

June 13, 1939:

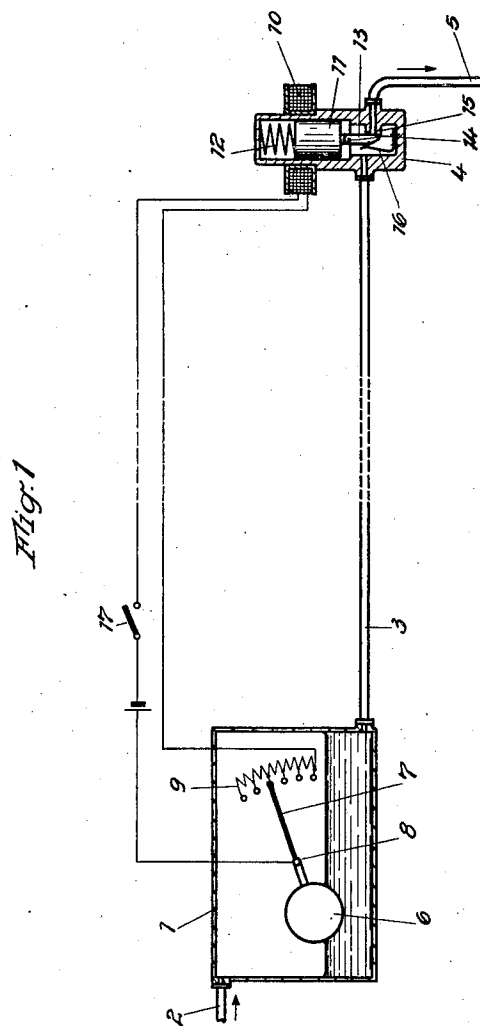
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REFRIGERATING APPARATUS OF THE COMPRESSION TYPE

Filed Dec. 16, 1937

2 Sheets-Sheet 1



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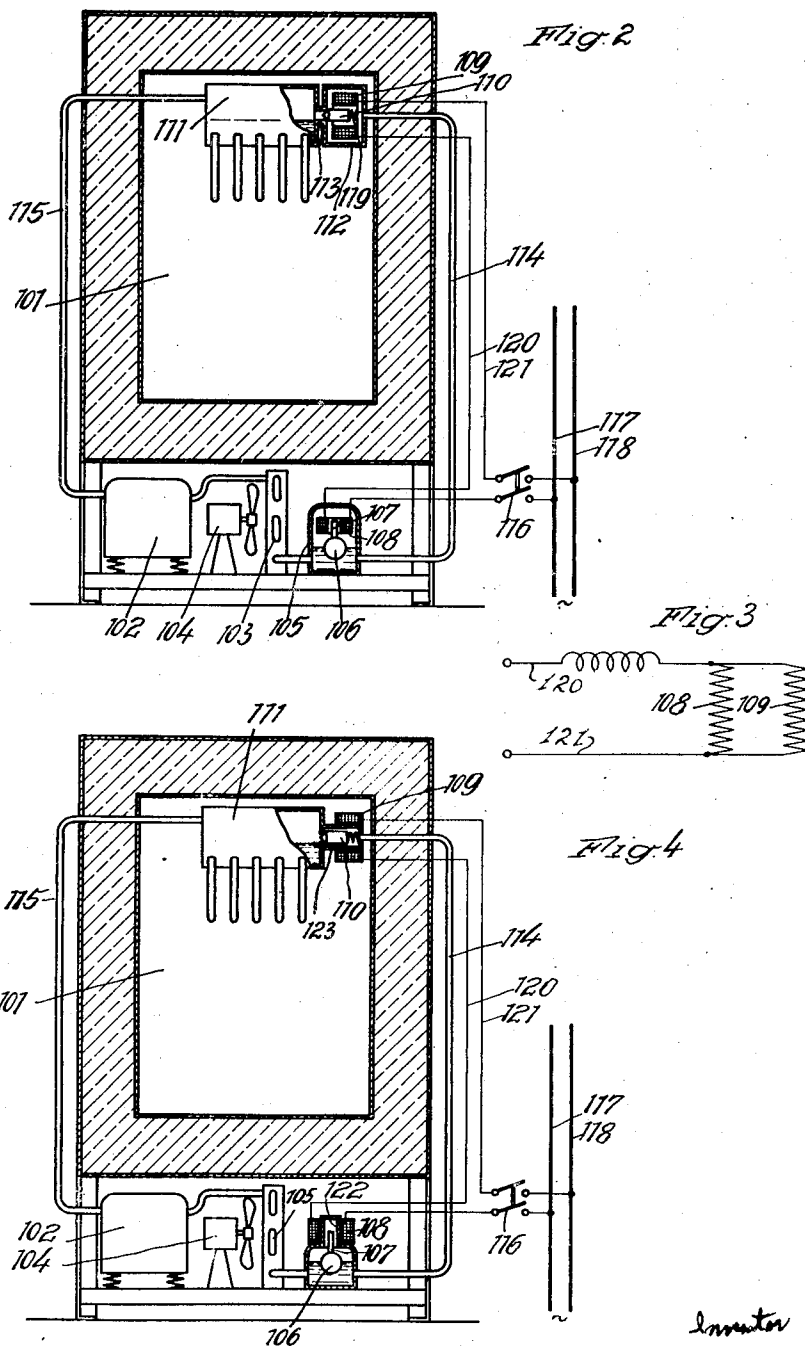
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UNITED STATES PATENT OFFICE

