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

(11) EP 2 187 150 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
19.05.2010 Bulletin 2010/20

(51) Int Cl.:
F25B 41/06 *(2006.01)* ***F25B 40/00*** *(2006.01)*

(21) Application number: **09175357.4**

(22) Date of filing: **09.11.2009**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR

(30) Priority: **18.11.2008 JP 2008294844**

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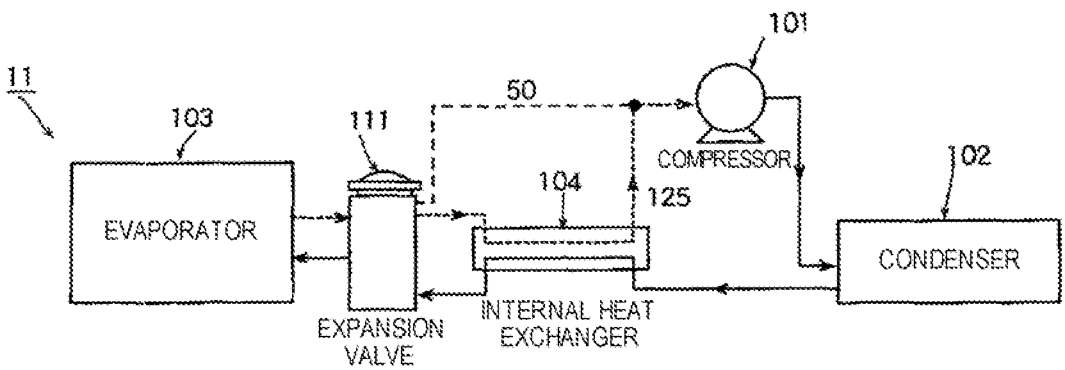
(54) Refrigerating Cycle

(57) A refrigerating cycle capable of certainly and effectively suppressing an excessive increase of refrigerant temperature at a suction side of a compressor without complicating a piping system and a structure of an expansion valve is provided. A refrigerant cycle includes a compressor 101, a condenser 102, an evaporator 103, an internal heat exchanger 104, and an expansion valve 111. In the internal heat exchanger 104, a heat exchange is carried out between a high-temperature refrigerant introduced from the condenser 102 to the expansion valve 111 and a low-temperature refrigerant introduced from the evaporator 103 to the suction side of the compressor 101. In order to detect temperature and/or pressure of a low-temperature refrigerant introduced toward the suction side of the compressor 101 after carrying out the heat exchange in the internal heat exchanger 104, a temperature-sensitive cylinder 70 and/or an external pressure introduction pipe 50 are additionally provided at the expansion valve 111. In the expansion valve 111, a flowing rate of a refrigerant introduced to the evaporator 103 is adjusted responding to temperature and/or pressure of a low-temperature refrigerant after the heat exchange.

FIG. 1(A)



Printed by Jouve, 75001 PARIS (FR)

Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a refrigerating cycle used for a car air-conditioner and the like, and particularly relates to a refrigerating cycle including a compressor, a condenser, an evaporator, an internal heat exchanger, and an expansion valve, wherein a heat exchange is carried out between a high-temperature refrigerant introduced from the condenser to the expansion valve and a low-temperature refrigerant introduced from the evaporator to the suction side of the compressor in the internal heat exchanger.

Description of the Conventional Art

[0002] As for an example of a conventional refrigerating cycle used for a car air-conditioner or the like, a refrigerating cycle illustrated in Fig. 9 has been proposed and practically used in order to improve refrigerating capacity, etc. That is, a refrigerating cycle 10 illustrated in Fig. 9 includes a compressor 101, a condenser 102, an evaporator 103, an internal heat exchanger 104, and an expansion valve 110 (which will be described below). A heat exchange is carried out between a high-temperature and high-pressure refrigerant (liquid phase) introduced from the condenser 102 to the expansion valve 110 and a low-temperature and low-pressure refrigerant (vapor phase) introduced from the evaporator 103 to the suction side of the compressor 101 in the internal heat exchanger 104. (For example, refer to Japanese Patent Application Laid-Open No. 2000-346466 and Japanese Patent Application Laid-Open No. 2007-240041)

[0003] One example of the expansion valve 110 used in the refrigerating cycle 10 is illustrated in Fig. 10. The expansion valve 110 illustrated in Fig. 10 includes an inflow orifice 21 and a valve chamber 24 at a lower part of a valve main body 20. The inflow orifice 21 is for introducing a high-temperature refrigerant from the internal heat exchanger 104, and the valve chamber 24 has a valve seat part 25 (a valve port 26). The expansion valve 110 further includes an outflow orifice 22 at a center part of the valve main body 20. The expansion valve 110 further includes a temperature-sensitive inflow orifice 31 and an outflow orifice 32 at the left and right of an upper part of the valve main body 20. The expansion valve 110 further includes a diaphragm device 40 as a temperature-sensitive and pressure-sensitive responding means at the uppermost part of the valve main body 20, and the diaphragm device 40 responds to a temperature change and a pressure change of a refrigerant flowing from the temperature-sensitive inflow orifice 31 to the outflow orifice 32.

[0004] In the valve chamber 24, a ball valve body 30 for opening and closing the valve port 26 and a coil spring 27 for urging the ball valve body 30 toward the valve closing direction are arranged.

[0005] The diaphragm device 40 has a diaphragm 42 for driving the ball valve body 30 in the opening and closing direction (the vertical direction) through a drive rod 35 and a connector 36. An upper pressure chamber 43 and a lower pressure chamber 44 are partitioned at the upper and lower sides of the diaphragm 42 used as a partition wall. The upper pressure chamber 43 encloses gas at a predetermined pressure, and is sealed by a cap 46. The lower pressure chamber 44 communicates with the temperature-sensitive inflow orifice 31 and the outflow orifice 32 through a communication opening 45, and pressure of the low-temperature refrigerant introduced from the evaporator 103 to the internal heat exchanger 104 acts on the lower face side of the diaphragm 42.

[0006] In addition, in order to shut off the communication and circulation between the lower pressure chamber 44, the temperature-sensitive inflow orifice 31 and the outflow orifice 32, and the refrigerant outflow orifice 22, a hole 38 is formed near an internal center part of the valve main body 20 where the drive rod 35 penetrates, and an O-ring 39 as a sealing member is interposed between an inner peripheral face of the hole 38 and an outer peripheral face of the drive rod 35. A spring pressure-adjusting nut 28 is screwed to a lower part of the valve chamber 24, and an O-ring 29 as a sealing member is interposed between a not-screwed part of the spring pressure-adjusting nut 28 and an inner peripheral face of the valve chamber 24.

[0007] Therefore, in the expansion valve 110 having the aforementioned configuration, a flow rate (a pressure drop rate and a temperature drop rate) of the refrigerant introduced from the outflow orifice 22 to the evaporator 103 is adjusted responding to a temperature and pressure of the low-temperature refrigerant before carrying out a heat exchange in the internal heat exchanger 104.

SUNIMARY OF THE INVENTION

Problem to be Solved by the Invention

[0008] However, in the refrigerating cycle 10 including the internal heat exchanger 104 and the expansion valve 110, temperature of a refrigerant sucked into the compressor 101 increases by carrying out a heat exchange in the internal heat exchanger 104. In consequence of this, there may be a case that a (discharge) temperature in the compressor becomes excessively high, and thereby oil contained in the refrigerant may be degraded so as to cause faults such as burn-out.

[0009] In order to prevent these faults, Japanese Patent Application Laid-Open No. 2000-346466 discusses a method of detecting refrigerant temperature at a suction side of a compressor and adjusting the amount of a refrigerant flowing in an internal heat exchanger by a three-way valve. However, since this method needs the three-way valve, a piping system becomes to be complicated and the number of parts tends to increase.

[0010] Further, Japanese Patent Application Laid-Open No. 2007-240041 discusses a method of providing a bypass passage at an expansion valve and cooling a refrigerant. However, in this method, when a load to the system fluctuates, refrigerant temperature at the compressor suction side cannot be controlled, and a structure of the expansion valve becomes to be complicated to increase cost.

