June 2, 1931. R. J. MITCHELL 1,808,056

REFRIGERATING SYSTEM

Filed May 9, 1929 2 Sheets-Sheet 1

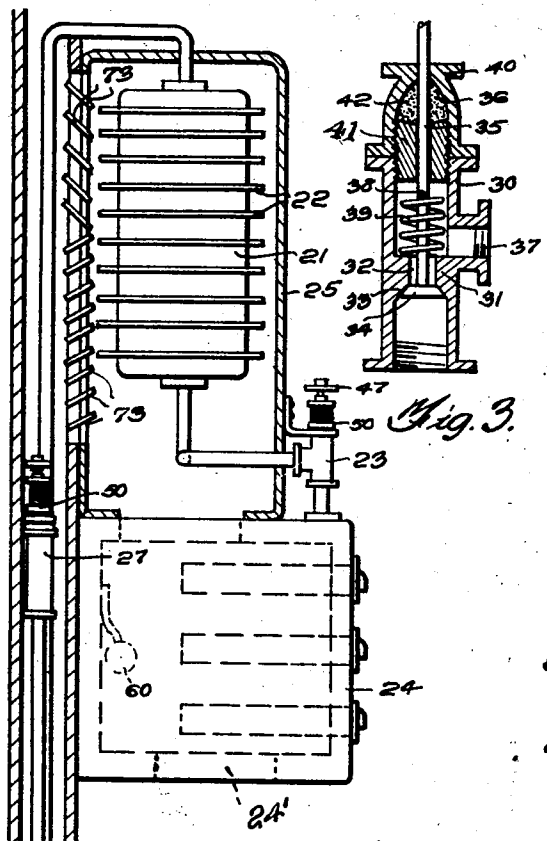


Fig. 2.

Fig. 3.

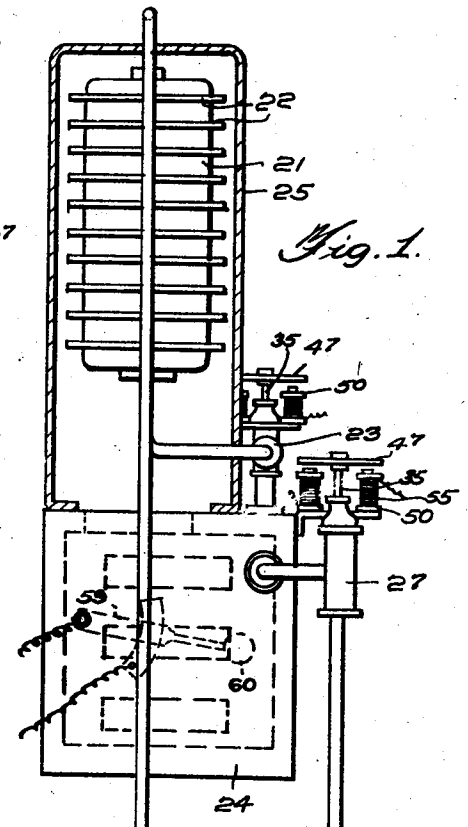
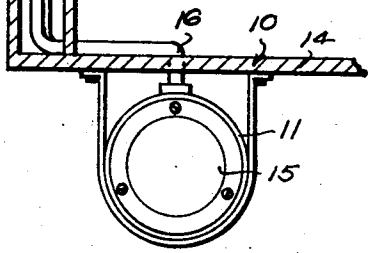
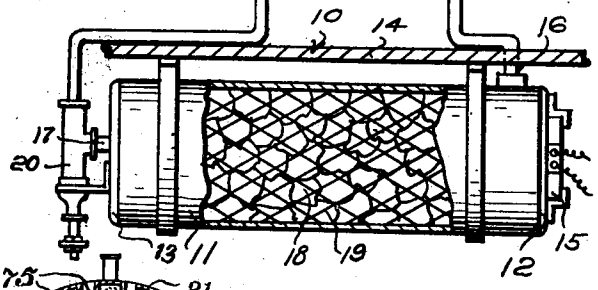


Fig. 1.





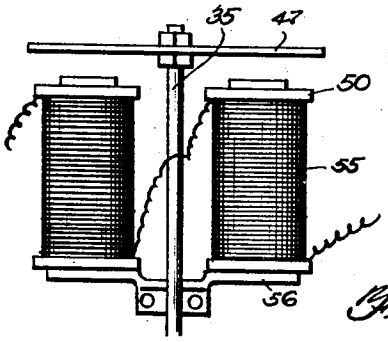


Fig. 4.

