May 19, 1925. 1,538,486

F. J. HUMPHREY ET AL

REFRIGERATING MACHINE

Filed June 14, 1923 4 Sheets-Sheet 1

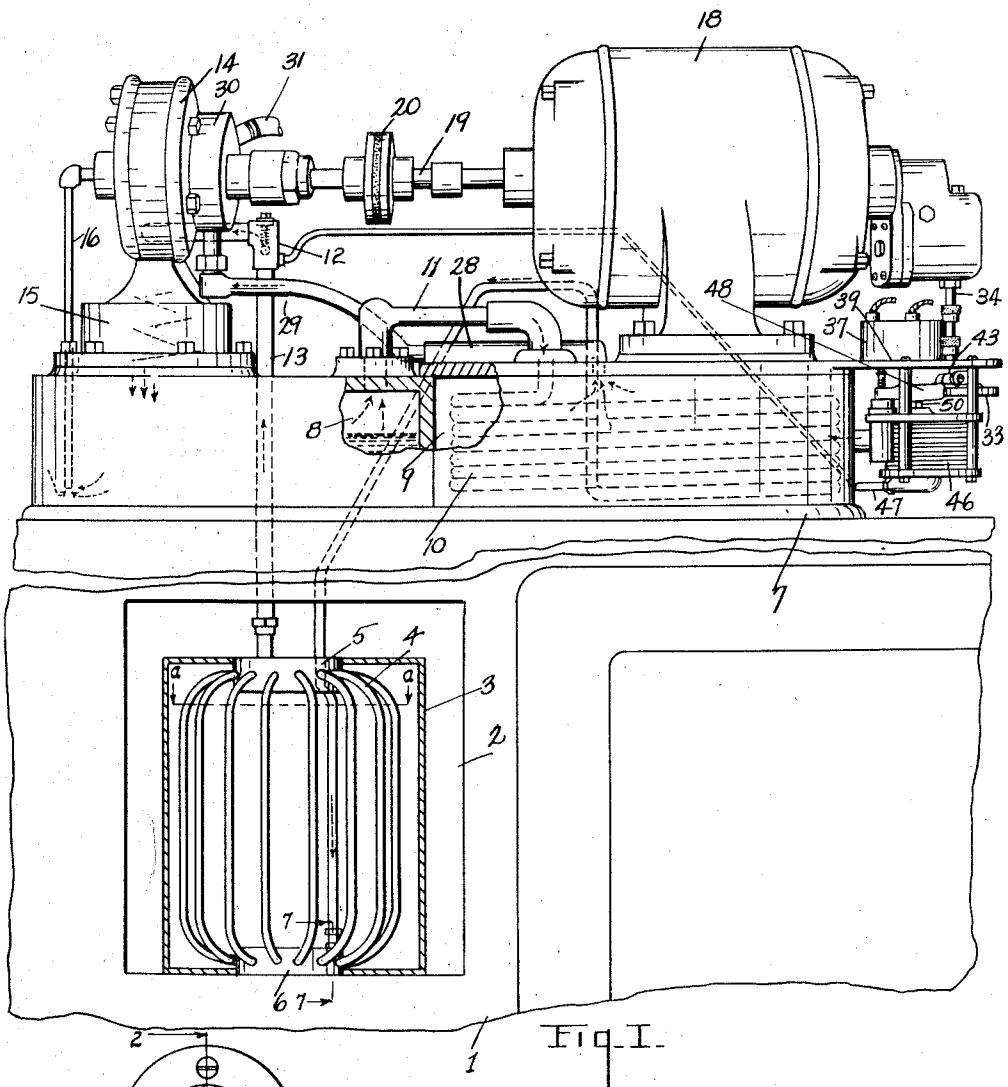


Fig. I.

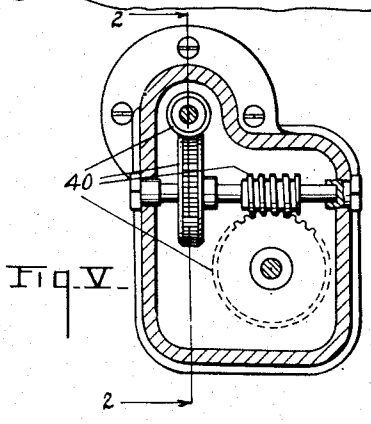


Fig. V.

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Fig. VI.