[0011] The present invention is to solve the aforementioned problems, and is directed to provide a refrigerating cycle capable of certainly and effectively suppressing an excessive increase of refrigerant temperature at the suction side of the compressor without complicating a piping system and a structure of an expansion valve.

Means for Solving the Problem

[0012] According to an aspect of the present invention to achieve the object, a refrigerating cycle of the present invention basically includes a compressor, a condenser, an evaporator, an internal heat exchanger, and an expansion valve. In the internal heat exchanger, a heat exchange is carried out between a high-temperature refrigerant introduced from the condenser to the expansion valve and a low-temperature refrigerant introduced from the evaporator to the suction side of the compressor. In order to detect temperature and/or pressure of a low-temperature refrigerant introduced toward the suction side of the compressor after carrying out the heat exchange in the internal heat exchanger, a temperature-sensitive cylinder and/or an external pressure introduction pipe are additionally provided at the expansion valve. In the expansion valve, a flowing rate of a refrigerant introduced to the evaporator is adjusted responding to temperature and/or pressure of a low-temperature refrigerant after the heat exchange.

[0013] According to another aspect of the present invention, the expansion valve includes a drive means such as a diaphragm device which drives a valve body in opening and closing directions responding to a pressure change of a low-temperature refrigerant introduced through the external pressure introduction pipe after carrying out the heat exchange.

[0014] According to yet another aspect of the present invention, the expansion valve includes a drive means such as a diaphragm device which drives a valve body in the opening and closing directions responding to a temperature change of a low-temperature refrigerant detected by the temperature-sensitive cylinder after carrying out the heat exchange.

Effect of the Invention

[0015] Considering that temperature and pressure of a low-temperature refrigerant after a heat exchange are higher than temperature and pressure before the heat exchange, the refrigerating cycle according to the present invention includes the temperature-sensitive cylinder and/or the external refrigerant pressure introduction pipe for detecting the temperature and/or pressure of the low-temperature refrigerant introduced toward the suction side of the compressor after carrying out the heat exchange in the internal heat exchanger. In the expansion valve, a flowing rate (a pressure drop rate and a temperature drop rate) of the refrigerant introduced to the evaporator is adjusted responding to temperature and/or pressure of the low-temperature refrigerant after the heat exchange. Thus, an excessive increase of the refrigerant temperature at the suction side of the compressor can be certainly and effectively suppressed without complicating a piping system and a structure of the expansion valve. Therefore, since an excessive increase of (discharge) temperature in the compressor can be previously prevented, oil contained in the refrigerant can be prevented from degradation, and thus faults such as burn-out can be prevented.

[0016] Further, the refrigerating cycle of the present invention can acquire the aforementioned effect only by slightly remodeling a currently used refrigerating cycle and an expansion valve used in it, so that there is a merit that the present invention does not greatly increase cost.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

Figs. 1(A), 1(B) and 1(C) are schematic configuration views illustrating a first exemplary embodiment, a second exemplary embodiment, and a third exemplary embodiment respectively of a refrigerating cycle according to the present invention.

Fig. 2 is a longitudinal sectional view illustrating an expansion valve used in a refrigerating cycle of the first exemplary embodiment.

Fig. 3 is a longitudinal sectional view illustrating an expansion valve used in a refrigerating cycle of the second exemplary embodiment.

Fig. 4 is a longitudinal sectional view illustrating an expansion valve used in a refrigerating cycle of the third exemplary embodiment.

Figs. 5(A), 5(B) and 5(C) are schematic configuration views illustrating a fourth exemplary embodiment, a fifth exemplary embodiment, and a sixth exemplary embodiment respectively of a refrigerating cycle according to the present invention.

Fig. 6 is a partially cut longitudinal sectional view illustrating an expansion valve used in a refrigerating cycle of the fourth exemplary embodiment.

Fig. 7 is a partially cut longitudinal sectional view illustrating an expansion valve used in a refrigerating cycle of the fifth exemplary embodiment.

Fig. 8 is a partially cut longitudinal sectional view illustrating an expansion valve used in a refrigerating cycle of the sixth exemplary embodiment.

Fig. 9 is a schematic configuration view illustrating one example of a conventional refrigerating cycle.

Fig. 10 is a longitudinal sectional view illustrating an expansion valve used in the conventional refrigerating cycle.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

[0018] The preferred embodiment of a refrigerating cycle of the present invention will be described below with reference to the drawings.

[0019] Figs. 1(A), 1(B), and 1(C) illustrate a first exemplary embodiment, a second exemplary embodiment, and a third exemplary embodiment respectively of a refrigerating cycle according to the present invention. Figs. 2, 3 and 4 illustrate expansion valves 111, 112 and 113 used in the first, second and third exemplary embodiments respectively. As for refrigerating cycles 11, 12, and 13 illustrated in Figs. 1(A), 1(B), and 1(C), and as for the expansion valves 111, 112, and 113 illustrated in Figs. 2 to 4, same reference numerals are given to parts corresponding to respective parts of the conventional example of the refrigerating cycle 10 and the expansion valve 110 used therein, which are illustrated in Figs. 9 and 10, and differences from the conventional example will be mainly described below.

[0020] As for the refrigerating cycle 11 of the first exemplary embodiment, in order to detect pressure of a low-temperature refrigerant introduced to the suction side of a compressor 101 after carrying out a heat exchange in an internal heat exchanger 104, one end of an external pressure introduction pipe 50 is connected to an intermediate part of a pipe 125 connecting the internal heat exchanger 104 and the suction side of the compressor 101. Another end of the external pressure introduction pipe 50 is connected with a pressure introducing passage 54 provided near a bottom part of a lower pressure chamber 44 of the expansion valve 111. In the expansion valve 111, a flowing rate (a pressure drop rate and a temperature drop rate) of the refrigerant introduced to an evaporator 103 is adjusted responding to pressure of the low-temperature refrigerant after the heat exchange.

[0021] More particularly, as for the expansion valve 111 used in the refrigerating cycle 11 of the first exemplary embodiment, as illustrated in Fig. 2, in order to shut off communication between the lower pressure chamber 44, and a temperature-sensitive inflow orifice 31 and an outflow orifice 32, a communication opening 45 of the conventional example is changed to a rod insertion hole 62 having a small diameter. An O-ring 63 as a sealing member is interposed between the rod insertion hole 62 and a drive rod 35, and the pressure of the low-temperature refrigerant after carrying out the heat exchange in the internal heat exchanger 104 is introduced into the lower pressure chamber 44 through the external pressure introduction pipe 50 and the pressure introduction passage 54.

[0022] Considering that temperature and pressure of a low-temperature refrigerant after a heat exchange are higher than temperature and pressure before the heat exchange, the refrigerating cycle 11 of this exemplary embodiment includes the external refrigerant pressure introduction pipe 50 for detecting pressure of the low-temperature refrigerant introduced toward the suction side of the compressor 101 after carrying out the heat exchange in the internal heat exchanger 104. In the expansion valve 111, the flowing rate of the refrigerant introduced to the evaporator 103 is adjusted responding to the pressure of the low-temperature refrigerant after the heat exchange. Thus, an excessive increase of the refrigerant temperature at the suction side of the compressor 101 can be certainly and effectively suppressed without complicating a piping system and a structure of the expansion valve. Therefore, since an excessive increase of (discharge) temperature in the compressor can be previously prevented, oil contained in the refrigerant can be prevented from degradation, and thus faults such as burn-out can be prevented.

[0023] Further, the refrigerating cycle of this exemplary embodiment can acquire the aforementioned effect only by slightly remodeling a currently used refrigerating cycle and an expansion valve used in the refrigerating cycle, so that there is a merit that the present invention does not greatly increase cost.