2,161,960

REFRIGERATING APPARATUS OF THE COMPRESSION TYPE

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Application December 16, 1937, Serial No. 180,195
In Germany December 24, 1936

12 Claims. (Cl. 62—8)

The present invention relates to improvements in refrigerating apparatus of the compression type, and more particularly to a control therefor.

5 In refrigerating apparatus of the compression type it is known to supply the refrigerant, liquefied in the condenser, to a collecting tank, whence the condensate passes into the evaporator under control of a valve. In the known arrangements of this kind, the valve is directly
10 operated by a float arranged in the collecting tank. Since there is a considerable difference in pressure between the condenser and the evaporator of the refrigerating apparatus, great control forces must sometimes be exerted by the
15 float. This causes the valve to be suddenly opened upon the liquid level in the tank exceeding a given value so that a relatively large quantity of refrigerant is allowed to flow into the
20 evaporator.

The object of this invention is to provide an arrangement, whereby the flow of the refrigerant into the evaporator is rendered as uniform as possible. To this end, the discharge valve to be
25 controlled in accordance with the liquid level in the tank is provided with an electric governor in the circuit of which lies a float controlled member. This arrangement has a number of advantages over the directly operated valves hitherto
30 known. The collecting tank for the liquid may be spaced, if desired, from the point where the valve is located. The adjusting forces released by the float may be easily transmitted to the distant control point by electric conductors. Furthermore, by suitably dimensioning the electro-
35 magnet it is easily possible to arrange that the valve is opened and closed in accordance with the difference in pressure prevailing between the condenser and the evaporator only when the liquid level in the collecting tank has attained a
40 given height. With the aid of the float, a switch may be operated which closes, upon the attainment of a given liquid level within the collecting tank, the exciting circuit of the electromagnet, thus causing the valve to open. The governor controlled by the float serves to adjust a
45 resistance lying in the circuit of the electromagnet. In this manner without the electromagnetic circuit being interrupted, the exciting current of the electromagnetically controlled valve is increased upon the attainment of a given liquid level within the collecting tank to such a value that this valve is opened.

55 The invention is, for instance, particularly advantageous in connection with such arrange-

ments in which the refrigerant compressor, the condenser and the float valve are arranged below the cooling chamber of a refrigerator, a conduit extending from the float valve to the evaporator arranged in the cooling chamber at the upper part thereof. Since in this case the
5 conduit leading to the evaporator is under the pressure prevailing in the condenser, a particular lagging of this conduit, or special valves for increasing the pressure in this conduit are not
10 necessary. These means had to be employed in the refrigerating apparatus of the compression type hitherto known in order to prevent the conduit extending from the float valve to the evaporator from being covered with hoarfrost owing to the undesirable evaporation of
15 the refrigerant.

