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(54) Refrigerating appliance having several compartments maintained at respective temperatures.

(57) A refrigerating appliance comprises a single-compressor refrigerant circuit, the compressor (12) of which is adapted to be periodically energized and deenergized, and a static evaporator (11) disposed in heat-exchange relationship with a first compartment (7) and with a separate passage (18) communicating with a second compartment (8).

A fan (23) is normally operable to create a closed-circuit air flow along said passage (18) and through said second compartment (8), and adapted to be deenergized during the deenergization periods of said compressor (12). Control means (5, 20) are provided for deenergizing said fan (23) when the temperature within said second compartment (8) descends below a predetermined level.

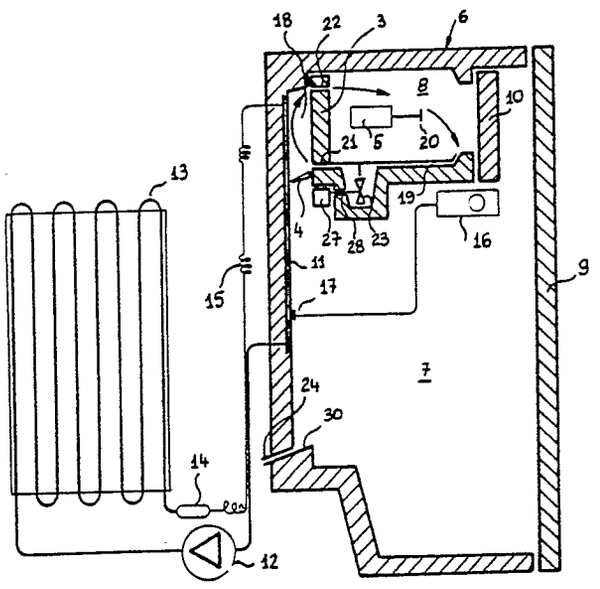

Fig. 1

EP 0 343 532 A2

REFRIGERATING APPLIANCE HAVING SEVERAL COMPARTMENTS MAINTAINED AT RESPECTIVE TEMPERATURES

The present invention relates to a refrigerating appliance having several compartments maintained at respective temperatures, of the type comprising a single-compressor refrigerant circuit controlled by a single thermostatic temperature control unit.

A refrigerating appliance of this type is described in Italian Patent Application No. 45703 A/88, filed on 29.01 .1988 in the name of the present applicant. According to this patent application, the refrigerating appliance comprises one storage compartment maintained at a food storage temperature of about +5 °C, and another compartment maintained at a lower temperature. The appliance includes a single static evaporator disposed in heat-exchange relationship with the storage compartment and with a passage provided separate from the storage compartment and communicating with the lower-temperature compartment. A fan is operable to create a forced air flow in a closed circuit extending along the passage and through the lower-temperature compartment, which is thereby indirectly, but intensely cooled by the evaporator. The latter belongs to a single-compressor refrigerant circuit the energization and deenergization periods of whose compressor are controlled by a single thermostatic control unit which is responsive to the surface temperature of the evaporator and thus able to also control the evaporator defrosting operation. In a corresponding manner, thermostatic control means are provided for deenergizing the fan substantially for the duration of the defrosting operation to thereby avoid any excessive temperature rise in the lower-temperature compartment.

This solution is particularly advantageous in that it provides a particularly simple and reliable refrigerating appliance with optimum performance.

It is noted, however, that the ambient temperature within the lower-temperature compartment is substantially determined by the relative dimensions of the various components of the appliance, and is specifically -although only indirectly - a function of the surface temperature of the evaporator, so that it can vary within a relatively wide range, although this may normally be acceptable.

On the other hand there is the need, however, to have -in a refrigerator with a static evaporator (with a relatively high degree of moisture being advantageously maintained in its interior) - a compartment, separate from the storage compartment, within which the temperature is not only lower, but can be maintained particularly accurately and constant, preferably at a value of about 0 °C and +1 °C; These conditions are particularly suitable for the storage of specific foods such as meat and certain kinds of fruit.

It is therefore an object of the invention to provide a refrigerating appliance having several compartments adapted to be maintained at respective temperatures, of the type comprising a single-compressor refrigerant circuit including a static evaporator, permitting at least one of its compartments to be maintained in a simple manner at a preselected and substantially constant temperature.

This object is attained by a refrigerating appliance having several compartments adapted to be maintained at respective temperatures, comprising a single-compressor refrigerant circuit controlled by a thermostatic control unit operable to cyclically determine operative and inoperative periods of said compressor for normally maintaining at least a first compartment at a food storage temperature. The appliance further includes a static evaporator connected to said circuit and disposed in heat-exchange relationship with said first compartment and a passage substantially separated from said first compartment and communicating with at least one second compartment. Blower means are normally operable to create a forced air flow in a closed circuit extending along said passage and through said second compartment, first control means being provided for deenergizing said blower means substantially for the duration of the inoperative periods of said compressor. According to the invention, a refrigerating appliance of the type defined above is characterized by additionally comprising further control means adapted to sense the ambient temperature within said second compartment and to deenergize said blower means when said ambient temperature descends below a predetermined value.

