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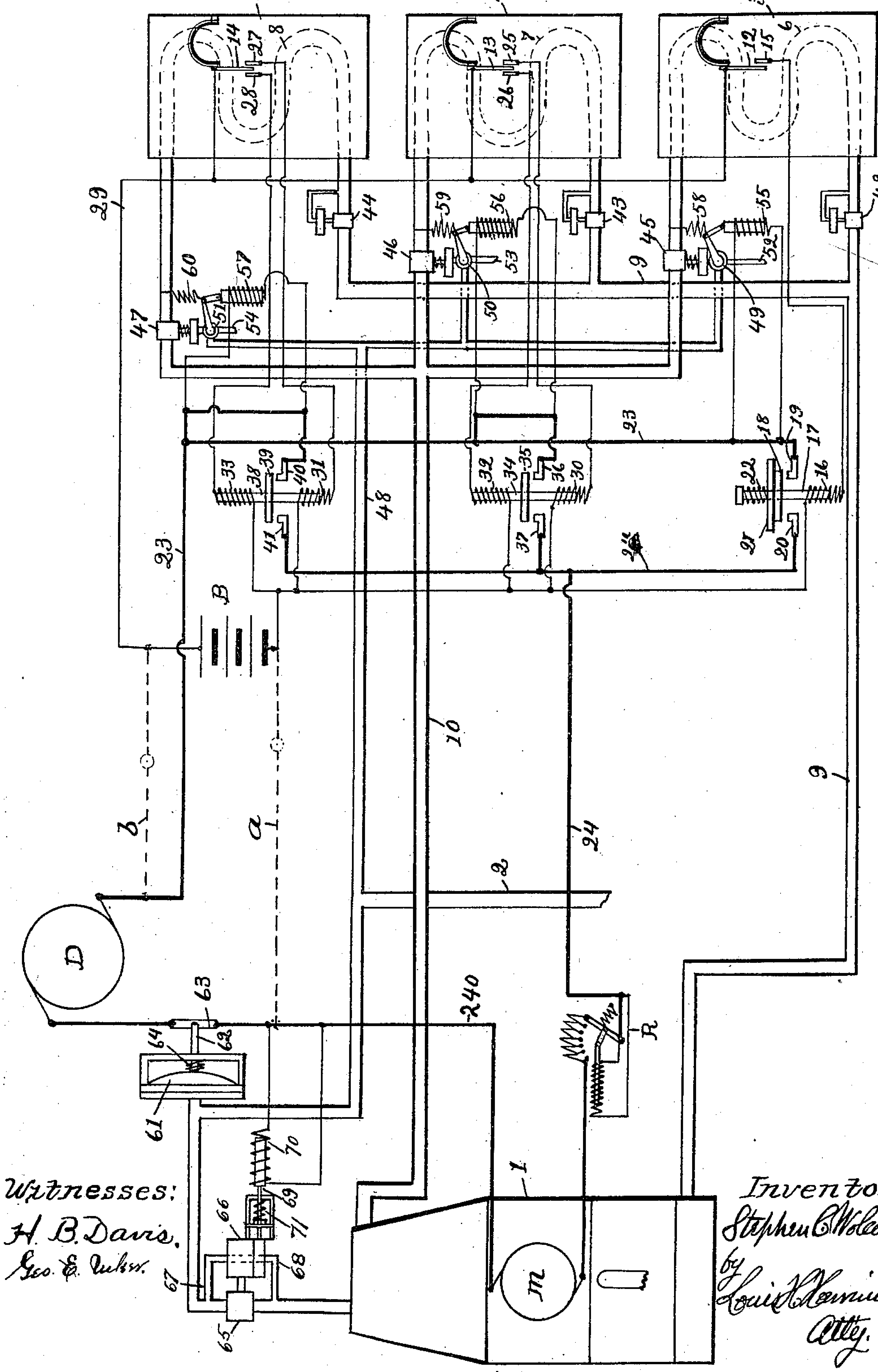
S. C. WOLCOTT.

AUTOMATIC REFRIGERATING APPARATUS.

(Application filed Feb. 11, 1901.)

(No Model.)



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UNITED STATES PATENT OFFICE.

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AUTOMATIC REFRIGERATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 684,894, dated October 22, 1901.

