

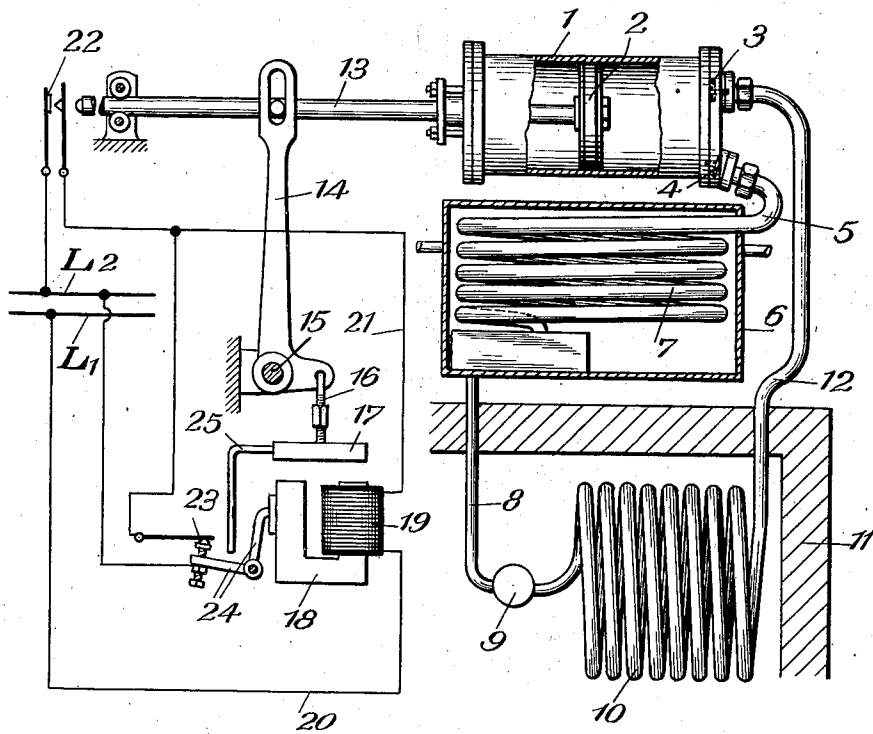
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FULLY AUTOMATIC REFRIGERATOR

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## UNITED STATES PATENT OFFICE

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## FULLY AUTOMATIC REFRIGERATOR

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This invention relates to fully automatic refrigerators.

In the fully automatic refrigerator cabinets hitherto known the compressor piston is positively driven during the compression stroke as well as during its return stroke and, when interruptions in the refrigerant circulation arise, the drive must be discontinued and then started again.

According to the present invention provision is made for driving the compressor piston by means of external power only during the compression stroke, whereas during the return stroke it is moved solely by refrigerant gas flowing into the compressor. In this way the power consumption of the refrigerator can be reduced and thus a corresponding economy in the costs of operation is obtained, since the output of the compressor is at all times automatically adapted to the energy demand of the refrigerator in that during periods of small energy demand the compressor piston is scarcely actuated, whereas during periods of increased demand the compressor piston reciprocates more often.

Furthermore, when interruptions of refrigerant circulation arise, the drive of the compressor piston is automatically set at rest, as the latter is then no more returned by refrigerant gas. As, therefore, in this refrigerator the movable parts, which are apt to cause disturbances, are considerably reduced in number, the drive is substantially simplified and thus also the costs of production and operation of the refrigerator are accordingly reduced.

There are fully automatic refrigerator cabinets known wherein the compressor piston is driven by means of an electromagnet. In a known refrigerator cabinet of this type, the return stroke of the compressor piston is effected by spring force, the spring being necessarily compressed again during each compression stroke. For closing and breaking the magnet energizing circuit a separate rotary interrupter is used which controls the number of reciprocations of the compressor piston. In this case the refrigerant gas is applied to the rear end of the piston of the compressor, whereupon it flows during the return stroke through a non-return valve controlled opening in the piston into the working space, so that during the return stroke the piston is not acted upon by refrigerant steam pressure.

In another known refrigerator cabinet the switching operations for changing over two electromagnets that are provided for shifting the compressor piston back and forth respectively

are initiated by the compressor piston in the end positions of the latter. By alternately closing and breaking the circuit the compressor piston is continually reciprocated in which way a uniform drive of the compressor piston is obtained similar to that obtained by means of an electric motor.

A drive of this kind is, however, unsuitable for refrigerator cabinets since the demand on power of the same depends on the exterior temperatures and on the amount of heat admitted and is thus subjected to great fluctuations. Therefore, if for example, due to the cabinet being frequently opened in succession, the internal temperature of the same rises relatively considerably, a relatively long time is then required, provided that the drive of the compressor piston operates uniformly, until the refrigerator cabinet is cooled down to its normal refrigerating temperature again. Moreover, the presence of two electromagnets complicates the refrigerator system to a great extent.

According to the present invention these drawbacks are eliminated by disconnecting by means of the compressor piston an electromagnet serving for driving the compressor piston prior to the beginning of the return stroke, which is effected by gas pressure, and connecting said magnet on the completion of the return stroke. For the drive of such a refrigerator only one electromagnet is required which needs no resetting by spring action.

