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(54) **COMPRESSOR UNIT**

KOMPRESSOREINHEIT

UNITÉ DE COMPRESSION

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EP 3 460 244 B1

Description

Technical Field

[0001] The present invention relates to a compressor unit installed in, among others, a refrigerating apparatus, an air-conditioning apparatus and a hot water supplier.

Background Art

[0002] A conventional refrigerating apparatus, air-conditioning apparatus or hot water supplier includes a compressor compressing refrigerant, a condenser rejecting heat from the compressed refrigerant, an expansion valve decreasing pressure of the refrigerant whose heat has been released and changing the refrigerant from liquid to gas, and an evaporator applying heat to adjust a refrigerant temperature to a target compressor suction temperature. Some compressors are equipped with an injection mechanism, in which a pipe is provided to permit a part of refrigerant flowing out of a condenser toward an evaporator to branch off and return to the compressor in a refrigerant circuit of an air-conditioning apparatus or other apparatuses. In the present description, this pipe is referred to as an injection pipe. The injection pipe is connected to an LEV (electronic linear expansion valve) of the refrigerant circuit. For example, Patent Literature 1 discloses an injection pipe having an oil separating function disposed between an LEV and a compressor of an air-conditioning apparatus.

[0003] When the amount of refrigerant in the injection pipe injected into the compressor is large or when an injection mechanism is not operative, the refrigerant may flow back from the compressor, and this generates pulsations in the injection pipe. The injection pipe disclosed in Patent Literature 1 is provided with a muffler at an end closer to the compressor to prevent damage or breakage of the injection pipe due to pulsations caused by flow-back of the refrigerant. Patent Literature 2 describes a screw compressor which includes an economizer circuit configured to eject intermediate pressure refrigerant into a compression chamber in the course of compression.

Citation List

Patent Literature

[0004]

Patent Literature 1: Japanese Patent No. 5683075 (page 6, Fig. 5)
Patent Literature 2: European Patent Application No. 2 634 432 A1

Summary of Invention

Technical Problem

[0005] However, the muffler disclosed in Patent Literature 1 has an inner diameter twice as large as an inner diameter of the injection pipe and has a length ten times as large as the inner diameter of the injection pipe. For this reason, it is difficult to stably fix the muffler to the injection pipe, causing a drawback in that the muffler is installed with weak installation strength. With insufficient installation strength, the muffler is unable to prevent pulsations generated in the injection pipe, resulting in a problem that damage or breakage of the injection pipe cannot be surely prevented.

[0006] The present invention has been made to solve the above problem, and aims to prevent pulsations generated in the injection muffler and thereby to prevent damage or breakage of the injection pipe.

Solution to Problem

[0007] The compressor unit of an embodiment of the present invention includes the features of claim 1. Particularly, the compressor unit comprises a compressor, a condenser, and an injection pipe constituting a part of a refrigerant pipe connecting the compressor and the condenser, the injection pipe permitting a part of refrigerant flowing out of the condenser to branch off and flow into the compressor, wherein the injection pipe includes: a compressor connecting part connected to the compressor; an expansion valve connecting part connected to an expansion valve disposed in the injection pipe; and an injection muffler disposed between the compressor connecting part and the expansion valve connecting part, wherein the injection muffler has an inner diameter larger than an inner diameter of the compressor connecting part and an inner diameter of the expansion valve connecting part, and the injection muffler is fixed to a side of the compressor.

Advantageous Effects of Invention

[0008] According to the compressor unit of an embodiment of the present invention, the injection muffler has an inner diameter larger than an inner diameter of the compressor connecting part and an inner diameter of the expansion valve connecting part of the injection pipe, and the injection muffler is fixed to a side of the compressor. This allows more effective prevention of pulsations caused by flow-back of the refrigerant, which in turn allows prevention of damage or breakage of the injection pipe.

Brief Description of Drawings

[0009]

[Fig. 1] Fig. 1 is a schematic block diagram of a refrigeration cycle of an air-conditioning apparatus of Embodiment 1 of the present invention.

[Fig. 2] Fig. 2 is a schematic diagram illustrating a cross section of a compressor unit of Embodiment 1 of the present invention.

