

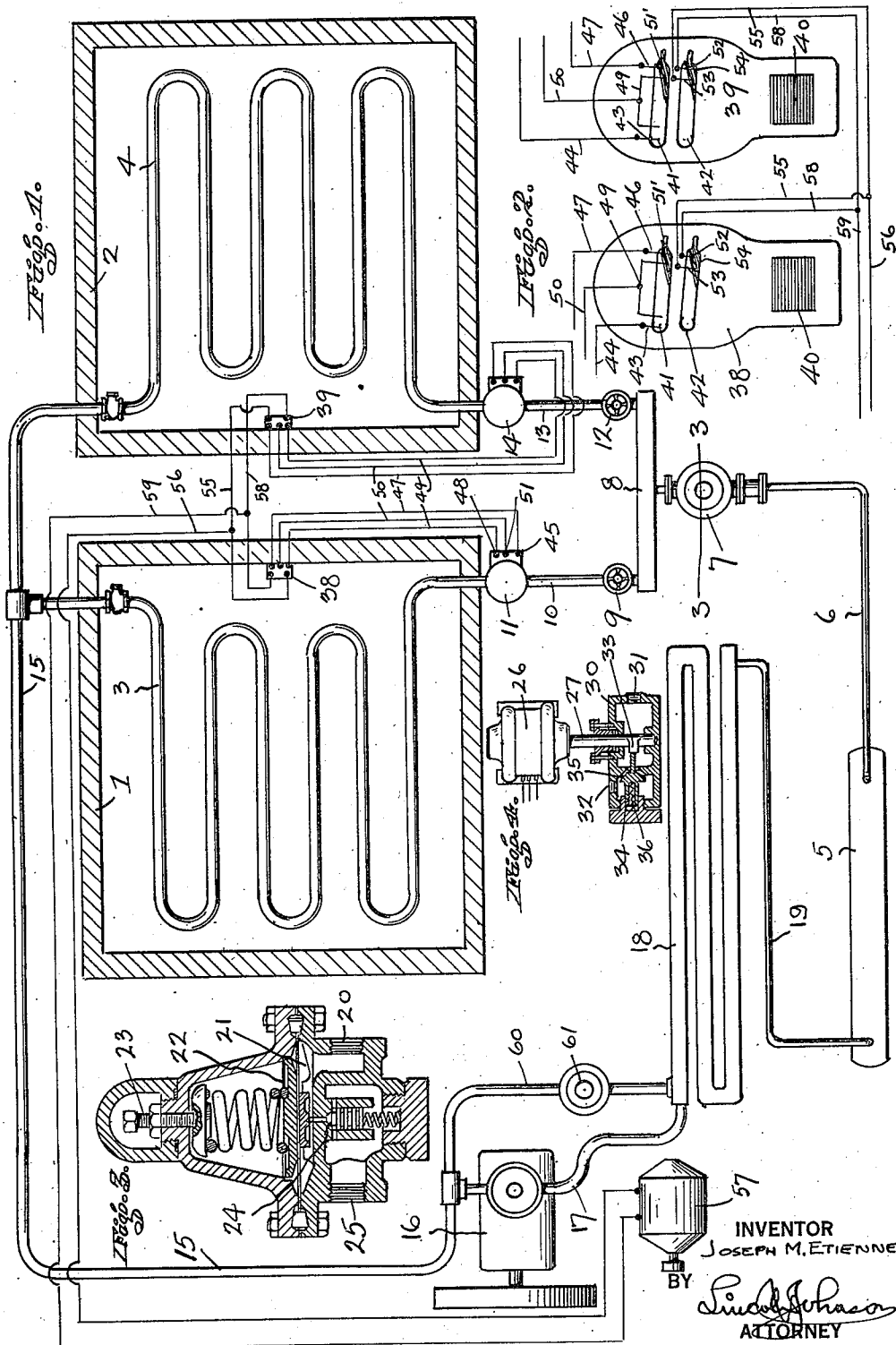
Nov. 12, 1929.

