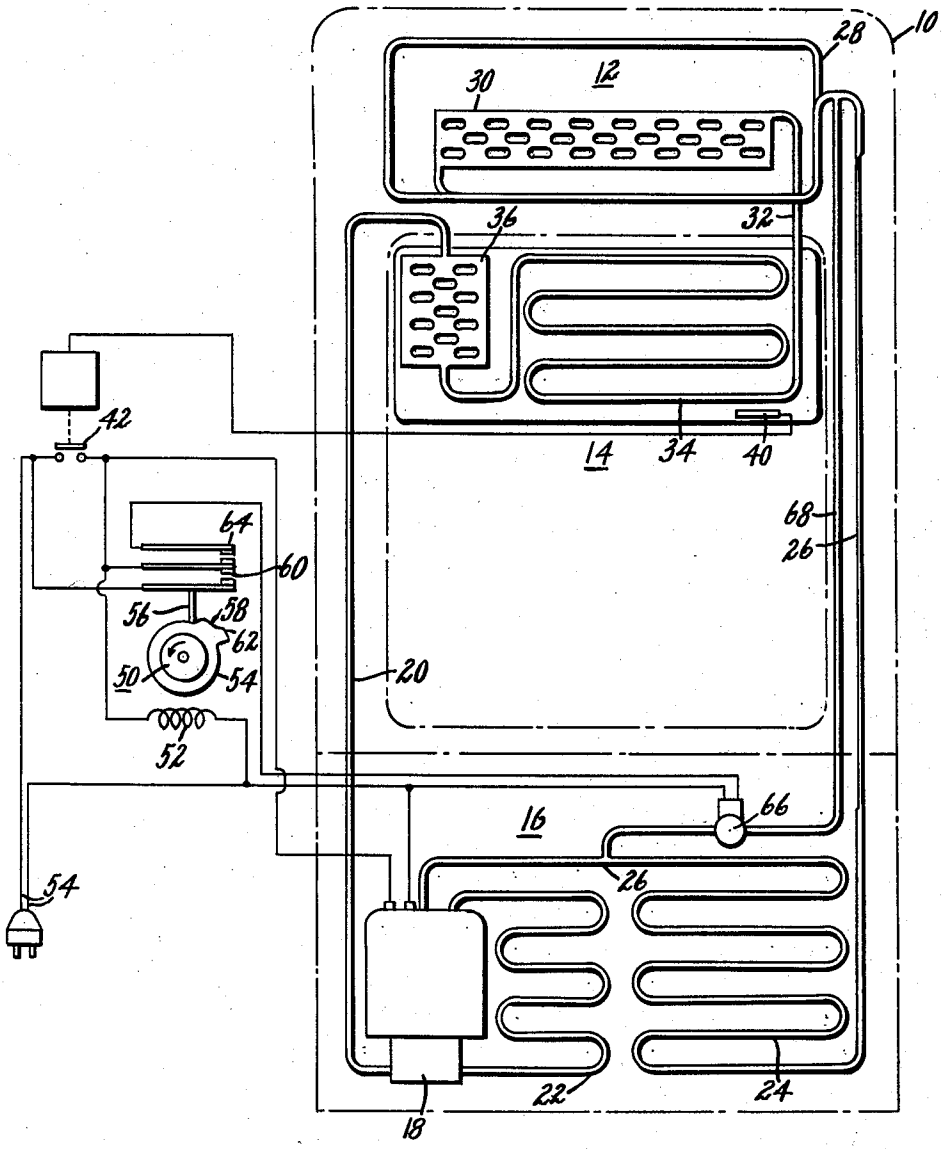
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REFRIGERATING APPARATUS

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REFRIGERATING APPARATUS

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This invention relates to refrigerating apparatus and more particularly to an arrangement for defrosting the freezer compartment evaporator in a two-temperature refrigerator.

It is an object of this invention to provide a simple and practical two-temperature refrigerating system wherein the evaporator in the high temperature food storage compartment is defrosted at relatively frequent intervals and the evaporator for the low temperature compartment is defrosted at less frequent intervals.