[Fig. 3] Fig. 3 is a block diagram of an injection pipe of Embodiment 1 of the present invention.

[Fig. 4] Fig. 4 is a side view of a compressor and the injection pipe of the compressor unit of Embodiment 1 of the present invention.

[Fig. 5] Fig. 5 is a diagram illustrating a mounting mechanism for an injection muffler of Embodiment 1 of the present invention.

[Fig. 6] Fig. 6 is a graph illustrating a correlation between a volume of the injection muffler and a pulsation amplitude generated in the injection pipe.

[Fig. 7] Fig. 7 is a diagram illustrating a compressor unit of Embodiment 2 of the present invention.

[Fig. 8] Fig. 8 is a diagram illustrating a modified example of the mounting mechanism for the injection muffler.

Description of Embodiments

[0010] Hereinafter, embodiments of the compressor of the present invention will be explained in detail with reference to the drawings. In the present description, a closed scroll compressor is taken as an example. The compressor is a component of a refrigeration cycle of an apparatus such as a refrigerator, a freezer, an automatic vending machine, an air-conditioning apparatus, a refrigerating device and a hot water supplier. In the following drawings, size relationships among components may be different from actual ones.

Embodiment 1.

[0011] Fig. 1 is a schematic block diagram of a refrigeration cycle of an air-conditioning apparatus of Embodiment 1 of the present invention. Fig. 2 is a schematic diagram of a cross section of a compressor unit of Embodiment 1 of the present invention. The air-conditioning device 100 includes a compressor 21, a condenser 22, an expansion valve 23, an evaporator 24, an injection pipe 25, and an LEV 27. The compressor 21 sucks gas refrigerant and compresses it into a high-temperature and high-pressure state before discharging it to a refrigerant circuit. For example, the compressor is a closed scroll compressor. The high-temperature and high-pressure gas refrigerant discharged from the compressor 21 flows into the condenser 22. The high-temperature and high-pressure gas refrigerant having flowed into the condenser 22 exchanges heat with air sent by a fan (not shown) disposed near the condenser 22 and becomes a two-phase gas-liquid refrigerant before flowing out of the condenser 22. The two-phase gas-liquid refrigerant having flowed out of the condenser 22 is expanded and depressurized by the expansion valve 23 to become a low-temperature and low-pressure two-phase gas-liquid refrigerant. The low-temperature and low-pressure two-phase gas-liquid refrigerant flows into the evaporator 24. In the evaporator 24, the two-phase gas-liquid refrigerant exchanges heat with air supplied by a fan (not shown) disposed near the evaporator 24 and evaporates to become low-temperature and low-pressure gas refrigerant before flowing out of the evaporator 24. The low-temperature and low-pressure gas refrigerant having flowed out of the evaporator 24 is sucked into the compressor 21.

[0012] A compressor unit 101 includes the compressor 21 and the injection pipe 25. The compressor 21 includes a shell 6, which is a sealed container. A frame 13 is disposed in an upper part of the shell 6, and a subframe 14 is disposed in a lower part of the shell 6. The frame 13 and the subframe 14 are fixed to an inner circumferential surface of the shell 6 by a method such as shrink-fitting and welding. A main bearing 13a is disposed in a through-hole formed in a central part of the frame 13, and an auxiliary bearing 14a is disposed in a through-hole formed in a central part of the subframe 14. A crank shaft 3 is rotatably supported by the main bearing 13a and the auxiliary bearing 14a.

[0013] A compression mechanism including a fixed scroll 1 and an orbiting scroll 2 is disposed in the upper part of the shell 6. The fixed scroll 1 is disposed above the orbiting scroll 2 and fixed to the shell 6 via the frame 13. The orbiting scroll 2 is disposed below the fixed scroll 1 and supported by the crank shaft 3 such that the orbiting scroll 2 can orbit. Each of the fixed scroll 1 and the orbiting scroll 2 has a spiral element formed along an involute curve. Spiral elements of the fixed scroll 1 and the orbiting scroll 2 are engaged with each other to form plural compression chambers 7.