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1,735,498

REFRIGERATING APPARATUS

Filed Dec. 20, 1926



UNITED STATES PATENT OFFICE

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REFRIGERATING APPARATUS

Application filed December 20, 1926. Serial No. 156,015.

This invention relates particularly to an automatically operated refrigerating apparatus.

An object of the invention is to provide a refrigerating apparatus capable of maintaining a predetermined temperature in one or more independent compartments or cooling rooms.

A further object of the invention is to provide a refrigerating apparatus having a plurality of independent compartments to be cooled, each compartment being provided with a thermostat therein to cause the temperature in each compartment to be maintained at a selected temperature and having the thermostats in all the compartments related so that a lowering of the temperature in all of the compartments will cause the apparatus to stop functioning until such time as the temperature in one or more of the compartments rises above the selected low temperature when the apparatus automatically resumes operation.

A further object of the invention relates to a refrigerating apparatus of a conventional character, in which a predetermined supply of refrigerant to the rooms to be cooled is controlled automatically by temperature responsive devices in each of the rooms, the said refrigerant being circulated through the cooling coils by a compressor which may be started and stopped in operation by said temperature responsive devices, provision being made in my apparatus to supply ammonia gas or refrigerant to the compressor when the volume of refrigerant being circulated through the rooms to be cooled is less than the predetermined supply.

A still further object of the invention is to provide, in combination with the refrigerant compressor of a refrigerating apparatus that is adapted to have a predetermined pressure of refrigerant therein, a conduit to supply refrigerant to the compressor automatically and at such times when the pressure of the refrigerant in the apparatus drops below or is less than the predetermined pressure.

In this specification and the annexed drawings, the invention is illustrated in the

form considered to be the best, but it is to be understood that the invention is not limited to such form, because it may be embodied in other forms, and it is also to be understood that in and by the claims following the description, it is desired to cover the invention in whatsoever form it may be embodied.

Other objects of the invention are to provide a refrigerating apparatus that will be superior in point of simplicity, inexpensiveness of construction, positiveness of operation and facility and convenience in use and general efficiency.

In the accompanying one sheet of drawings

Fig. 1 represents a diagrammatic plan view of a refrigerating apparatus constructed in accordance with my invention.

Fig. 2 is a front elevation of a pair of temperature responsive devices connected together electrically.

Fig. 3 is an enlarged vertical section taken through an automatic expansion valve shown at 3—3 in Fig. 1.

Fig. 4 is an elevation and section of a magnetic or motor operated valve.

In detail, the construction illustrated in the drawings comprises a plurality of compartments or cooling rooms 1 and 2, each having a coil of pipes 3 and 4, respectively, arranged therein. Each of the coils in the compartments to be cooled are expansion coils in which the liquid refrigerant under pressure may expand and perform the cooling functions expected of it. Although I have shown but two compartments to be cooled, I wish it to be understood that my invention may be applied equally well to an apparatus including a greater number of compartments to be cooled.

The refrigerant used in my system, preferably anhydrous ammonia, is stored in a receiver 5 in liquid form, from which it is passed, through a conduit 6, into an automatic expansion valve 7. The refrigerant held in the receiver 5 is under pressure and the expansion valve causes the pressure of the refrigerant to be reduced at the time it is discharged into a distributing drum 8. The

low pressure refrigerant is distributed from the drum 8 through a set hand valve 9 to a conduit 10 which communicates through a motor operated or magnetic valve 11 with the expansion coil 3 in the compartment 1. A similar set hand valve 12 on the drum 8 is connected by a conduit 13 to a motor operated or magnetic valve 14 on the expansion coil 4 in the compartment 2. The refrigerant admitted into the expansion coils 3 and 4 is discharged therefrom into a return conduit 15 or suction line that is connected to a refrigerant compressor 16. The compressor 16 draws the expanded refrigerant from the suction line 15, compresses the refrigerant and discharges it through a discharge line 17 into a condenser 18. From the condenser 18 the compressed refrigerant passes through a conduit 19, in a liquid form, back into the receiver 5. The system and apparatus thus far described is more or less conventional, to many of the refrigerating apparatuses now in use.

