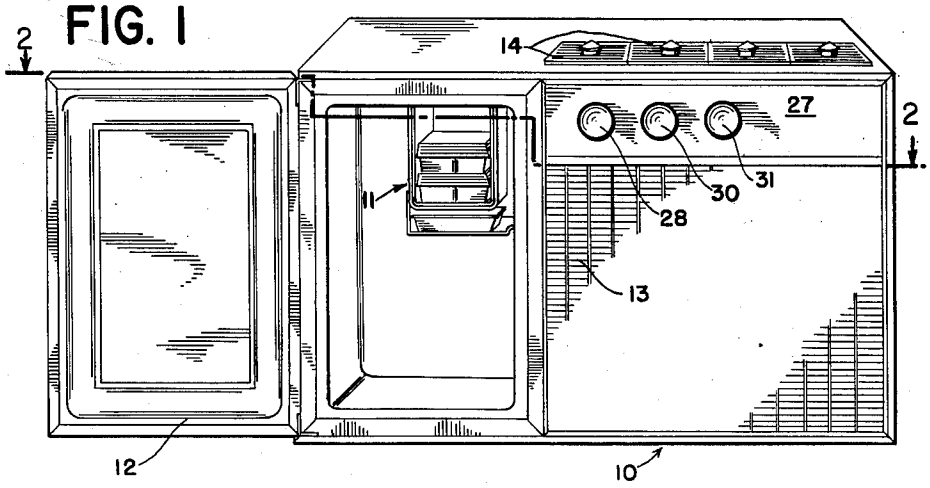
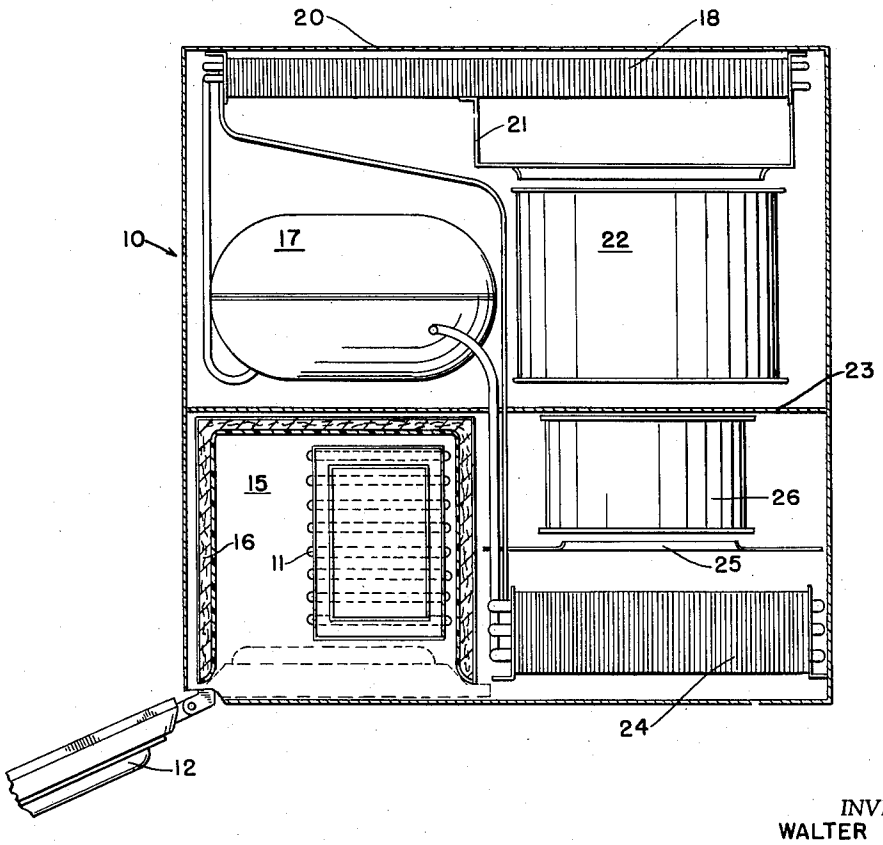