[0014] The fixed scroll 1 is provided with an injection port 1b. Also, a structural element 10 for connection with the injection pipe 25 is detachably attached to the fixed scroll 1. The refrigerant led by the injection pipe 25 is injected into the compression chambers 7 via the injection port 1b.

[0015] A driving mechanism including a rotor 4 and a stator 5 is disposed between the frame 13 and the subframe 14. The stator 5 is substantially cylindrical and an outer circumferential surface thereof is fixed to the shell 6 by a method such as shrink-fitting. The rotor 4 is fixed to an outer circumference of the crank shaft 3 and has a permanent magnet inside. The rotor 4 is rotatably held inside the stator 5 with a slight gap from the stator 5. In response to the stator 5 being energized, the rotor 4 is rotary-driven to rotate the crank shaft 3. The rotation of the rotor 4 transmits a rotary driving force to the above-described compression mechanism via the crank shaft 3. In response to the rotary driving force being transmitted to the compression mechanism, the orbiting scroll 2 starts an orbiting movement. Along with the orbiting movement of the orbiting scroll 2, the compression chambers 7 move to a center while reducing their volumes, thereby compressing the refrigerant.

[0016] The shell 6 is provided with a suction pipe (not shown) for sucking refrigerant, and a discharge pipe 9 for discharging refrigerant. The refrigerant having flowed out of the evaporator 24 is sucked into the suction pipe and fills the shell 6. The refrigerant is then sucked into the compression chambers 7, in which the refrigerant is compressed. Then, the refrigerant passes through a discharge port 1a and a connecting member 8 connecting the discharge port 1a and the discharge pipe 9 and is discharged from the shell 6 via the discharge pipe 9.

[0017] The injection pipe 25 permits a part of the refrigerant flowing out of the condenser 22 to the expansion valve 23 to branch off and return to the compression chambers 7 of the compressor 21. Sending the two phase gas-liquid refrigerant to the compression chambers 7 of the compressor 21 prevents an excessive increase in temperature of the gas refrigerant discharged from the compression chambers 7.

[0018] Fig. 3 is a block diagram of an injection pipe of Embodiment 1 of the present invention. The injection pipe 25 includes a compressor connecting part 25a, an expansion valve connecting part 25b, and an injection muffler 25c. The compressor connecting part 25a is connected to the compressor 21. The expansion valve connecting part 25b is connected to the LEV 27. The injection muffler 25c is disposed between the compressor connecting part 25a and the expansion valve connecting part 25b. Each of the compressor connecting part 25a, the expansion valve connecting part 25b and the injection muffler 25c has a cylindrical shape. As shown in FIG. 2, the compressor connecting part 25a, the expansion valve connecting part 25b and the injection muffler 25c are formed such that they satisfy relationships of $\phi d1 \leq \phi muff$ and $\phi d2 \leq \phi muff$, where $\phi d1$ is an inner diameter (pipe diameter) of the compressor connecting part 25a, $\phi d2$ is an inner diameter of the expansion valve connecting part 25b and $\phi muff$ is an inner diameter of the injection muffler 25c.

[0019] Compared to HFC refrigerant, which is used in many compressors, carbon dioxide refrigerant, for example, requires a large compression ratio to exhibit its capacity. For this reason, a pressure at which liquid refrigerant is discharged and a pressure at which refrigerant flows back from the injection port 1b also increase. As a result, a pressure generated in the injection pipe 25 also increases, and pulsations generated inside the injection pipe 25 are magnified.

[0020] As the pulsations inside the injection pipe 25 are magnified, vibrations generated inside the injection pipe 25 increase, which may result in cracking of the pipe. In a fluid circuit, a sudden increase in pipe diameter from a certain pipe diameter produces a change in flow velocity and frequency. In view of this, in Embodiment 1, the injection muffler 25c having an inner diameter equal to or larger than inner diameters of the compressor connecting part 25a and the expansion valve connecting part 25b of injection pipe 25 is disposed in an injection circuit connecting the compressor 21 and the LEV 27. This reduces pulsations generated inside the injection pipe 25 even when the carbon dioxide refrigerant is used.

