(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 246 465**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: 87106106.5

(22) Date of filing: 28.04.87

(51) Int. Cl.³: F 25 B 5/00
F 16 K 31/06

(30) Priority: 20.05.86 IT 4572886

(43) Date of publication of application:
25.11.87 Bulletin 87/48

(84) Designated Contracting States:
CH DE ES FR GB IT LI

(71) Applicant: Zanussi Elettrodomestici S.p.A.
Via Giardini Cattaneo, 3
I-33170 Pordenone-C.P. 147(IT)

(72) Inventor: Beson, Duilio
Via Svevo 1
I-33170 Pordenone(IT)

(72) Inventor: Filippetto, Federico
Via Trevisit 28
I-33084 Cordenons (Pordenone)(IT)

(74) Representative: Patentanwälte Grünecker, Kinkeldey,
Stockmair & Partner
Maximilianstrasse 58
D-8000 München 22(DE)

(54) **Refrigerant circuit with rotary compressor.**

(57) Described is a refrigerant circuit for domestic refrigerating apparatus operating at two temperatures and including a rotary compressor (5).

The circuit includes a thermostatically controlled solenoid valve (7) having an inlet (8) and two outlets (9, 10) both of which are adapted to be closed when the compressor (5) is inoperative, and to be separately and selectively opened when the compressor (5) is in operation.

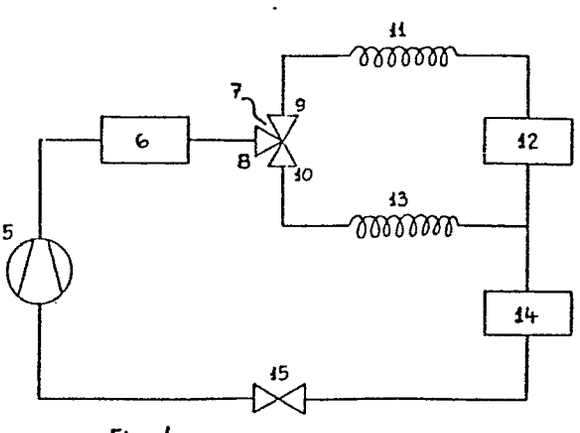

Fig. 1

EP 0 246 465 A1

Description

The present invention relates to a refrigerant circuit for domestic refrigerating apparatus operating at two different temperatures, in particular for a so-called "no frost" refrigerating apparatus of the automatic defrosting type including a rotary compressor.

As generally known, the refrigerant circuit of refrigerating apparatus of this type comprises a compressor (formerly of the reciprocating type exclusively), a condenser, at least one capillary and two evaporators disposed respectively in a storage compartment and a freezer compartment. The two compartments are disposed separately from one another in a cupboard housing and closed by separate doors. The evaporators are preferably interconnected in series, and the refrigerant circuit normally includes a thermostatically controlled valve permitting the flow of the refrigerant to be selectively directed to both evaporators or to the evaporator of the freezer compartment only.

Recent developments provide the employ of compressors of the rotary type in domestic refrigerating apparatus having only a single compartment for the cold storage of foods and thus only a single evaporator. The employ of rotary compressors is advantageous from the viewpoint of energy consumption which is reduced by about 5% by comparison to that of corresponding reciprocating compressors. On the other hand the rotary compressor has the shortcoming of requiring a longer period of time than a reciprocating compressor for attaining the proper operation pressure when the circuit operates under thermostatic control. This is because during inoperative periods of the rotary compressor the refrigerant fluid remaining in the compressor body at a high temperature and high pressure tends to escape towards the evaporator with the resultant equilibration of the pressure in the entire circuit.

The elimination of this disadvantage requires the insertion

into the circuit of two interceptor valves, upstream and downstream, respectively, of the compressor; the considerable pressure difference (6-8 bar) existing between the inlet and the outlet of the compressor when it is started does not represent a problem in the case of a rotary compressor thanks to its high starting torque. The employ of the two valves, however, envolves a complicated construction, particularly at their welded connections, as the weld seams constitute critical points in the refrigerant circuit. For further reducing the energy consumption in a refrigerating apparatus having a single evaporator, it has also been proposed to employ a special valve having a high-pressure inlet connected to the condenser, a high-pressure outlet connecetd to the capillary and to the evaporator, a low-pressure inlet connected to the evaporator, and a low-pressure outlet connected to the compressor. A valve of this type is thus rather complicated, expensive, and above all cannot be adapted to refrigerating apparatus operating at two temperatures, that is, having two evaporators to be supplied in series or selectively.

It is therefore an object of the present invention to provide a refrigerant circuit with a single rotary compressor for refrigerating apparatus operating at two temperatures, preferably with automatic defrosting, such circuit to be of simple construction and to operate at reduced energy consumption and with improved reliability.