FIG. 2



INVENTORS
WALTER LUKAS
PAUL KOMROFF
ROBERT MILLER

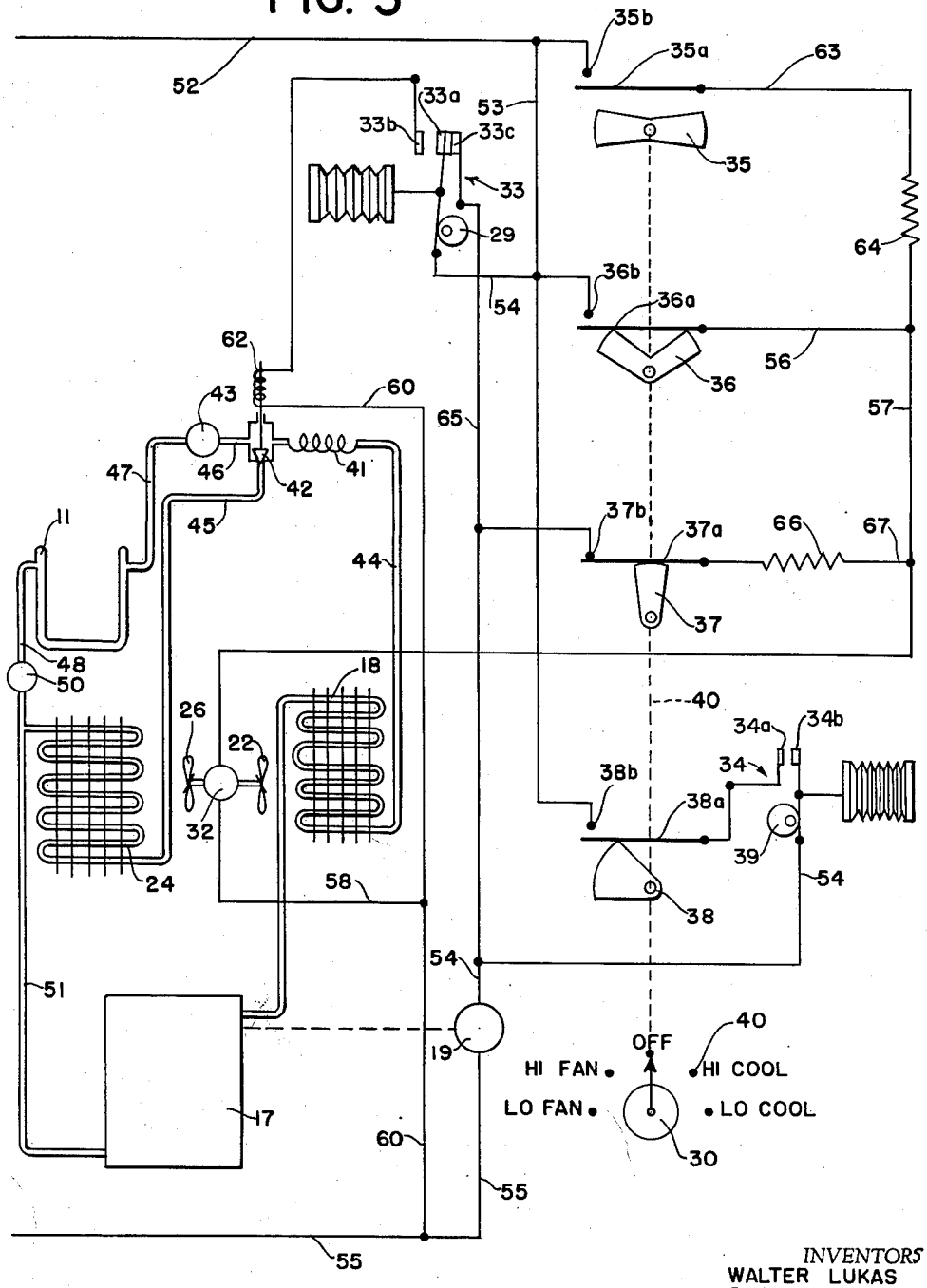
BY Darby & Darby
ATTORNEYS

March 10, 1964 W. LUKAS ETAL 3,123,986

COMBINED REFRIGERATOR, AIR CONDITIONER AND CONTROLS

Filed Nov. 28, 1962 2 Sheets-Sheet 2

FIG. 3



INVENTORS
WALTER LUKAS
PAUL KOMROFF
ROBERT MILLER

BY Darby & Darby
ATTORNEYS

United States Patent Office 3,123,986 Patented Mar. 10, 1964

3,123,986

COMBINED REFRIGERATOR, AIR CONDITIONER AND CONTROLS

Walter Lukas, Glen Rock, Paul Komroff, Union, and Robert Miller, Iselin, N.J., assignors to Emerson Radio & Phonograph Corporation, Jersey City, N.J., a corporation of New York

Filed Nov. 28, 1962, Ser. No. 240,581
12 Claims. (Cl. 62—181)

The present invention relates to a combined refrigerator and air conditioning unit and particularly to such a unit which is of the same general size and shape as window air conditioning units in common use at the present time.