[0021] Fig. 4 is a side view of the compressor and the injection pipe of the compressor unit of Embodiment 1 of the present invention. Fig. 5 is a diagram illustrating a mounting mechanism for the injection muffler of Embodiment 1 of the present invention. The injection pipe 25 is disposed such that the injection muffler 25c runs along an outer circumferential surface of the shell 6, namely a side of the compressor 21. The compressor connecting part 25a is directed upward from a point where the compressor connecting part 25a is connected to the compressor 21, is then bent in a lateral direction, and further bent to be directed downward. That is, the compressor connecting part 25a is bent twice to have a reverse U-shape as a whole. The injection muffler 25c, which is continuous to the compressor connecting part 25a, runs in a vertical direction along the outer circumferential surface of the shell 6 of the compressor 21. The expansion valve connecting part 25b, which is continuous to the injection muffler 25c, extends downward from a point where the expansion valve connecting part 25b is connected with the injection muffler 25c, is then bent in a lateral direction, and is further bent to be directed upward. That is, the injection muffler 25c is bent twice to have a U-shaped portion. The upwardly bent portion runs up to the LEV 27. In this way, in Embodiment 1, the injection pipe 25 is bent four times in total.

[0022] Also, a vertically-extending portion of the compressor connecting part 25a, a vertically-extending portion of the expansion valve connecting part 25b and the injection muffler 25c each run parallel to an axial center of the compressor 21.

[0023] The injection muffler 25c is fixed to the outer circumferential surface of the shell 6 of the compressor 21 at two points each by the mounting mechanism 30. Fig. 5 is a diagram illustrating the mounting mechanism for the injection muffler of Embodiment 1 of the present invention. The mounting mechanism 30 includes a fixed sheet metal 31 and a holding sheet metal 32. The fixed sheet metal 31 is a thin plate member with a substantially U-shaped cross section, and fixed to the outer circumferential surface of the shell 6 by welding. The fixed sheet metal 31 includes a pair of sides 31a, 31b extending in parallel to each other, and a mounting surface 31c connecting the pair of sides 31a, 31b. The fixed sheet metal 31 is disposed on the outer circumferential surface of the shell 6 such that the sides 31a, 31b run in the vertical direction.

[0024] The holding sheet metal 32 is a belt-like member, and has a protrusion in its substantially central part in a longitudinal direction. The holding sheet metal 32 includes a holding part 32c between right and left ends 32a, 32b. The holding part 32c has a shape corresponding to a part of a cylindrical member. The holding sheet metal 32 is placed on the mounting surface 31c of the fixed sheet metal 31, and the injection muffler 25c is held between the mounting surface 31c of the fixed sheet metal 31 and the holding part 32c of the holding sheet metal 32. With the injection muffler 25c being held between the mounting surface 31c and the holding part 32c, the end 32a of the holding sheet metal 32 is fixed to the mounting surface 31c of the fixed sheet metal 31 with a screw 41, and the end 32b of the holding sheet metal 32 is fixed to the mounting surface 31c of the fixed sheet metal 31 with a screw 42.

[0025] Here, the structure of the injection muffler 25c will be explained. Enlarging an inner diameter of the injection muffler 25c allows a volume inside the injection muffler 25c to be secured easily, which in turn allows easy reduction in pulsations. However, the injection muffler 25c may be difficult to install depending on its size due to limited space being available for fixing the injection muffler 25c inside a housing of the air-conditioning device 100. Also, unnecessary increase in inner diameter of the injection muffler 25c increases a weight of the injection muffler 25c, which may lead to increased vibrations. Accordingly, it is important to identify a minimum volume required to reduce pulsations before determining an inner diameter and a total length of the injection muffler 25c.

[0026] In Embodiment 1, as shown in Fig. 2, a diameter of the injection port 1b is set to ϕport, an inner diameter of a distal end 250a of the injection pipe 25 that is continuous to the compressor connecting part 25a and disposed inside the compressor 21 is set to ϕinj, the inner diameter of the compressor connecting part 25a of the injection pipe 25 is set to ϕd1, the inner diameter of the expansion valve connecting part 25b of the injection pipe 25 is set to ϕd2, and the inner diameter of the injection muffler 25c is set to ϕmuff. In Embodiment 1, the injection pipe 25 is formed so as to satisfy relationships of $\phi port \leq \phi inj \leq \phi d1 \leq \phi muff$ and $\phi inj \leq \phi d2 \leq \phi muff$. In this way, the injection muffler 25c having a larger inner diameter than the inner diameters of the compressor connecting part 25a and the expansion valve connecting part 25b fixed to injection pipe 25 enables a reduction of injection pulsations.

