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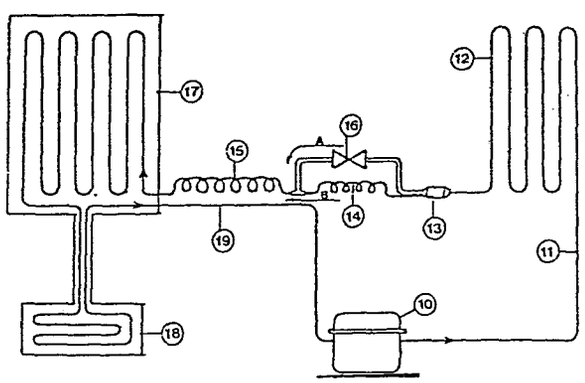
(54) Refrigerant circuit for a refrigerator-freezer combination.

(57) A refrigerant circuit for a refrigerator-freezer combination comprises a single compressor, an evaporator each for a refrigerating compartment and a freezer compartment, a condenser and at least one capillary.
The invention provides the connection of the two evaporators (17, 18) in series, and the employ of two series-connected capillaries (14, 15) one of which is bypassed with the aid of a solenoid valve (16).
With respect to an electric control circuit, the invention provides that a thermostat (23) associated with the refrigerating compartment controls the solenoid valve (16) and a defroster resistor (22) of the refrigerating compartment, while a thermostat (21) associated with the freezer compartment is connected to the compressor (10) and to the thermostat (23) associated with the refrigerating compartment.



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Description

The present invention relates to a refrigerator-freezer combination particularly for domestic use, comprising two separate compartments each provided with its own evaporator and a common compressor.

In refrigerator-freezer combinations of this type there exists a problem in designing and dimensioning the refrigerant circuit so as to achieve the performance required by set standards, particularly to ensure a temperature of between 0 and 5 °C within the refrigerating compartment, and a temperature of -18 °C or less in the freezing compartment. In addition, the freezer compartment should be capable of deep-freezing a predetermined amount of foods within a period limited to no more than 24 hours. Although this quick- or deep-freezing operation is not carried out very frequently, it imposes certain modifications on the refrigerant circuit (such as increasing the compressor capacity, reducing the size of the evaporator in the refrigerating compartment, inclusion of special valves and controls) and on the structure of the housing of the combination (increasing the thickness of the insulation for the freezer compartment). All these modifications have certain limits from the structural viewpoint, and additionally result in an increased energy consumption. On the other hand, the temperature of the freezing compartment is dependent on that of the refrigerating compartment, because the refrigerant circuit is provided with only a single control element for controlling the refrigerant flow, this element operating in response to the temperature in the refrigerating compartment.

For avoiding these serious problems, it has been proposed to employ two completely separate refrigerant circuits, one for the freezer compartment and the other for the refrigerating compartment, each provided with its own compressor. A solution of this type obviously requires a greater number

of components, reduces the useful volume of the combination (the outer dimensions of which are limited to uniform standards), and results in an inacceptable augmentation of the cost therefor.

It is therefore an object of the present invention to provide a refrigerant circuit for a refrigerator-freezer combination particularly for domestic use, comprising only a single compressor while being still capable of ensuring the required performance, whereby the construction of the combination is simplified and a low energy consumption is ensured in operation.

In particular, the invention provides a one-piece construction of the two evaporators of the freezer and refrigerating compartments by forming them of a single "roll-bond" panel of the conventional type, while under the functional aspect the invention provides that the first expansion of the refrigerant fluid takes place in the evaporator of the freezer compartment.

These and other characteristics of the invention will become more clearly evident from the following description of an exemplary embodiment with reference to the accompanying drawings, wherein:

fig. 1 shows a functional diagram of the refrigerant circuit for a refrigerator-freezer combination according to the invention, and

fig. 2 shows an elctric circuit diagram of electromechanical components of the circuit shown in fig. 1.

As shown in fig. 1, the refrigerant circuit of the refrigerator-freezer combination according to the invention comprises a compressor 10 connected to a condenser 12 through an output tube 11. Downstream of condenser 12 there is provided a filter 13 followed by a first capillary 14 and a second capillary 15. Connected in parallel to first

capillary 14 between the outlet of filter 13 and the inlet of second capillary 15 is a solenoid valve 16. The outlet of second capillary 15 is connected to the the coil of the evaporator 17 associated with the freezer compartment, itself connected in series to the evaporator 18 of the refrigerating compartment through a bridging strip. The refrigerant circuit is completed by a return pipe 19 leading from freezer evaporator 17 to compressor 10.