The automatic expansion valve 7, as shown in detail in Fig. 3, is a standard type of automatic valve. In this valve the refrigerant is admitted through an inlet port 25, then it passes through a valve 24, controlled by a diaphragm 22. The spring tension of the diaphragm is regulated by a set screw 23. From the valve 24 the refrigerant passes into a chamber 21, and under reduced pressure is discharged out of the port 21. The expansion valve 7 can be regulated to reduce the pressure of the refrigerant to any desired pressure.

The condenser 18, receiver 5 and other operative connections leading from the compressor 16 to the expanding valve 7 constitute the high pressure side of the refrigerant circuit. The coils 3 and their operative connections leading to the compressor intake constitute the low pressure side of the refrigerant circuit.

Each of the motor operated or magnetic valves 11 and 14 consist of a motor 26 having an armature shaft 27 thereon that extends within a casing 30 having the inlet ports 31 and 32, respectively, formed therein. The motor shaft 27 is provided with an eccentric 33 thereon. The eccentric 33 is adapted to displace a valve 34, mounted within the casing 30 from its valve seat 35, the valve 34 being yieldably pressed by a spring 36 against the valve seat, thus tending to hold said valve closed. The valve 34 is thus opened or closed by the eccentric on the motor shaft, depending upon the position of the temperature responsive devices, to be hereinafter described.

In the compartment 1, I have provided a thermostat or other equivalent temperature responsive device 38 and a similar thermostat 39 in the compartment 2. The thermostats are shown in enlarged form in Fig. 2. The thermostats are of a conventional type

and each consists of a stack of diaphragms or wafers 40 that will expand or contract when influenced by variations in temperature. The diaphragms 40 operate a mechanism (not shown) which actuates a pair of bulbs 41 and 42, each of which contain a quantity of mercury 51'. Each of the bulbs 41 and 42 are pivoted centrally between their ends so that each may be tipped with either of the opposite ends thereof in a downward position, to cause the quantity of mercury contained in each bulb to run from the high end to the low end thereof. The bulb 41 is provided with a contact 43 therein connected by a wire 44 to a terminal 45 on one of the motor operated or magnetic valves 11 and 14. The connections between each thermostat and each magnetic or motor valve being the same, only one of the connections will be described, as it will apply equally well to the other. The opposite end of the bulb 41 has a contact 46 therein connected by a wire 47 to a terminal 48 on one of the motor operated valves 11 or 14. A dual contact 49 is arranged adjacent each of the opposite ends of the bulb 41 and is connected by a wire 50 to a terminal 51 on one of the motor operated valves 11 or 14. Electrical energy is supplied to the wire 50 and through it carried to the dual contact 49. When the bulb 41 is in the position shown in Fig. 2, said bulb is so tipped that the mercury 51' therein will connect one of the contacts 49 with the contact 46 to pass the electrical energy through the wire 49 to the motor operated valve to cause said motor to rotate in a forward direction. When the bulb 41 is tipped into the opposite position the mercury 51' will connect the other contact 49 with the contact 43, and through it the electrical energy will be carried to the motor to cause said motor to rotate in a reverse direction. As heretofore described the tipping of the bulb 41 is actuated and controlled by the stack of diaphragms 40 in each thermostat. Thus, the supply of refrigerant from the low pressure drum 8 into the respective expansion coils 3 and 4, is passed through the motor operated or magnetic valves 11 and 14 and said valves are in turn automatically operated by the temperature responsive devices 38 and 39 in each compartment to be cooled.

Each thermostat is also provided with a second bulb 42 having a pair of contacts 52 and 53 at one end thereof, which are adapted to be connected by mercury 54 when the bulb 42 is tipped into the position shown in Fig. 2. The contact 52 is connected by a wire 55 to a line 56 that leads to one side of the motor 57 for operating the compressor 16. The other contact 53 is connected by a wire 58 to a line 59 that is also connected to the compressor motor 57. Each of the thermostats 38 and 39 are connected in parallel to the lines that supply electrical energy to the motor. Thus the bulb 42 in one thermostat may tip

so as to disconnect one thermostat from the compressor motor, but the compressor motor will continue to operate so long as the contact connecting the source of electrical energy to the said motor is not broken by the other thermostat. If the temperature in one of the compartments drops below a selected low minimum temperature, the thermostat in that compartment will tip causing the motor operated or magnetic valve to close, preventing more refrigerant from entering the expansion coil. The same action of the thermostat will also break the connection to the compressor motor, but the thermostats in all compartments being connected in parallel, the compressor motor will not stop until all thermostats have tipped into the inoperative position.