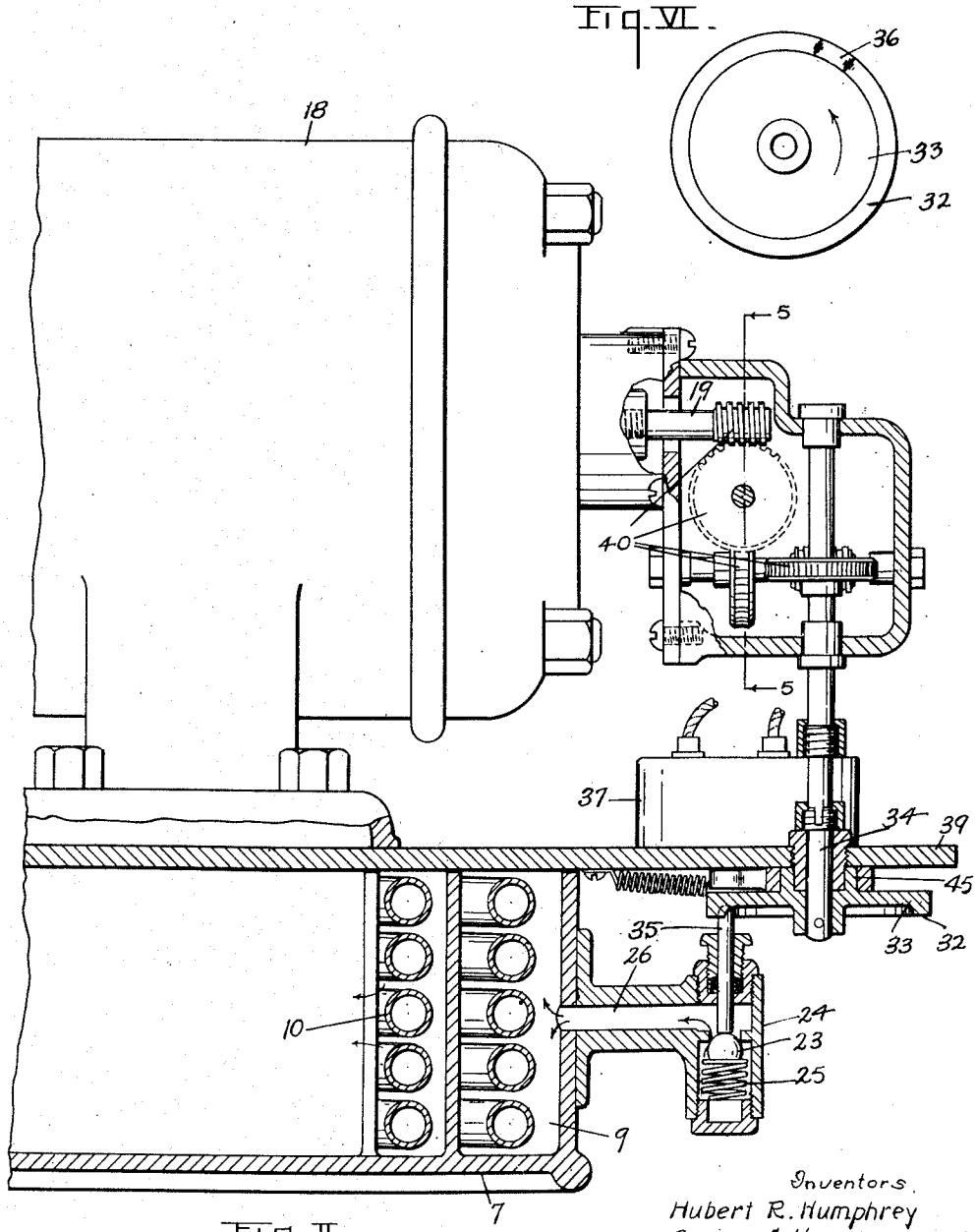


Fig. II.

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Filed June 14, 1923 4 Sheets-Sheet 3