The member controlled by the float may also be designed in such a manner that it varies by its movement a reactance, i. e. an inductive or capacitive resistance, lying in the main circuit
20 of the electromagnet controlling the valve. In this manner it is possible to design the control member in such a manner that no current interruptions occur as well as no sliding of the movable control members, which otherwise would
25 cause a wear and tear of the same. The arrangement according to the invention may further be so designed that the valve is adjusted by varying the resistance of a coil whose relative position with respect to an iron core is varied
30 in accordance with the liquid level in the collecting tank. In this case the movable float may be either connected to the iron core and the current traversed coil firmly secured within the
35 collecting tank, or vice versa, the first mentioned arrangement being particularly advantageous since no movement of current carrying parts is required when governing. Another modification of the invention employs for adjusting the valve
40 a variable plate condenser whose coatings are in part firmly secured to the collecting tank and in part to the movable float.

In the accompanying drawings are shown
45 some embodiments of the present invention in diagrammatic form.

Fig. 1 shows an embodiment in which the float arranged in the condensate collecting tank adjusts a control member consisting of an ohmic
50 resistance.

Fig. 2 shows as a further embodiment of the invention a domestic refrigerator in which an inductive resistance arranged in the condensate
55 collecting tank is employed as a control member.

Fig. 3 shows a modified wiring diagram of the control member of Fig. 2, and

Fig. 4 illustrates a modification of the arrangement shown in Fig. 2.

Referring to Fig. 1, 1 denotes a collecting tank for the liquefied refrigerant flowing through the conduit 2 from the condenser (not shown) into the tank from which a conduit 3 extends to the valve 4, the refrigerant passing thence through the conduit 5 to the evaporator (not shown) of the refrigerating apparatus. The flow of the refrigerant from the collecting tank 1 into the evaporator is controlled with the aid of a float 6 in accordance with the liquid level in the tank 1. To the float 6 is rigidly secured a governor arm 7 rotatably mounted as indicated at 8. The governor lever 7 adjusts a series resistance 9 lying in the circuit of the electromagnet 10 of the valve. The valve has an armature 11 held in the position shown by a spring 12 and a slide 13 pivotally secured to the armature 11 as indicated at 14. The slide cooperates with the valve seat 15 to which is connected the discharge conduit 5 for the condensate. The slide 13 is pressed against the valve seat by a spring 16. 17 denotes a switch actuated preferably simultaneously with the operating switch of the refrigerating apparatus; i. e., the switch is closed when putting the refrigerating apparatus into operation. In this manner the exciting current circuit for the electromagnet 10 is closed. The condensate collecting in the tank 1 raises the slide 6 and therefore cuts out the resistance 9 gradually from the exciting circuit, so that upon the attainment of a given liquid level the exciting current of the electromagnet 10 suffices to close the valve.

In the embodiment shown in Fig. 2 are arranged below the cooling chamber 101 the motor compressor set 102, the condenser 103, a ventilator 104 for circulating the cooling air and a float tank 105. In the latter is placed a float 106 secured to an iron core 107. The iron core 107 cooperates with a coil 108 which lies in the circuit of the electromagnet 109 serving to operate a valve 110. The latter controls the flow of the liquid refrigerant into the evaporator 111 arranged in the upper part of the cooling chamber. The electromagnet 109 and the valve 110 are located in a casing 112 connected directly to the collecting tank through a short conduit 113. A conduit 114 leads directly from the float tank 105 to the tank 112. The vaporous refrigerant flows from the evaporator 111 through a conduit 115 back into the suction side of the compressor 102.

The control circuit for the electromagnet 109 is connected to the alternating-current supply circuit 117-118. The above-described arrangement operates as follows:

Since as above described the iron core 107 is secured to the float 106, it moves within the coil 108 in the upward or downward direction depending upon the liquid level of the condensate in the tank 105. At a high liquid level the float 106 assumes the position shown in Fig. 2 so that the resistance of the coil 108 is reduced to such an extent that the force of the electromagnet 109 is sufficient to open the valve 110 against the force of the compression spring 119. The valve 110 therefore permits the refrigerant to flow into the evaporator 111 through the conduit 114. Accordingly, the liquid level in the tank 105 lowers and the iron core 107 moves in the downward direction. The increase in resistance of the coil 108 caused thereby, weakens the exciting current

of the electromagnet 109 to such an extent that the valve 110 is again closed under the action of the compression spring 119.

The coil 108 and the electromagnet 109 may also be connected in parallel as is schematically shown in Fig. 3. In this case upon the upward movement of the iron core 107 within the coil 108, the resistance of the coil 108 is reduced to such an extent that the current flowing through the magnetic coil 109 is no longer sufficient to permit the magnet to hold the valve firmly seated. In this connection a tension spring may be allotted to the valve the force of which being then sufficient to open the valve.