[0024] As for the refrigerating cycle 12 of the second exemplary embodiment, in order to detect temperature of a low-temperature refrigerant introduced to the suction side of a compressor 101 after carrying out a heat exchange in an internal heat exchanger 104, a temperature-sensitive cylinder 70 is arranged closely to a pipe 125 connecting the internal heat exchanger 104 and the suction side of the compressor 101. Further, as illustrated in Fig. 3, the temperature-sensitive cylinder 70 and an upper pressure chamber 43 of the expansion valve 112 are connected with a capillary tube 72, and a flowing rate of the refrigerant introduced to an evaporator 103 is adjusted responding to temperature of the low-temperature refrigerant after the heat exchange in the expansion valve 112.

[0025] The refrigerating cycle 12 having this configuration includes the temperature-sensitive cylinder 70 to detect the temperature of the low-temperature refrigerant introduced to the suction side of the compressor 101 after carrying out the heat exchange in the internal heat exchanger 104, and the flowing rate of the refrigerant introduced to the evaporator 103 is adjusted responding to the temperature of the low-temperature refrigerant after the heat exchange in the expansion valve 112. Thus, an excessive increase of the refrigerant temperature at the suction side of the compressor 101 can be certainly and effectively suppressed without complicating a piping system and a structure of the expansion valve, like the first exemplary embodiment. Therefore, since an excessive increase of (discharge) temperature in the compressor can be previously prevented, oil contained in the refrigerant can be prevented from degradation, and thus faults such as burn-out can be prevented.

[0026] Further, the refrigerating cycle of this exemplary embodiment can acquire the aforementioned effect only by slightly remodeling a currently used refrigerating cycle and an expansion valve used in the refrigerating cycle, so that there also is a merit that the present invention does not greatly increase cost.

[0027] The refrigerating cycle 13 of the third exemplary embodiment is a combination of the refrigerating cycle 11 of the first exemplary embodiment and the refrigerating cycle 12 of the second exemplary embodiment. The refrigerating cycle 13 includes both the external pressure introduction pipe 50 and the temperature-sensitive cylinder 70. A configuration around the lower pressure chamber 44 of an expansion valve 113 used therefore is approximately similar to the configuration of the first exemplary embodiment, and a configuration around the upper pressure chamber 43 is approximately similar to the configuration of the second exemplary embodiment. In the expansion valve 113, a flowing rate of the refrigerant introduced to an evaporator 103 is adjusted responding to temperature and pressure of the low-temperature refrigerant after the heat exchange.

[0028] In the refrigerating cycle 13 having the aforementioned configuration, since an excessive increase of (discharge) temperature in the compressor can be previously prevented, oil contained in the refrigerant can be prevented from degradation, and thus faults such as burn-out can be prevented like the first and second exemplary embodiments.

[0029] Figs. 5(A), 5(B) and 5(C) illustrate a fourth exemplary embodiment, a fifth exemplary embodiment, and a sixth exemplary embodiment of a refrigerating cycle according to the present invention. Fig. 6 illustrates an expansion valve 114 used in the fourth exemplary embodiment. Fig. 7 illustrates an expansion valve 115 used in the fifth exemplary embodiment. Fig. 8 illustrates an expansion valve 116 used in the sixth exemplary embodiment. As for the refrigerating cycles 14, 15 and 16 illustrated in Figs. 5(A), 5(B), and 5(C), and as for the expansion valves 114, 115, and 116 illustrated in Figs. 6, 7, and 8, same reference numerals are given to parts corresponding to respective parts of the refrigerating cycles 11, 12 and 13 of the first, second and third exemplary embodiments and the expansion valves 111, 112, and 113. Then, different points between them will be mainly described below.

[0030] The expansion valves 114, 115, and 116 used in the refrigerating cycles 14, 15, and 16 of the fourth, fifth, and sixth exemplary embodiments do not include the temperature-sensitive inflow orifice 31 and the outflow orifice 32, which are provided in the expansion valves 111, 112, and 113 used in the refrigerating cycles 11, 12, and 13 of the first, second, and third exemplary embodiments. Thus, a low-temperature refrigerant introduced from an evaporator 103 does not pass the insides of the expansion valves 114, 115 and 116, but is directly introduced to an internal heat exchanger 104.

[0031] The refrigerating cycle 14 of the fourth exemplary embodiment is similar to the refrigerating cycle 12 of the second exemplary embodiment regarding described below. As for the refrigerating cycle 14, in order to detect temperature of a low-temperature refrigerant introduced to the suction side of a compressor 101 after carrying out a heat exchange in the internal heat exchanger 104, a temperature-sensitive cylinder 70 is arranged closely to a pipe 125 connecting the internal heat exchanger 104 and the suction side of the compressor 101. Further, as illustrated in Fig. 6, the temperature-sensitive cylinder 70 and an upper pressure chamber 43 of the expansion valve 114 are connected with a capillary tube 72, and a flowing rate of the refrigerant introduced to the evaporator 103 is adjusted responding to the temperature of the low-temperature refrigerant after the heat exchange in the expansion valve 114. A valve main body 20 of the expansion valve 114 used in this exemplary embodiment includes an internal pressure passage 66 for communicating between the lower pressure chamber 44 and the outflow orifice 22.

[0032] In addition, as for an expansion valve in this type, a temperature-sensitive cylinder usually detects the refrigerant temperature near the outflow orifice of the evaporator 103 (refer to Fig. 5(B)). However, in this exemplary embodiment, the temperature-sensitive cylinder 70 detects the refrigerant temperature after carrying out the heat exchange in the internal heat exchanger 104. That is, it is characterized that a position of the temperature-sensitive cylinder 70 is changed.

[0033] The refrigerating cycle 14 having the aforementioned configuration can acquire effects which are approximately similar to the effects of the refrigerating cycle 12 of the second exemplary embodiment.

[0034] The refrigerating cycle 15 of the fifth exemplary embodiment is similar to the refrigerating cycle 11 of the first exemplary embodiment regarding described below. As for the refrigerating cycle 15, in order to detect pressure of a low-temperature refrigerant introduced to the suction side of a compressor 101 after carrying out a heat exchange in an internal heat exchanger 104, one end of the external pressure introduction pipe 50 is connected with the intermediate part of the pipe 125 connecting the internal heat exchanger 104 and the suction side of the compressor 101. Another end of the external pressure introduction pipe 50 is connected with a L-shaped pressure introducing passage 54 for communicating between a lower pressure chamber 44 of the expansion valve 115 and the external. In the expansion valve 115, a flowing rate of a refrigerant introduced to an evaporator 103 is adjusted responding to pressure of the low-temperature refrigerant after the heat exchange. In addition, in this embodiment, the temperature-sensitive cylinder 70 is arranged closely to a pipe 124 (near an outflow orifice of the evaporator 103) for connecting the evaporator 103 and the internal heat exchanger 104, and the temperature-sensitive cylinder 70 and an upper pressure chamber 43 of the expansion valve 115 are connected with a capillary tube 72.

[0035] The refrigerating cycle 15 having the aforementioned configuration can acquire effects which are approximately similar to the effects of the refrigerating cycle 11 of the first exemplary embodiment.

[0036] The refrigerating cycle 16 of the sixth exemplary embodiment is a combination of the refrigerating cycle 14 of the fourth exemplary embodiment and the refrigerating cycle 15 of the fifth exemplary embodiment. The refrigerating cycle 16 includes both the external pressure introduction pipe 50 and the temperature-sensitive cylinder 70. A configuration around the lower pressure chamber 44 of the expansion valve 116 used in the refrigerating cycle 16 is approximately similar to the configuration of the fifth exemplary embodiment, and a configuration around the upper pressure chamber 43 is approximately similar to the configuration of the fourth exemplary embodiment. In the expansion valve 116, a flowing rate of a refrigerant introduced to an evaporator 103 is adjusted responding to the pressure and temperature of the low-temperature refrigerant after the heat exchange.

[0037] In the refrigerating cycle 16 having the aforementioned configuration, since an excessive increase of (discharge) temperature in the compressor can be previously prevented, oil contained in the refrigerant can be prevented from degradation, and thus faults such as burn-out can be prevented, like the first and second exemplary embodiments.