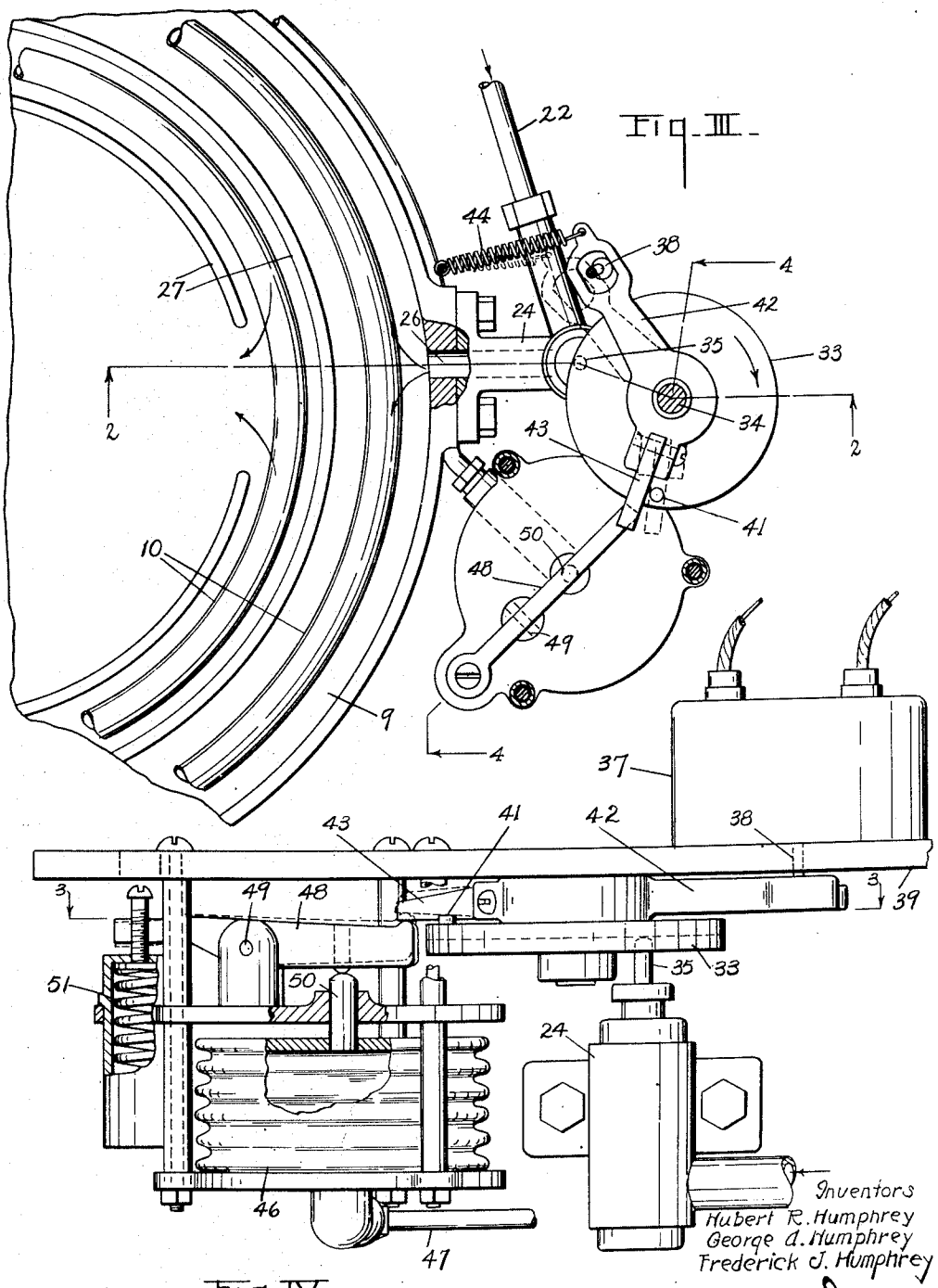


Fig. III.

Fig. IV.

