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REFRIGERATOR

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Fig. 1.

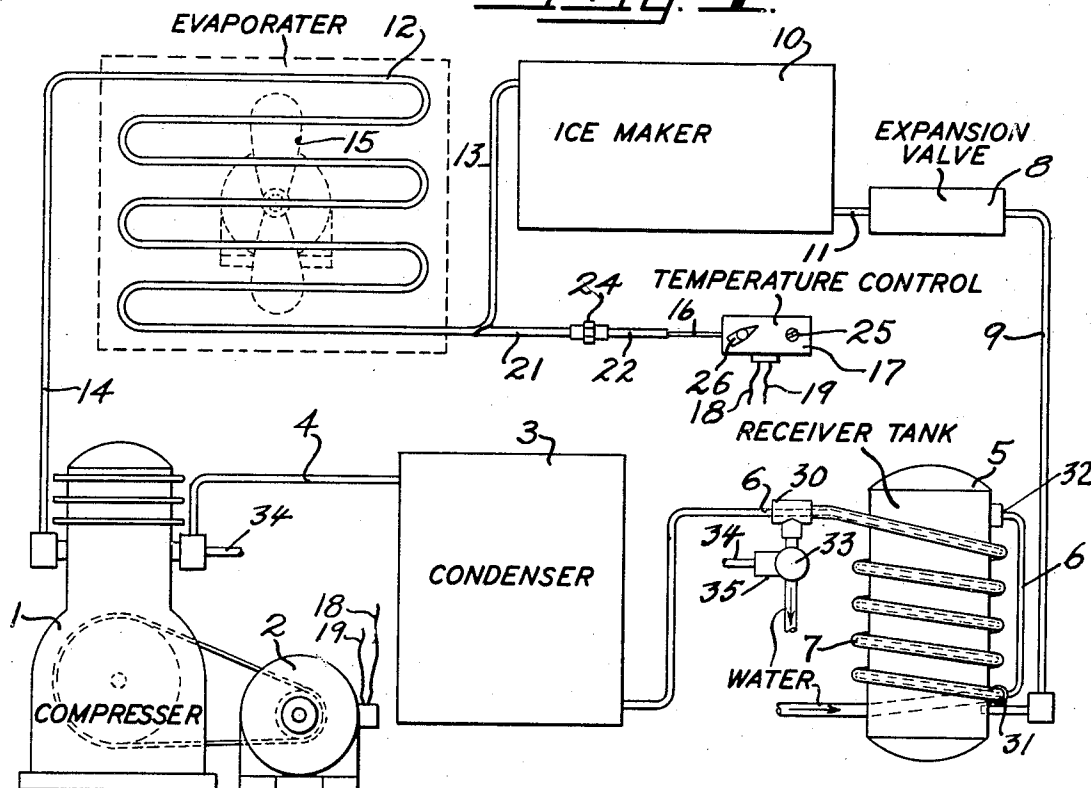
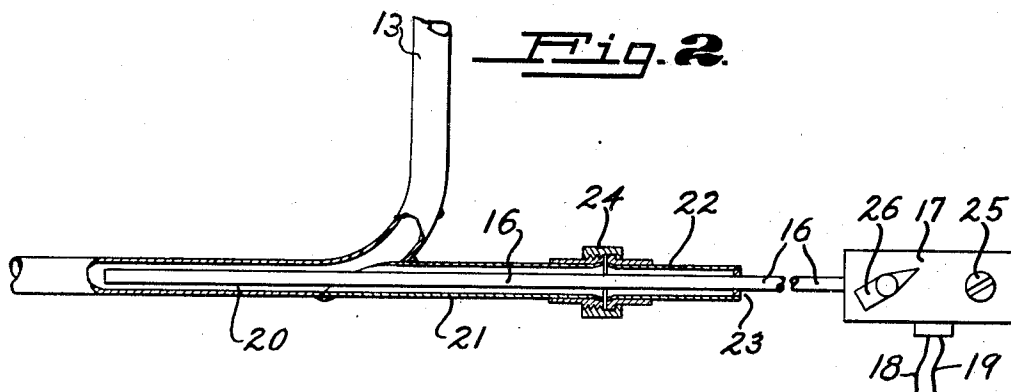


Fig. 2.