Claims

1. A refrigerant cycle comprising:

a compressor;
a condenser;
an evaporator;
an internal heat exchanger; and
an expansion valve,

wherein, in the internal heat exchanger, a heat exchange is carried out between a high-temperature refrigerant introduced from the condenser to the expansion valve and a low-temperature refrigerant introduced from the evaporator to the suction side of the compressor,
wherein, in order to detect temperature and/or pressure of a low-temperature refrigerant introduced toward the suction side of the compressor after carrying out the heat exchange in the internal heat exchanger, a temperature-sensitive cylinder and/or an external pressure introduction pipe are additionally provided at the expansion valve, and
wherein, in the expansion valve, a flowing rate of a refrigerant introduced to the evaporator is adjusted responding to temperature and/or pressure of a low-temperature refrigerant after the heat exchange.

2. The refrigerating cycle as claimed in claim 1, wherein the expansion valve includes a drive means such as a diaphragm device which drives a valve body in the opening and closing direction, responding to a pressure change of a low-temperature refrigerant introduced through the external pressure introduction pipe after carrying out the heat exchange.

3. The refrigerating cycle as claimed in claim 1 or 2, wherein the expansion valve includes a drive means such as a diaphragm device which drives a valve body in the opening and closing direction, responding to a temperature change of a low-temperature refrigerant detected by the temperature-sensitive cylinder after carrying out the heat exchange.

FIG. 1(A)

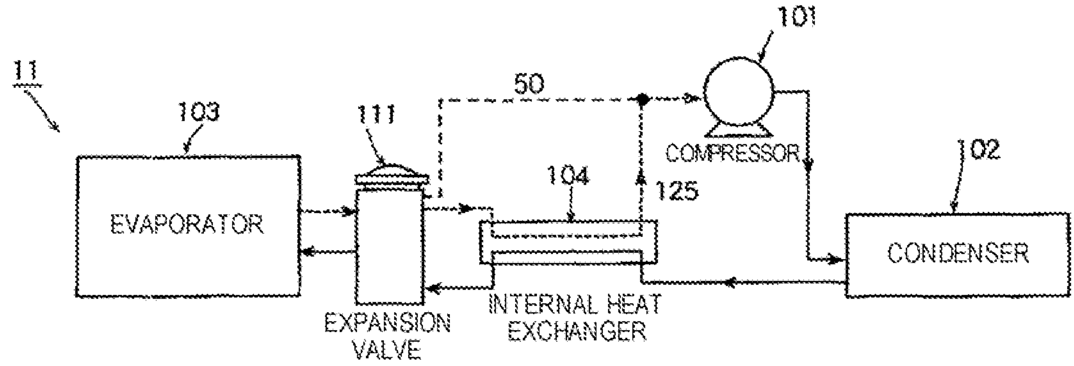


FIG. 1(B)

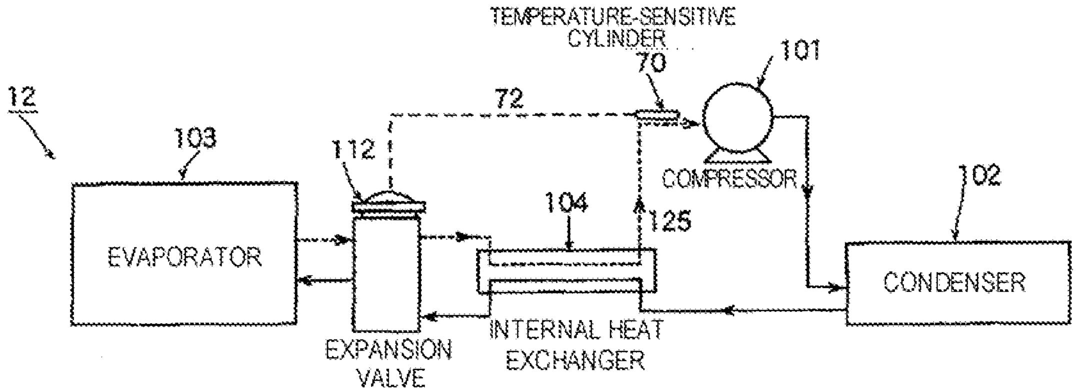


FIG. 1(C)