This predetermined value is preferably smaller than that of the food storage temperature.

The characteristics and advantages of the invention will become more clearly evident from the following description, given by way of example with reference to the accompanying drawings, wherein:

fig. 1 is a diagrammatic illustration of a preferred embodiment of a refrigerating appliance according to the invention, and

fig. 2 shows an electric circuit diagram for the control of the appliance shown in fig. 1

With particular reference to fig. 1, the refrigerating appliance according to the invention has an insulated housing 6 enclosing at least two separate compartments 7 and 8 for the storage of foods at respective temperatures.

Each compartment 7, 8 is provided with a

separate access door 9 and 10, respectively, compartment 8 with its door 10 being preferably housed within compartment 7.

The two compartments 7 and 8 may of course also be completely separated from one another, as by being disposed side by side or one on top of the other, in which case they are independently accessible through their respective doors 9 and 10.

Associated to compartment 7 in heat-exchange relationship therewith is an evaporator 11 of the so-called "static" type forming part of a refrigerant circuit additionally including a compressor 12, a condenser 13, a demoistening filter 14 and a refrigerant flow laminator element 15.

The refrigerating appliance is further provided with a thermostatic temperature control unit 16 or thermostatic switch of a per se known type disposed for instance within compartment 7. Associated to control unit 16 is a sensor 17 for detecting the temperature of evaporator 11; in a per se known manner control unit 16 is operable to determine the operative and inoperative periods of compressor 12 to thereby maintain the interior of compartment 7 at a preselected mean temperature for the storage of foods, for instance at about +5 °C.

Also in a per se known manner, static evaporator 11 is automatically defrosted at predetermined intervals during inoperative periods of compressor 12. Evaporator 11 is preferably extended upwards to extend into a passage 18 which in the described example is defined by a rear wall 3 of compartment 8, the rear wall of compartment 7 and respective portions of the lateral walls of compartment 7. For the remainder, passage 18 is substantially separated from compartment 7 proper by a lip seal 4 or the like extending transversely adjacent the bottom of compartment 8. The upper portion of evaporator 11 is thus in heat-exchanging relationship with passage 18, the latter having at least one inlet 21 and at least one outlet port 22 communicating with compartment 8.

A motor-driven fan 23 or the like is preferably disposed within compartment 8, specifically within a flow guide passage 19, and operable to create a forced air flow in a closed circuit.

This air flow, represented by arrows in fig. 1, flows from compartment 8 through guide passage 19 and along passage 18, in heat-exchange relationship with evaporator 11, to subsequently return into compartment 8. The latter is thus indirectly - but nevertheless intensely, thanks to the forced circulation - refrigerated by the same evaporator 11 also used for refrigerating compartment 7.

By suitably dimensioning the various components of the appliance, in particular the volume of compartment 8 and the heat exchange relationship between evaporator 11 and passage 18, it is possible to arrive at different constructions in which the ambient temperatures in compartments 7 and 8 are substantially equal to or different from one another.

In a particularly advantageous embodiment, the mean temperature within compartment 7 may be kept at about +5 °C, while the temperature within compartment 8 may be noticeably below 0 °C when fan 23 is in operation.

According to an important aspect of the invention, the operation of fan 23 is controlled by thermostatic control means 5 including a sensor 20 for detecting the ambient temperature within compartment 8, and operable to deenergize fan 23, which is normally in its operative state, when the temperature drops below a predetermined fixed value. In the present embodiment, this predetermined value is about 0 °C to -1 °C and thus corresponds to the optimum temperature for the storage of certain foods, such as meat and certain types of fruit.

Fan 23 has of course also to be deenergized during the defrosting periods of evaporator 11, to thereby avoid an excessive temperature rise within compartment 8, substantially as described in the Italian Patent Application No. 45703 A/88 cited above.

With reference to fig. 2, this operating mode of the refrigerating appliance may be achieved by connecting compressor 12 to the terminals 25, 26 of an electric power source through the thermostatic switch 16 controlled by sensor 17. Connected in parallel to compressor 12 is the series-connected circuit formed of the motor 27 operating fan 23, and thermostatic switch 5 controlled by sensor 20.

As soon as sensor 17 detects a surface temperature of evaporator 11 lying above a determined value, thermostatic switch 16 is closed to energize compressor 12, resulting in the operation of refrigerant circuit 11 to 15 as a whole.