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REFRIGERATOR

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6 Claims. (Cl. 62—4)

The present invention relates to improvements in refrigerators and has particular reference to the temperature control thereof.

The conventional refrigerator system comprises a condensing unit including a compressor, a condenser and a receiving tank, an evaporator unit which absorbs heat from the atmosphere for cooling the interior of the refrigerator, a conduit connecting the receiving tank with the evaporator and having an expansion valve therein, and a return conduit connecting the outlet of the evaporator with the intake of the compressor. An ice maker may be interposed between the expansion valve and the evaporator, and the latter may have a fan associated therewith for effecting forced draft circulation.

Most refrigerators have an automatic temperature control whereby the temperature within the refrigerator is kept near a desired degree. But the conventional temperature controls are arranged in such a manner as to allow the evaporator to collect ice and frost on the surface and to make it necessary to periodically subject the evaporator to a de-frosting or de-icing process.

In the present invention it is proposed to arrange the temperature control in such a manner as to cause the system itself to periodically take care of the de-frosting or de-icing of the evaporator in its normal cycle of operations.

It is further proposed, as an incident to this temperature control, to provide for the manufacture of a better quality of ice in the ice maker. While heretofore the ice, made in the ice-maker in the form of cubes, contained a large number of air bubbles which gave to the ice a frosty appearance, my temperature control will be instrumental in producing an ice cube that is more nearly clear.

And finally it is proposed to provide certain structural arrangements whereby one section of the temperature control is built into a unit with the evaporator which facilitates the manipulation and installation of the different units.

Further objects and advantages of my invention will appear as the specification proceeds.

The preferred form of my invention is illustrated in the accompanying drawing, in which:

Figure 1 shows a diagrammatic view of a refrigerating system having my improved temperature control incorporated therein, and

Figure 2, a sectional detail view showing my control as attached to the evaporator.

While I have shown only the preferred form of my invention, I wish to have it understood that various changes or modifications may be

made within the scope of the claims attached hereto without departing from the spirit of the invention.

Referring to the drawing in detail, Figure 1 shows a typical refrigerating system including a compressor 1, a motor 2 for driving the same, a condenser 3 for receiving and condensing a refrigerant from the compressor and connected thereto by the conduit 4, a receiving tank 5 connected to the condenser outlet by a conduit 6, a cooling system 7 for the conduit 6, an expansion valve 8 connected to the latter tank by a conduit 9, an ice maker including a coil (not shown) connected to the expansion valve by a conduit 11, an evaporator 12 having a coil connected to the ice maker coil by a conduit 13, and a return conduit 14 connecting the evaporator coil to the intake side of the compressor 1.

The whole system thus constitutes a closed circuit for circulating a suitable refrigerant. In operation the vaporized refrigerant coming from the evaporator is compressed by the compressor and fed into the condenser where it is reduced to liquid form and from where it is advanced to the receiving tank 5. It is then discharged through the expansion valve in the form of liquid spray to successively pass through the ice maker coil and the evaporator where it vaporizes and absorbs heat units to make the ice and to cool the refrigerator, and after having absorbed heat units to a desired saturation point, returns to the compressor for a new cycle of operations.

The evaporator 12 is conventionally formed with a large number of fins (not shown) for effecting a more rapid and thorough heat exchange and is preferably combined with a fan indicated at 15 for driving air through the spaces between the fins, in which case it is known as a forced draft evaporator.

