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

(11) Publication number: **0 408 999 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **90112828.0**

(51) Int. Cl.5: **F25B 41/00**, F24F 1/02

(22) Date of filing: **05.07.90**

(30) Priority: **18.07.89 IT 2121389**

(43) Date of publication of application:
23.01.91 Bulletin 91/04

(84) Designated Contracting States:
ES FR GB GR IT

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(54) An air conditioning apparatus of the type having separate outdoor and indoor units.

(57) This apparatus (1) for air conditioning applications is of the type comprising separate outdoor (3) and indoor (2) units interconnected by a flexible connection element (4). The expansion device for the apparatus (1) locates within the connection element (4) and consists preferably of a capillary tube (25).

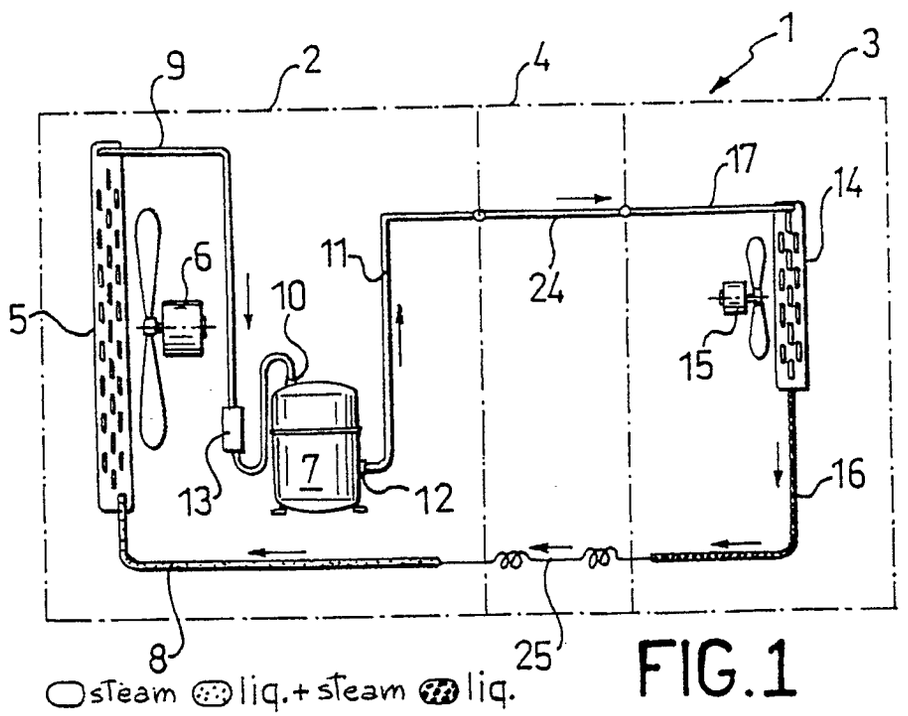

FIG.1

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This invention relates to a refrigerating apparatus for air conditioning applications, being of the type composed of two separate units to be accommodated, the one inside a space to be air conditioned and the other outdoors.

More particularly, the invention relates to a refrigerating apparatus for air conditioning applications, comprising an indoor unit, an outdoor unit, a flexible connection element between the indoor unit and the outdoor unit, an indoor heat exchanger within the indoor unit, an outdoor heat exchanger within the outdoor unit, a compressor within the indoor unit,an expansion device, and connection ducting between the outdoor heat exchanger, the expansion device, the indoor heat exchanger, and the compressor, including, within the connection element, a first flexible line for the thermal fluid flow between the outdoor heat exchanger and the compressor and a second flexible line for the thermal fluid flow between the indoor heat exchanger and the outdoor heat exchanger.

Apparatus of this kind have been known and appreciated especially for use with portable air conditioners, that is non-permanent applications. In fact, highly valued is in this case the possibility to install the apparatus without cutting holes through window panes, it being sufficient that a window wing be kept ajar or a notch cut in a window frame and/or jamb for the connection element to pass through.

The connection element is provided, in fact, in the form of a thick flattened cable. It has an outer sleeve or sheath which encloses the electrical harness (three cables), the refrigerating water connections (two lines) going either directions, and customarily a drain pipe to take to the outdoor heat exchanger condensation water which has formed over the indoor heat exchanger during operation in the cooling mode.

The problem that underlies this invention is one of reducing the size of the connection element to further enhance ease of installation of the apparatus.

The subject-matter of this invention is a refrigerating apparatus for air conditioning applications, of the type specified above, which is characterized in that said expansion device is accommodated within the flexible connection element.

Advantageously, the second flexible line within the connection element is a capillary tube, said capillary tube constituting said expansion device.

Even more advantageously, the second flexible line within the connection element is formed of a plurality of capillary tubes, said capillary tubes constituting said expansion device.

Further features and the advantages of a refrigerating apparatus according to the invention will be more clearly apparent from the following detailed description of a preferred embodiment thereof, given with reference to the accompanying drawings.