Fig. 2 depicts the electric ciruit arrangement for controlling the functional components of the refrigerant circuit. The compressor 10 is connected to the electric supply network in series with a delay element 20 and a thermostat 21 associated with the freezer compartment and having two contacts 26 and 27. The solenoid valve 16 is connected to a contact 24 of a thermostat 23 associated with the refrigerating compartment and having a second contact 25 connected to a defroster resistor 22 for the refrigerating evaporator 18. Contact 24 of thermostat 23 is additionally connected to contact 26 of thermostat 21. The delay element 20 permits compressor 10 to start operating at the end of a predetermined delay period after one of thermostat switches 21 or 23 has opened, when the pressures upstream and downstream of the compressor are in equilibrium.

The refrigerant circuit according to the invention operates as follows: When only the refrigerating compartment requires to be cooled, contacts 24 of thermostat 23 and 26 of thermostat 21 are closed, as is also the contact of delay element 20 (fig. 2). Under these conditions, compressor 10 starts to operate and solenoid valve 16 is energized, so that the refrigerant flows therethrough, bypassing capillary 14 (fig. 1). The pressure reduction is now accomplished by capillary 15 alone, resulting in adequate cooling of the refrigerating compartment.

When cooling is required only for the freezer compartment, contacts 27 of thermostat 21 and 25 of thermostat 23 close as does that of delay element 20. In this case, compressor 10 is started to operate, while solenoid valve 16 is deenergized and remains closed. As a result, the refrigerant flows through both capillaries 14 and 15 in succession, resulting in a pressure drop (and thus in a reduction of the volume flow within the circuit) sufficient to ensure the required refrigerating of the freezer evaporator 17. The refrigerant vapour flowing through refrigerating evaporator 18 under these conditions is at an elevated temperature. Also under these conditions, the defroster resistor 22 associated with the refrigerating evaporator 18 is energized, so that the latter is automatically defrosted.

When both the freezer compartment and the refrigerating compartment are in need of coolant, contacts 24 of thermostat 24 and 27 of thermostat 21 close, as does that of delay element 20. As a result, solenoid valve 16 is energized, and thus open, and the compressor 10 is started. Under these conditions, capillary 14 is bypassed and the refrigerant flow is at its maximum value, resulting in adequate cooling of both the refrigerating compartment and the freezer compartment.

For completing the description of the possible operative states of the refrigerant circuit, the situation has finally to be considered in which the contacts 25 of thermostat 23 and 26 of thermostat 21 are closed, as is that of delay element 20. In this case, neither the refrigerating nor the freezer compartment are in need of coolant, so that the compressor 10 is inoperative, and the refrigerant is not in circulation. Only under this condition, under which neither thermostat 21 or 23 signals a need for coolant, the contact of delay element 20 opens and remains open for a predetermined time. At the end of this period, delay element 20 closes again in preparation of compressor 10 being restarted when so required by the condition of the

refrigerant circuit.

The solution provided by the refrigerant circuit according to the invention is thus adapted to satisfy all of the operative requirements of a refrigerator-freezer combination with the employ of only a single compressor and an only slightly modified refrigerant circuit, thus avoiding in particular the necessity to employ separate refrigerant circuits or special valving. The proposed solution additionally permits the energy consumption to be reduced to a minimum and to also reduce the manufacturing and operating costs of the combination. The logic function of the refrigerant circuit may of course also be achieved by other means within the scope of the present invention. It is thus for example possible to employ an electronic device for controlling the start-up of compressor 10 and the energization of solenoid valve 16 and defroster restistor 22. In this case, a contact holds compressor 10 energized as long as solenoid valve 16 is energized. When the latter is deenergized, the contact associated with compressor 10 remains closed only if suppied with a voltage through a connection controlled by a contact externally of the electronic device, for instance one of the contacts of refrigerating compartment thermostat 21.

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Refrigerant Circuit for a Refrigerator-Freezer Combination

Patent Claims

1. A refrigerant circuit for a refrigerator-freezer combination particularly for domestic use, comprising a single compressor, an evaporator associated with the freezer compartment, an evaporator associated with the refrigerating compartment, a condenser and at least one capillary, characterized in that the evaporator (18) associated with the refrigerating compartment is connected downstream of the evaporator (17) associated with the freezer compartment and in series therewith, and in that upstream of said capillary (15) there is provided a second capillary (14) connected in series therewith and in parallel to a normally closed solenoid valve (16).