More particularly still the invention relates to a combined refrigerator and air conditioner wherein a minimum of equipment has been added in order to provide for the cooling of the refrigerator box which is built into the air conditioning unit and to means for controlling the refrigerating mechanisms so that the refrigerator is the controlling unit and refrigerant directed thereto when its thermostat calls for a lower temperature, the air conditioning unit being secondary and going into operation only when the refrigerator has reached the desired and preset temperature.

As will be readily understood, it is frequently convenient to have a combined refrigerator and air conditioning unit as for example in an office where ice cubes are desirable for cooling of beverages, in a bedroom where it is convenient to refrigerate food, particularly infant's milk, which may be utilized during the night. At the present time no such units are available of reasonably small size and adapted to perform both of the functions stated above.

It is therefore an object of the present invention to provide a combined refrigerator and air conditioner of the type commonly designated as window units, it being understood that such units might be installed through a wall opening other than the window.

It is another object of the invention to provide such a combined refrigerator and air conditioner which is of substantially the same size as the air conditioning unit alone.

A still further object of the invention is to provide such a combination wherein a single compressor and condenser are utilized together with the usual air conditioner evaporator and an additional refrigerator evaporator.

It is a still further object of the invention to provide controls for the device whereby the air conditioner may be used separately as may be the refrigerator and to provide that when both the air conditioner and refrigerator are in operation the refrigerator will be dominant and will operate to achieve its preset desired temperature after which the air conditioning portion of the mechanism will become operative and will operate until the preset temperature condition in the room has been achieved, or until the refrigerator again calls for cooling.

Other objects and features of the invention will be apparent when the following description is considered in connection with the annexed drawings, in which,

FIGURE 1 is a front perspective view of the combined air conditioner and refrigerator of our invention, the door to the refrigerator compartment being shown open in order to indicate the position of the refrigerator evaporator;

FIGURE 2 is a horizontal cross-sectional view of the device of FIGURE 1, the view being taken on the plane of the line 2—2 of FIGURE 1. This view is somewhat schematic in that it does not show all of the details of mounting of components and the like; and

FIGURE 3 is a schematic wiring and piping diagram showing the connections between the various refrigerator mechanisms and showing also the electrical connections

for the control of the compressor, fan and certain valve arrangements.

Referring now to the drawings and particularly to FIGURE 1, it will be seen that the combined refrigerator and air conditioning unit comprises a housing **10** of the usual rectangular form and adapted to be placed in a wall opening such as a window with the forward portion thereof in the room and the rearward portion extending outwardly and into contact with the outer atmosphere.

A portion of the housing has been partitioned off in the present instance and made into a box lined with insulating material such for example as foamed urethane, the refrigerator evaporator **11** being placed in this compartment in the usual manner and the compartment being provided with a door **12** provided with the usual insulating lining and sealing gasket.

The remaining portion of the front of the unit is provided with a grille **13** through which air is drawn from the room, passed over the air conditioner evaporator and forced through the deflectors **14** positioned in the forward portion of the top of the housing **10**, the air circulation being produced by means of a fan or blower as will be described.

Referring now to FIGURE 2, the refrigerator compartment designated **15** is provided with insulating lining previously mentioned and designated **16**, the refrigerator evaporator **11** being mounted in this compartment and being formed in the usual manner in a U-shape suspended from the top of the compartment thus providing a low temperature compartment in which ice trays may be placed.

The compressor unit is designated **17** and is of the type wherein the driving motor and compressor are sealed within a single housing. Extending across the back of the entire unit is the condenser, this unit being placed behind the grille **20**. A box-like partition **21** extends the height of the condenser **18** and is so formed as to provide an air conduit to the blower **22** the output of which is then discharged through the left portion of the condenser **18**.