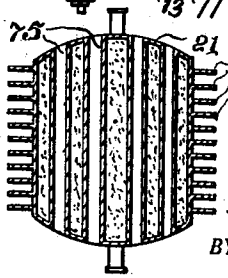


Fig. 8.

INVENTOR:
Robert J. Mitchell,
BY H. S. Woodward,
ATTORNEY.

June 2, 1931. R. J. MITCHELL 1,808,056

REFRIGERATING SYSTEM

Filed May 9, 1929 2 Sheets-Sheet 2

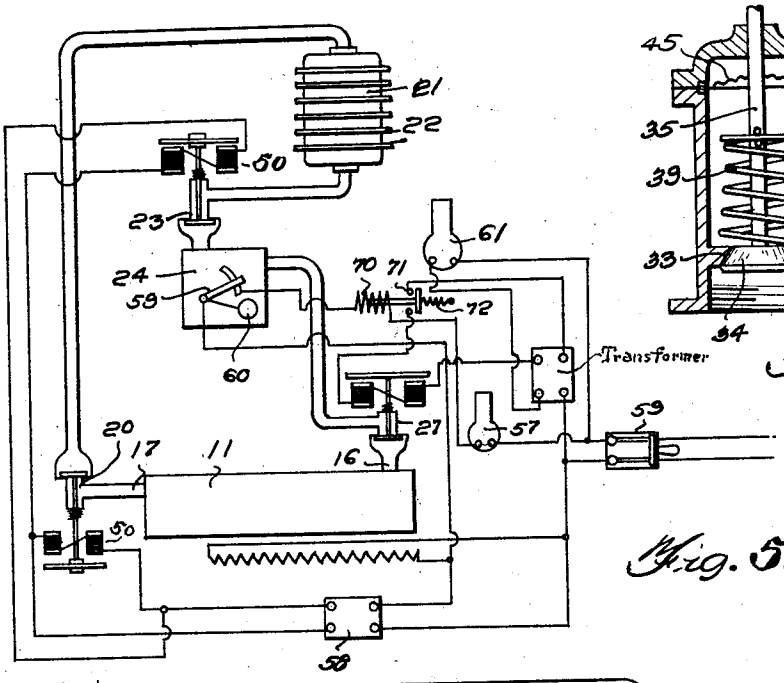


Fig. 5.

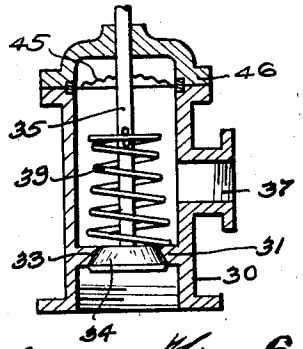


Fig. 6.