Another object of this invention is to provide a refrigerating system in which hot gas is fed into the low temperature evaporator for defrosting the same in such a quantity and manner that any hot gas which may condense therein will be re-evaporated before returning to the compressor.

Still another object of this invention is to provide a refrigerating system wherein hot gas is fed from the condenser into the evaporator for defrosting the evaporator and wherein a means is provided for insuring high head pressure in the condenser immediately preceding the defrosting operation.

Still another object of this invention is to provide an improved arrangement for timing the frequency of the defrost operation.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

The sole figure in the drawing somewhat diagrammatically illustrates the refrigerant circuit as well as the electrical controls for use in automatically defrosting a two-temperature refrigerator.

Referring now to the drawing, wherein a preferred embodiment of the invention has been shown, reference numeral **10** generally designates a conventional insulated refrigerator cabinet having a frozen food storage compartment **12** located in the upper part thereof and a relatively high temperature food storage compartment **14** located directly below but insulated from the freezer compartment **12**. A machinery compartment **16** is located beneath the compartment **14**, as shown.

The refrigerating system is of the general type shown in U.S. Patent No. 2,672,020 except for certain differences to be more fully outlined hereinafter. Thus, the refrigerating system includes a conventional sealed motor-compressor unit **18** having its outlet connected to the usual super heat removing coil **22** which returns the compressed refrigerant to the outer housing for the motor-compressor unit **18** in accordance with well-known practice. In returning the compressed gas to the housing of the motor-compressor unit **18**, any entrained lubricant vapor has a chance to settle out from the refrigerant vapor before the refrigerant flows into

the condenser **24** through the line **26**, in accordance with conventional practice.

During the refrigeration cycle, the compressed refrigerant condenses in the condenser **24** and is fed through a fixed restrictor **26** into a low temperature evaporator **28** which surrounds the frozen food compartment **12** so as to maintain the compartment **12** at a temperature of approximately 0° or lower. The amount of liquid refrigerant fed into the evaporator **28** is more than enough to maintain the frozen food compartment refrigerated and as a result thereof, a portion of the refrigerant is fed into the accumulator or disengaging chamber **30** which may be formed within one wall of the compartment **12**, such as the back wall, as shown. The preferred arrangement is to use an accumulator of the roll bonded waffle plate type so as to conserve space and at the same time provide a fairly large and effective disengaging chamber. Liquid refrigerant leaves the chamber **30** through a line **32** which leads to the plate-type evaporator **34** located in the higher temperature food storage compartment **14**. The plate-type evaporator **34** is provided with an accumulator or disengaging chamber **36** of the waffle design at the outlet thereof, as shown.

During normal operation of the apparatus thus far described, the frozen food storage compartment **12** is maintained at a low enough temperature to store frozen foods, whereas the compartment **14** is maintained at a temperature of approximately 36° for the purpose of preserving unfrozen foods. A thermostat **40** located on the plate evaporator **34** normally cycles the motor-compressor unit **18** by opening and closing the main motor control switch **42**. This thermostatic control is of the type which closes the switch **42** whenever the temperature of the plate evaporator **34** exceeds 34° F. and maintains the circuit to the compressor closed until the temperature of the evaporator **34** falls to approximately 2° F. at which time the motor-compressor unit stops operating until the evaporator **34** has been defrosted. The thermostat **40** and the switch **42** very effectively serve to control the operation of the refrigeration system so as to defrost the plate evaporator **34** during each "off" cycle without causing any defrosting of the frozen food storage evaporator **28**.