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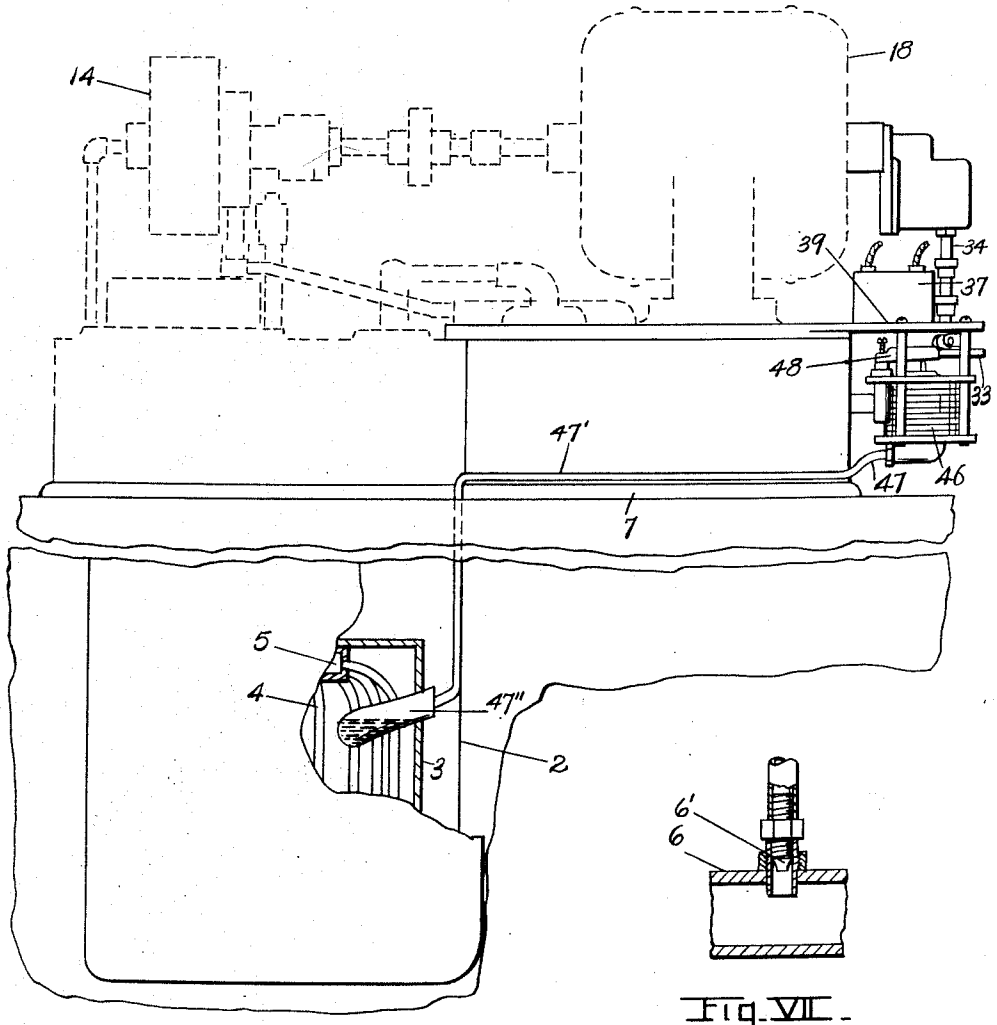


Fig. VIII.

Fig. VII.

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UNITED STATES PATENT OFFICE.

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REFRIGERATING MACHINE.

Application filed June 14, 1923. Serial No. 645,285.

To all whom it may concern:

Be it known that we, FREDERICK J. HUMPHREY, HUBERT R. HUMPHREY, and GEORGE A. HUMPHREY, citizens of the United States, residing at the city and county of Kalamazoo, State of Michigan, have invented certain new and useful Improvements in Refrigerating Machines, of which the following is a specification.

This invention relates to improvements in refrigerating machines.

The main objects of the invention are:

First, to provide in a refrigerating machine an improved motor control means whereby the motor is permitted to run for predetermined periods, the intervals between these running periods being governed by temperatures controlled by the refrigerant fluid.

Second, to provide an improved refrigerating machine without expansion valves or float valves.

Third, to provide in a refrigerating machine an improved control means permitting the return at intervals of all the liquid refrigerant from the condenser to the expansion chamber or refrigerant element.

Fourth, to provide a refrigerating machine in which the condensed refrigerant is delivered to the expansion chamber so as to agitate the liquid refrigerant therein.

Fifth, to provide in a refrigerating machine an automatic control means which is positive and reliable in action and operation.

Sixth, to provide in a refrigerating machine having an electric motor an improved control means whereby the motor is controlled so that it is not likely to become overheated.

Seventh, to provide in a refrigerating machine an improved control means for the condenser.

Eighth, to provide an improved refrigerating machine having these advantages which is compact and simple in structure.

Further objects, and objects relating to structural details, will definitely appear from the detailed description to follow.

We accomplish the objects of our invention by the devices and means described in the following specification. The invention is clearly defined and pointed out in the claims.

A structure which is a preferred embodiment of our invention is clearly illustrated in the accompanying drawing, forming a part of this application, in which:

Fig. I is a side perspective view of a refrigerating machine embodying the features of our invention, parts being broken away for convenience in illustration.

Fig. II is an enlarged detail view, partially in section, on a line corresponding to line 2—2 of Figs. III and V.

Fig. III is a horizontal section on a line corresponding to line 3—3 of Fig. IV.

Fig. IV is a detail elevation, partially in vertical section, on a line corresponding to line 4—4 of Fig. III showing details of the control means.

Fig. V is a vertical section through the driving mechanism on a line corresponding to line 5—5 of Fig. II.

Fig. VI is an inverted view of the water valve control cam.

Fig. VII is a detail view, partially in vertical section, on a line corresponding to line 7—7 of Fig. I, showing details of the condenser connection to the expansion chamber.

Fig. VIII is a fragmentary side elevation of a modified form of our invention in which a thermostatic control is provided.