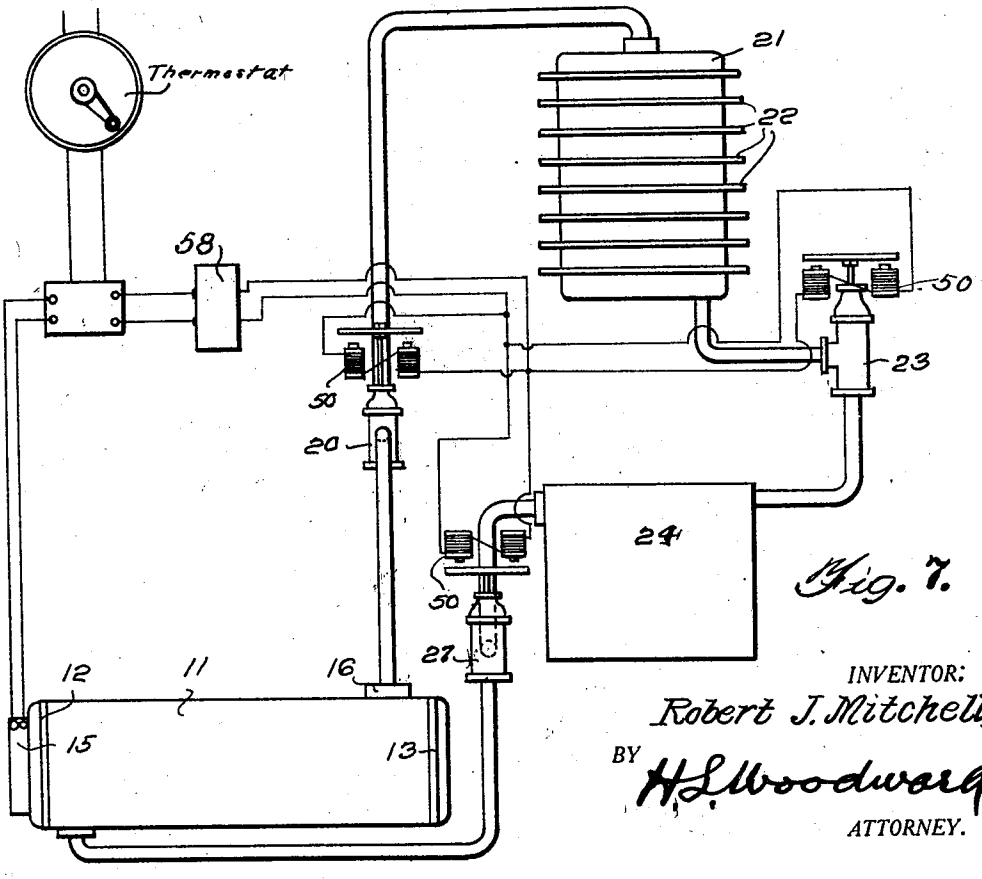


Fig. 7.

INVENTOR:
Robert J. Mitchell,
BY H. L. Woodward,
ATTORNEY.

Patented June 2, 1931 1,808,056

UNITED STATES PATENT OFFICE

ROBERT J. MITCHELL, OF KENT, OHIO

REFRIGERATING SYSTEM

Application filed May 9, 1929. Serial No. 361,781.

The invention has for an object to provide an improved refrigeration system utilizing the absorption-distillation principle, especially adaptable to embodiment in a form suitable for domestic use, though it may also find use in larger sizes.

It is an important object of the invention to improve the construction of such devices to the end that much piping and other complications of manufacture and erection will be eliminated.

An especially important purpose of the invention is to present an electrically controlled plant adapted to be manufactured for automatic operation in a novel manner eliminating many objectionable features of prior systems of construction, and attaining peculiar efficiency and dependability, as well as being liable in a minimum degree to derangement.

Another important purpose of the invention is to attain a prompt functioning of the device in condensing and evaporating a refrigerant such as is capable of being absorbed efficiently by known materials, then liquefied and expanded.

Additional objects, advantages and features of invention reside in the construction, arrangement, and combination of parts involved in the production of an operative machine utilizing my invention, and these will be more clearly apparent from a consideration of the following description and the accompanying drawings, wherein,

Figure 1 is a vertical elevation of a plant constructed in accordance with the invention.

Figure 2 is a view at right angles to Figure 1.

Figure 3 is a detail of a valve.

Figure 4 is a detail of the operating means for the valve.

Figure 5 is a diagrammatic view of the system.

Figure 6 is a detail of a modified valve.

Figure 7 is a diagrammatic view of a modified system.

Figure 8 is a detail vertical section through a condenser.

There is illustrated a chamber or box 10 of a refrigerator in which food or other material is to be put to be maintained at a low temperature. This chamber may be constructed in accordance with approved practice in the art. Beneath the chamber 10 there is shown an absorber-still tank 11 of a simple cylindrical form having its ends closed by respective heads 12 and 13. The tank is suspended from the floor 14 of the box 10, and may be constructed in any approved manner suited to the uses contemplated. One of the heads at least is planiform and mounted detachably thereon there is an electrical heating unit 15. For this reason the absorber may be mounted in a vertical position, if desired. There is a single inlet connection 16 on this tank, and a single outlet connection 17. Within the tank 11 there is enclosed a suitable bulk of porous silica compound 18, one form of which is known at present as "silica gel". This may be enclosed in a net or other cartridge or foraminate envelope 19—woven wire having been employed.