As the thermostat in each compartment causes the valves controlling the refrigerant supply to the expansion coils to be cut off, the refrigerant compressor 16 has less work to do, and being of a fixed capacity, will, in a short time, possibly create a vacuum in the suction line connected to the expansion coils.

It is an object of my invention to keep the compressor 16 in operation just as long as any one of the expansion coils in any one of the compartments is receiving refrigerant from the source of supply. I eliminate continued starting and stopping of the compressor, as the source of refrigerant supply is connected or disconnected to each cooling compartment. The connections that I have made, heretofore, are such that so long as one cooling compartment remains in operation, the compressor will also remain in operation, to circulate refrigerant therethrough. When only one of the expansion coils is drawing refrigerant from the source of supply, the capacity of the compressor is such that it will in a short time create a pressure in the said expansion coil below the predetermined pressure. In order to keep the pressure of the refrigerant in the coil or coils above the predetermined pressure and to overcome the possible pumping of a vacuum in the suction line, I connect a conduit 60 to the top side of the condenser 18 or to any other source of refrigerant supply, and to the suction line 15. A regulating valve 61 is provided in the by-pass line 60, to regulate the amount of refrigerant to be by-passed from the condenser 18 or other source of supply back into the suction line. The valve 61 can be adjusted to maintain any desired pressure on the suction line to prevent the system from operating with a vacuum or a pressure lower than the predetermined pressure in the suction line. The by-pass conduit 60 supplies refrigerant or gas to the suction line leading to the compressor, giving the compressor work to do (and prolonging the period of operation of the compressor which would otherwise be materially shortened if the compressor were

allowed to stop operating when receiving a sub-normal supply of refrigerant from any single expansion coil remaining in operation), and keeping a partial supply of refrigerant in the expansion coils and suction line. Just as soon as any last operating expansion coil has its supply of refrigerant cut off from the source of supply, then the compressor will be stopped from operating and the entire system will remain at a standstill. The compressor will only be stopped from operating when the temperature in all of the compartments drops below a selected minimum low temperature. When the temperature in any single compartment rises above the low minimum, the compressor is again started in operation and the entire system made operative.

In order to prevent "hot" gas or refrigerant flowing from the condenser and back through the by-pass 60 and suction line 15 to the cooling coils 3 and 4 to heat or defrost said coils, I provide check valves 70 and 71, respectively, on the coils 3 and 4. The check valves permit refrigerant to go toward the compressor but not from the compressor into the coils.

Having thus described this invention, what I now claim and desire to secure by Letters Patent is:

1. A refrigerating apparatus comprised of a plurality of compartments to be cooled; a coil in each compartment; a refrigerant compressor; a high pressure refrigerant line leading from the compressor to each compartment coil to circulate refrigerant thereto; a low pressure refrigerant line leading from each compartment coil to the compressor to return refrigerant thereto; a temperature responsive device in each compartment; means operable by each temperature responsive device to automatically regulate the volume of refrigerant that passes from the high pressure line into each coil to maintain the temperature in the respective compartments above a selected minimum temperature and to connect or disconnect the individual compartment coils to the high pressure line as the temperature in the different compartments rises or falls below the selected low temperature; and means operable by each temperature responsive device to stop the compressor motor when the temperature in all compartments falls below the selected temperature, a by-pass connecting discharge and intake sides of the compressor; and means in said by-pass responsive to the pressure on the discharge side of the compressor for permitting the passage of refrigerant from the discharge side of the compressor to the intake side thereof, to maintain the volume of refrigerant to the compressor substantially constant.