Application filed February 11, 1901. Serial No. 46,769. (No model.)

To all whom it may concern:

Be it known that I, STEPHEN C. WOLCOTT, a citizen of the United States, and a resident of Brookline, in the county of Norfolk and State of Massachusetts, have invented certain new and useful Improvements in Automatic Refrigerating Apparatus, of which the following is a specification.

My invention relates to an electrically-operated apparatus for performing the functions of the apparatus disclosed in my prior application, Serial No. 40,746, filed in the United States Patent Office December 22, 1900.

Although the functions to be performed by this apparatus are substantially the same in nearly every particular as those performed by the apparatus disclosed in my prior invention, yet I have found that an electrical means for performing these functions is more desirable under certain conditions than the compressed-air method disclosed in said application.

For an understanding of my invention reference is made to the accompanying drawing, in which a diagrammatical view of the entire apparatus is shown.

The compressor 1 is operated by an electric motor M in any well-known manner, and the source of the electric current is indicated by the dynamo D, which may be a central power-station. The water from the water-main for cooling the refrigerant as it is compressed is supplied through the pipe 2.

Numerals 3, 4, and 5 indicate a series of refrigerating-chambers, each of which is provided with an expansion-coil 6, 7, and 8, respectively. The inflow ends of these coils are connected to the main distributing-pipe 9, which leads from the condenser, and the exhaust ends thereof are all connected to a return-pipe 10, which conducts the refrigerant back to the compressor, so that said coils may be said to be connected in parallel. Each refrigerating-chamber is provided with a thermostat 12, 13, and 14, respectively. Each of these thermostats may be of any well-known form and preferably consists of two curved strips of different metals, which are riveted together and carry an arm at their free end, which will be swung back and forth, according to the variations of the temperature to which the thermostat is subjected. The thermostat 12 is provided with a single contact-point 15, which is connected by means of a wire to one end of the coil of the solenoid 16. The opposite end of the solenoid-coil leads to one pole of the battery B. The swinging arm of the thermostat 12 is connected by means of wire 29 with the other pole of the battery B. The bar 17 of the solenoid 16 is provided with a cross-piece 18, which is adapted to engage and make electrical connection between the two contact-points 19 and 20, when the solenoid is energized. A fixed bar 21 is arranged above the cross-bar 18, and a spring 22 around said bar 17 is adapted to to engage a shoulder on the upper end thereof and lift said bar 18 out of engagement with the contact-points when the solenoid is not energized. The contact-point 19 is connected by a main wire 23 to one pole of the dynamo, and the contact-point 20 is connected by the wire 24 to one pole of the motor. The opposite pole of the motor is connected to the dynamo by wire 240. An automatic rheostat R is interposed in the wire 24, so that when the circuit is completed by means of the bar 18 the current will be gradually turned onto the motor M.

The operation of the thermostat 12 in controlling the temperature in chamber 3 is as follows: When the temperature in the chamber 3 is raised above the desired point, the bar of the thermostat will be swung into engagement with the contact-point 15, so that the circuit through the solenoid 16 will be completed. The solenoid will draw the cross-bar 18 down into engagement with the contact-points 19 and 20, thus completing the motor-circuit and starting the motor. The motor will continue in operation until the temperature in the chamber 3 is again reduced to the desired point. Then the arm of the thermostat will be swung away from the contact-point 15, breaking the circuit through the solenoid 16 and permitting the spring 22 to draw the bar 18 out of engagement with the contact-points, thus breaking the motor-circuit and causing the motor to stop. This method of regulation of a single chamber is only desirable when it is wished to keep the temperature of the chamber at almost exactly one point; but usually it is immaterial if the temperature varies as much as five degrees. If the temperature is reduced one point below the average normal temperature and the motor is then stopped and permitted to remain at rest until the temperature is again raised in the chamber to a point somewhat above the desired normal temperature, the apparatus may be operated more economically, as it will not be continually starting and stopping. To permit the temperature to vary without stopping and starting the motor, I employ the method of regulation shown in connection with chambers 4 and 5. In these chambers the thermostats are provided with two contact-points at each side of the swinging arm, the contact-points in the chamber 4 being indicated by the numbers 25 and 26 and in chamber 5 by the numbers 27 and 28. The swinging arm of each of the thermostats 13' and 14 is connected to the main wire 29, which leads from the battery B. The contact-points 25 and 27 are connected, respectively, to one end of the coil of solenoids 30 and 31, and the contact-points 26 and 28 are connected to the coils of solenoids 32 and 33, respectively. The solenoids 30 and 32 are oppositely wound and arranged, and the opposite ends of the bar 34 are located therein. The central part of said bar is provided with a cross-bar 35, which is adapted to be brought into engagement with the contact-points 36 and 37 when the solenoid 30 is energized and to be drawn away from said contact-points when the solenoid 32 is energized. The solenoids 31 and 33 are also arranged in precisely the same manner as the solenoids 30 and 32 and are also provided with a common bar 38, which carries a cross-bar 39, said bar being adapted to make an electrical connection between the contact-points 40 and 41. The contact-points 36 and 40 are both connected to the main wire 23 from the dynamo, and the contact-points 37 and 41 are both connected to the wire 24.