In the drawings:

Figure 1 shows schematically an apparatus according to the invention, and

Figure 2 is a sectional view of the connection element of the apparatus shown in Figure 1.

In the drawing views, the reference numeral 1 generally denotes a refrigerating apparatus for air conditioning applications.

The apparatus 1 comprises an indoor unit 2, an outdoor unit 3, and a flexible connection element 4 extending between the indoor unit 2 and the outdoor unit 3.

The indoor unit 2 comprises an indoor heat exchanger 5 having conventional air-forcing means associated therewith which are only schematically depicted at 6 in the drawings. The indoor unit 2 also comprises a compressor 7, a line 8 between the indoor heat exchanger 5 and the connection element 4, a line 9 between the indoor heat exchanger 5 and an intake port 10 of the compressor 7, and a line 11 between the connection element 4 and a delivery port 12 of the compressor 7. Provided on the line 9 near the intake port 10 of the compressor 7 is a liquid/vapor separator 13 adapted to prevent liquid-phase thermal fluid from entering the compressor 7 and damaging it.

The outdoor unit 3 comprises an outdoor heat exchanger 14 having conventional air-forcing means associated therewith which are only schematically shown at 15 in the drawings. The outdoor unit 3 also includes two lines, 16 and 17, between the outdoor heat exchanger 8 and the connection element 4.

The connection element 4 comprises an outer sleeve or sheath 18, wherein two longitudinal cavities 19 and 20 are defined which are separated by a partition 21.

The connection element 4 comprises a condensation water drain pipe 22 and an electrical cable 23 of the three-wire type; both tube 22 and cable 23 are accommodated inside the cavity 20.

The connection element 4 further comprises a first flexible line 24 connected at one end to line 11 of the indoor unit 2, and at the other end, to the line 17 leading to the outdoor unit 3, and a second flexible line 25 connected at one end to line 8 of the indoor unit 2 and to line 16 of the outdoor unit 3 at the other end.

The first flexible line 24 consists basically of a tube positioned within cavity 19 of the sleeve 18; the second flexible line 25 is, in turn, comprised of at least one capillary tube, preferably two capillary tubes in parallel, positioned within cavity 20.

Thus, the following circuit path is established for the thermal fluid: compressor 7, line 11, first flexible line 24, line 17, outdoor heat exchanger 14,

line 16, second flexible line 25, line 8, indoor heat exchanger 5, line 9, compressor 7.

It should be noted that the indoor heat exchanger 5 functions as the evaporator, the outdoor heat exchanger 14 as the condenser, and the second flexible line 25 as the expansion device.

Thus, in an apparatus according to the invention, the flexible connection element between the outdoor and indoor units is greatly reduced in size by virtue of the space requirements of the capillary tubes being much lower than those of a traditional tube.

A further advantage comes then from eliminating the iso-enthalpic expansion valve as an independent device.

Claims

1. A refrigerating apparatus for air conditioning applications, comprising an indoor unit (2), an outdoor unit (3), a flexible connection element (4) between the indoor unit and the outdoor unit, an indoor heat exchanger (5) within the indoor unit (2), an outdoor heat exchanger (14) within the outdoor unit (3), a compressor (7) within the indoor unit (2), an expansion device (25), and connection ducting between the outdoor heat exchanger, the expansion device, the indoor heat exchanger , and the compressor, including, within the connection element (4), a first flexible line (24) for the thermal fluid flow between the outdoor heat exchanger (14) and the compressor (7) and a second flexible line (25) for the thermal fluid flow between the indoor heat exchanger (5) and the outdoor heat exchanger (14), characterized in that said expansion device (25) is accommodated within the flexible connection element (4).

2. An apparatus according to Claim 1, characterized in that said second flexible line (25) within the connection element (4) consists of a capillary tube, said capillary tube constituting said expansion device.

3. An apparatus according to Claim 1, characterized in that said second flexible line (25) within the connection element (4) is formed of a plurality of capillary tubes, said capillary tubes constituting said expansion device.