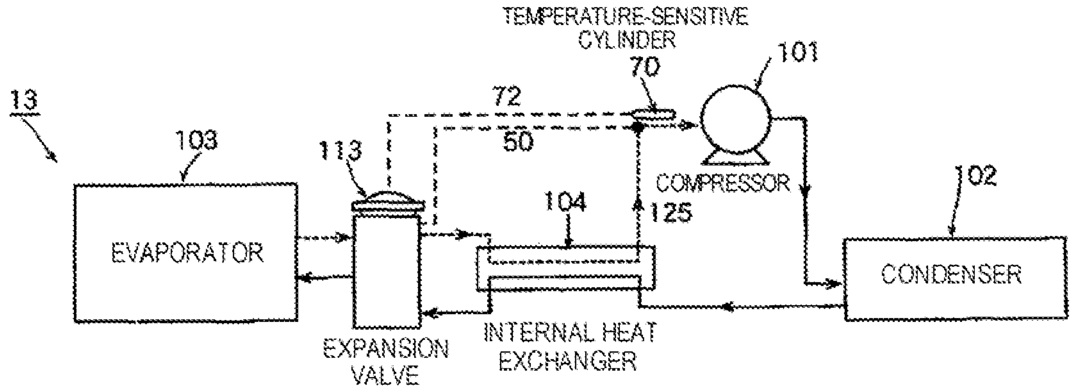


FIG. 2

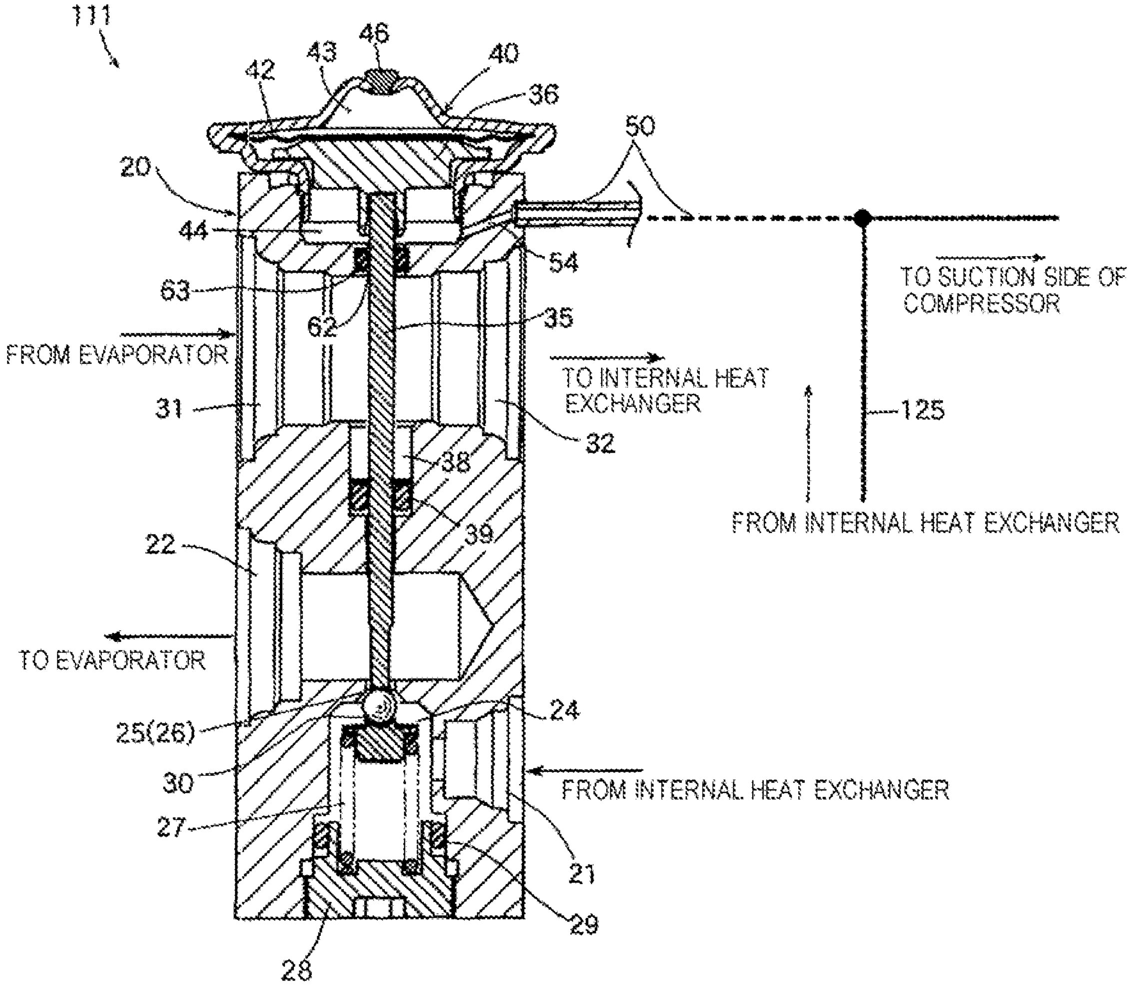

111
46
43
40
42
36
50
20
44
54
TO SUCTION SIDE OF COMPRESSOR
63
62
35
FROM EVAPORATOR
TO INTERNAL HEAT EXCHANGER
31
125
32
38
39
FROM INTERNAL HEAT EXCHANGER
22
TO EVAPORATOR
24
25(26)
30
FROM INTERNAL HEAT EXCHANGER
27
21
29
28

FIG. 3

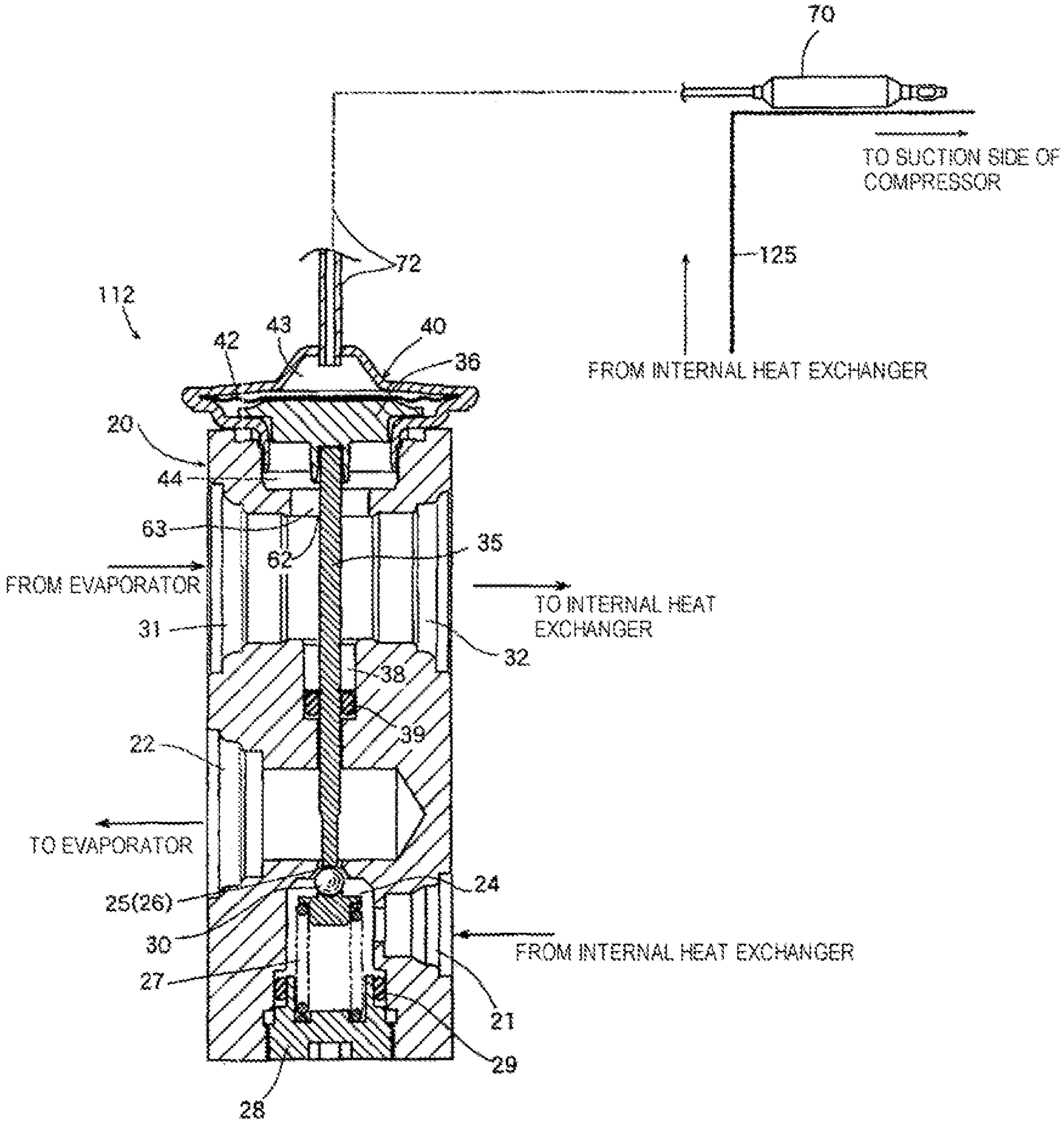
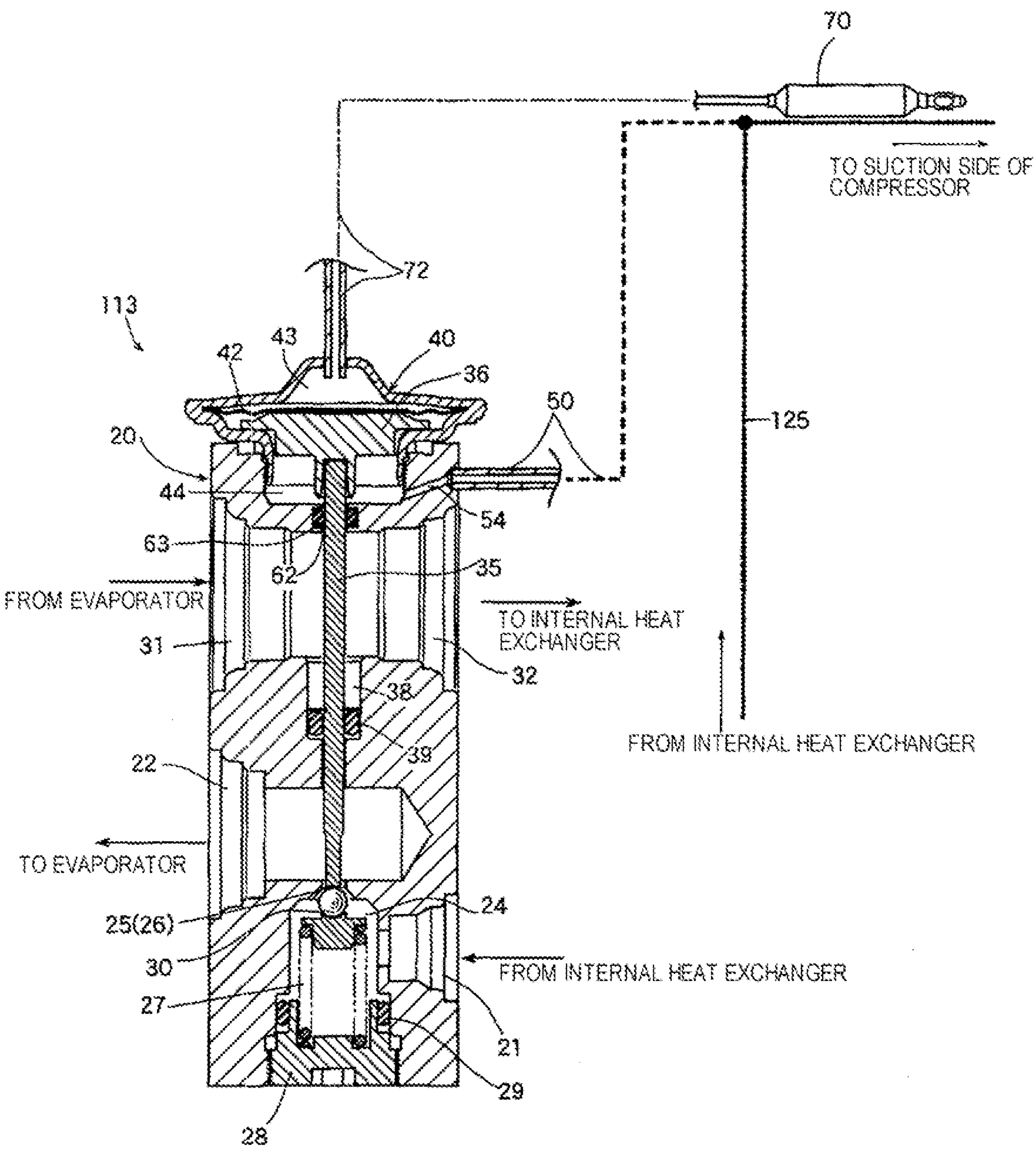