When the temperature in either of the chambers 4 or 5 is raised above the point desired, the arm of the thermostats 13 or 14 will swing into engagement with their respective contact-points 25 or 27 and energize their respective solenoids 30 or 31, drawing the cross-bars 35 or 39 down into engagement with the contact-points 36 and 37 or 40 and 41, respectively, completing the circuit to the dynamo and starting the motor. This part of the operation is precisely the same as previously explained with respect to chamber 3. When the temperature in either of said chambers 4 and 5 is brought down to the particular point desired therein, its thermostat will swing into engagement with its contact-point 26 or 28, energizing its solenoid 32 or 33 and drawing the contact-bars 35 or 39 out of engagement with their respective contact-points, thus breaking the circuit to the motor which was completed through these bars.

It will be obvious that the thermostat in each chamber will be set according to the particular temperature desired in that chamber, so that, for example, chamber 3 may be kept at approximately 20°, chamber 4 at 30°, and chamber 5 at 40°. Each of these thermostats operate independently of the others, and when the temperature in one of said chambers is brought down to the point desired it will simply break one of the circuits from the dynamo to the motor, but the motor will continue in operation until all the chambers have been reduced to their desired points. When the temperature in the last chamber is brought to its particular point desired, the last circuit between the dynamo and the motor will be broken and the motor will stop. If the temperature in any one of these chambers is raised above the point desired therein, the particular solenoid which is connected to the thermostat in this chamber will be energized, and the circuit will be completed from the dynamo and to the motor, starting the latter.

Instead of employing the battery B connections may be made with the dynamo-circuit, as indicated by the dotted lines *a a*, a resistance, such as a lamp, being placed therein.

As the several coils in the several chambers are each connected to the same compressor, it will be obvious that if some means were not provided for disconnecting each particular coil from the compressor after the temperature in the chamber in which the coil is located has been reduced to the point desired the compressor would continue to lower the temperature in said chamber irrespective of the fact that its thermostat has acted to break one of the circuits between the motor and the dynamo. I therefore provide the inflow end of each coil with automatic back-pressure valves 42, 43, and 44, respectively, said valves being adapted to close their respective pipes when the pressure in their respective coils is raised above a certain point. Valves of this character are well known in the art and need no specific description. I also provide the discharge end of each coil with a diaphragm-valve 45, 46, and 47, each of which is adapted to close its respective pipe when pressure is applied to its diaphragm. These valves are also well known in the art and need no further description. I connect the diaphragm-chamber of each of said valves 45, 46, and 47 to the water-supply main 2 by means of the pipe 48 and suitable branch pipes which are connected to said pipe 48, and I provide a three-way valve 49, 50, and 51, respectively, in each branch pipe and connect waste-pipes 52, 53, and 54 to each valve, respectively. The handle of each valve is connected to the bar of the solenoids 55, 56, and 57, respectively, so that when either of these solenoids is energized the handle of the valve which is connected thereto will be moved in one direction. I also provide springs 58, 59, and 60, which act to throw the respective handles in the opposite direction when their particular solenoid is not energized. The coils of solenoids 55, 56, and 57 are respectively shunted onto the several circuits, which are completed by means of cross-bars 18, 35, and 39, so that when any one of these circuits is completed by means of the said cross-bars its particular solenoid will be energized, throwing the three-way valve, which is connected thereto, to such a position that the diaphragm-chamber of the diaphragm-valve which it controls will be open to the exhaust-pipe of the three-way valve. When any one of these circuits is broken by its cross-bar, the spring which is connected to the opposite end of the handle of the three-way valve for that circuit will throw said valve to the opposite position, so that the pressure from the water-main will be opened to the chamber of the diaphragm-valve, which is controlled by said three-way valve, closing the exhaust end of its coil. When either of the valves 45, 46, or 47 is closed by the water-pressure in the manner just described closing the exhaust end of a coil, the pressure in the coil will immediately begin to increase, so that the back pressure therein will soon become sufficient to close the back-pressure valve at the inlet side of the coil. It will thus be seen that when the temperature in any one of the chambers is brought down to the point desired the coil in that chamber is disconnected from the circulating system. When the temperature in any one of these chambers is raised above the normal, the thermostat therein will move, so that one of the circuits to the motor is closed, the solenoid, which is shunted on this circuit, will become energized, moving the three-way valve, which is connected thereto, so that its connected diaphragm-valve will be opened. The pressure in the coil will then be reduced, so that the back-pressure valve will open.