In the drawing similar reference numerals refer to similar parts throughout the several views, and the sectional views are taken looking in the direction of the little arrows at the ends of the section lines.

Referring to the drawing, 1 represents the refrigerator proper provided with a refrigerating chamber 2 having a brine tank 3 therein. The expansion chamber or refrigerant element in the structure illustrated comprises the coils 4 connected by the top and bottom headers 5 and 6. It will be understood that various refrigerants may be used, sulphur dioxide being frequently used in machines of this class.

We provide a base 7 which, in the structure illustrated, is mounted on the top of the refrigerator. This base is provided with a

lubricant chamber 8 and a condensing chamber 9, the condensing coils 10 being arranged in this condensing chamber as shown in Fig. III. The upper end of the coil is connected to the chamber 8 by a suitable conduit 11, while the lower end of the coil is connected to the bottom header 6 of the expansion chamber, as shown in Fig. VII. This connection is through a restricted discharge nozzle 6', the purpose of which will appear as the description proceeds.

The top header 5 of the expansion chamber or refrigerant element is connected by the suction pipe or conduit 13 to the intake of the pump 14. This connection 13 is provided with a check valve 12, shown conventionally in Fig. I. The pump is, for convenience, mounted at one end of the base 7 and delivers to a separating chamber 15 in the base of the pump, this chamber being provided with baffles, shown conventionally by dotted lines in Fig. I.

The chamber 8 in the base 7 also serves as a separating chamber.

Oil is supplied to the pump through the pipe 16 projecting into the chamber 8 to a point below the level of the lubricant therein, as illustrated in Fig. I.

The pump is driven from the motor 18 mounted upon the base 7, the driving shaft 19 being preferably provided with a universal joint, indicated at 20. The details of the pump form no part of this invention and are therefore not illustrated herein.

The condensing chamber 9 is connected to a suitable water supply by the pipe 22 controlled by the valve 23, a casing 24 of this valve being designed so that the valve seats with the pressure of the water. A spring 25 is provided to urge the valve towards its seat. Water is delivered through the passage 26 from the valve casing into the side of the condensing chamber and is caused to take a circuitous path therein by the baffles 27 which are arranged in an alternate relation, as shown in Figs. II and III.

The discharge pipe 28 of the condensing chamber is connected by the pipe 29 to a cooling chamber or jacket 30 for the pump. This cooling chamber or jacket has a waste or discharge pipe 31 connected thereto.

The motor is controlled by a timing means driven by the motor so that the period of operation of the motor is predetermined, the machine, as we have embodied it, being designed to run for a period of fifteen minutes at the end of which period it is automatically stopped, the motor being started by a means controlled by the temperature conditions in the refrigerator either through the refrigerant itself or through a thermostatic means.

In the embodiment shown in Fig. I the refrigerant is the primary or direct actuating means.

In the embodiment shown in Fig. VIII a thermostatic fluid is the primary or direct actuating means for the motor starting mechanism. This timing control means also serves as a means for controlling the water valve 23, that is, the mechanism is designed to hold the valve 23 open during the operation of the motor.

In the embodiment illustrating the timing member 33 is mounted on the shaft 34 and is provided with a cam 32 adapted to coact with the valve stem 35 which reciprocates through a suitable gland in the valve casing 24 to engage the ball valve 23, see Fig. II. The cam 32 has a recess 36 therein adapted to receive the stem 35 allowing the valve to seat, the recess being positioned so that the valve is seated when the parts are in their initial position or position of rest.

The motor is controlled by the switch 37, shown conventionally in the drawing, the switch being provided with a lever 38 projecting downwardly from the supporting bracket 39. The shaft 34 is connected by the train of gears 40 to the motor shaft 19, the train of gears being designed to reduce the speed of the shaft 34 relative to the shaft 19, the structure illustrated being arranged so that about fifteen minutes is required for one complete revolution of the timing member 33.

The timing member is provided with a tappet 41 for the switch actuating lever 42, this lever being pivoted upon the hub-like projection 45 on the timing member 33 and having a hole therein through which the switch lever 38 projects.

The lever 42 is provided with a pivoted dog 43 coacting with the tappet 41, the tappet engaging this dog and swinging the lever 42 to switch opening position. When the dog 43 is disengaged from the tappet 41 the lever 42 is actuated to switch closing position by means of the coiled spring 44 so that the releasing of the dog 43 starts the motor. This dog 43 is released or disengaged from the tappet by the control diaphragm or expansible element 46 which is connected in the embodiment shown in Fig. I by the pipe 47 to the expansion chamber suction pipe 13, the connection to the pipe 13 being at a point in advance of the check valve 12 therein.

