

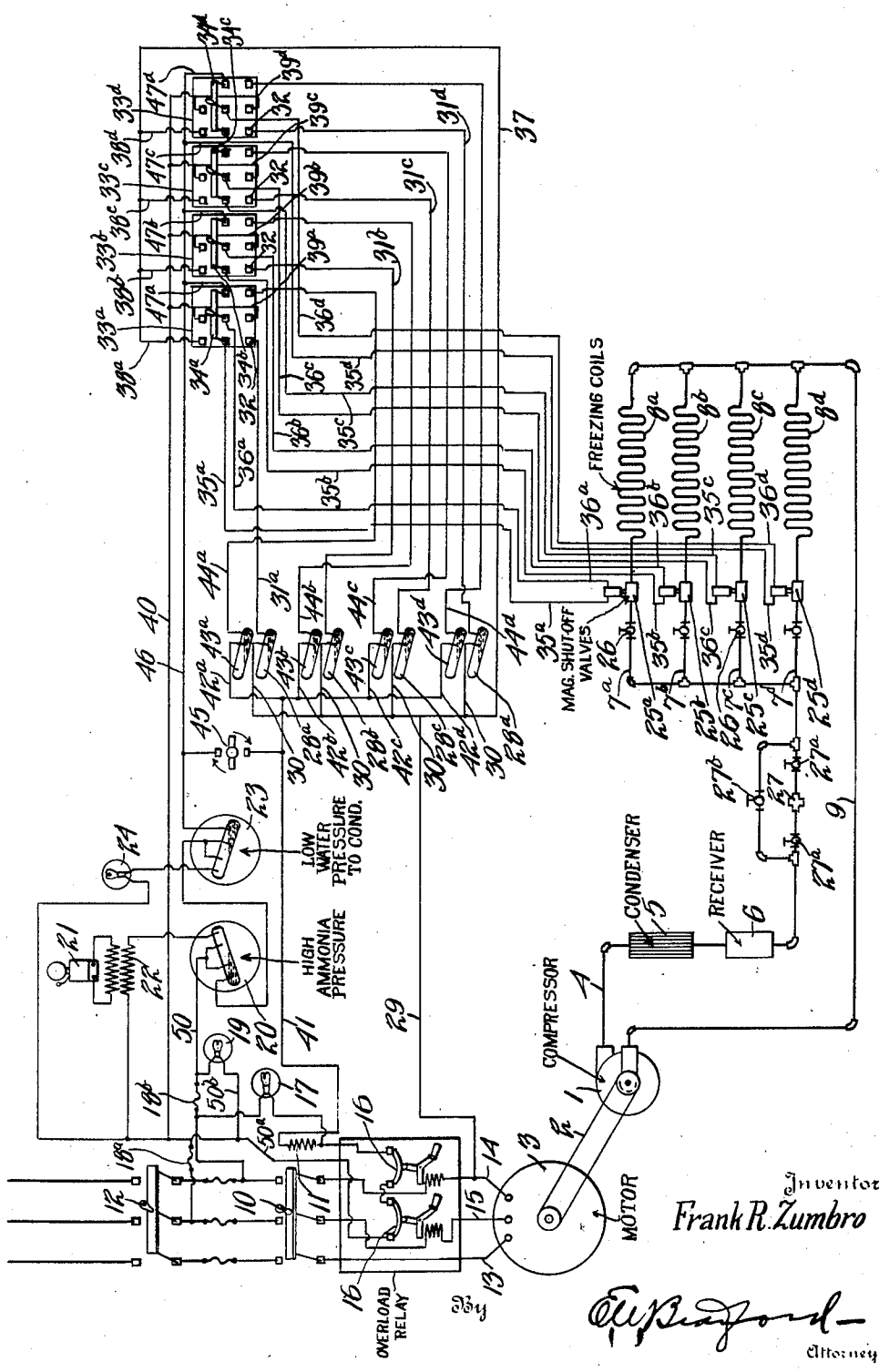
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REFRIGERATING SYSTEM WITH AUTOMATIC CONTROL

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REFRIGERATING SYSTEM WITH AUTOMATIC CONTROL.