This object is attained in a refrigerant circuit for domestic refrigerating apparatus operating at two temperatures, and in particular with automatic defrosting, said circuit comprising a compressor, a condenser, two evaporators preferably connected in series, and at least one valve for selectively directing the refrigerant fluid to said evaporators, said valve having one inlet and two outlets and being inserted between said condenser and said evaporators, said circuit being characterized in that said compressor is of the rotary type, and said valve comprises

two closure members adapted to close both outlets when said compressor is inoperative, and to selectively open one of said two outlets when said compressor is in operation.

The advantages and characteristics 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 shows a diagram of a refrigerant circuit according to the invention for a refrigerating apparatus operating at two temperatures, and

figs. 2 - 4 show diagrammatic illustrations of different operating positions of a valve inserted into the circuit shown in fig. 1.

The refrigerant circuit shown in fig. 1 comprises a compressor 5 which according to the invention is of the rotary type. The outlet of compressor 5 is connected to a condenser 6, the outlet of which is connected to the inlet 8 of a three-way solenoid valve 7. The two outlets 9 and 10 of solenoid valve 7 are connected respectively to two parallel branches of the circuit. In particular, a branch connected to outlet 9 comprises a capillary 11 and an evaporator 12 disposed in the cold-storage compartment of the refrigerating apparatus. This compartment is usually to be kept at a temperature of about +5 °C. Another branch connected to outlet 10 comprises a capillary 13 and is connected to the first branch downstream of evaporator 12. Downstream of this connection the circuit includes another evaporator 14 disposed in the freezer compartment of the refrigerating apparatus, which is usually to be kept at a temperature of about -24 °C.

The return branch of the circuit leading from evaporator 14 to compressor 5 is provided with a non-return valve 15. In the inoperative state of compressor 5, valves 7 and 15 are effective to divide the circuit into a high-pressure portion comprising compressor 5 and condenser 6, and a low-

pressure portion including the two evaporators 12 and 14.

The described circuit is typical for a refrigerating apparatus operating at two temperatures, with the exception of non-return valve 15, the employ of which is required by the employ of the rotary compressor. In the particular case of a so-called "no frost" refrigerating apparatus with automatic defrosting, a fan (not shown in the drawing) is provided to cooperate in a known manner with evaporator 14 for creating a forced air circulation in the freezer compartment. Valve 7 in accordance with the invention comprises a tubular body formed with the two outlets 9 and 10 facing in opposite directions, and inlet 8 extending at right angles to outlets 9 and 10. Disposed in the tubular body are two closure members 16 and 17 cooperating with outlets 9 and 10, respectively, and a compression spring 18 inserted therebetween. Associated to each closure member 16, 17 is a respective electromagnetic coil 19, 20. The control of solenoid valve 7 and the resultant operation of the entire refrigerant circuit proceeds as follows:

When the compartments of the refrigerating apparatus are not in need of refrigeration, compressor 5 is inoperative, valve 15 is closed, and both outlets 9 and 10 of valve 7 are likewise closed (fig. 2). To this purpose coils 19 and 20 are deenergized, and spring 18 acts to hold closure members 16 and 17 in the closure position.

Under these conditions the portion of the circuit extending beteen valve 15 and valve 7 and including compressor 5 and condenser 6 contains the refrigerant fluid at relatively high temperature and pressure.

In the remaining portion of the circuit the refrigerant fluid is at relatively low pressure and temperature. The two portions of the circuit are thus completely separated from one another. When both compartments of the refrigerating apparatus are in need of refrigeration, compressor 5 is started and valve 15 is opened. At the saem time coil 19

is energized to retract closure member 16 against the action of spring 18 for opening outlet 9 of vlave 7 (fig.3). As a result the refrigerant fluid is permitted to flow through both evaporators 12 and 14.

The same situation arises when only the cold-storage compartment is in need of refrigeration. Also in this case the refrigerant fluid flows through both evaporators 12 and 14. The resultant additional refrigeration of the freezer compartment, although not required, cannot do any harm. When on the other hand only the freezer compartment is in need of refrigeration, compressor 5 is started, valve 15 is opened, and coil 20 - instead of coil 19 - is energized to retract closure member 17 against the action of spring 18. In this manner outlet 10 of valve 7 is opened, so that the refrigerant fluid flows only through evaporator 14.

The advantages of the proposed solution, namely, reduced cost and improved reliability, are evident, in that a single valve is required for establishing the various operating modes of a refrigerator-freezer, to thereby simplify the construction of the circuit by providing a reduced number of welds therein. The energy consumption is reduced by the employ of a single rotary compressor and by reducing the time the coils are to be energized for actuating solenoid valve 7.