The conductors 120, 121 connecting the coil 108 arranged in the tank 105 with the electromagnet 109 mounted in the casing 112 may under certain circumstances also be arranged in the conduit 114. The entire electric part of the control may be placed outside the system containing the refrigerant. In this case the magnetic flux traverses the thin sleeves of suitable material and passes into the interior of the system. Such an arrangement is shown in Fig. 4 in which the corresponding parts are denoted by the same numerals as in Fig. 2. The coil 108 which is controlled by the iron core 107 of the float 106 and the electromagnet 109 serving to control the valve 110 are arranged outside the system for the refrigerant; i. e., the coil 108 surrounds a sleeve 122 within which the iron core 107 controlled by the float 106 moves in the upward or the downward direction depending upon the liquid level. The electromagnet 109 surrounds a tube 123 in which the valve 110 is mounted.

What is claimed is:

1. With a refrigerating apparatus having a circulating system for the refrigerant, comprising a compressor, a condenser, a condensate collecting tank, an evaporator, and conduits connecting said compressor, condenser, tank, and evaporator, in combination, a regulating system comprising a valve arranged in the conduit between said tank and said evaporator for controlling the flow of the refrigerant through said conduit, a float arranged in said tank, an adjustable impedance regulator connected with said float so as to have its impedance value varied responsive to variations of the level of the refrigerant in said tank, and a control circuit operatively connecting said impedance and said valve.

2. With a refrigerating apparatus having a circulating system for the refrigerant, comprising a compressor, a condenser, a condensate collecting tank, an evaporator, and conduits connecting said compressor, condenser, tank, and evaporator, in combination, a regulating system comprising an electromagnetically controlled valve arranged in the conduit between said tank and said evaporator for controlling the flow of the refrigerant through said conduit, said valve being designed to assume an intermediate control position between its "on" and "off" positions, a float arranged in said tank, a regulator having more than two regulating positions, said regulator being connected with said float so as to be operated responsive to variations of the level of the refrigerant in said tank, and a control circuit operatively connecting said regulator and said valve.

3. With a refrigerating apparatus having a circulating system for the refrigerant, comprising a compressor, a condenser, a condensate collecting tank, an evaporator, and conduits connecting said compressor, condenser, tank, and evaporator, in combination, a regulating system comprising a

valve arranged in the conduit between said tank and said evaporator for controlling the flow of the refrigerant through said conduit, a float arranged in said tank, a regulatable impedance mounted in said tank and connected with said float so as to be varied responsive to variations of the level of the refrigerant in said tank, and a control circuit operatively connecting said impedance and said valve.

4. With a refrigerating apparatus having a circulating system for the refrigerant, comprising a compressor, a condenser, a condensate collecting tank, an evaporator, and conduits connecting said compressor, condenser, tank, and evaporator, in combination, a regulating system comprising an electromagnetically controlled valve arranged in the conduit between said tank and said evaporator for controlling the flow of the refrigerant through said conduit, said valve being designed to assume an intermediate control position between its "on" and "off" positions, a float arranged in said tank, a resistor designed to be adjusted to several resistance values, said resistor being mounted in said tank and connected with said float so as to be adjusted responsive to variations of the level of the refrigerant in said tank, and a control circuit operatively connecting said impedance and said valve.

5. With a refrigerating apparatus having a circulating system for the refrigerant, comprising a compressor, a condenser, a condensate collecting tank, an evaporator, and conduits connecting said compressor, condenser, tank, and evaporator, in combination, a regulating system comprising a valve arranged in the conduit between said tank and said evaporator for controlling the flow of the refrigerant through said conduit, a float arranged in said tank, a variable inductive control member mounted in said tank and connected with said float so as to have its inductance value varied responsive to variations of the level of the refrigerant in said tank, and a control circuit operatively connecting said inductance and said valve.

6. With a refrigerating apparatus having a circulating system for the refrigerant, comprising a compressor, a condenser, a condensate collecting tank, an evaporator, and conduits connecting said compressor, condenser, tank, and evaporator, in combination, a regulating system comprising a valve arranged in the conduit between said tank and said evaporator for controlling the flow of the refrigerant through said conduit, a float arranged in said tank, a control device having an inductance coil and an iron core movable relatively to each other, said control device being mounted in said tank and connected with said float so as to have the relative position of said coil and said core varied responsive to variations of the level of the refrigerant in said tank, and a control circuit operatively connecting said coil and said valve.