My temperature control is of the thermostat type and comprises a capillary tube 16 containing a suitable refrigerant and having one end connected, in any suitable and conventional manner as by a bellows, to operate a switch 17, which through suitable conductors 18 and 19, controls the motor 2 driving the compressor. The other end of the capillary tube, indicated at 20, is made to project into a section of the evaporator coil 12 so as to be in direct heat exchange with the refrigerant passing therethrough.

The connection is preferably made as follows: A sleeve 21 is permanently secured upon the coil, by welding or the like, so as to form a continuation of a section of the coil. A second sleeve 22 is secured to the capillary tube, at a distance

from its end, as at 23, and so as to form a closure therewith. The projecting end of the capillary tube is sufficiently long to project through the first sleeve into the coil through considerable distance, say six inches or more, when the two sleeves are brought into alinement and are fastened upon one another by a suitable union coupling indicated at 24.

The switch 17 is of conventional construction and may be set to close the motor circuit at a desired maximum temperature and to open the motor circuit at a desired minimum temperature. Adjustment for closing at maximum temperature is made by operation of the screw 25 and adjustment for opening of the motor circuit at minimum temperature is made by operation of the knob 26.

For the purpose of my invention the adjustments of the switch should be made as follows: The switch should close for starting the motor when the refrigerant in the evaporator reaches a temperature slightly above 32° F., that is to say, approximately 33° F. or thereabouts. The switch should open for stopping the motor when the refrigerant in the evaporator reaches a desired minimum temperature, which is preferably held in the range between 5 and 17 degrees F., depending upon the position of the knob 26.

It will be noted that under these conditions frost or ice cannot collect on the evaporator for any considerable length of time because it is made to thaw during each shut-off period of the motor. When the refrigerant in the inlet end of the evaporator coil has reached a predetermined minimum temperature, say a temperature between 5 and 17 degrees F., the switch 17 opens the motor circuit and the compressor ceases to operate. As a result the refrigerant slowly rises in temperature until it reaches 32 degrees Fahrenheit. It cannot rise any higher, then, until whatever frost or ice is present on the evaporator has been melted. Only after the evaporator has thus become completely defrosted or de-iced, can the temperature rise further, and as soon as it has reached a temperature slightly above 32 degrees, say 33 degrees, the switch 17 is operated to close the motor circuit and the compressor becomes active to lower the temperature until a predetermined minimum has again been reached.

Thus each off-cycle of the motor circuit is utilized for the de-frosting of the evaporator and the on-cycle is delayed until the ice or frost on the evaporator has become melted.

This delay has its influence on the ice in the ice maker. By the time the temperature of the refrigerant in the evaporator has risen to 33° F., the temperature of the ice cubes in the ice maker also rises, at least to the melting point, with the result that the forming of the ice cubes takes place in a series of successive and progressive stages of freezing and partial melting. Thus air bubbles confined in the ice cubes during the freezing stages have a change to at least partly escape during the melting stages. This tends to produce clear ice in the end and still keeps the ice cubes in their respective receptacles sufficiently loose to make removal of the ice cubes comparatively easy at any time.

Under extreme atmospheric heat conditions it may happen that the full capacity of the unit is required for the operation of the refrigerator and that no cyclic interruption of the process takes place. In that case there would be no alternate melting and freezing of the ice in the

ice maker and the ice made would again be frosty.

To guard against this, I provide the water-cooling system 7, which comprises a coil surrounding the refrigerant conduit 6 and coiled, with the latter, about the receiving tank 5. The conduit 6 enters the coil, as at 30, and leaves the coil, as at 31, to connect with the tank, as at 32. The coil is closed around the conduit at both ends and water is made to flow through the coil in reverse direction to refrigerant flow.

Under normal temperature conditions the coil, which may be connected to any suitable supply of water, is closed by a valve 33. This valve is operated by the refrigerant, as it leaves the compressor 1, through a conduit 34, by any suitable pressure- or temperature-responsive control 35 well known in the art.