A partition wall **23** isolates the condenser **18** and its blower from the air conditioning evaporator **24** which is located at the front of the housing behind the grille **13**. A partition wall **25** is formed to provide an air inlet conduit to the blower **26** which thus draws air through the evaporator coil **24** and discharges it through the air deflectors **13**, see FIGURE 1.

Referring once again to FIGURE 1 there is provided above the grille **13** a control panel **27** having thereon control members **28**, **30** and **31**. Controls **28** and **31** are temperature setting devices for the control cam **29** of the refrigerator thermostat **33**, FIGURE 3, and for control cam **39** of the air conditioning thermostat **34**, FIGURE 3, respectively, while control **30** governs the switching of the electrical connections to determine the operation of the blowers **22** and **26** and of the compressor **17**. It will be understood that thermostats **33** and **34** are of the snap action type and that the cams **29** and **39** determine the pressure against the bellows operated contact arm and thus the setting of the thermostat.

Referring now to FIGURE 3, the condenser **18** is shown therein in a rather schematic form as is the refrigerator evaporator **11** and the air conditioning evaporator **24**. It will be noticed that the blowers **26** and **22** are mounted on a common shaft and driven by a single motor **32** which is not shown in FIGURE 2. Also the compressor **17** is shown with an exterior motor **19** in FIGURE 3 in order to simplify the wiring diagram, it being understood that as stated heretofore the compressor **17** and motor **19** may be in a single sealed unit.

The switching control **30** may take many forms but is shown in FIGURE 3 as having a plurality of cams designated **35**, **36**, **37** and **38** mounted on the common

shaft 40, the knob or control member 30 cooperating with a scale on the panel 27 in order to indicate the position of the switching members, this indication being given by a designation of the function performed in a particular switch position.

In the refrigerant circuit between condenser 18 and the refrigerator evaporator 11 and air conditioner evaporator 24 are placed a capillary coil 41, a solenoid operated valve 42 which determines whether refrigerant is to flow to the refrigerator evaporator or the air conditioner evaporator and a flow control device such as expansion valve 43 which is in the branch of the refrigerant circuit leading to the refrigerator evaporator 11. Thus the condenser is connected to the capillary coil 41 by means of pipe 44 and the capillary coil 41 is then connected directly to the solenoid valve 42. A pipe 45 connects one output port of the valve 42 to the evaporator 24 while another pipe 46 connects the second output from the valve 42 to the expansion valve 43. The expansion valve 43 is connected by pipe 47 to the refrigerator evaporator 11 which is in turn connected by means of pipe 48 to a check valve 50 and this valve by means of pipe 51 is connected to the input side of the compressor 17. The opposite end of the air conditioner evaporator is connected into the pipe 51, the refrigerant gas thus joining that from check valve 48 and being returned to the input side of the compressor 17.

The expansion valve 43 is adjusted so that it will open at a relatively low pressure corresponding to the low temperature which is required in the refrigerator compartment. The functioning of the expansion valve and of the check valve 50 will be made clear as the operation of the device is described for the various conditions of operations intended.

When the air conditioner is to be utilized alone the refrigerator thermostat 33 is adjusted by means of its control 28 and cam 29 so that the refrigerator cannot call for cooling, thus maintaining the movable contact 33*a* against contact 33*b*, and the control members 30 is set to one of its right hand positions designated high cool and low cool. The setting of this control to the high cool position will cause cam 38 to close contact arm 38*a* against contact 38*b*, will move contact arm 37*a* away from contact 37*b* and will close contact arm 36*a* on its contact 36*b* as well as maintaining contact arm 35*a* in its open position away from contact 35*b*. A circuit will then be completed from the A.C. power supply over conductor 52 and through conductor 53, contacts 38*b* and 38*a* to air conditioner thermostat 34 and, assuming that the air conditioner thermostat has been set to a temperature lower than the room temperature, through the thermostat contacts 34*a* and 34*b* and over conductor 54 to compressor motor 19 and to the other side 55 of the A.C. line. This will of course start the compressor in operation. At the same time a circuit will be completed from conductor 52 over contact 36*b* and contact arm 36*a* and over conductors 56 and 57, thence to the fan or blower motor 32 and through conductors 58 and 60 to the return line conductor 55. This will energize the fan motor causing it to run at its highest speed.