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My said invention relates to a refrigerating system with automatic controlling means, preferably electrically operated, whereby the temperature in any number of rooms in a direct expansion system may be controlled individually. It is an object of the invention to provide means in such a system whereby the entire system may be controlled automatically, or part may be under automatic control and another part under manual control or the whole may be manually controlled.

A further object is to provide signalling means for indicating the condition of the system.

Still another object is to provide a manually-operated valve auxiliary to the automatic pressure-controlled valve.

Referring to the accompanying drawings which are made a part hereof and on which similar reference characters indicate similar parts,

The figure is a diagrammatic plan view of an embodiment of the system.

In the drawing reference character 1 indicates a compressor driven by a belt 2 from a three-phase motor 3. The compressor forms part of an ammonia circuit including a pipe 4 leading to the condenser 5 and a receiver 6. This pipe is provided with branches 7^a, 7^b, 7^c and 7^d leading to freezing coils 8^a, 8^b, 8^c and 8^d. The ammonia or other refrigerant is returned from these freezing coils to the compressor by means of a return pipe 9.

The coil 11 is a part of an automatic starter for the main motor 3 and is arranged to close a magnetically-operated switch 10 whenever the coil is energized thereby closing the motor circuit through lines 13, 14 and 15 and opening the switch when it is de-energized thus breaking the circuit and stopping the motor.

A manually-operated main line switch 12 is also provided for controlling the motor circuits. Overload relays at 16 serve to protect the motor, these relays being in circuit with the coil 11 so that the coil will be de-energized if the relays are opened from overload. This will break the motor circuit and shut down the motor. The overload relays are in circuit with a lamp 17 arranged to go out if said relays open and so give a signal. Fuses 18^a and 18^b in the circuits are connected with lamps 17 and 19

which go out selectively when a fuse blows out and thus give a signal to indicate the nature of the defect. The circuit for lamp 17 may be traced from main line 15 through fuse 18^a, conductor 50^a, relays 16, 16, lamp 17 and conductor 50 to main line 14, while that for lamp 19 may be traced from main line 14 through conductor 50, fuse 18^b, lamp 19, conductor 50^b and fuse 18^a to main line 15. If either fuse burns out lamp 19 will go out but lamp 17 will go out only if fuse 18^a burns out as hereinafter explained.

A high ammonia pressure cut-out is provided at 20, and an electric bell 21 is in circuit with the cut-out, said bell being operated by a transformer 21 arranged to ring for indicating excessive ammonia pressure. This cut-out is provided with manual means for resetting it. A low water pressure cut-out 23 has a lamp 24 in circuit therewith arranged to light up when the circuit is broken. This cut-out is provided with automatic resetting means.

The control circuit, as illustrated, provides for control of four rooms and includes a series of four normally-closed magnetic shut-off valves 25^a, 25^b, 25^c and 25^d in the respective branches of the line going to the different rooms. Each branch is also provided with a hand-operated expansion valve 26 between the magnetic shut-off valve and the automatic expansion valve 27 through which passes all the ammonia of the system. Manually operated valves 27^a provide means for cutting the automatic expansion valve 27 out of the system and a normally closed by-pass provided with a manually operated valve 27^b provides means to continue the operation of the system when the automatic expansion valve is cut out. Each valve 26 is intended to be set so as to limit the flow of ammonia to the coil of the corresponding unit, while the shut-off valves 25^a to 25^d are either fully closed or fully open.

The magnetic shut-off valves are controlled as to opening and closing by two-pole single throw thermostats of the mercury type having a snap action, the lower poles of such thermostats being indicated at 28^a, 28^b, 28^c and 28^d. Such thermostats are of advantage over three-wire thermostats in that no relay having a locking circuit is required. These thermostats are connected in circuit with their respective valves by means of a conductor 29 leading off from wire 14

and having a branch 30 for each thermostat.