When on the other hand sensor 17 detects a temperature of evaporator 11 lying below a preselected value, thermostatic switch 16 is caused to open to thereby deenergize compresscr 12 for a period during which evaporator 11 is being defrosted.

During these defrosting periods, which may be abbreviated in a per se known manner by the energization of suitable heater elements (not shown for simplicity), the water produced by the defrosting operation flows downwards by the action of gravity and collects in a channel 30 (fig. 1) disposed in the lower part of the appliance, from which it is drained through a drain port 24. In particular, the lip seal 4 permits the water produced by defrosting the upper portion of evaporator 11 associated to passage 18 to flow downwards into channel 30; on the other hand, however, and as already explained above, lip seal 4 acts as a thermal insulation separating passage 18 from com-

partment 7.

The cyclical energization and deenergization of compressor 12, as determined by the dimensions of the various components, is controlled to maintain compartment 7 at a mean temperature of about +5 °C.

As long as thermostatic switch 16 is closed, motor 27 of fan 23 is normally also energized through thermostatic switch 5, which remains closed until sensor 20 detects a temperature in compartment 8 which is lower than a predetermined fixed value of 0°C to -1 °C in the present example.

The air flow created by fan 23 is thus effective to rapidly refrigerate compartment 8, this refrigeration being discontinued, however, when the above defined predetermined value of 0 °C to -1 °C has been attained; this is accomplished by the temporaneous deenergization of fan 23, as a result of which the temperature within compartment 8 is substantially independent of the temperature of evaporator 11.

In this manner the thermostatic control assembly 5, 20 acts to repeatedly energize and deenergize fan 23, to thereby maintain the temperature within compartment 8 at a substantially accurate and constant value, independent of and different from the temperature within compartment 7.

Fan 23 is of course always inoperative as long as thermostatic switch 16 is opened for the periodical defrosting of evaporator 11; this prevents an undesirable temperature rise within compartment 8, as already explained, and contributes to maintaining the temperature within compartment 8 substantially constant at the predetermined value defined above.

As a further provision for maintaining this temperature at the predetermined value, motor 27 may preferably be located outside compartment 8 and connected to fan 23 by a drive transmission shaft sealingly extending through an opening 28 formed in a wall of the compartment. In this manner the heat generated by the operation of motor 27 will not have the least influence on the temperature within compartment 8.

The described refrigerating appliance may of course be modified in any manner within the scope of the invention. It may for instance additionally include one or several freezer compartments, and the predetermined temperature within compartment 8 may be different from the value defined above by way of example. By varying the dimensions of the various components, these values may be selected to be equal to or greater than those of the ambient temperature within compartment 7. In addition, thermostatic switches 5 and 16 may be adjustable for permitting the user to vary the fixed value of the temperature within compartment 8 and/or of the mean temperature within compartment 7.

Passage 18 may also be designed in a different manner, and evaporator 11 may be arranged differently, as for instance descibed in the already cited Italian Patent Application No. 45703 A/88.

As already explained, compartments 7 and 8 may likewise arranged in a different manner, for instance above one another or side by side, with the associated access doors 9 and 10, respectively, completely independent of each other.

It is finally noted that thermostatic control means 5 may be associated to electronic control circuitry (of a per se known type and therefore not shown) for permitting the rotational speed of fan 23 to be varied in proportion to albeit slight variations of the temperature within compartment 8; in any case, of course, fan 23 is deenergized when the temperature within compartment 8 drops below the above defined predetermined value.

Claims

1. A refirgerating appliance having several compartments adapted to be maintained at respective temperatures, comprising a single-compressor refrigerant circuit controlled by a thermostatic control unit operable to cyclically determine operative and inoperative periods of said compressor for normally maintaining at least a first compartment at a food storage temperature, and further comprising a static evaporator connected to said circuit and disposed in heat-exchange relationship with said first compartment and with a passage substantially separated from said first compartment and communicating with at least a second compartment, and blower means normally operable to create a forced air flow in a closed circuit extending along said passage and through said second compartment, first control means being provided for deenergizing said blower means substantially for the durection of the inoperative periods of said compressor, characterized by additionally comprising further control means (5, 20) adapted to sense the ambient temperature within said second compartment (8) and to deenergize said blower means (23) when said ambient temperature dexcends below a predetermined value.

2. Refrigerating appliance according to claim 1, characterized in that said predetermined value lies below that of said food storage temperature within said first compartment (7).

3. Refrigerating appliance according to claim 1, wherein said blower means is disposed within said second compartment and operable by means of an electric motor, characterized in that said electric motor (27) is located outside said second compartment (8), with its drive transmitting shaft connected

to said blower means (23) and passing in a sealing fit through an opening (28) formed in a wall of said second compartment (8).