[0027] Fig. 6 is a graph illustrating a correlation between a volume of the injection muffler and an amplitude of a pulsation generated in the injection pipe. Referring to Fig. 6, an appropriate shape of the injection muffler 25c with respect to a compressor displacement volume will be explained. In the graph of Fig. 6, a horizontal axis represents a ratio Vrat of an injection muffler volume Vmuff to a compressor displacement volume Vst (Vmuff / Vst), and a vertical axis represents a difference Pdiff of a maximum value Pmax and a minimum value Pmin (Pmax - Pmin) of pulsations generated in the injection pipe.

[0028] To provide the injection muffler 25c that reduces pulsations generated in the injection pipe 25, it is necessary to identify an injection muffler volume required to reduce a pulsation amplitude. Pdiff tends to decrease as Vrat increases, and when Vrat is 3, Pdiff can be decreased by 50% or more as compared to when Vrat is 1. When Vrat exceeds 4, Pdiff shows smaller changes. Increase in Vrat means an increase in size of the injection muffler itself, which may result in difficulty in installing the injection muffler or increased vibrations of the injection muffler itself; unnecessary enlargement of the injection muffler should thus be avoided. Therefore, the injection muffler 25c of Embodiment 1 is formed to satisfy a relationship of $3 \leq Vrat \leq 5$.

Embodiment 2.

[0029] Fig. 7 is a diagram illustrating a compressor unit of Embodiment 2 of the present invention. As shown in Fig. 7, the compressor unit 102 of Embodiment 2 includes an injection muffler 25d at a portion of the expansion valve connecting part 25b running upward to the LEV 27, in addition to the injection muffler 25c. Similarly to Embodiment 1 described above, each of the injection muffler 25c and the injection muffler 25d is fixed to the outer circumferential surface of the compressor 21 at two points each by the mounting mechanism 30.

[0030] For example, in case of a compressor using refrigerant that is likely to be used under high-pressure conditions such as carbon dioxide refrigerant, pulsations generated in the injection pipe 25 are so large that it may be difficult to reduce pulsations with the single injection muffler 25c alone. In this case, by adding the injection muffler 25d to the expansion valve connecting part 25b, which is bent upward from a lower portion of the compressor 21, pulsations may be reduced even under conditions where pulsations increase. Further, even when a large diameter muffler cannot be installed due to limited space inside the air-conditioning device 100, installing the two injection mufflers ensures injection muffler volumes while using less space to dispose the compressor inside the housing of the air-conditioning apparatus. This increases flexibility in configurations inside the air-conditioning apparatus.

[0031] In Embodiment 2, the injection muffler volume Vmuff is a sum of volumes of pipes and constituent components intended to produce the muffler effect.

[0032] In Embodiments 1 and 2, the injection muffler 25c and the injection muffler 25d are securely held on the outer circumferential surface of the shell 6 of the compressor 21 each through the mounting mechanism 30. This reduces pulsations and vibrations generated in the injection pipe 25, preventing cracking of the pipe.

[0033] In Embodiments 1 and 2, the holding sheet metal 32 by which the injection mufflers 25c, 25d are held is fixed to the fixed sheet metal 31, which is fixed to the outer circumferential surface of the shell 6 of the compressor 21, with the screws 41, 42. Thus the holding sheet metal 32 is detachable from the fixed sheet metal 31. This allows easy removal of the injection pipe 25 for replacement when there are problems with the injection pipe 25.

[0034] Also, the mounting mechanism 30 is structured such that the holding sheet metal 32 is fixed to the fixed sheet metal 31 with the screws 41 and 42 in a state where the injection mufflers 25c and 25d are each held between the mounting surface 31c of the fixed sheet metal 31 and the holding part 32c of the holding sheet metal 32. This allows easy attachment or removal of the injection mufflers 25c, 25d by tightening or loosening the screws 41 and 42, resulting in good workability.