In the embodiment shown in Fig. VIII the expansion member 46 is connected by the conduit 47' to the bulb 47'' which is shown as disposed within the brine tank.

It will be understood that other thermostatic means might be utilized.

A trip lever 48 is pivoted at 49 to engage the stem 50 of the expansible element 46, the trip lever being positioned to coact with the dog 43 so that when the expansible member is actuated or expanded the dog 43 is released and the motor started.

The lever 48 is provided with a regulating spring 51 so that the pressures at which the device will operate may be determined.

The motor thus started continues to run until the timing member has completed its revolution when the tappet 41 will engage the dog 43 and actuate the lever 42 to open the switch, thereby stopping the motor so that the motor is positively stopped on each complete revolution.

Through the mechanism described the water is delivered to the condenser only during the periods of operation.

As soon as the motor is started the operation of the pump draws on the suction connection 13 and the diaphragm or expansible element being connected to this connection in the embodiment shown in Fig. I the dog 43 is permitted to return to stopping position. The normal liquid refrigerant level in the expansion chamber or refrigerant element is indicated at A—A, the same being below the top header 5. The condenser discharge is connected to the bottom header 6 through the restricted delivery nozzle 6'. This restriction is relatively fixed, that is, it does not open and close as is the case, for instance, with the common type of expansion valve, and is of such capacity that under normal operation some liquid refrigerant will accumulate within the coils during the periods of operation of the pump. However, during the intervals of rest the liquid or condensed refrigerant is all returned to the expansion chamber. The delivery of this condensed or liquid refrigerant to the bottom of the expansion chamber causes an agitation or ebullition therein which increases the refrigerating action. The periods between operation are of course governed broadly by the temperatures within the refrigerating chamber as until the temperature has been reduced to approximately the desired point the pressure of the gasified refrigerant will soon become such as to operate the motor starting mechanism. However, there is a sufficient interval between each operation to allow the condensed refrigerant to return from the condenser to the expansion chamber and this interval also permits the cooling of the motor.

By this arrangement of parts we avoid the use of expansion valves, floats and the like, and we thus eliminate elements which are frequently the cause of trouble in machines of this character.

Our improved refrigerating machine is entirely automatic in operation, is not likely to get out of repair or become inoperative. It conserves power and prevents over-heating of the motor.

For example, refrigerating machines in which the motor is controlled thermostatically are likely to operate for long periods of time because of not attaining the degree of temperature at which the thermostat is set to operate. The thermostat may be set to operate at 20 degrees and a temperature of 20½ degrees be reached, but it is impossible for the machine to reach the additional one-half degree necessary to actuate the thermostat. The result is that the machine continues to operate, although from a practical standpoint the 20½ degrees refrigeration is all that is required. Further, it is found that the temperature is likely to fall after the machine has ceased to operate. With the periodical stopping of our motor, these conditions do not arise.

We have illustrated and described our improvements in an embodiment or adaptation which we have found very practical. We have not attempted to illustrate or describe other adaptations or modifications which we contemplate as we believe the disclosure made will enable those skilled in the art to which our invention relates to embody or adapt the same as may be desired.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent, is:

1. In a structure of the class described, the combination of a compressor, a motor for driving said compressor, an expansion chamber, a condenser operatively connected to said compressor and expansion chamber, means for controlling said motor comprising a switch, an actuating lever for said switch provided with a dog, a timing member driven by said motor provided with a tappet coacting with said dog for actuating said lever to switch opening position, a spring for actuating said lever to switch closing position when said dog is disengaged from said tappet, releasing means for said dog operatively associated with said expansion chamber, and a water supply valve for said condenser provided with a stem, said timing member being provided with a cam adapted to hold said valve open during the actuation of said timing member, said cam permitting the valve to close when the timing member is in its initial position.

2. In a structure of the class described, the combination of a compressor, a motor for driving said compressor, an expansion chamber, a condenser operatively connected to said compressor and expansion chamber, means for controlling said motor comprising a switch, an actuating lever for said switch provided with a dog, a timing member driven by said motor provided with a tappet coacting with said dog for actuating said lever to switch opening position, a spring for actuating said lever to switch closing position when said dog is disengaged from said tappet, and releasing means for said dog operatively associated with said expansion chamber.

3. In a structure of the class described, the

combination of a compressor, a motor for driving said compressor, an expansion chamber, a condenser operatively connected to said compressor and expansion chamber, means for controlling said motor comprising a switch, an actuating lever for said switch provided with a dog, a rotating timing member driven by said motor and provided with a tappet coacting with said dog for actuating said lever to switch opening position, a spring for actuating said lever to switch closing position when said dog is disengaged from said tappet, and a pressure controlled means operatively associated with said expansion chamber and comprising a trip member for said dog.