When the refrigerant leaves the compressor at normal temperature, say about 100° F., the valve 33 remains closed. But when, due to excessive atmospheric temperature conditions, the refrigerant leaves the compressor at a higher temperature, say 120° F., the increased pressure operates the valve 33 to open the same and to cause water to flow through the coil for cooling the refrigerant before entering the tank 5.

I claim:

1. In combination, an evaporator coil for a refrigerator, a sleeve projecting from the coil so as to form an alined continuation of a coil section, a capillary tube having a refrigerant therein, a second sleeve mounted upon the said tube to form a closure therewith and means for coupling the two sleeves, with one section of the capillary tube projecting into the said coil section.

2. In a temperature control for a refrigerator having a refrigeration circuit including an evaporator, an ice maker, a motor for circulating a refrigerant therethrough and temperature-responsive means for periodically cutting off and re-starting the motor, the latter means comprising a conduit having a heat-responsive medium confined therein and having a section projecting into the evaporator coil at the point of entry of the refrigerant for direct contact with the refrigerant therein, and a motor control element operable by the said medium to shut off the motor when the said medium reaches a predetermined temperature below 32 degrees Fahrenheit, and to turn on the motor when the said medium reaches a temperature slightly higher than 32 degrees Fahrenheit whereby the evaporator is completely defrosted during each off-cycle period, the ice maker being positioned in advance of the location of said conduit section.

3. In a temperature control for a refrigerator having a refrigeration circuit including an evaporator, an ice maker, a motor for circulating a refrigerant therethrough and temperature-responsive means for periodically cutting off and re-starting the motor, the latter means comprising a conduit having a heat-responsive medium confined therein and having a section projecting into the evaporator coil for direct contact with the refrigerant therein and a motor control element operable by the said medium to shut off the motor when the said medium reaches a predetermined temperature below 32 degrees Fahrenheit, and to turn on the motor when the said medium reaches a temperature slightly higher than 32 degrees Fahrenheit whereby the evaporator at the location of the said conduit section is completely defrosted during each off-cycle

period, the ice maker being positioned in advance of the location of said conduit section.

4. In a temperature control for a refrigerator having a refrigeration circuit including an ice maker, an evaporator, a motor for circulating a refrigerant through the circuit and temperature-responsive means for periodically shutting off and re-starting the motor with the ice maker disposed in advance of the evaporator in the flow of the refrigerant, the latter means comprising a conduit having a heat-responsive medium confined therein and having a section extending into the evaporator coil at the point of entry of the refrigerant for direct contact with the refrigerant therein, and a motor control element operable by the said medium to shut off the motor when the said medium reaches a predetermined temperature below 32 degrees Fahrenheit, and to turn on the motor when the said medium reaches a temperature slightly higher than 32 degrees Fahrenheit whereby the evaporator is completely defrosted during each off-cycle period and whereby the ice in the ice maker is partly melted during each such period.

5. In a temperature control for a refrigerator having a refrigeration circuit including an ice maker, an evaporator, a motor for circulating a refrigerant through the circuit and temperature-responsive means for periodically cutting off and

re-starting the motor with the ice maker disposed in advance of the evaporator in the flow of the refrigerant, the latter means comprising a conduit having a heat responsive medium confined therein and having a section projecting into the evaporator coil for direct contact with the refrigerant therein, and a motor control element operable by the said medium to shut off the motor when the said medium reaches a predetermined temperature below 32 degrees Fahrenheit, and to turn on the motor when the said medium reaches a temperature slightly higher than 32 degrees Fahrenheit whereby the evaporator at the location of the said conduit section is completely defrosted during each off-cycle period and whereby the ice in the ice maker is partly melted during each such period.

6. In a refrigeration system having a closed circuit with a refrigerant therein, means for moving the refrigerant through the circuit in alternate stages of compression and expansion, a compressor, a condenser, a receiving tank and a connecting conduit, a liquid-carrying coil arranged about the tank and surrounding a portion of the conduit and having a valve therein, and means for controlling the valve operable in response to predetermined conditions in the refrigerant in the compression stage.

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