[0035] In Embodiments 1 and 2, the injection pipe 25 is bent at four points; however, the way of bending the injection pipe 25 is not limited to this. The injection pipe 25 may be bent as appropriate in consideration of space limitations inside the housing of the air-conditioning apparatus or other apparatuses in which the compressor units 101 and 102 are installed as well as installation positions of the injection mufflers 25c and 25d.

[0036] In Embodiments 1 and 2, the injection muffler 25c is held between the mounting surface 31c of the fixed sheet metal 31 and the holding part 32c of the holding sheet metal 32; however, the way of holding the injection muffler 25c is not limited to this. Fig. 8 is a diagram illustrating a modified example of the mounting mechanism for the injection muffler of Embodiment 1. The mounting mechanism 130 includes a fixed sheet metal 131 and a holding sheet metal 132. The fixed sheet metal 131 is an element of a substantially cuboid shape and fixed to the outer circumferential surface of the shell 6 by welding. A surface of the fixed sheet metal 131 that is in contact with the shell 6 is formed in an arc shape conforming to the outer circumferential surface of the shell 6. A surface of the fixed sheet metal 131 opposite to the surface in contact with the shell 6 is provided with a pair of wall parts 131a, 131b extending in parallel to each other. The fixed sheet metal 131 thus has a U-shaped cross section. The fixed sheet metal 131 is disposed on the outer circumferential surface of the shell 6 such that the wall parts 131a, 131b run in the vertical direction.

[0037] The holding sheet metal 132 includes a plate-like base part 132a and a cylindrical holding part 132b integrally formed with the base part 132a. The holding sheet metal 132 is fixed to the fixed sheet metal 131 with screws 141, 142 with the base part 132a being sandwiched between the pair of wall parts 131a, 131b of the fixed sheet metal 131 such that an axial center of the holding part 132b extends in the vertical direction. The injection muffler 25c is inserted through a hole 132c of the holding part 132b. In the modified example, by virtue of the fixed sheet metal 131 being a substantially cuboid shaped member, the fixed sheet metal 131 is securely fixed to the outer circumferential surface of the shell 6 by welding. This ensures rigidity enough to hold the injection pipe 25. In this modified example, a holding sheet metal similar to the belt-like holding sheet metal 32 described above may be used to hold the injection muffler 25c between the substantially cuboid fixed sheet metal 131 and the belt-like holding sheet metal.

Reference Signs List

[0038]

1 fixed scroll 1a discharge port 1b injection port 2 orbiting scroll 3 crank shaft 4 rotor 5 stator 6 shell 7 compression chamber 8 connecting element 9 discharge pipe

10 structure element 13 frame 13a main bearing 14 subframe

14a auxiliary bearing 21 compressor 22 condenser 23 expansion valve 24 evaporator 25 injection pipe 25a compressor connecting part

25b expansion valve connecting part 25c injection muffler 25d injection muffler 27 LEV 30 mounting mechanism 31 fixed sheet metal 31a side 31b side 31c mounting surface 32 holding sheet metal 32a end 32b end 32c holding part

41 screw 42 screw 100 air-conditioning device 101 compressor unit 102 compressor unit 130 mounting mechanism 131 fixed sheet metal 131a wall part 131b wall part 132 holding sheet metal 132a base part 132b holding part 132c hole 141 screw 142 screw 250a distal end

Claims

1. A compressor unit (101) comprising:

a compressor (21);
a condenser (22); and
an injection pipe (25) constituting a part of a refrigerant pipe connecting the compressor (21) and the condenser (22), the injection pipe permitting a part of refrigerant flowing out of the condenser (22) to branch off and flow into the compressor (21),
wherein the injection pipe (25) includes:

a compressor connecting part (25a) connected to the compressor (21);
an expansion valve connecting part (25b) connected to an expansion valve (23) disposed in the injection pipe (25); and
an injection muffler (25c) disposed between the compressor connecting part (25a) and the expansion valve connecting part (25b),