In the accompanying drawing an embodiment of the invention is schematically illustrated by way of example only.

The refrigerant compressor comprises a cylinder which guides the displaceable piston 2 and is provided with an inlet valve 3 and an outlet valve 4. The valve 4 communicates through a conduit 5 with a pipe coil which is included in the condenser 6 and which on its other end is connected with a conduit 8 including a pressure reducing valve 9 and leading to the evaporator 10 in which the refrigerant vaporizes and thus withdraws heat from the refrigerator cabinet.

A return conduit 12 for the refrigerant gas leads from the evaporator 10 to the valve 3 of the compressor. The piston rod 13 of the compressor piston 2 projects out of the cylinder 1 and engages with one end of a bell crank lever 14 which is pivotally connected to an axle 15 and which carries at its other end a depending rod 16 to which a metal block 17 is connected which cooperates with a stirrup-shaped magnet 18 for being attracted thereby.

One end of the winding 19 of this magnet is connected with a line conductor L<sub>1</sub> of an alternating current network via a lead 20. The other end of the winding 19 is connected with the line conductor L<sub>2</sub> of this network via a lead 21, and a switch 22, which is controlled by the outer end of the piston rod, as well as with a switch 23 which is controlled by the electromagnet 18 by means of a bell crank lever 24. To the metal block 17 a rectangularly bent rod 25 is connected which cooperates with the bell crank lever 24 for putting out the switch 23, when the metal block is completely attracted.

In the positions of the movable parts as shown in the drawing, the circuit of the electromagnet 19 is closed via the switch 23. By the electromagnet 18 attracting the metal block 17 the piston rod 13 is shifted from left to right by means of the rod 16 and the bell crank lever 14. Consequently the compressor piston 2 displaces the portion of the refrigerant present in the cylinder into the evaporator 6.

On the metal block 17 being completely attracted, the piston 2 has arrived at its end position and the bell crank lever 24 is rocked by the rod 25 thereby to put out the switch 23. By this means the circuit through the winding 19 is interrupted and the piston 2 is reset from right to left by pressure action of the refrigerant gas flowing back from the evaporator 19 via the valve 3. In the extreme end position of the piston 2 the switch 22 is put in by means of the end of the piston rod 13, so that the circuit through the winding 19 of the electromagnet is closed. Thereupon the magnet 18 attracts the metal block 17 thereby to rock the bell crank lever 24. Due to this rocking movement of the bell crank lever 24, the switch 23 is put in so that at this switch the circuit through the winding 19 remains closed during the compression stroke, whereas the switch 22 is put out again at the beginning of the compression stroke.

When, by action of the thermostat regulator, the circulation of the refrigerant through the refrigerator system is temporarily throttled, the piston 2 is no more returned, in which way the drive of the compressor is automatically set at rest and thus no separate means for interrupting the compressor drive are required.

Instead of using an electromagnet for supplying the external power a reciprocating hydraulic plunger may be employed for this purpose.

I do not limit myself to the particular size, shape, number or arrangement of parts as shown and described, all of which may be varied without going beyond the scope of my invention as shown, described and claimed.

What I claim is:—

1. In a fully automatic refrigerator, an evaporator, a condenser, a refrigerant gas compressor cylinder including a reciprocable piston, a com-

pressor chamber cooperating with one end of said piston, means connecting said chamber with said evaporator and said condenser respectively for refrigerant circulation therethrough, a drive for said piston actuated by external power and influencing the latter only during its compression stroke, and control means for said connections between said chamber and said condenser and said evaporator respectively for shutting the former and opening the latter to said chamber between the compression and the return stroke for admitting refrigerant gas to said piston for effecting its return stroke by pressure of said refrigerant gas.

2. In a fully automatic refrigerator, an evaporator, a condenser, a refrigerant gas compressor cylinder including a reciprocable piston, a compressor chamber cooperating with one end of said piston, means connecting said chamber with said evaporator and with said condenser respectively for refrigerant circulation therethrough, a source of electricity, an electromagnet drive for said piston operative only during the compression stroke of said piston, means cooperating with said piston for connecting said electromagnet in and out before and after the return stroke respectively of said piston, and control means for said connections between said chamber and said condenser and said evaporator respectively for shutting the former and opening the latter to said chamber between the compression and the return stroke for admitting refrigerant gas to said piston for effecting its return stroke by the pressure of the refrigerant gas.

3. In a fully automatic refrigerator, an evaporator, a condenser, a refrigerant gas compressor cylinder including a reciprocable piston and piston rod, a compressor chamber cooperating with one end of said piston, means connecting said chamber with said evaporator and with said condenser respectively for refrigerant circulation therethrough, an electromagnet drive for said piston actuated only during the compression stroke of said piston, a source of electricity switching means controlled by said piston rod for connecting the energizing circuit of said electromagnet with said source of electricity at the end of the return stroke of said piston, further switching means controlled by said magnet for maintaining the energizing circuit of the same closed during the compression stroke and for opening the circuit at the end of said stroke, and control means for said connections between said chamber and said condenser and said evaporator respectively for shutting the former and opening the latter to said chamber between the compression and the return stroke for admitting refrigerant gas to said piston for effecting its return stroke by refrigerant gas.

OTTO ZEHLER.