4. A refrigerating apparatus according to claim 1, characterized in that said evaporator (11) has a part of it located adjacent a wall of said first compartment (7) and another part adjacent a wall of said passage (18), the latter being substantially separated from said first compartment (7) by a lip seal (4) or the like.

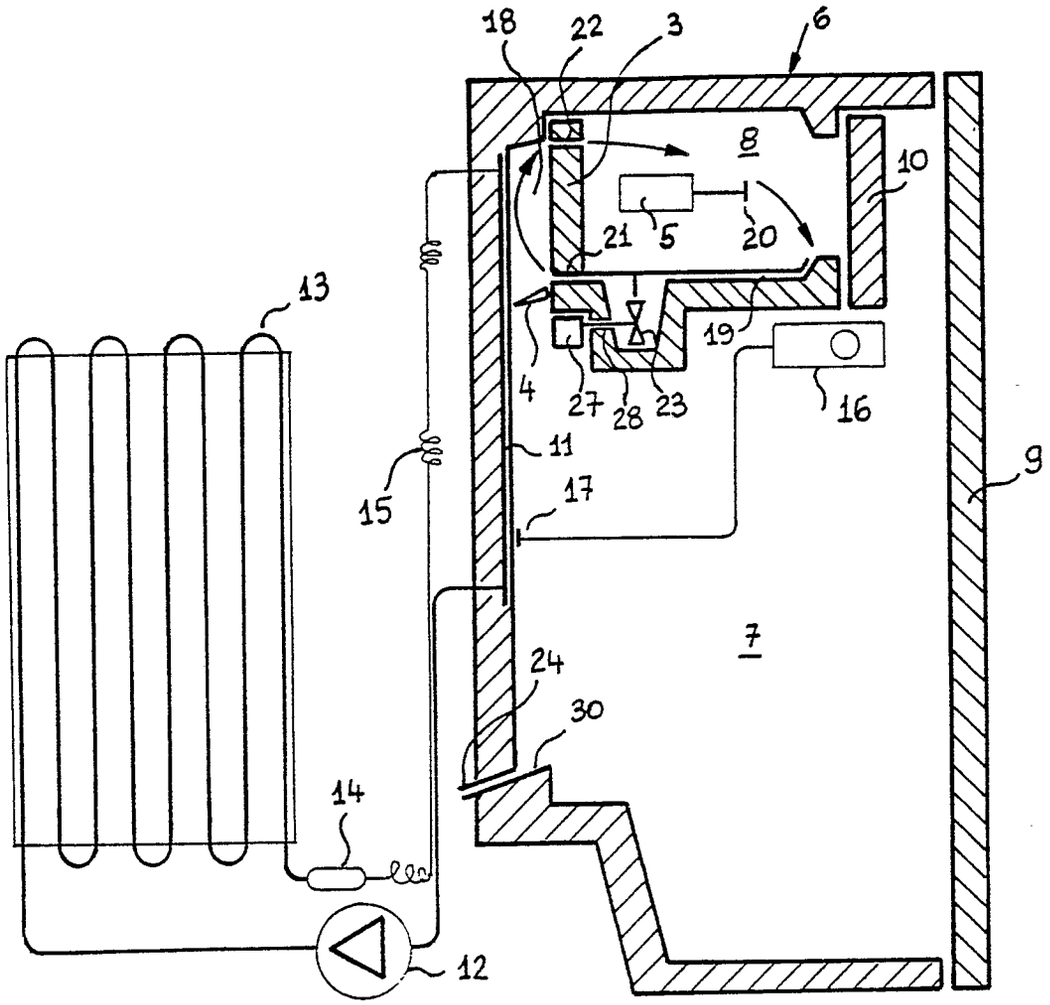
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Fig. 1

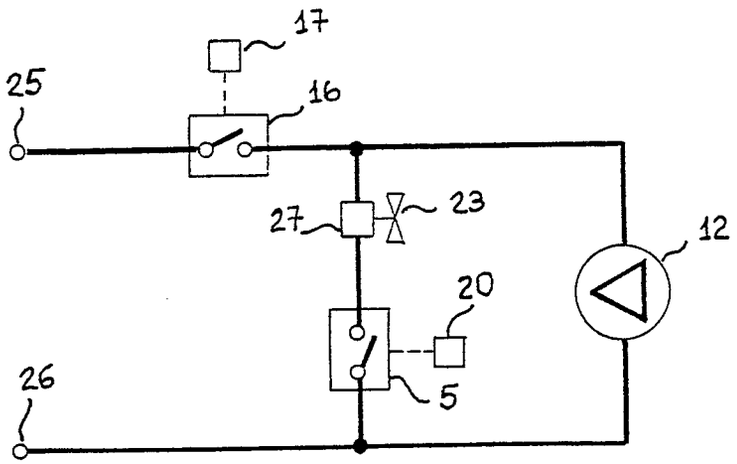
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Fig. 2