Also a circuit will be completed from conductor 53 over conductor 54, contact arm 33*a* and contact 33*b* of the refrigerator thermostat 33, conductor 61, the winding 62 of the solenoid which operates valve 42 and conductor 60 to the return line 55. This will energize the solenoid 62 and valve 42 will establish communication between the condenser 18 and the air conditioners evaporator 24. Under these conditions the unit operates as an ordinary air conditioning unit. The refrigerant is compressed by the compressor 17, condensed in the condenser 18 by virtue of the cool outside air flowing over the condenser, the flow of air being caused by operation of the fan 22 at high speed. The liquid refrigerant then flows through the capillary coil 41 and through the valve 42 to the evaporator 24. As usual the liquid is vaporized in the evaporator due to the absorption of heat therefrom resulting from the flow of warm room air over the evaporator coils, and the gas returned to the compressor 17.

When the control member 30 is moved to the extreme clockwise position providing for low cooling the conditions remain as set forth above except that cam 36 causes contact arm 36*a* to move away from contact 36*b* and cam 35 causes contact arm 35*a* to close against contact 35*b*. As a result of this the direct circuit from conductor 53 through conductors 56 and 57 to fan motor 32 is broken and a circuit is closed from conductor 52 through contact arm 35*a* and contact 35*b*, conductor 63 and resistor 64 to conductor 57 and thence to the fan motor. Since the resistor 64 is now in series with the motor 32 the fan operates at a lower speed but the conditions are otherwise the same and the compressor will continued in operation until the thermostat 34 operates due to the room air reaching the preset temperature at which time of course the compressor will stop, the fan, however, continuing in operation and the compressor starting and stopping to maintain the desired room temperature.

It will be understood that although the fan motor is shown as a simple motor with a series resistance to control its speed it might well be a motor having a tapped winding or other type of motor having a controllable speed.

A second situation is that in which the refrigerator is being utilized alone, the air conditioner operation not being desired. In this event the control member 30 is set to the off position and the refrigerator thermostat 33 adjusted to give a desired refrigerator temperature. The condition mentioned is that shown in FIGURE 3. As will be obvious under these circumstances solenoid 62 is deenergized and the compressor motor is energized over a circuit extending from conductor 53 through the contact arm 33*a* and contact 33*c* of thermostat 33 and thence over conductors 65 and 54 to the compressor motor 19. Also, a circuit is completed from conductor 65, now energized as explained above, and over contacts 37*b* and contact arm 37*a*, through resistor 66 and conductor 67 to conductor 57 and to the fan motor 32. Resistance 66 has a higher value than that of resistor 64 and consequently the fan motor now operates at an even lower speed than upon the low air conditioning setting. The refrigerant now circulates through the expansion valve 43, evaporator 11 and check valve 50, this operation continuing until the refrigerator compartment has reached the preset low temperature. At this time, of course, the contact arm 33*a* of thermostat 33 breaks from contact 33*c* and both the fan and compressor cease to operate. In addition, solenoid 62 is again energized connecting the capillary coil 41 with air conditioning evaporator 24 and this condition continues until the refrigerator compartment has increased in temperature and the thermostat 33 again operates to energize the compressor and fan.

A third condition is that in which both the refrigerator and the air conditioner are in operation. In this case the refrigerator thermostat 33 is set to call for cooling of the refrigerator and the control member 40 is positioned on either its high cool or low cool position. Due to the closure of thermostat contact arm 33*a* against its contact 33*c* the compressor motor 19 is energized over the circuit just above traced. At the same time, assuming the setting of control member at the high cool position, the fan 32 is caused to operate at its highest speed over a direct circuit from line conductor 53 through contact 36*b* and contact arm 36*a* which circuit has already been traced. As a result the refrigerator operates in the manner already described. The compressor 17 attempts to draw refrigerant into the suction side but cannot do so because the solenoid 62 is deenergized and the passageway to pipe 45 and evaporator 24 closed. As the compressor continues to run it creates a lower and lower pressure in the refrigerator evaporator, the check valve being then opened

because the spring pressure thereon is overcome by the suction.