70
TO SUCTION SIDE OF COMPRESSOR
125
72
112
43
40
42
36
FROM INTERNAL HEAT EXCHANGER
20
44
63
62
35
FROM EVAPORATOR
TO INTERNAL HEAT EXCHANGER
31
32
38
39
22
TO EVAPORATOR
24
25(26)
30
FROM INTERNAL HEAT EXCHANGER
27
21
29
28

FIG. 4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TO SUCTION SIDE OF COMPRESSOR
72
113
43
40
42
36
50
20
125
44
54
63
62
35
FROM EVAPORATOR
TO INTERNAL HEAT EXCHANGER
31
32
38
FROM INTERNAL HEAT EXCHANGER
39
22
TO EVAPORATOR
25(26)
24
30
FROM INTERNAL HEAT EXCHANGER
27
21
29
28

FIG. 5(A)

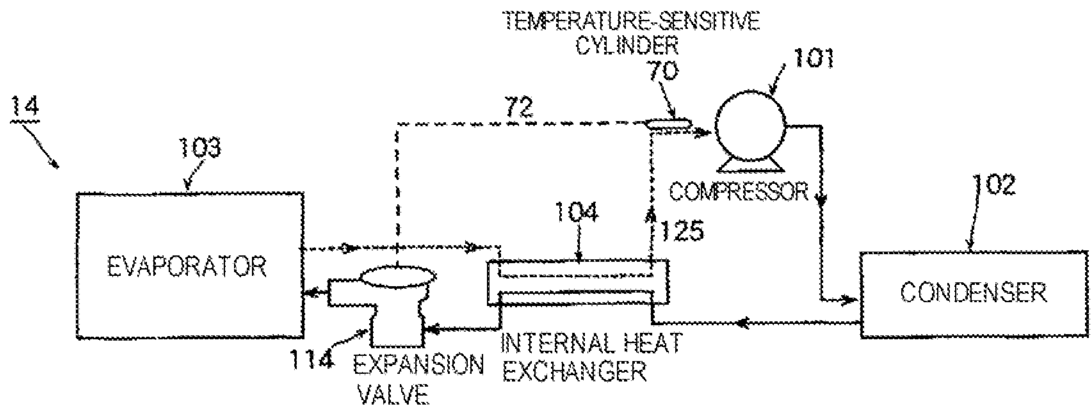


FIG. 5(B)

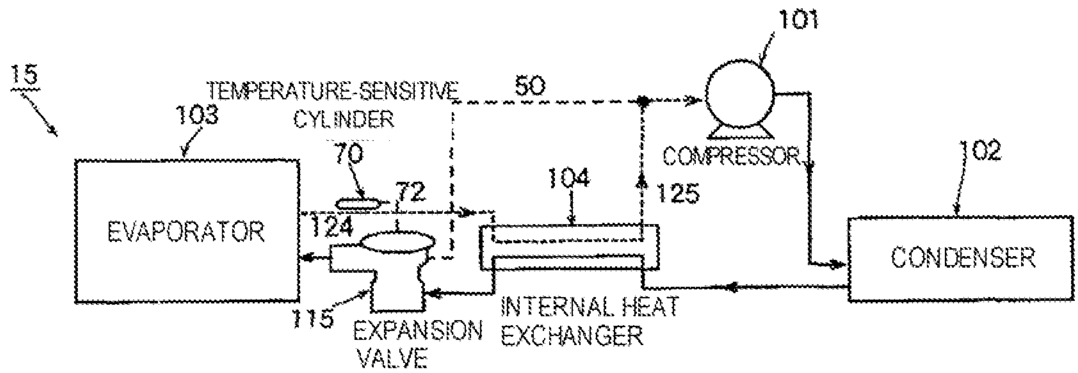


FIG. 5(C)

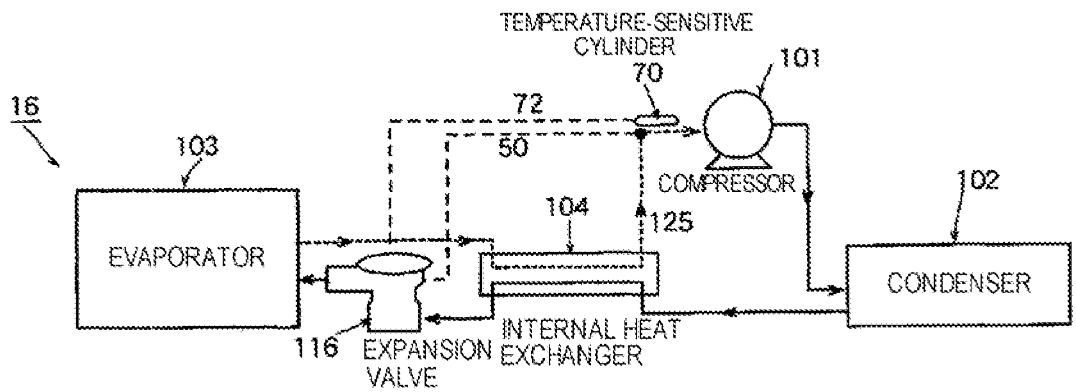
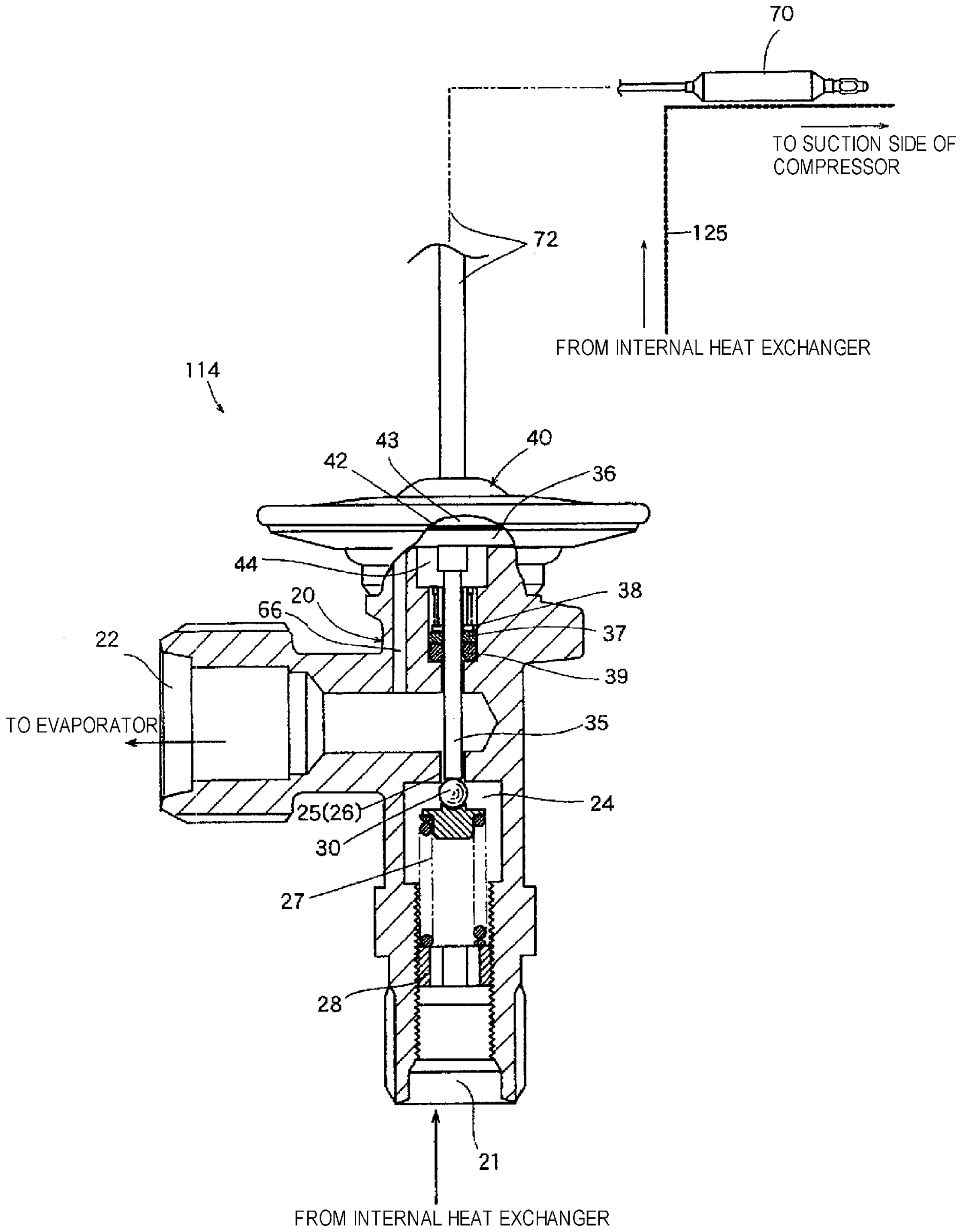