4. In a structure of the class described, the combination of a compressor, a motor for driving said compressor, an expansion chamber, a condenser operatively connected to said compressor and expansion chamber, a control switch for said motor, an actuating lever for said switch, a rotatably mounted timing member, a tappet on said timing member for actuating said lever to switch opening position, and means for closing said switch including a member operatively associated with said expansion chamber.

5. In a structure of the class described, the combination of a compressor, a motor for driving said compressor, an expansion chamber, a condenser operatively connected to said compressor and expansion chamber, means for controlling said motor comprising a timing member driven by said motor and whereby the period of continuous operation of said motor is predetermined, and a valve for said condenser, said timing member being adapted to hold said valve in open position during the actuation of said timing member.

6. In a structure of the class described, the combination of a compressor, a motor for driving said compressor, an expansion chamber, a condenser operatively associated with said compressor and expansion chamber, means for stopping said motor comprising a timing member driven by said motor and whereby the period of continuous operation of said motor is predetermined, means for starting said motor including a member operatively associated with said expansion chamber, a water supply valve for said condenser, and means for controlling said valve including said timing member and adapted to hold said valve in open position when said timing member is actuated.

7. In a structure of the class described, the combination of a compressor, a motor for driving said compressor, an expansion chamber, a condenser operatively associated with said compressor and expansion chamber, motor control means comprising a timing member driven by said motor and whereby the period of continuous operation of said motor is predetermined, a supply valve for said condenser, said timing member being provided with means for controlling said valve, and means for starting said motor operatively associated with said expansion chamber.

8. In a structure of the class described, the combination of a compressor, a motor for driving said compressor, an expansion chamber, a condenser operatively associated with said compressor and expansion chamber, motor control means comprising a timing member driven by said motor and whereby the period of continuous operation of said motor is predetermined, and a supply valve for said condenser, said timing member being provided with means for controlling said valve.

9. In a structure of the class described, the combination of a compressor, a motor for driving said compressor, an expansion chamber, a condenser operatively associated with said compressor and expansion chamber, motor control means comprising a timing member driven by said motor and whereby the period of continuous operation of said motor is predetermined, and means for starting said motor operatively associated with said expansion chamber.

10. In a structure of the class described, the combination of a compressor, a motor for driving said compressor, an expansion chamber, a condenser operatively associated with said compressor and expansion chamber, and motor control means comprising a timing member driven by said motor and whereby the period of continuous operation of said motor is predetermined.

11. In a structure of the class described, the combination of a pump, a motor for driving said pump, an expansion chamber comprising upper and lower headers and connecting pipes, the normal liquid refrigerant level being below the upper header, a suction connection for said pump to said expansion chamber above said normal liquid refrigerant level thereof, said suction connection being provided with a return check valve, a condenser to which said pump delivers, a delivery connection for said condenser to the bottom header, such connection having a fixed restriction therein adjacent the header, means for stopping said motor comprising a timing member driven by said motor and whereby the period of continuous operation of said motor is predetermined, and means for starting said motor comprising a pressure actuated member connected to said suction connection in advance of said check valve.

12. In a structure of the class described, the combination of a pump, a motor for driving said pump, an expansion chamber, a connection for said chamber to said pump including a check valve, a condenser oper-

atively connected to said pump, a connection for said condenser to said expansion chamber having a restriction therein, means for stopping said motor comprising a timing member, and means for starting said motor including a member operatively connected so that it is subject to the pressure in advance of said check valve.

13. In a structure of the class described, the combination of a compressor, a motor for driving said compressor, a condenser, an expansion chamber operatively associated with said compressor and condenser, and means for controlling said motor comprising a timing member driven by said motor and whereby the period of continuous operation of the motor is predetermined.

14. In a structure of the class described, the combination of a pump, a motor for driving said pump, an expansion chamber, a suction line connecting said expansion chamber with said pump, said suction line being provided with a check valve, a condenser operatively connected to said pump, a delivery connection for said condenser to said expansion chamber having a restriction therein, means for controlling said motor comprising a timing element driven by the motor whereby the motor is stopped, and means for starting said motor including a pressure actuated member connected to said suction line in advance of said check valve.

15. In a structure of the class described, the combination of a pump, a motor for driving said pump, a refrigerant element, a suction line connecting said refrigerant element with said pump, a condenser operatively connected to said pump, a delivery connection for said condenser to said refrigerant element, means for controlling said motor comprising a timing element driven by the motor whereby the motor is stopped, and means for starting said motor including a pressure actuated member connected to said suction line.