In contrast to the case of the refrigerant circuit of a refrigerator-freezer having a single reciprocating compressor in combination with a solenoid valve, there is no need of a device for retarding the re-starting of the compressor. While a reciprocating compressor due to its lower starting torque requires the pressures in the circuit to be substantially in equilibrium, a rotary compressor encounters no starting problems in the presence of substantial pressure differences in the refrigerant circuit.

The described construction of solenoid valve 7 is of course solely given by way of example. The control of the valve

may in fact be accomplished by an electronic device (e.g. PTC or the like) instead of by electromechanical means, it being understood that such valve be capable of controlling the different operating modes described, and in particular of simultaneously closing both of its outlets.

Refrigerant Circuit with Rotary Compressor

Patent Claims:

1. Refrigerant circuit for a domestic refrigerating apparatus operating at two temperatures, and in particular with automatic defrosting capability, comprising a compressor, a condenser, two evaporators preferably connected in series, and at least one valve for selectively directing the refrigerant fluid to said evaporators, said valve having an inlet and two outlets and being disposed between said condenser and said evaporators, characterized in that said compressor (5) is of the rotary type, and said valve (7) comprises two closure members (16, 17) adapted to close both said outlets (9, 10) when said compressor (5) is inoperative, and to selectively open one of said outlets (9, 10) when said compressor (5) is in operation.

2. A refrigerant circuit according to claim 1, characterized in that said closure members (16, 17) of said valve (7) are disposed opposite one another with a compression spring (18) interposed therebetween, each closure member (16, 17) being operable by means of a respective electromagnetic coil (19, 20) so as to open the corresponding outlet of said valve (7) when the respectibe coil is energized.