As set forth in my application above referred to, it is desirable to provide means for automatically stopping the motor when the water-supply fails or is turned off and to also shut off the water-supply automatically when the motor is stopped and turn the same on when the motor is started.

To accomplish the first function above referred to, I employ a similar apparatus to that disclosed in my said prior application, which consists, essentially, of a diaphragm-chamber 61, which is connected to the water-supply pipe 2 above the point where the latter enters the compressor. The diaphragm of chamber 61 has a stem 62 connected to the outer side thereof, and said stem is connected to a switch 63, through which the return-current from the dynamo to the motor passes. A spring 64 is provided on the outside of the diaphragm, so that when the water runs out of the chamber 61 into the compressor after the water is shut off the spring 64 will move the diaphragm inwardly and open the switch 63, breaking the circuit and stopping the motor.

In order to shut off the water-supply automatically when the motor is stopped for any reason, as by reason of its being stopped by the automatic apparatus which is controlled by the thermostats in the refrigerating-chambers, I provide an automatic valve 65 in the water-supply main 2 between the chamber 61 and the compressor. This valve may be of any well-known form which may be automatically operated by a current of electricity. The form indicated in the drawing consists of a valve the stem of which is connected to the piston in a cylinder 66. An ordinary three-way slide-valve may be provided at one side of said cylinder 66, so that when said slide-valve is in one position water-pressure from the water-main may be introduced through the pipe 67, so as to open the valve 65, and when the slide-valve is in the opposite position the valve 65 may be closed by water-pressure introduced through the same pipe, the discharge from the opposite side of the piston in the cylinder 66 being provided for through the waste-pipe 68. The construction referred to will be understood to be the same as a simple form of slide-valve engine. The stem 69 of the slide-valve is connected to the bar of the solenoid 70, and the coil of said solenoid is shunted onto the wire 240, so that when the current flows through the wire 240 the solenoid will be energized, moving the stem 69 of the pilot or slide valve, so as to cause the valve 65 to open. When the current is shut off from the motor, so that there is no longer a flow of electricity through the wire 240, the solenoid will no longer be energized and the pilot-valve will be moved to the opposite position by means of a spring 71, causing the valve 65 to close.

It will be obvious that this system for controlling the temperature in a series of refrigerating-chambers, as well as the system shown in my prior application, may be applied to the circulating-brine system of refrigeration, as well as the expansion system herein referred to—that is, the motor instead of operating a compressor will operate a brine-pump, which will cause the brine to circulate through the various coils in the same manner that the compressed gas is described as circulating above. As the coils will be connected in parallel, as shown in the drawing, the circulation through any one of the coils may be stopped without interfering with the circulation through the other coils, and when the circulation through the last coil is closed the motor will stop simultaneously.

In the brine system the automatic back-pressure valves at the inlet end of the coils would be omitted, as would the automatic devices used in connection with the water-supply pipe to the compressing apparatus.

The particular electrical appliances described are simply illustrative, and other electrical appliances which perform the same functions may be substituted.