FIG. 6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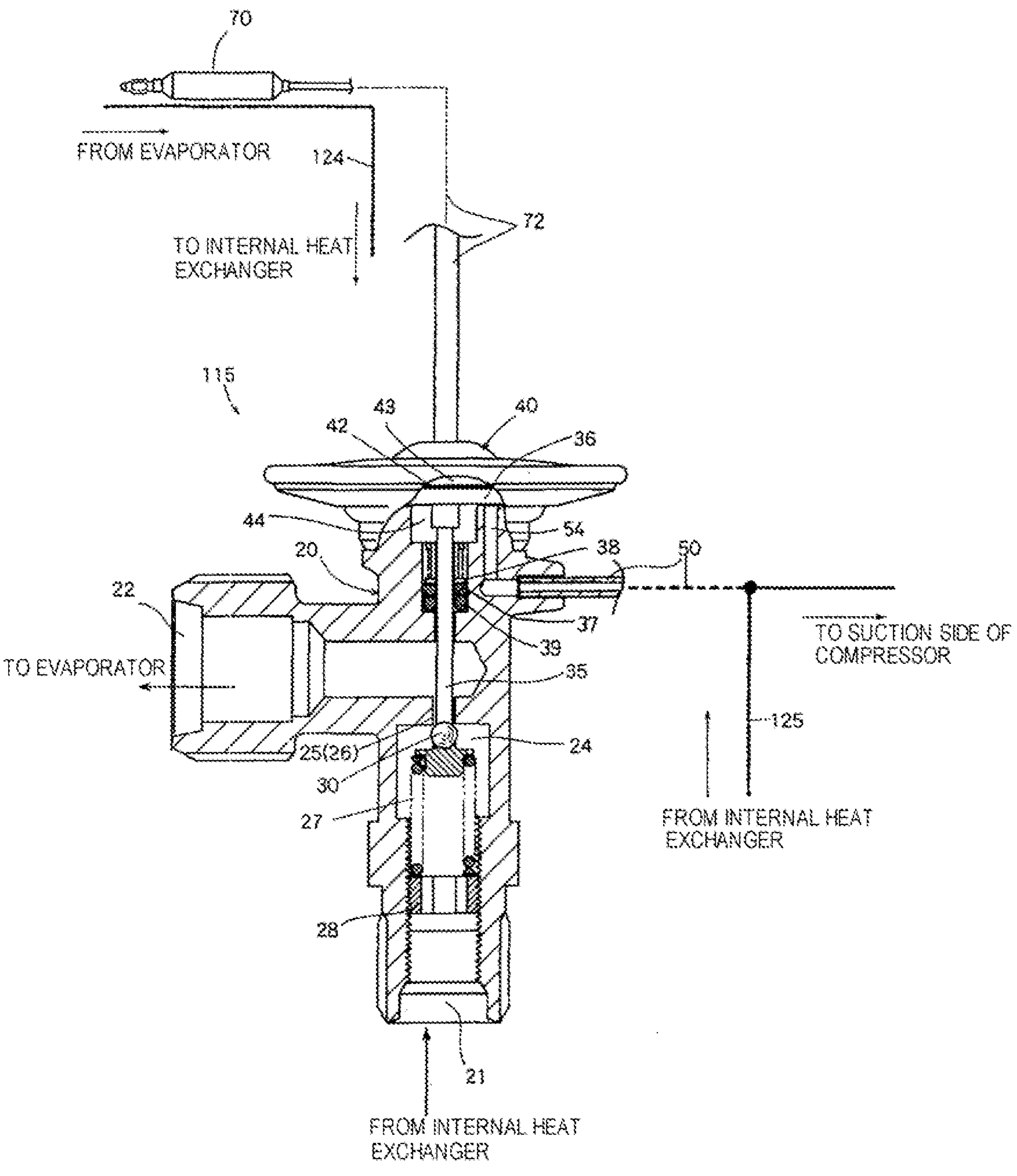
TO SUCTION SIDE OF COMPRESSOR
72
125
FROM INTERNAL HEAT EXCHANGER
114
43
40
42
36
44
38
20
66
37
22
39
TO EVAPORATOR
35
25(26)
24
30
27
28
21
FROM INTERNAL HEAT EXCHANGER

