E. CARPENTER & F. M. KIMBALL.

AUTOMATIC CONTROLLING MECHANISM FOR REFRIGERATING SYSTEMS.

APPLICATION FILED AUG. 21, 1907.

**982,794.** Patented Jan. 31, 1911.

Fig. 1.

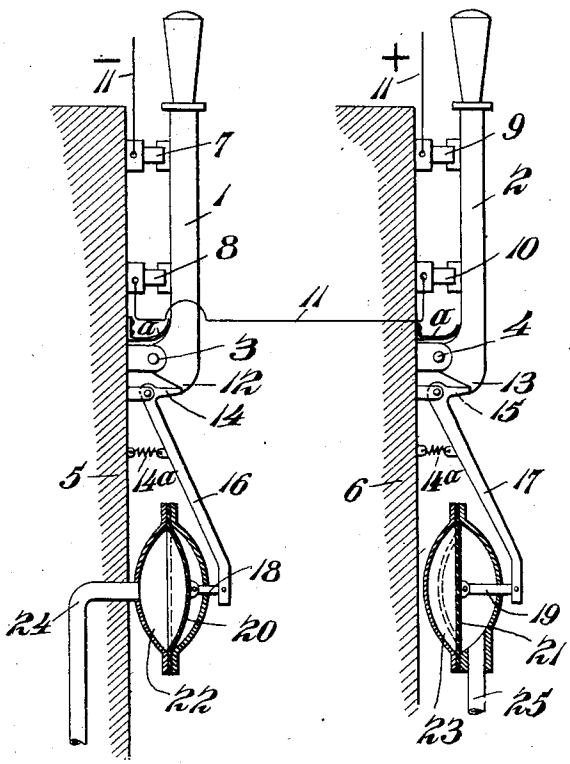



Fig. 2.

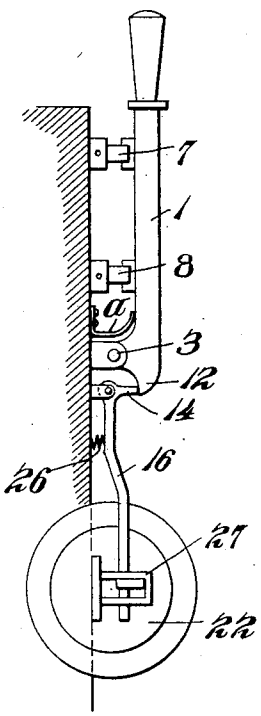
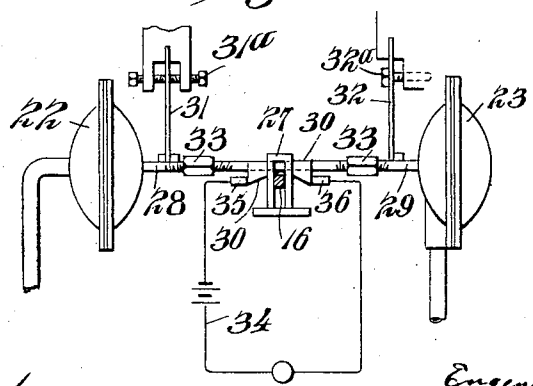



Fig. 3.




WITNESSES

H. G. Dieterich

Ira F. Becker

INVENTORS

Eugene Carpenter

Fred. M. Kimball

BY

Thos. G. Orr

ATTORNEYS

# UNITED STATES PATENT OFFICE.

EUGENE CARPENTER, OF NEWTON, AND FRED M. KIMBALL, OF SOMERVILLE, MASSACHUSETTS, ASSIGNORS TO THE AUTOMATIC REFRIGERATING COMPANY, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY.

## AUTOMATIC CONTROLLING MECHANISM FOR REFRIGERATING SYSTEMS.

**982,794.** Specification of Letters Patent. **Patented Jan. 31, 1911.**

Original application filed March 15, 1907, Serial No. 362,518. Divided and this application filed August 21, 1907. Serial No. 389,433.

*To all whom it may concern:*

Be it known that we, EUGENE CARPENTER and FRED M. KIMBALL, citizens of the United States, and residing at Newton, county of Middlesex, State of Massachusetts, and Somerville, county of Suffolk, State of Massachusetts, respectively, have invented certain new and useful Improvements in Automatic Controlling Mechanism for Refrigerating Systems, of which the following is a specification.

Our present application is a division of our prior application filed March 15, 1907, serially numbered 362,518.

Our invention relates especially to that type of refrigerating apparatus in which the maintenance of constant temperature in the refrigerated chamber or space, is, so far as possible, automatically controlled. Such apparatus involves a conduit for the refrigerant, whose low pressure side is located in the space to be refrigerated, whether the same be a cold storage chamber for example, or the cooling tank of a brine circulating system; a pump for compressing and circulating the refrigerant in said conduit; a motor (usually electric) for operating said pump, and a thermostat or other equivalent device in the refrigerating chamber or space to control the stopping and starting of the motor and therefore of the refrigerant circulating pump, in accordance with temperature conditions in said chamber or space. In such systems, situated as they are in a great variety of widely detached locations, the water supply depended upon for the condenser upon the high pressure side of the refrigerant circuit is not uniformly reliable or constant, and should its flow be diminished or cut off or should for any reason a properly reduced temperature be unattainable on the high pressure side of the refrigerant circuit, an abnormal pressure may develop in the latter interrupting the properly normal operation of the apparatus or even resulting in the accumulation of dangerous pressure.