2. A refrigerating apparatus comprising a compressor, condenser, evaporator and expansion valve connected to form a closed sys-

tem, a by-pass connecting the discharge and intake sides of the compressor, and means in said by-pass responsive to the pressure on the low side of the system for permitting the passage of gas from the discharge side of the compressor to the intake side thereof to maintain the volume of gas to the compressor substantially constant.

3. A refrigerating apparatus comprising a compressor; a condenser; a plurality of evaporator coils; and an expansion valve connected to form a closed system, the evaporator coils being disposed in a plurality of compartments to be cooled; a temperature responsive device in each compartment to automatically disconnect the refrigerant supply from the respective evaporator coils; a by-pass connecting the discharge and intake sides of the compressor; and means in said by-pass responsive to the pressure on the low side of the system for permitting the passage of refrigerant from the discharge side of the compressor to the intake side thereof, to maintain the volume of refrigerant to the compressor substantially constant.

4. A refrigerating apparatus comprising a compressor; a condenser; a plurality of evaporator coils; and an expansion valve connected to form a closed system, the evaporator coils being disposed in different compartments to be cooled; an electrically operated valve between each evaporator coil and the expansion valve; a thermostat in each compartment connected to a source of electricity for automatically actuating the corresponding electrically operated valve in accordance with the temperature in the compartment; a by-pass connecting the discharge and intake sides of the compressor; and means in said by-pass responsive to the pressure on the low side of the system for permitting the passage of refrigerant from the discharge side of the compressor to the intake side thereof, to maintain the volume of refrigerant to the compressor substantially constant.

5. A refrigerating apparatus comprising a compressor; a condenser; a plurality of evaporator coils, and an expansion valve connected to form a closed system, the evaporator coils being disposed in a plurality of compartments to be cooled; a temperature responsive device in each compartment to automatically disconnect the refrigerant supply from the respective evaporator coils; a by-pass connecting the discharge and intake sides of the compressor; means in said by-pass responsive to the pressure on the low side of the system for permitting the passage of refrigerant from the discharge side of the compressor to the intake side thereof, to maintain the volume of refrigerant to the compressor substantially constant; and means operable by each temperature responsive device to render the compressor inactive

when the temperature in all the compartments reaches a selected degree.

6. A refrigerating apparatus comprising a compressor; a condenser, a plurality of evaporator coils, and an expansion valve connected to form a closed system, the evaporator coils being disposed in different compartments to be cooled; an electrically operated valve between each evaporator coil and the expansion valve; a thermostat in each compartment connected to a source of electricity for automatically actuating the corresponding electrically operated valve in accordance with the temperature in the compartment; a by-pass connecting the discharge and intake sides of the compressor; means in said by-pass responsive to the pressure on the low side of the system for permitting the passage of refrigerant from the discharge side of the compressor to the intake side thereof, to maintain the volume of refrigerant to the compressor substantially constant; and means operable by each temperature responsive device to render the compressor inactive when the temperature in all the compartments reaches a selected degree.

7. A refrigerating apparatus comprising an electric motor driven compressor, a condenser connected to the discharge side of the compressor, an expansion valve connected to the condenser, a plurality of evaporator coils connected to the expansion valve, and to the intake side of the compressor; an electrically actuated valve connected between the expansion valve and each coil for controlling the supply of refrigerant to the respective coil; temperature responsive means in the compartments cooled by said coils, and connected to a source of electricity and to said electrically actuated valves for disconnecting the supply of refrigerant to a coil when the temperature in the compartment around the coil reached a certain low temperature; each of said temperature responsive means being so connected to the said electric motor as to render said motor inactive when the temperature in all the compartments falls below a selected degree; a by-pass connecting the intake and discharge sides of the compressor; and means in said by-pass responsive to the pressure on the intake side of the compressor for permitting passage of refrigerant from the discharge side of the compressor to the intake side thereof, to maintain the volume of refrigerant to the compressor substantially constant.

In testimony whereof, I have hereunto set my hand at San Francisco, California, this 30th day of October, 1926.

JOSEPH M. ETIENNE.