Conductors 31^a, 31^b, 31^c and 31^d extend from the respective thermostats to the left-hand contact 32 in the lower set of each group of contacts cooperating with the respective control switches 33^a, 33^b, 33^c and 33^d. The movable members of the respective control switches, indicated at 34^a, 34^b, 34^c and 34^d, are connected to the respective magnetic fluid shut-off valves by pairs of conductors 35^a, 36^a; 35^b, 36^b; 35^c, 36^c; and 35^d, 36^d, respectively. A branch 37 of conductor 29 is connected through branches 38^a, 38^b, 38^c and 38^d to the contacts at the left upper corners of the switches 33^a, 33^b, 33^c and 33^d. The middle contacts of the upper and lower rows are connected by branches 39^a, 39^b, 39^c and 39^d to a wire 40. The contacts at the lower right-hand corners of the switches are connected in circuit with the low voltage coil 11 of the motor starter by a conductor 41 divided into branches 42^a, 42^b, 42^c and 42^d connected respectively to the top poles 43^a, 43^b, 43^c and 43^d of the thermostats and to poles which control the starting and stopping of the machine. Wires 44^a, 44^b, 44^c and 44^d connect these thermostats to the lower right-hand contacts above referred to. A transfer switch 45 serves to bridge the conductors 41 and 46, the latter of which is connected by branches 47^a, 47^b, 47^c and 47^d to terminals at the right-hand side of the respective control switches.

In the operation of the device above described, if it is desired to have the system operate under full automatic control the switch 45 is placed in the "off" position and the control switches 33^a, 33^b, 33^c and 33^d in the "down" position. The thermostats will now control the action of the motor by their upper poles 43^a to 43^d, and by their lower poles 28^a to 28^d will control the respective valves 25^a to 25^d each for itself. When all the rooms are cold enough the motor stops, and it starts again as soon as any room becomes heated to a predetermined degree. In such cases, assuming the room controlled by the thermostat nearest the top in the drawing to be the heated one, this thermostat will be in the "on" position and the other three in the "off" position. A circuit will be closed from main line 15 through fuse 18^a, wire 50^a, coil 11 and wire 41 to tube 43^a, then through wire 44^a to switch 33^a, the movable member of which is in the "down" position so as to be connected through wire 47^a, wire 46, low water cut-out 23, high ammonia pressure cut-out 20, wire 50 and main line 14.

The automatic starter is operated by the circuit above described so as to start the motor and operate the compressor. After the motor has started current flows from main line 14 through wires 29 and 30, the lower tube 28^a of the uppermost thermostat, line 31^a to terminal 32, through the switch 34^a,

line 35^a, the coil of shut-off valve 25^a, and line 36^a back to the center terminal of control switch 33^a, then through wires 39^a and 40 and fuse 18^a to main line 15 thus operating the liquid ammonia shut-off valve 25^a and allowing ammonia to flow into the corresponding room.

In like manner the other three thermostats control their respective rooms in a cycle like that just described, the arrangement being such that the compressor will operate as long as any one thermostat has its upper pole (or tube) in the "on" position and will not close down until all of said upper poles of the thermostats are in the "off" position, it being recalled that the shut-off valve for each room is controlled by the temperature in that room so that the valve will be closed when the room is cold and the lower pole of the corresponding thermostat is "off" and open to admit ammonia when such lower pole is in the "on" position.

The high ammonia pressure cut-out switch 20 cuts out the motor in case of excessive pressure of ammonia and is hand reset, while the low water pressure cut-out switch 23 does the same when the water pressure to the condensers becomes low, the latter cut-out being automatically reset upon restoration of water pressure.

The transfer switch 45 and control switches 33^a, 33^b, 33^c and 33^d and the indicating lamps 17, 19 and 24 will all be on the control panel which carries the controlling and indicating means for the entire electrical system. By means of the instrumentalities on the control panel it is possible as above explained to arrange for full automatic operation of the system, as well as for other modes of operation.

If it is desired to operate all rooms under manual control alone all the control switches are thrown into the "up" position and transfer switch 45 into the "on" position. This puts the top pole of each thermostat out of action, the circuit through switch 45 bridging the contacts of these poles in such manner that the circuit through the pull-up coil of the automatic starter is in circuit all the time. This circuit may be traced from main line 15 through fuse 18^a, conductor 50^a, relays 16, 16, coil 11, conductor 41, transfer switch 45, cut-outs 23 and 20, conductor 50 and fuse 18^b to main line 14. If either or both of the cut-outs 20 and 23 is open the coil 11 will be de-energized, the switch 10 will open, and the motor will stop. The switches 33^a to 33^d being "up", the circuits of the magnetic shut-off valves are bridged directly across the power line and these valves remain open all the time.