The object of our invention is to prevent absolutely the operation of the pump and automatically throw it out of operation, if it is in operation, should abnormal pressure develop in the refrigerant circuit or should the condenser water supply fall to an inadequate amount.

Our invention particularly contemplates the coaction of both the refrigerant pressure and condenser fluid pressure (and any other fluid pressure whose abnormality might be prejudicial to the proper operation of the system) in controlling the motor, so that they have to be in substantially normal state in order that the motor shall start or continue in operation and the development of abnormal pressure in either or any conduit will automatically stop the motor.

In the forms of our invention here illustrated and more particularly described, the driving power for the pump is supposed to be an electric motor, but the invention is not to be understood as so limited, for the controlling devices here shown are applicable to other forms of motive power and the member controlled thereby and itself controlling the motor may be a switch as here shown or the controlling lever or other devices of a water, steam or gas motor.

In the accompanying drawing: Figure 1 exhibits partly in diagram and partly in sectional elevation so much of the apparatus only as is necessary to an understanding of our invention in a form employing two separate switches arranged in series in the motor circuit; Figs. 2 and 3 show respectively in side and plan views a form of our invention wherein a plurality of controlling devices control a single switch.

In these examples of our invention the circuit is closed manually, and automatically controlled only as to the opening of the circuit.

Referring to Fig. 1 of the drawing, 1 and 2 are members controlling the stopping and starting of the refrigerant circulating pump. As here shown they are hand knife plate switches pivoted at 3 and 4 either alongside of each other on the same base plate, or on separate base plates 5 and 6. They may be so hung and weighted or spring actuated as by leaf spring *a*, as to be held normally away from their contacts but may be shifted by hand to engage a series of contacts 7, 8 and 9, 10 arranged in

series in circuit 11 which may include the pump motor or the controlling circuit thereof. Should either of said switches be opened the motor is out of circuit and the pump absolutely prevented from operation. Only two switches are here shown but it will be obvious that an additional one may be supplied for each part of the refrigerating system in which an abnormal or changed condition may render necessary or desirable the stopping of the motor and the consequent stoppage of circulation of the refrigerant. One of said switches may for example be controlled by the pressure in the condenser water conduit, the other by the pressure in the high pressure side of the refrigerant conduit, and a third might be controlled by the low pressure side of the latter. Various means may be adopted to this end, and those herein shown are intended to be illustrative merely and may be modified to suit the requirements. As here shown each switch arm 1 and 2 has a shoulder 12 and 13 engaged by the short arm or pawl 14 and 15 of an angle lever pivoted to the base plate and connected at the end of its long arm 16 and 17 to the pin 18 and 19 of the diaphragm or piston 20 and 21 in a pressure chamber 22 and 23. The angle levers are so actuated by springs $14^a$ or equivalent means as to prevent the short arms thereof engaging with the shoulders of the switch levers except at such times as the diaphragms are in position due to the normal operation of the system. The pressure chambers may be in various forms, for example, a cylinder and piston, a Bourdon tube or equivalent construction may be used; but as the simplest form we have shown and prefer the inclosed pressure chamber here illustrated with flexible diaphragm directly controlling the pin 18 and 19.

The pressure chamber 22 is on the side of the diaphragm opposite from the controlling pin 18 connected as by pipe 24 with a condenser water conduit, while the opposite side of the pressure chamber 23 is connected as by pipe 25 with the high pressure side of the refrigerant circulating conduit. Thus one of the diaphragms is controlled by the pressure of the water supply to the condenser and the other by the refrigerant circulation, both of which have to be in the proper condition in order that the system shall operate. Referring for example, to the switch 1 and its control pressure chamber, it will be seen that normally the pressure in pipe 24 will hold the diaphragm 20 to the position shown in full lines holding the locking pawl 14 in position to engage the shoulder of switch arm 1, but if there is an inadequate pressure of water in the pipe 24 diaphragm 20 will be drawn in to the position shown in dotted lines. The pawl 14 will not engage its switch and if the latter is closed, it cannot remain closed; also if with the pump in operation low pressure develops in the pipe 24, the diaphragm moving into the position shown in dotted lines will disengage the pawl 14 from the switch and the electric circuit will be automatically opened. Referring to switch 2 it will be seen that if when said switch is manipulated to close it, the pressure in the pipe 25 is abnormally high, the diaphragm 21 will be in the position shown in dotted lines and the switch cannot be held closed, and that the pump will not be started and if with the pump in operation such abnormal pressure develops in the refrigerant circuit, the switch will be automatically unlatched and will open the motor circuit and stop the pump. A duplicate of switch 1 and its controlling mechanism may, as already stated, be arranged in series therewith, but connected to the low pressure side of the refrigerant conduit so that abnormal drop of pressure therein would also open the circuit. The conduit would in that case be controlled by all three switches, all of the controlling pressures of which would have to be in a normal condition in order that the motor might be started and kept in operation.