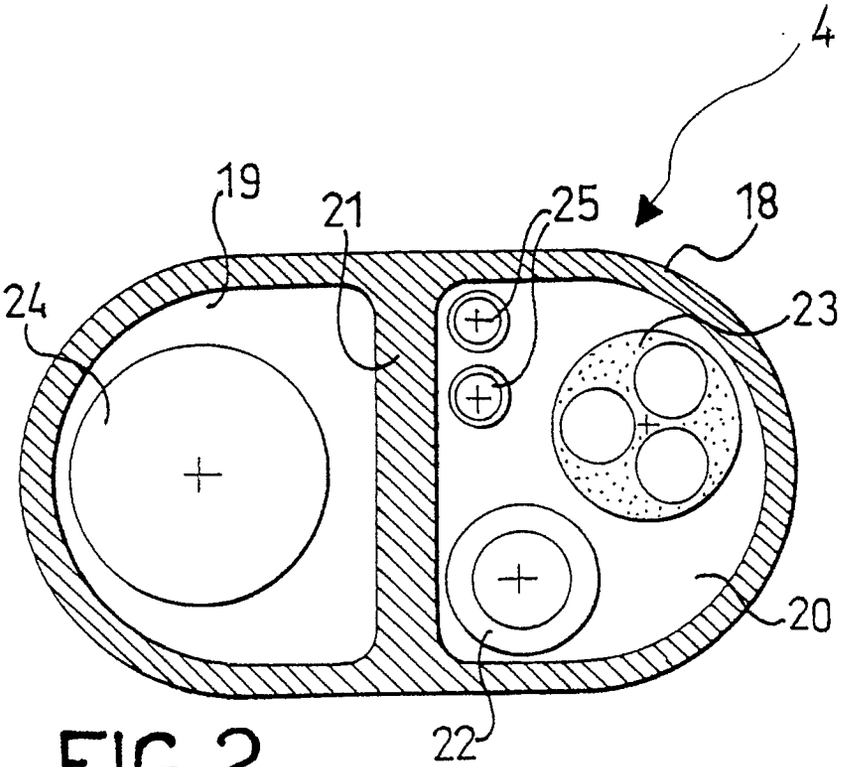
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FIG.2

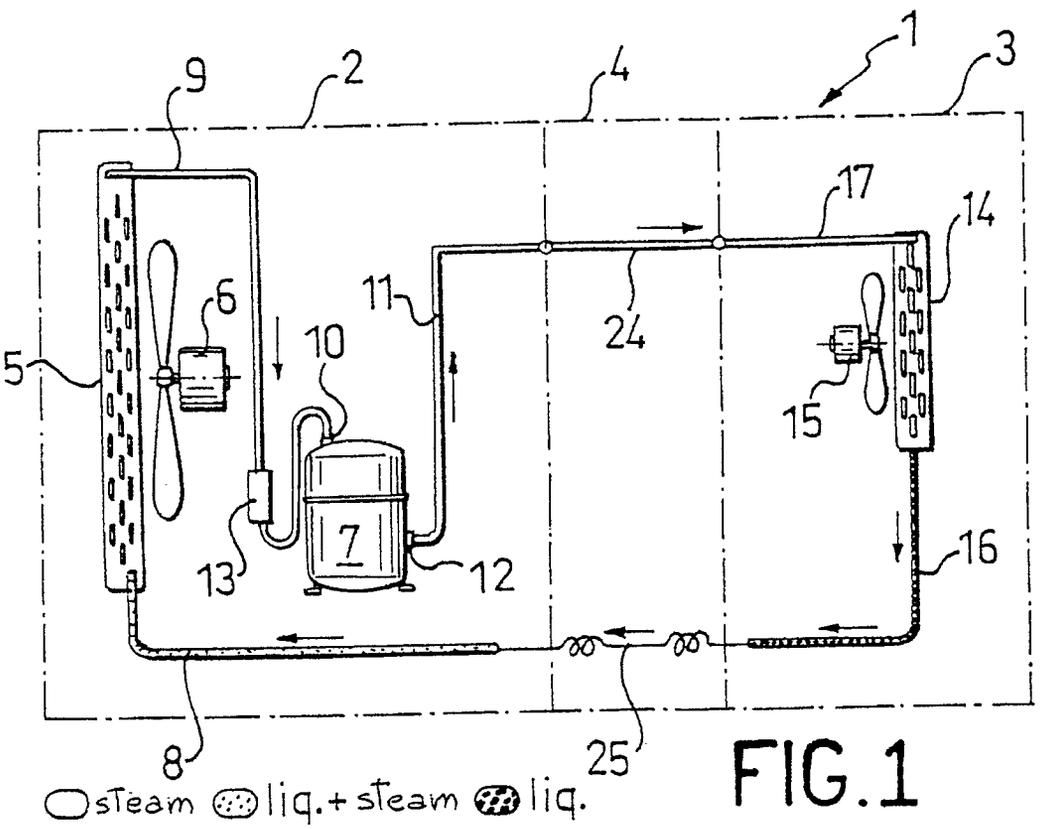
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FIG.1

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 11 2828

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.5)
Y	US-A-3 611 743 (MANGANARO) * Column 3, line 2 - column 4, line 24; figures 1-5 *	1,2	F 25 B 41/00 F 24 F 1/02
Y	EP-A-0 145 114 (HALLETT) * Page 4, line 25 - page 5, line 30; figure 1 *	1,2	
A		3	
A	US-A-2 708 833 (NIGRO)		
A	US-A-2 760 354 (BRADY)		
A	CH-A- 631 807 (DUOFROST KÜHL- UND GEFRIERGERÄTE)		
A	US-A-4 641 503 (KOBAYASHI)		
A	DE-A-2 826 813 (BRAUN)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

F 25 B
F 24 F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	22-10-1990	BOETS A.F.J.

CATEGORY OF CITED DOCUMENTS

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