Only a relatively small amount of frost tends to accumulate on the lower temperature evaporator **28** and consequently, it is not necessary or desirable to defrost this evaporator each time the evaporator **34** is defrosted. The amount of ice which accumulates is determined to a large extent by the amount of ice that is frozen within the compartment **12** and the frequency at which the doors to the food compartment are opened. The above factors also determine to a large extent the portion of the time during which the motor-compressor unit **18** is required to operate and consequently, the timer **50** which has been provided for timing the defrost cycle for the frozen food compartment **28** is so connected in the circuit that it will only count the time during which the motor-compressor unit **18** operates. Thus, the timer motor **50** includes a field winding **52** which is arranged as shown in series with the switch **42** across the power supply line **54**. The timer motor **50** is provided with a driven cam **54** which serves to actuate a switch operating plunger **56**, as shown. The plunger **56** is adapted to ride on the cam **54** and does not close any circuits until the cam follower **56** rides up onto the cam surface **58** at which time a circuit is closed at the contacts **60**. Closing of the circuit through the contacts **60** short-circuits the thermostatically operated switch **42** whereby the motor-compressor unit **18** will serve to operate even though the thermostat **40** may indicate that no refrigeration is required. The purpose

of this is to build up the head pressure in the condenser **24** just prior to the defrosting of the evaporator **28**.

The cam **54** is provided with a second raised portion **62** which subsequently serves to raise the cam follower high enough to close a circuit through the contacts **64**. When the contacts **64** are closed, current is fed to the solenoid operated valve **66** located in a bypass line **68** which is arranged as shown. Upon opening of the valve **66** hot uncondensed refrigerant vapor contained in the motor-compressor housing **18**, the super heat removing coil **22**, and the condenser **24** is free to flow upwardly through the bypass line **68** into the evaporator **28**. The condensed liquid in the condenser **24** goes through a phase change because of the sudden lowering of the vapor pressure upon it. Thus, the liquid in the condenser boils and the condenser **24** becomes a high temperature evaporator. The vapor in the condenser then passes up the bypass line **68** into the freezing compartment evaporator **28**. This quantity of vapor which is fed through the line **68** into the evaporator **28** for defrost purposes is in excess of that actually required to defrost the evaporator whereby the refrigerant vapor which has been condensed in the evaporator **28** during the defrost cycle is re-evaporated by such excess refrigerant prior to its return to the compressor, with the result that no slugs of refrigerant enter the compressor.

It will be noted that even though some liquid refrigerant is shoved out of the evaporator **28** by the inrushing hot gas flowing through the line **68**, this refrigerant will be trapped either in the accumulator **30** or in the accumulator **36** and by virtue of the construction and arrangement of these accumulators and the refrigerant lines connected to these accumulators, the hot gas will have a chance to vaporize any accumulated refrigerant liquid before the same will have a chance to return in liquid form to the motor-compressor unit **18**.

The frequency at which the frozen food compartment evaporator **28** is defrosted is broadly immaterial insofar as certain aspects of this invention are concerned. In actual practice, this evaporator should not be defrosted more than once a day and under certain conditions, it may not be necessary to defrost the evaporator more than once every week, and possibly once or twice a month. In the system shown, the frequency of the defrost cycle for the evaporator **28** will be determined by the length of time that the motor-compressor operates in any given time interval and will also be determined by the design of the motor **50** and the cam wheel **54** driven thereby. The length of the cam surface **58** should be sufficient to build up the head pressure in the condenser prior to the opening of the valve **66** and the length of the cam surface **62** should be great enough so as to maintain the valve **66** open long enough to defrost the evaporator **28** and to re-evaporate any of the refrigerant which may have been condensed in the evaporator **28** during the main portion of the defrost cycle.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, as may come within the scope of the claims which follow.

What is claimed is as follows:

1. Refrigerating apparatus including an above-freezing food storage compartment and a below-freezing compartment, a thermal heat transfer barrier between said compartments, a refrigerant liquefying means, a freezing evaporator means in heat exchange relation with said below-freezing compartment and having its inlet connected to an outlet of said liquefying means, a food compartment evaporating means in heat exchange relation with said food compartment and having its inlet connected to the outlet of said freezing evaporator means, means for returning evaporated refrigerant from said freezing and food compartment evaporating means to said liquefying means, a thermostatic cycling control means having a thermally sensitive element in direct intimate contact with said food compartment evaporating means having means for preventing the starting of said liquefying means until the food compartment evaporating means reaches a temperature above 32° F. for defrosting said food compartment evaporating means and having means for preventing the stopping of said liquefying means until said food compartment evaporating means is cooled to below-freezing temperatures, and means for supplying compressed refrigerant to said freezing evaporating means at defrosting temperatures so as to defrost said freezing evaporating means, and means for controlling the supply of said compressed refrigerant to said freezing evaporating means so as to cause defrosting thereof at less frequent intervals than said food compartment evaporating means is defrosted.