2. A refrigerant circuit according to claim 1, including a thermostat associated with the freezer compartment and a thermostat associated with the refrigerating compartment, characterized in that the thermostat (23) associated with the refrigerating compartment is provided with two contacts (24, 25) connected respectively to said solenoid valve (16) and to a defroster resistor (22) associated with said evaporator (18) of said refrigerating compartment, while the thermostat (21) associated with said freezer compartment is connected to the compressor (10) and to one (24) of the contacts of said thermostat (23) associated with the refrigerating compartment.

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Fig. 1

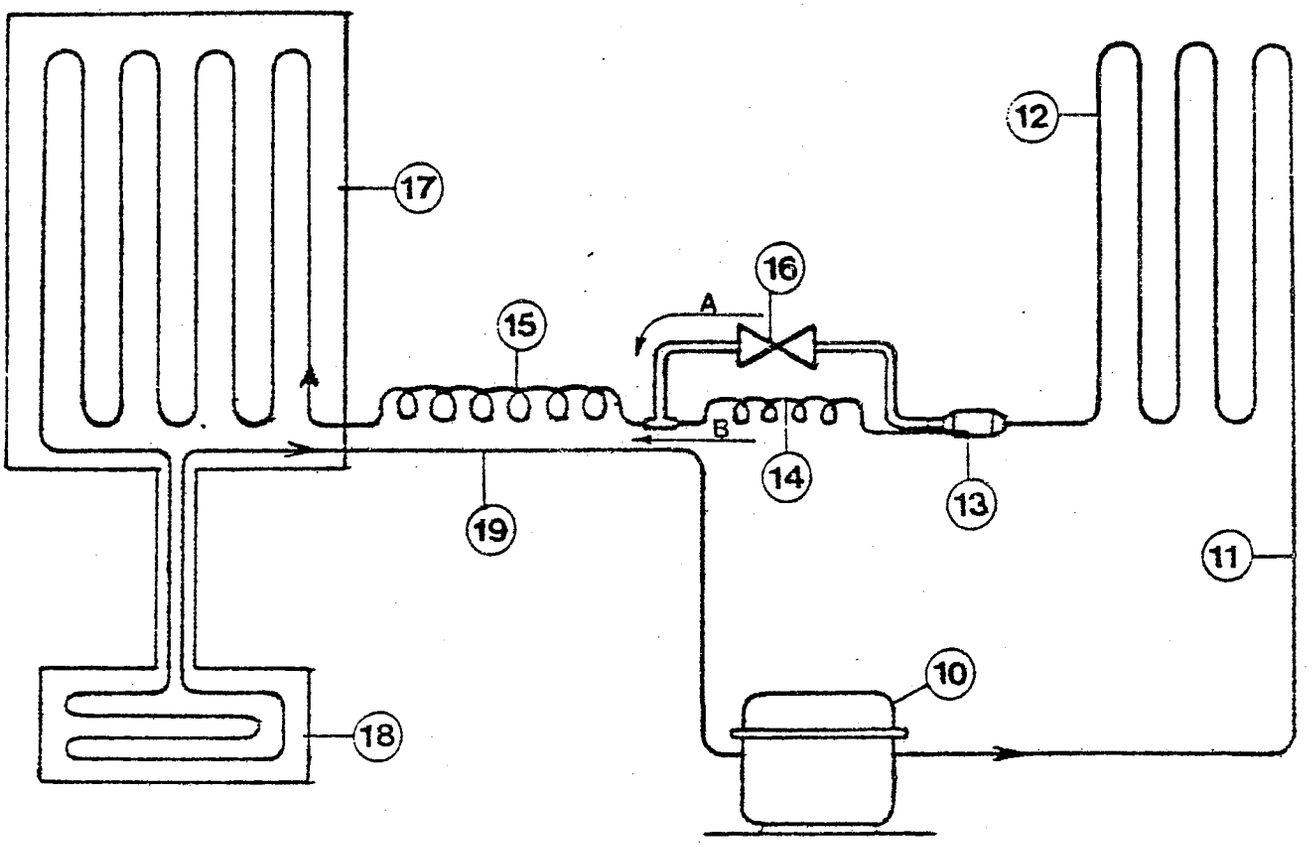

Fig. 2