If the use of one or more rooms is to be discontinued altogether, it is only necessary to open the proper switch on the control panel, by which the shut-off valve for that

room is controlled, when the flow of refrigerant will be entirely stopped.

To operate part of the rooms under automatic control and others under manual control part of switches 33^a—33^d are placed in "up" position whereby the upper poles 43^a—43^d of their thermostats will be out of circuit, the switch 45 being in "on" position to put the plant in condition to operate manually as to starting and stopping the motor (the upper pole of each double-pole thermostat being now out of action). Now if switches 33^a and 33^b are in "down" position, so that the poles of thermostats 28^a and 28^b, controlling the opening and closing of the corresponding magnetic fluid shut-off valves, are in action, then the opening and closing of valves 25^a and 25^b will be under automatic control of said poles, while the valves in the remainder of the system will be open all the time, subject to manual control by valves 26.

If the low water pressure gauge 23 knocks off and so shuts down the plant, current will pass through lamp 24 to afford a visible signal. When the main line switch 12 is closed, and the fuses and overload relay are intact, the lamps 17 and 19 remain lit, but lamp 19 will go out if the fuse 18^b blows. If both fuses blow, lamps 17 and 19 both go out. In the event of the overload relays opening up and the fuses remaining intact, lamp 17 only goes out. In the above manner a visible indication is given of any trouble which may develop and the nature thereof.

A bell ringing transformer 22 and its bell 21 are so connected in circuit with the ammonia high pressure cut-out that the bell will ring in case the plant is shut down due to such pressure.

It will be obvious to those skilled in the art that various changes may be made in my device without departing from the spirit of the invention and therefore I do not limit myself to what is shown in the drawings and described in the specification but only as indicated in the appended claims. As an example of such changes the hand-operated valve 26 might be placed at the other side of the magnetic shut-off valve without causing any difference in the operation or the efficiency of the device. I may dispense entirely with the automatic expansion valve and pass the liquid ammonia directly to the magnetic shut-off valve and use the hand operated expansion valve on the other side of the magnetic shut-off valve from that

shown in the drawing forming a part of the application. In this method of operation of course, the suction pressure on the evaporating system would be controlled by setting the expansion valves by hand.

Having thus fully described my said invention, what I claim as new and desire to secure by Letters Patent, is:

1. A direct expansion refrigerating system comprising a plurality of rooms or tanks, a compressor for supplying refrigerant thereto, a condenser and receiver for said refrigerant, a motor operating the compressor, two double-pole snap-action thermostats in the respective rooms or tanks, and connections from such thermostats to the motor whereby the motor will be stopped when all the thermostats are in off position, audible means for indicating high refrigerant pressure and visible means for indicating low water pressure to the condenser in circuit with said thermostats, substantially as set forth.

2. A refrigerating system comprising cooling compartments, means for supplying refrigerant thereto, a condenser and receiver for said refrigerant, operating means for the refrigerant supplying means, a temperature responsive device in each refrigerating compartment, connections from said temperature responsive devices to the operating means whereby the same will be stopped when the temperature responsive devices are in off position, means for indicating high refrigerating pressure, and additional means associated with the temperature responsive devices for indicating low water pressure in the condenser, substantially as set forth.

3. A refrigerating system comprising a plurality of cooling compartments, a compressor for supplying refrigerant thereto, a condenser and receiver for said refrigerant, a motor for operating the compressor, a thermostat in each refrigerating compartment, connections from said thermostat to the motor whereby the motor will be stopped when all the thermostats are in off position, signalling means for indicating high refrigerating pressure, and additional signalling means in circuit with the thermostats for indicating low water pressure in the condenser, substantially as set forth.

In witness whereof, I have hereunto set my hand at Waynesboro, Pennsylvania this 30th day of April, A. D. nineteen hundred and twenty-five.

FRANK R. ZUMBRO.