0246465

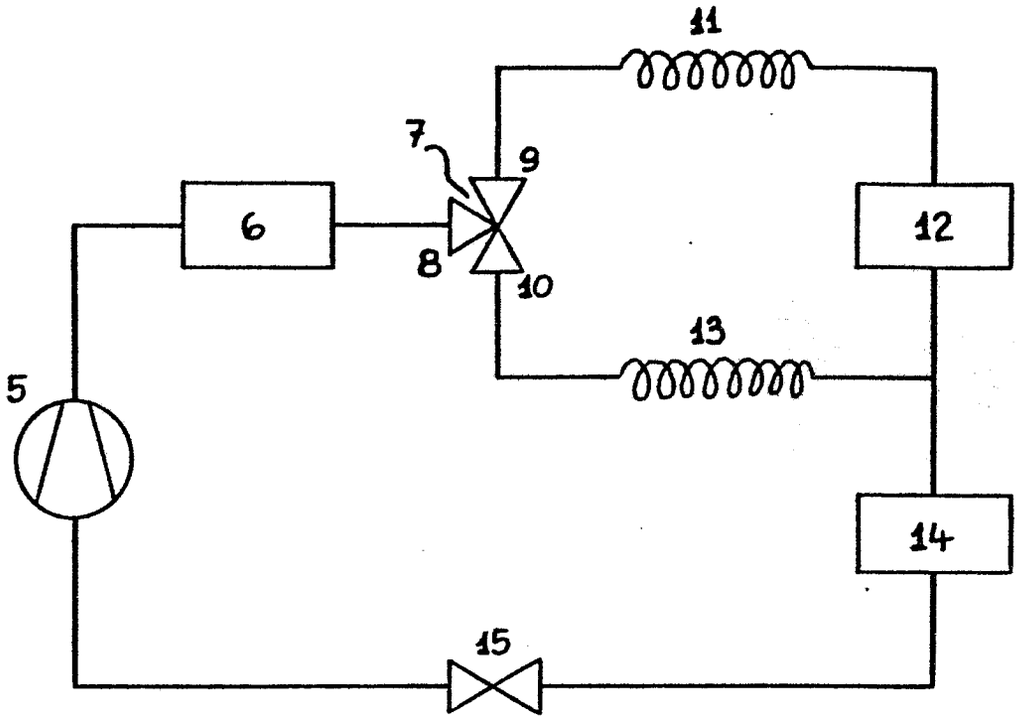

Fig. 1

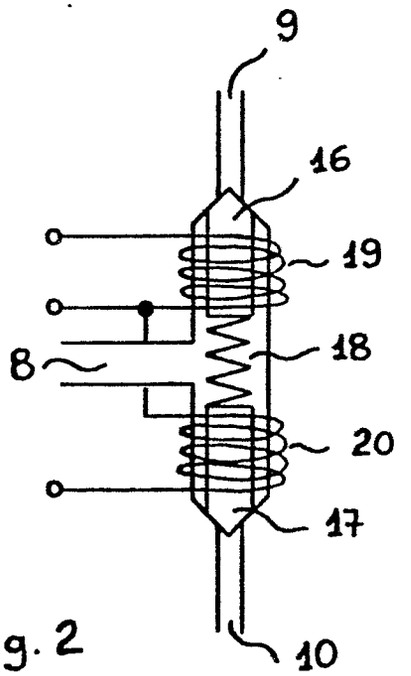

Fig. 2

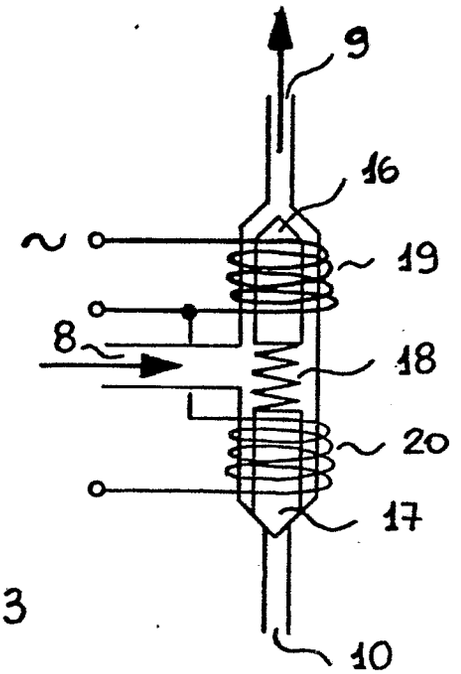

Fig. 3

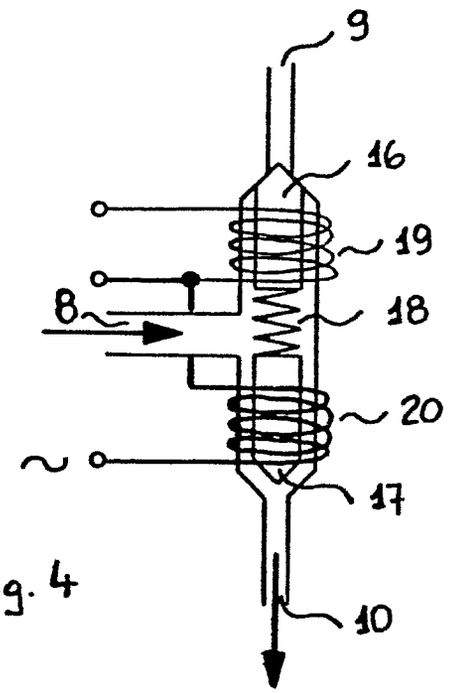

Fig. 4

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 87 10 6106

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int Cl 4)
Y	GB-A-2 154 722 (TOSHIBA) * Page 2, line 79 - page 5, line 103; figures 3-9 *	1	F 25 B 5/00 F 16 K 31/06
Y	GB-A- 575 440 (HEYWOOD COMPRESSOR) * Page 2, lines 39-72; figure 1 *	1	
A		2	
A	US-A-2 481 605 (MACLEOD) * Column 1, line 31 - column 3, line 49; figure *	1	
A	US-A-2 333 899 (STICKEL) * Page 2, right-hand column, line 69 - page 10, left-hand column, line 70; figures 2-10 *	1	TECHNICAL FIELDS SEARCHED (Int Cl 4) F 25 B F 25 D F 16 K
A	DE-C- 723 128 (LUMOPHON-WERKE BRUCKNER & STARK) * Page 2, line 13 - page 3, line 74; figure *	1	
A	EP-A-0 061 104 (INDESIT) * Page 9, line 25 - page 13, line 21; figures 1-3 *	1	

-/-

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	01-09-1987	BOETS A.F.J.

CATEGORY OF CITED DOCUMENTS

- X : particularly relevant if taken alone
- Y : particularly relevant if combined with another document of the same category
- A : technological background
- O : non-written disclosure
- P : intermediate document
- T : theory or principle underlying the invention
- E : earlier patent document, but published on, or after the filing date
- D : document cited in the application
- L : document cited for other reasons
- & : member of the same patent family, corresponding document

EPO Form 1503 03 82

European Patent Office

EUROPEAN SEARCH REPORT

Application number
EP 87 10 6106

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	SOVIET INVENTIONS ILLUSTRATED, section III, Mechanical & General, June 1966, page 9, Derwent Publications Ltd, London, GB; & SU-A-175 363 (G.D. TASHKINOV et al.) 22-05-1963	2	
A	US-A-3 842 860 (STAMPFLI) * Column 1, line 41 - column 2, line 47; figure *	2	
A	US-A-2 423 386 (HUBACKER)		
A	EP-A-0 165 220 (ELECTROLUX)		
A	US-A-4 242 116 (ASCHBERGER)		TECHNICAL FIELDS SEARCHED (Int. Cl.4)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	01-09-1987	BOETS A.F.J.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO Form 1503 03 82