FIG. 7



70
FROM EVAPORATOR
124
72
TO INTERNAL HEAT EXCHANGER
115
43
40
42
36
44
54
20
38
50
22
37
39
TO SUCTION SIDE OF COMPRESSOR
TO EVAPORATOR
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25(26)
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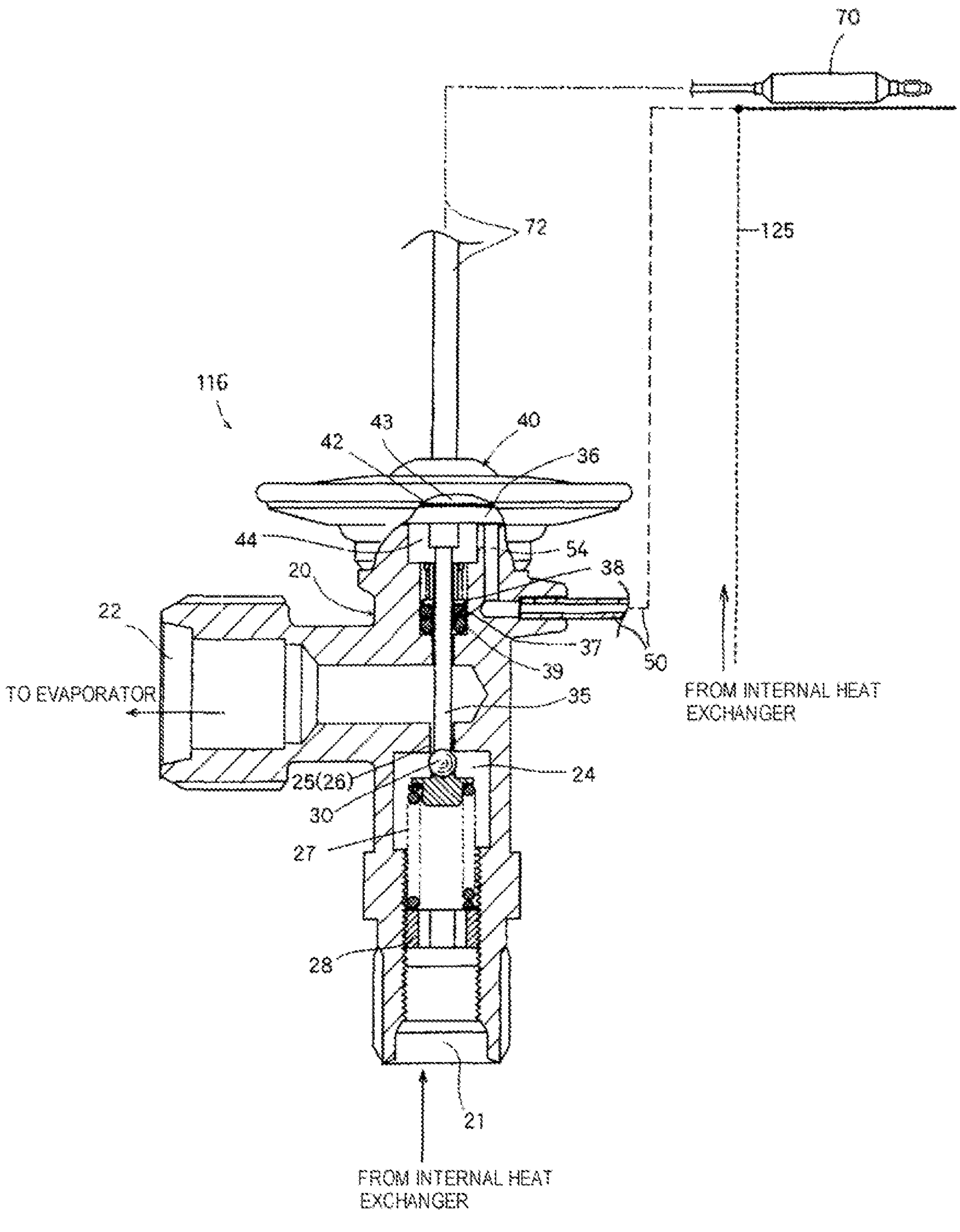
FROM INTERNAL HEAT EXCHANGER
28
21
FROM INTERNAL HEAT EXCHANGER

FIG. 8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116
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42
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44
54
20
38
22
37
50
39
TO EVAPORATOR
35
FROM INTERNAL HEAT EXCHANGER
25(26)
24
30
27
28
21
FROM INTERNAL HEAT EXCHANGER

FIG. 9

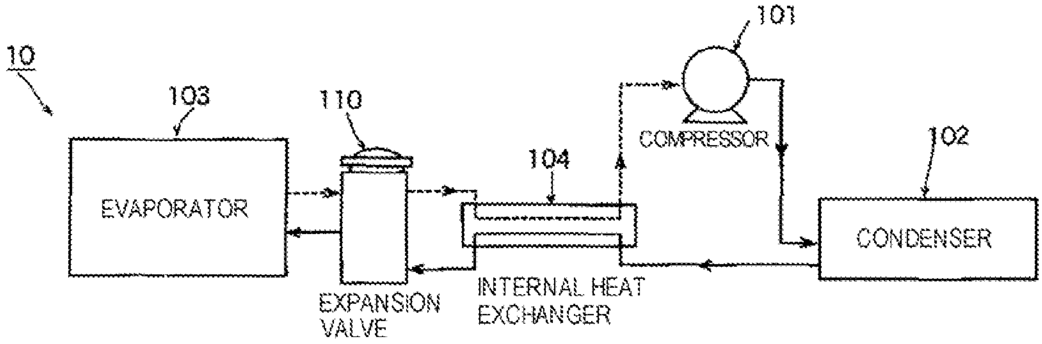
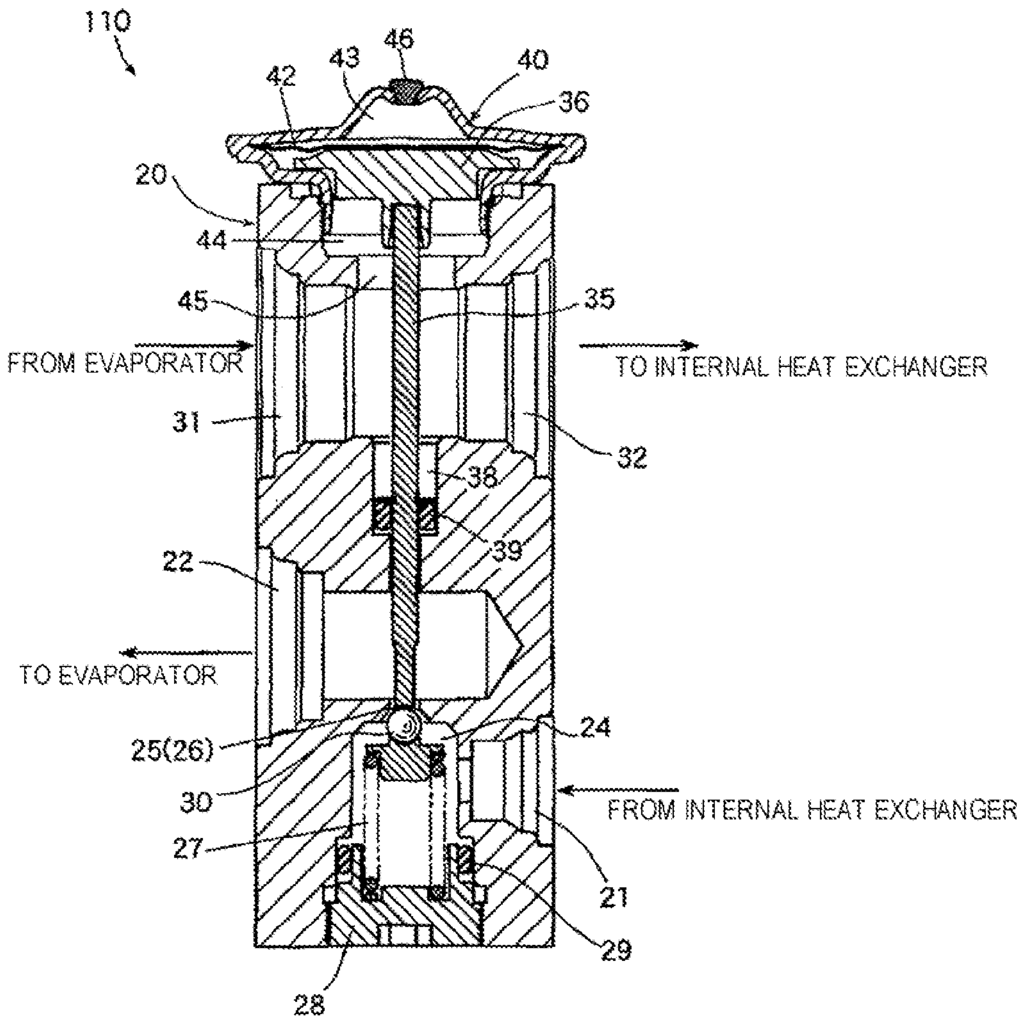

10
103
110
104
101
102
EVAPORATOR
COMPRESSOR
CONDENSER
EXPANSION
VALVE
INTERNAL HEAT
EXCHANGER

FIG. 10


110
46
43
40
42
36
20
44
45
35
FROM EVAPORATOR
TO INTERNAL HEAT EXCHANGER
31
32
38
39
22
TO EVAPORATOR
25(26)
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30
FROM INTERNAL HEAT EXCHANGER
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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2000346466 A **[0002] [0009]**
- JP 2007240041 A **[0002] [0010]**