Either switch 1 or 2 may be controlled by several pressure chambers. For example, we have illustrated in Figs. 2 and 3 how switch 1 may be controlled by pressure in two or more pressure chambers in several fluid circulating conduits. With this form of the mechanism switch 2 arranged in series with switch 1 may still be employed and be controlled by other fluid pressure devices, or it may be omitted and the motor circuit controlled by the single switch 1 controlled by all the fluid pressure circuits whose liability to abnormal conditions might be prejudicial to the proper operation of the system.

In Figs. 2 and 3 a single controlling switch or lever 1 is employed, having a pivoted locking pawl lever 14 and 16 engaging the shoulder 12 thereof. The spring 26 holds and returns the pawl lever to engaging position, so that in the normal operation of the apparatus the pawl 14 will engage and lock the switch whenever it is closed. The long arm 16 of the pawl lever enters a yoke 27 fixed to the base plate. Each diaphragm pin 28 and 29 of the condenser water pressure and refrigerant pressure controlling chambers 22 and 23 is prolonged to enter said yoke from opposite sides in rear of the arm 16, and they have inclines or cam faces 30 at their adjacent ends engaging the rear edge of arm 16. Thus abnormal pressure in either chamber 22 or 23 causing an outward movement of the corresponding pin 28 or 29 will cause movement of lever 16, 14 sufficient to free the switch and allow it to fall and open the circuit. It will be apparent

that with this form also both or all controlling pressure conditions must be normal to allow the switch to remain closed.

The pressure controlling devices above described may be made adjustable to suit the varying conditions and may be provided with signaling apparatus to indicate return of pressure conditions to normal. We have illustrated such mechanism in the form of the apparatus shown in Fig. 3. Suitable devices, for example, springs 31 and 32 of any desired form and adjustable if desired in either or both directions by adjusting screws as shown, may be employed to adjust the pressure required for releasing or holding the switches.

The arrangement is evidently capable of extension by simple addition of pressure chambers, etc., to the controlling of the switch by any number of members. In this way a pressure chamber controlled by the low side of the refrigerant circuit may be added. However many such controlling devices are used, all must indicate a normal condition in their several conduits before the motor can be started, and any departure from normal conditions of a predetermined amount in any conduit will stop the motor.

The pins 28 and 29 may be made with adjusting means such as turn buckles 33 placed on pins 28 and 29, so that their length may be adjusted as required for different conditions, for example, different normal positions of the respective diaphragms.

A signal circuit, as for example, the light circuit 34 may be so arranged as to give a signal when both or all of the controlling pressure conditions are normal. As here shown the signal circuit has terminals 35 and 36 engaged by contacts on pins 28 and 29 when the diaphragms are in normal position, thus completing the circuit through the engaging metal parts 27, 28 and 29.

We claim:

1. In a refrigerating system, the combination with a motor controlling switch, a plurality of pressure operated devices, each dependent upon the pressure in its own controlling fluid, and independent of the pressure in the controlling fluid of another, and means for adjusting said pressure operated devices to be operated at the desired pressure; of means controlled by all of said pressure operated devices conjointly for keeping the motor controlling switch closed, and by any one of them alone for opening the motor controlling switch.

2. In a refrigerating system, the combination with a motor controlling switch, and means constantly tending to open the same; of a plurality of pressure operated devices, each controlled by the pressure in its own controlling fluid, and independent of the pressure in the controlling fluid of another, means for adjusting each of said pressure operated devices to operate at the desired pressure, and means for holding said switch closed when all of said pressure operated devices are normal, and for permitting said switch to open when any one of them is abnormal.

3. In a refrigerating system, the combination with a motor controlling switch, means constantly tending to open the same, and a latch adapted to hold said switch closed; of a plurality of pressure operated devices, each controlled by the pressure in its own controlling fluid, and independent of the pressure in the controlling fluid of the other, means for adjusting each of said pressure operated devices to operate at the desired pressure, and means for permitting said latch to hold said switch closed when all of said pressure operated devices are normal, and for preventing it from holding said switch closed when any one of them is abnormal.

4. In a refrigerating system, the combination with a motor controlling switch, means constantly tending to open the same, and a latch adapted to hold the switch closed; of a plurality of pressure operated devices, each controlled by the pressure in its own controlling fluid, but independent of the pressure in the controlling fluid of the other, means for adjusting each of said pressure operated devices to operate at the desired pressure, and means for moving said latch out of said switch holding position when any one of said pressure operated devices is abnormal.

EUGENE CARPENTER.
FRED M. KIMBALL.

Witnesses:
M. S. NORTON,
M. J. FITCH.