At the outlet 17 an electrically operated valve 20 is provided, from which leads a fresh gas line to a condenser 21 of approved construction, mounted at a convenient point for diffusion of heat from the gas distilled in the tank 11. For convenience, the tank 21 is indicated at the top of the "box" 10, but may be located elsewhere as discretion dictates; it is sufficient to say that for efficient diffusion of the heat incident to liquefaction of the refrigerant (as may be involved with ammonia), it is desirable that an adequate air circulation be provided for. The condenser may be located within a jacket or case 25 adapted to facilitate the circulation of air between the fins 22, and in the present instance this case is indicated as located inside the box 10. It must be above the receiver 24, as will be understood. The case 25 is open at top and bottom in the rear so that thermo-siphon circulation of air may be induced by the heat imparted to the air through radiation from the fins on the condenser 21. From the lower part of the condenser a connection is made through an electrically operated valve 23, (similar to the valve 20) to a receiver of liquefied refrigerant at 24. The

latter is a simple rectangular box-like tank as shown, and is formed with a double wall within which is packed a suitable insulation, except at certain upper parts exposed to the interior of the box 10, where only the inner wall portion is provided, and no insulation.

These parts without insulation serve as heat absorbing areas on the receiver, so that during a period when the refrigerant is evaporating refrigeration will occur in the box.

From the upper part of the tank an outlet leads to the still-absorber 11, and has a valve 27 therein similar to the valve 20 already referred to.

The valves 20, 23, and 27, are all of the same construction, each including a body 30 substantially cylindrical in its main part and having a partition 31 nearer one end than the other, in which there is formed a port 32, this port having a seat 22 at its outer side, on which may seat a valve 34, the stem 35 of which passes through the port 32 and also outwardly through a packing device 36 at the end of the body 30. The body has a lateral inlet extension 37 opening into the body at that side of the partition 31 opposite the seat 33. The valve stem 35 is provided with a cross member 38 against which there is engaged a helical spring 39 encircling the stem 35 and seated against the partition 31, so that the valve is maintained yieldingly seated. The packing device may comprise a bonnet 40 held to the body of the valve by a nipple 41 screwed into each, and the nipple is constructed so as to serve as both a guide for the stem 35 and compression for the packing 42 within the bonnet 40. In another form of the device (Fig. 6), the stem 35 is united to the central part of a diaphragm 45, through which the stem passes axially, the diaphragm being confined between the end of the body of the valve and a flange 46 outwardly of the diaphragm. The last arrangement provides a complete seal around the valve stem, yet permits the necessary movement of the valve.

To operate the valve, there is provided an armature 47 fixed on the extremity of the stem 35. Beneath this there is an electro-magnet 50 capable of exerting the desired force to open the valve and in operative relation to the armature. The coils 55 of the electro-magnet are mounted on a bracket 56 attached to the valve although any other support may be used.

It is to be noted that all of the valves will close automatically by the action of the spring when the circuit is broken, so that in case of an interruption of circuit, by the wiring circuit to be described, the system will merely go into a state of inoperativeness as to all parts, and no liability of danger be involved.

The system is controlled by thermostats entirely in response to requirements in the box 10. The valves 20 and 23 and the heater 15 are controlled by a single thermostat 57 located in the refrigerator. This is adapted to close the main heating circuit when the temperature in the box is above a given minimum and at the same time a circuit in multiple is closed to a transformer 58, the secondary of which supplies a proper current for the operation of the magnets 50 of the valves 20 and 23, so that these valves are opened simultaneously with the operation of the heater 15. The circuit to the heater from the thermostat also includes a switch 59 operated by a float 60 in the liquefied ammonia receiver 24. The construction of the switch and float are of such kind that a delayed break of the circuit is effected when the displacement of liquid by the float is sufficient to raise it beyond its position at the time the actual breakage of the circuit occurs. In this way a considerable amount of the liquefied refrigerant will have been evaporated before the switch 59 is closed again by the falling of the float, and before that time the temperature in the box will have become lowered sufficiently to cause the opening of the circuit at the thermostat 57, preventing premature operation of the heater and valves 20—23.

The valve 27 is controlled by a separate thermostat 61 also located in the box 10, and arranged to close the circuit to open the valve when the temperature is above a predetermined maximum. In the circuit from the switch 59 there is included a solenoid coil 70, utilized to open a switch 71 in the circuit from the thermostat 61 by which the valve 27 is controlled. The switch 71 incudes a yielding closing means such as a spring 72, connected to the movable member and tending to move it to closed position in opposition to the solenoid, the latter, however, being so constructed that it may overcome the force of the spring when energized. This insures against the opening of the valve 27 while the heater is operating and thereby prevents entrance of hot vapor directly to the receiver 24.

In operation, the thermostat 61 would be set to close the circuit when the temperature is above 40 degrees, or at some lower stage if preferred, according to the need.

The thermostat 57 might be set to operate to close the circuit at a temperature of 55 degrees or less.