16. In a structure of the class described, the combination of a pump, a motor for driving said pump, an expansion chamber, a connection for said chamber to said pump, a condenser operatively connected to said pump, a connection for said condenser to said expansion chamber, means for stopping said motor comprising a timing member driven by said motor, and means for starting said motor including a member operatively associated with said expansion chamber.

17. In a structure of the class described, the combination of a pump, a motor for driving said pump, a refrigerant element, a suction line connecting said refrigerant element with said pump, a condenser operatively connected to said pump, a delivery connection for said condenser to said refrigerant element, and means for controlling said motor comprising a timing element driven by the motor whereby the motor is stopped.

18. In a structure of the class described, the combination of a pump, a motor for driving said pump, an expansion chamber, a connection for said pump to said expansion chamber above the normal liquid refrigerant level thereof, a condenser operatively connected to said pump, a restricted delivery connection for said condenser connected to said expansion chamber below the normal liquid refrigerant level thereof whereby the delivery of the condensed refrigerant causes ebullition within the expansion chamber, and means for controlling the motor whereby it is stopped at the end of predetermined periods of operations permitting the liquid within the condensing chamber to return to the expansion chamber.

19. In a refrigerating apparatus, the combination of a means for compressing refrigerant, a motor for operating said compressing means, an expansion chamber, a continuously open restricted delivery connection from said compressing means to said expansion chamber delivering thereto below the liquid level thereof, and a motor control means including a mechanical timing means whereby the motor is periodically stopped and means for starting the motor controlled by the pressure in the system in advance of said compresing means.

20. In a refrigerating apparatus, the combination of a means for compressing refrigerant, a motor for operating said compressing means, an expansion chamber, a continuously open restricted delivery connection from said compressing means to said expansion chamber, and a motor control means including a mechanical timing means whereby the motor is periodically stopped and means for starting the motor controlled by the pressure in the system in advance of said compressing means.

21. In a refrigerating apparatus, the combination of an expansion chamber, a condenser, a compressor operatively associated with said expansion chamber and condenser, a motor for driving said compressor, a continuously open restricted delivery connection for said condenser to said expansion chamber, automatically acting timing means for periodically stopping said motor at the end of uniform periods of operation, and means for starting said motor operatively associated with said expansion chamber.

22. In a refrigerating apparatus, the combination of an expansion chamber, a condenser connected to deliver to said expansion chamber, a compressor operatively associated with said expansion chamber and condenser, a motor for driving said compressor, automatically acting timing means

for periodically stopping said motor at the end of uniform periods of operation, and means for starting said motor operatively associated with said expansion chamber.

23. The combination in a mechanical refrigerating apparatus including a driving motor, of a control comprising automatically acting timing means for periodically stopping said motor at the end of uniform periods of operation, and means for automatically starting said motor controlled by refrigerant conditions.

24. In a refrigerating apparatus, the combination of a compressor, a motor for driving said compressor, a condenser, an expansion chamber operatively associated with said compressor and condenser, a motor control means including a mechanical timing means driven by the motor and whereby the motor is periodically stopped, and means for starting the motor control means by the condition of the refrigerant.

25. In a refrigerating apparatus, the combination of a compressor, a motor for driving said compressor, a condenser, an expansion chamber, a continuously open restricted delivery connection for said condenser to said expansion chamber, a connection for said expansion chamber to said compressor, and an automatically acting motor control means comprising a driven timing member whereby the period of continuous operation of the motor is predetermined.

26. In a refrigerating apparatus, the combination of means for compressing refrigerant, a motor for operating said compressing means, a condenser, an expansion chamber, a delivery connection from said condenser to said expansion chamber, a connection for said expansion chamber to said compressing means, a motor control means including a mechanical timing means whereby the motor is periodically stopped, and means for starting the motor controlled by the condition of the refrigerant.

27. In a refrigerating apparatus, the combination of a compressor, means for compressing refrigerant, a motor for operating said compressing means, an expansion chamber, a continuously open restricted delivery connection from said condenser to said expansion chamber, a return connection from said expansion chamber to said compressing means, a motor control means including a mechanical timing means whereby the motor is periodically stopped, and a refrigerant controlled means for starting the motor.

In witness whereof, we have hereunto set our hands and seals.

FREDERICK J. HUMPHREY. [L. S.]
HUBERT R. HUMPHREY. [L. S.]
GEO. A. HUMPHREY. [L. S.]