I furthermore consider it within the scope of my invention to substitute a hydraulic or steam motor for the electric motor shown herein, providing an independent supply-pipe to the motor for each chamber, and providing an automatic valve in each supply-pipe, which is controlled by its respective thermostat, so that it may be opened fully and closed partially or fully, according to the requirements of the particular chamber in which the thermostat is located.

Having described my invention, what I claim as new, and desire to secure by Letters Patent of the United States, is as follows:

1. The combination in a refrigerating apparatus of a series of refrigerating-coils connected in parallel, an electric motor for causing a circulation through said coils, a chamber for each coil, a thermostat in each chamber, an independent circuit for each chamber between the generator and motor, and means controlled by the thermostat in each chamber for controlling the flow of current through its corresponding circuit according to the variations in temperature in the chamber in which a particular thermostat is located.

2. The combination in a refrigerating apparatus of a series of refrigerating-coils which are connected in parallel, an electric motor for causing a circulation of the refrigerating medium through each of said coils, a refrigerating-chamber for each coil, a thermostat in each chamber, an independent circuit for each chamber between the generator and motor, electrically-operated means for controlling the flow of electrical current through each circuit and electrical connections between each of said thermostats and its corresponding circuit-controller, whereby each circuit may be automatically controlled according to the variations of temperature in each chamber.

3. The combination of a refrigerating apparatus of a series of circulating-coils which are connected in parallel, an electric motor for causing a circulation of the refrigerating medium through each coil, a chamber for each coil, a thermostat for each chamber, and independent circuit for each thermostat between the source of the electrical supply and the motor, means controlled by each thermostat for controlling the flow of the current through its respective circuit according to the variations in temperature in its particular chamber, an automatic valve in each coil, electrically-controlled means for opening and closing said valves, electrical connections between each of said valve-controlling means and its corresponding independent motor-circuit, whereby each valve may be automatically controlled according to the flow of electricity through its corresponding motor-circuit.

4. An automatic refrigerating apparatus comprising a compressor, an electric motor for driving the same, an expansion-coil connected to said compressor, a water-supply pipe for said compressor, an automatic valve in said pipe, and electrical controlling means for said valve which are connected to the circuit between the motor and generator, said means being adapted to close said valve when said circuit is broken and to open said valve when said circuit is closed.

5. A system which is adapted to maintain different temperatures in a series of chambers comprising a series of circulating-coils which are connected in parallel, a chamber in which each coil is located, a motor for causing the circulation through each coil, an independent conductor for each coil between the source of power and said motor, a thermostat in each chamber, and means for controlling communication between the source of power and the motor through each conductor, the means for controlling communication through each conductor being controlled by its corresponding thermostat according to the variation of temperature in the chamber in which a particular thermostat is located.

6. A refrigerating apparatus comprising a series of circulating-coils which are connected in parallel, a chamber in which each coil is located, a motor for causing a circulation through each coil, an independent conductor for each coil between the source of power and said motor, a thermostat in each chamber, means for controlling communication between the source of power and the motor through each conductor, the means for controlling communication through each conductor being controlled by its corresponding thermostat according to the variations of temperature in the chamber in which a particular thermostat is located, an automatic valve in each coil, connections between each conductor and its corresponding valve, and means for controlling each valve, said means being controlled by the motive power as it passes through the several conductors.

7. The combination in a refrigerating apparatus of a series of refrigerating-coils which are connected in parallel, an electric motor for causing a circulation of the refrigerating medium through each of said coils, a refrigerating-chamber for each coil, a thermostat in each chamber, an independent circuit for each chamber between the generator and motor, an automatic switch in each circuit, connections between each switch and its corresponding thermostat, and means for causing each thermostat to open its corresponding switch when the temperature in its chamber falls to a predetermined point, and to close the same when the temperature therein is raised above a predetermined point, whereby the motor will be stopped when the temperature in each chamber is brought to the particular point desired therein, and will be started when the temperature in any one of said chambers is raised above the point desired therein.

In testimony whereof I have affixed my signature in presence of two witnesses.

STEPHEN C. WOLCOTT.

Witnesses:

LOUIS H. HARRIMAN,

GEO. E. UCKER.