The various parts of the system being assembled and connected as described, silica compound or other material of the proper kind being introduced into the absorber 11, ammonia is then introduced so that it may be absorbed by the silica compound. A proper amount having been introduced and the system closed, the condition in the refrigerator box 10 will then involve closing of the circuit by which the heater is energized and the valves 20 and 23 opened. The refrigerant will be consequently distilled and passed through the condenser to the receiver 24,

from which it is prevented from escaping by the closed valve 27. The temperature will remain high in the box and thus keep the heater in operation until the refrigerant is distilled sufficiently to raise the level of the liquefied refrigerant sufficiently to open the circuit to the heater at the switch 59. The valves 20 and 23 will be closed at the same time, and the temperature being above 40 degrees the valve 27 will be opened, the circuit being closed at the solenoid switch as well as at the thermostat 61.

Refrigeration will then occur, lowering the temperature in the box 10 so that the thermostat for the heater and its associated valves will not operate to close the circuit. Refrigeration will thus continue until all of the refrigerant in the receiver 24 is exhausted, when the rise in temperature will cause the thermostat 57 to close the circuit to the heater, and to the valves 20 and 23, so that the latter will be opened. Simultaneously, at the solenoid switch the circuit by which the valve 27 was held open will be broken and this valve permitted to close by action of its spring.

In Figure 7 there is illustrated a modification of the system in which the valve 27 differs in construction from the valves 20 and 23 in having the spring located so as to open the valve instead of closing it, and the magnet 50 is located outwardly of the armature on the valve stem, so as to close the valve when energized.

Here, all of the valves are operated simultaneously on a single circuit, and a single thermostat is used to control the whole system, which operates as follows:

Initially, the anhydrous ammonia is introduced and permitted to become absorbed by the silica compound. This having been completed, and the system properly closed, the thermostat is set and adjusted so that at a predetermined low temperature it will close the circuit to the valve magnets. The circuit is initially closed otherwise for a time so as to cause initial distillation of the ammonia and its collection in the receiver. The circuit is then opened, which will permit the valve 27 to open by its spring, and the valve 20 and 23 to close under action of their springs. Evaporation of the ammonia will then produce a low temperature in the refrigerator box, and the evaporated ammonia will be reabsorbed in the absorber. When the temperature has fallen to a point a suitable distance below the normal desired temperature, the thermostat may close the circuit and permit refrigeration to be repeated as before. This system will be found satisfactory where very low temperatures are not undesirable. The high temperature at which the thermostat will open the circuit to discontinue distillation and permit refrigeration to begin may be a comparatively low one, so that damage will not be suffered by the contents of the refrigerator.

In order to facilitate dispersion of the heat evolved in condensation of the refrigerant, the back of the box 10 over the open side of the case 25 is provided with louvres 73 spaced sufficiently close together to prevent ingress of vermin, those at the lower half of the opening being inclined inwardly and upwardly from their outer parts, while those at the upper half are inclined inwardly and downwardly from their outer parts. Any air circulation or other cooling method may be utilized as desired.

The condenser 21 may of course be constructed in accordance with approved practice and condensation requirements in various ways. As shown, it comprises a tank vessel provided with cooling fins 22 and having a multiplicity of vertical tubes 75 therethrough permitting free circulation of air for cooling. Any other form of condenser may be substituted.

I claim:—

1. A refrigeration system comprising a still-absorber, a condenser and a receiver-evaporator orbitally connected; valves respectively between the still-absorber and condenser; between the condenser and receiver, and between the receiver and still-absorber; a heater for the still-absorber, means responsive to low content in the receiver, and to temperature thereadjacent to control the heater, coresponsive means to control the valves between the still-absorber and condenser, and between the condenser and receiver, to open said valves during distillation and close them during the period of evaporation, and means to control the valve between the receiver and still-absorber to close the same during distillation periods and open the same during evaporation periods.

2. The structure of claim 1 in which the heating means is electrical, the controlling devices for the valves are electrical, and a thermostat is located in the vicinity of the receiver-evaporator operatively associated with the circuits to the heater and valves.

3. The structure of claim 1 in which the heating means is electrical, the controlling devices for the valves are electrical and thermostatic means to operate the heater and open the valves responsive to high temperature including means in the system with the first two mentioned valves to reverse the position of the third mentioned valve.

In testimony whereof I affix my signature.

ROBERT J. MITCHELL.