7. With a refrigerating apparatus having a circulating system for the refrigerant, comprising a compressor, a condenser, a condensate collecting tank, an evaporator, and conduits connecting said compressor, condenser, tank, and evaporator, in combination, a regulating system comprising a valve arranged in the conduit between said tank and said evaporator for controlling the flow of the refrigerant through said conduit, a float arranged in said tank, a control device arranged within said tank and having an inductance coil and an iron core movable relatively to each other, said coil being firmly secured to said tank, said

core being connected with said float so as to be moved responsive to variations of the level of the refrigerant in said tank, and a control circuit operatively connecting said coil and said valve whereby said valve is operated in accordance with the inductance variations of said coil.

8. In a domestic refrigerator having a cooling chamber and a refrigerating circulation system comprising a compressor, a condenser, a condensate collecting tank, an evaporator, and conduits connecting said compressor, condenser, tank, and evaporator, in combination, a regulating system comprising a valve arranged in the conduit between said tank and said evaporator for controlling the flow of the refrigerant through said conduit, said valve having electromagnetic actuating means, a float arranged in said tank, a variable impedance connected with said float so as to be adjusted responsive to variations of the level of the refrigerant in said tank, and a control circuit operatively connecting said valve actuating means and said impedance, said evaporator and said valve being arranged in said cooling chamber, and said compressor, condenser and tank being arranged outside of said chamber.

9. In a refrigerator of the cabinet type having a cooling chamber, a drive motor, and a refrigerating system comprising a compressor, a condenser, a condensate collecting tank, an evaporator, and conduits connecting said compressor, condenser, tank, and evaporator, in combination, a regulating system comprising a valve arranged in the conduit between said tank and said evaporator for controlling the flow of the refrigerant through said conduit, said valve having electromagnetic actuating means, a float arranged in said tank, a variable impedance connected with said float so as to be adjusted responsive to variations of the level of the refrigerant in said tank, and a control circuit operatively connecting said valve actuating means and said impedance, said evaporator and said valve being arranged in said cooling chamber, and said drive motor, compressor, condenser and tank being arranged below said cooling chamber.

10. With a refrigerating apparatus having a circulating system for the refrigerant, comprising a compressor, a condenser, a condensate collecting tank, an evaporator, and conduits connecting said compressor, condenser, tank, and evaporator, in combination, a regulating system comprising a valve arranged in the conduit between said tank and said evaporator for controlling the flow of the refrigerant through said conduit, a float arranged in said tank, an inductive regulator having an inductance coil arranged exteriorly of said tank and an iron core arranged within said tank and connected with said float so as to vary the inductivity of said coil responsive to variations of the level of the refrigerant in said tank, and a control circuit operatively connecting said coil and said valve.

11. With a refrigerating apparatus having a circulating system for the refrigerant, comprising a compressor, a condenser, a condensate collecting tank, an evaporator, and conduits connecting said compressor, condenser, tank, and evaporator, in combination, a regulating system comprising a valve arranged in the conduit between said tank and said evaporator for controlling the flow of the refrigerant through said conduit, a casing enclosing said valve so as to be passed through by the refrigerant, an electromagnet arranged in said casing for operating said valve, a float arranged in said tank, an electric regulator connected with

said float so as to be adjusted responsive to variations of the level of the refrigerant in said tank, and an electric circuit connecting said electromagnet with said regulator.

- 5 12. With a refrigerating apparatus having a circulating system for the refrigerant, comprising a compressor, a condenser, a condensate collecting tank, an evaporator, and conduits connecting said compressor, condenser, tank, and
10 evaporator, in combination, a regulating system comprising a valve arranged in the conduit between said tank and said evaporator for control-

ling the flow of the refrigerant through said conduit, a casing enclosing said valve so as to be passed through by the refrigerant, an electromagnet for operating said valve, said magnet being arranged outside of said casing, a float arranged in said tank, an electric regulator connected with said float so as to be adjusted responsive to variations of the level of the refrigerant in said tank, and an electric circuit connecting
10 said electromagnet with said regulator.

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