2. Refrigerating apparatus including an above-freezing food compartment and a below-freezing compartment, a thermal heat transfer barrier between said compartments, a refrigerant liquefying means, a freezing evaporator means in heat exchange relation with said below-freezing compartment and having its inlet connected to an outlet of said liquefying means, a food compartment evaporating means in heat exchange relation with said food compartment and having its inlet connected to the outlet of said freezing evaporator means, means for returning evaporated refrigerant from said freezing and food compartment evaporating means to said liquefying means, a thermostatic cycling control means having a thermally sensitive element in direct intimate contact with said food compartment evaporating means having means for preventing the starting of said liquefying means until the food compartment evaporating means reaches a temperature above 32° F. for defrosting said food compartment evaporating means and having means for preventing the stopping of said liquefying means until said food compartment evaporating means is cooled to below-freezing temperatures, means for supplying relatively hot compressed refrigerant vapor to said freezing evaporating means so as to defrost said freezing evaporating means, means for controlling the supply of said compressed refrigerant vapor to said feezing evaporating means so as to cause defrosting thereof at less frequent intervals than said food compartment evaporating means is defrosted, and means for insuring energization of said refrigerant liquefying means for a given period of time immediately preceding the supply of compressed refrigerant vapor to said freezing evaporating means irrespective of refrigeration requirements.

3. In a two-temperature refrigerating system, a first evaporator, a second evaporator, a compressor, a condenser, means for connecting said compressor, condenser and first and second evaporator means in series refrigerant flow relationship, said means including a pressure reducing element between the outlet of said condenser and the inlet of said first evaporator, means responsive to the temperature of said second evaporator for cycling said compressor so as to operate said second evaporator on a defrosting cycle wherein said second evaporator defrosts during each "off" cycle of said compressor, means for bypassing compressed vapor from the inlet of said condenser to the inlet of said first evaporator so as to cause defrosting of said first evaporator, and mechanically controlled means for cycling the flow of refrigerant through said bypass so as to cause defrosting of said first evaporator at less frequent intervals than that at which said second evaporator is defrosted.

4. In a two-temperature refrigerating system, a first evaporator, a second evaporator, a compressor, a condenser, means for connecting said compressor, condenser and first and second evaporator means in series refrigerant flow relationship, said means including a pressure reducing element between the outlet of said condenser and the inlet of said first evaporator, means responsive to the temperature of said second evaporator for cycling said compressor so as to operate said second evaporator on a defrosting cycle wherein said second evaporator defrosts

during intervals corresponding to each "off" cycle of said compressor, means for bypassing compressed vapor from the inlet of said condenser to the inlet of said first evaporator so as to cause defrosting of said first evaporator, and mechanically controlled means for controlling said bypassing means, said last named means including means for insuring operation of said compressor for an interval of time immediately preceding the opening of said bypass means.

5. In combination, means forming a plurality of insulated compartments, a first evaporator maintaining one of said compartments at a relatively low temperature, a second evaporator maintaining the other of said compartments at a relatively higher temperature, refrigerant liquefying apparatus including a compressor and condenser, means including a pressure reducing means supplying liquid refrigerant from said condenser to said first and second evaporators in series, means for returning refrigerant vaporized in said second evaporator to said compressor, control means for said compressor including a thermostat arranged in thermal exchange relationship with said second evaporator and calibrated to cause operation of said compressor on a defrost cycle whereby said

second evaporator is defrosted during each "off" portion of said cycle, and means for supplying refrigerant vapor at controlled intervals from the outlet of said compressor to the inlet of said first evaporator so as to defrost said first evaporator at less frequent intervals than said second evaporator is defrosted.

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