Finally, at the preset spring pressure of the expansion valve **43** the valve opens establishing a flow of refrigerant into the evaporator **11** and thereby causing cooling of the refrigerator compartment. This operation continues until the refrigerator compartment reaches the predetermined and preset low temperature. At this time the moving contact **33***a* of thermostat **33** moves to its contact **33***b* and solenoid **62** is energized. Now refrigerant flows through the air conditioner evaporator **24** and the operation continues until the preset temperature called for by thermostat **34** is reached.

The check valve **50** closes during flow of refrigerant through the evaporator **24** and thus prevents condensation of gas in the refrigerator evaporator. Lacking this check valve, there would be a tendency for gas to pass back into the refrigerator evaporator **11** since this is the coldest element in the system and gas would therefore condense therein. The use of the check valve together with the expansion valve **43** on the opposite side of the evaporator **11** isolates the refrigerator evaporator and thus prevents short-cycling which would otherwise occur due to the condensation of the gas in the evaporator and the consequent warming of the refrigerator compartment.

The expansion valve **43** prevents the high pressure side of the compressor from "unloading" to the low pressure side through the refrigerator evaporator **11** and check valve **50** and the refrigeration system can unload only when the solenoid valve **42** is in the open position, that is, only when the solenoid **62** is energized. In order to assure that valve **42** will open the circuit is arranged so that whenever the compressor **17** stops the solenoid valve **42** is energized and thus assures that the pressures may be equalized through the low resistance path presented by the capillary tube **41** and the air conditioner evaporator **24**. This equalization of pressure may take two to three minutes after which the compressor is capable of restarting. It will be noted that if the compressor is operating during the air conditioning phase the solenoid valve remains open but that if the compressor is operating during the refrigeration phase then the solenoid **42** closes until the temperature in the box reaches that set on its controlling thermostat **33**.

It has been found that with this system when both the refrigerator and the air conditioner are operative as described just above, approximately 10% of the operating time is spent in cooling the refrigeration compartment, the remaining 90% being available for air conditioning operation. It will also be obvious from the above that by the addition of a minimum of equipment we have provided a compact combination air conditioner and refrigerator while at the same time assuring that there be no undesirable recycling and no lack of pressure equalization in the system to thereby render the compressor inoperative. Moreover, the usual air conditioner controls have been provided so that the air conditioning portion of the system may be operated separately from the refrigerator or together therewith in both instances being capable of operating with a high fan speed or a low fan speed and likewise under thermostatic control to maintain room temperature at the desired level.

In addition to these usual controls the control member **30** is so arranged as is obvious from FIGURE 3 as to make it possible to utilize the fan **26** for air circulation at either a high or low rate without air cooling and this may be done either while the refrigerator is operating or while it is idle.

While we have described a preferred embodiment of the invention, it will be understood that we wish to be limited not by the foregoing description, but solely by the claims granted to us.

What is claimed is:

1. In a combination refrigerator and air conditioner, a housing adapted to extend through an opening in an exterior building wall and providing a portion in communication with the atmosphere outside the building and having a refrigerator condenser therein, a portion in communication with the atmosphere inside of the building having an air conditioning evaporator therein, and a portion insulated from the inside and outside atmosphere forming a refrigerator compartment having a refrigerator evaporator therein, a refrigerant compressor in said housing, means interconnecting said compressor, condenser and said evaporators in a refrigerant circuit, said evaporators being in parallel relationship, a first thermostatic means responsive to a rise in temperature in said refrigerator compartment to energize said compressor and direct the flow of refrigerant from said compressor through said condenser to said refrigerator evaporator and to the inlet side of said compressor and a second thermostatic means responsive to the temperature of air entering said air conditioner housing for causing operation of said compressor and flow of refrigerant through said air conditioner evaporator when said first thermostatic means has responded to a decrease in temperature to direct refrigerant to said air conditioner evaporator branch.

2. In a combination refrigerator and air conditioner, a housing adapted to extend through an opening in an exterior building wall and providing a portion in communication with the atmosphere outside the building and having a refrigerator condenser therein, a portion in communication with the atmosphere inside of the building having an air conditioning evaporator therein, and a portion insulated from the inside and outside atmosphere forming a refrigerator compartment having a refrigerator evaporator therein, a refrigerant compressor in said housing, means interconnecting said compressor, condenser and said evaporators in a refrigerant circuit, said evaporators being in parallel relationship, valve means for preventing flow of refrigerant through said air conditioner evaporator, a first thermostatic means responsive to a rise in temperature in said refrigerator compartment to operate said compressor to circulate refrigerant through said refrigerator evaporator, means operated by said first thermostatic means upon a fall in temperature in said refrigerator compartment to a preset level to operate said valve to direct refrigerant to said air conditioner evaporator, and a second thermostatic means responsive to a rise in temperature in said air conditioner housing portion for starting and stopping said compressor as the temperature in said air conditioner housing portion rises and falls above and below preset levels.

3. The combination as claimed in claim 2 wherein said valve is a solenoid operated valve and said first thermostatic means is in an electrical circuit controlling said solenoid valve and said compressor and said second thermostatic means is in said circuit and controls said compressor when said first thermostatic means operates to deenergize said solenoid and permit flow of refrigerant through said air conditioner evaporator.

4. The combination as claimed in claim 3 wherein an expansion valve is positioned in said refrigerator evaporator branch refrigerant circuit between said solenoid valve and said refrigerator evaporator and a check valve is placed between said refrigerator evaporator and the junction between said air conditioner evaporator branch and said refrigerator evaporator branch on the compressor side of said evaporators, said check valve preventing flow of refrigerant in reverse direction to said refrigerator evaporator and said expansion valve remaining closed when said solenoid valve is energized.

5. The combination claimed in claim 2 wherein said air conditioner evaporator communicates with said refrigerant condenser through a restriction and wherein said valve means operates under control of said first thermostatic means to permit refrigerant flow through said restriction and said air conditioner evaporator to thereby assure equalization of pressure on the high and low pressure sides of said compressor and permit restarting there-

of after stopping under control of either said first or said second thermostatic means.

6. The combination as claimed in claim 2 wherein said first thermostatic means and said second thermostatic means are both manually adjustable to detemine the temperature in said refrigerator compartment and said air conditioner housing portion respectively.

7. The combination of claim 2 wherein a fan is provided for circulating air over said condenser and said compresser and a second fan is provided for circulating air over said air conditioning evaporator, said fans being driven by a common motor manually operable switch means for disabling said air conditioner, and means comprising a resistor in said fan motor circuit whereby said first thermostatic means causes operation of said fan motor at a reduced speed when said air conditioner is disabled and said solenoid valve is deenergized and refrigerant flows through said refrigerator evaporator.

8. The combination of claim 2 wherein manually operable switch means are provided for closing a circuit to said second thermostatic means to thereby render said compressor operative under control of said second thermostatic means.

9. The combination of claim 8 wherein manually operable switch means are provided, said switch means serving to close the circuit to said second thermostatic means to render said compressor operative under control thereof, said switch means also serving to energize said fan motor to operate at selected speeds greater than said reduced speed.

10. The combination of claim 8 wherein said second thermostatic means is ineffective to deactivate said compressor when said first thermostatic means operates in response to a temperature in said refrigerator compartment higher than a preset temperature.

11. The combination of claim 10 wherein said second thermostatic means is rendered effective to control said compressor when said manually operable switch is closed and said first thermostatic means is rendered inoperative by manually presetting it to a temperature higher than the temperature in the interior of said building.

12. In a combined refrigerator and air conditioner, a housing adapted to extend through an opening in a building exterior wall and providing a portion in communication with the outside atmosphere, said portion having a refrigerant compressor and a refrigerant condenser therein, a portion in communication with the inside atmosphere and having an air conditioning evaporator therein, and a portion normally insulated from both the inside and outside atmosphere forming a refrigerator compartment having a refrigerator evaporator therein, means interconnecting said compessor, condenser, air conditioner evaporator and refrigerator evaporator, said evaporators being connected in a parallel relationship between said condenser and said compressor, a first thermostatic means responsive to the temperature in said refrigerator compartment, a second thermostatic means responsive to temperature of air entering said air conditioner evaporator portion of said housing, and electrical circuit means for directing the flow of refrigerant to one or the other of said evaporators, said circuit means being controlled primarily by said refrigerator thermostatic means and secondarily by said air conditioner thermostatic means.

References Cited in the file of this patent

UNITED STATES PATENTS

2,133,949	Buchanan	Oct. 25, 1938
2,249,772	Maniscalco	July 22, 1941
2,778,197	Legeza	Jan. 22, 1957