characterized in that the injection muffler (25c) has an inner diameter larger than an inner diameter of the compressor connecting part (25a) and an inner diameter of the expansion valve connecting part (25b), and satisfies a relationship of $3 \leq Vrat \leq 5$, where Vst is a compressor displacement volume, Vmuff is an injection muffler volume, and Vrat is a ratio of the injection muffler volume to the compressor displacement

volume (Vmuff / Vst),
and the injection muffler (25c) is fixed to a side of the compressor (21), wherein
the injection pipe (25) includes a distal end (250a) continuous to the compressor connecting part (25a) and disposed inside the compressor (21),
the compressor (21) includes an injection port (1b) through which the refrigerant flowing into the compressor (21) via the distal end (250a) of the injection pipe (25) is led into a compression chamber (7) of the compressor (21),
the injection pipe (25) satisfies relationships of $\phi port \leq \phi inj \leq \phi d1 \leq \phi muff$ and $\phi inj \leq \phi d2 \leq \phi muff$, where ϕport is an inner diameter of the injection port (1b), ϕinj is an inner diameter of the distal end (250a), ϕd1 is the inner diameter of the compressor connecting part (25a), ϕd2 is the inner diameter of the expansion valve connecting part (25b) and ϕmuff is the inner diameter of the injection muffler (25c).

2. The compressor unit (101) of claim 1, wherein the injection pipe (25) is bent at four points, and the injection muffler (25c) is fixed to the compressor (21) at at least two points.

3. The compressor unit (101) of any one of claims 1 or 2, further comprising a fixing mechanism (30) fixing the injection muffler (25c) to the compressor (21), wherein the fixing mechanism (30) includes a fixed part (31) fixed to the side of the compressor (21), and a holding part (32) holding the injection muffler (25c), and
the holding part (32) is detachably attached to the fixed part (31).

4. The compressor unit (101) of claim 3, wherein the fixed part (31) is welded to the side of the compressor (32).

5. The compressor unit (101) of claim 3 or 4, wherein the holding part (32) is screwed to the fixed part (31).

6. The compressor unit (101) of any one of claims 1 to 5, wherein the refrigerant is a carbon dioxide refrigerant.

Patentansprüche

1. Verdichtereinheit (101), umfassend:

einen Verdichter (21);
einen Kondensator (22); und
eine Einspritzleitung (25), die einen Teil einer Kältemittelleitung bildet, die den Verdichter (21) und den Kondensator (22) verbindet, wobei die Einspritzleitung es einem Teil des aus dem Kondensator (22) strömenden Kältemittels ermöglicht, abzuzweigen und in den Verdichter (21) zu strömen,
wobei die Einspritzleitung (25) umfasst:

einen Verdichterverbindungsteil (25a), der mit dem Verdichter (21) verbunden ist;
einen Expansionsventilverbindungsteil (25b), der mit einem in der Einspritzleitung (25) angeordneten Expansionsventil (23) verbunden ist; und
einen Einspritzschalldämpfer (25c), der zwischen dem Verdichterverbindungsteil (25a) und dem Expansionsventilverbindungsteil (25b) angeordnet ist,

dadurch gekennzeichnet, dass der Einspritzschalldämpfer (25c) einen Innendurchmesser aufweist, der größer ist als ein Innendurchmesser des Verdichterverbindungsteils (25a) und ein Innendurchmesser des Expansionsventilverbindungsteils (25b), und eine Beziehung von $3 \leq Vrat \leq 5$ erfüllt, wobei Vst ein Verdichterverdrängungsvolumen, Vmuff ein Einspritzschalldämpfervolumen und Vrat ein Verhältnis des Einspritzschalldämpfervolumens zum Verdichterverdrängungsvolumen ist (Vmuff / Vst),
und der Einspritzschalldämpfer (25c) an einer Seite des Verdichters (21) befestigt ist, wobei
die Einspritzleitung (25) ein distales Ende (250a) umfasst, das sich an den Verdichterverbindungsteil (25a) anschließt und im Inneren des Verdichters (21) angeordnet ist,
der Verdichter (21) eine Einspritzöffnung (1b) umfasst, durch die das über das distale Ende (250a) der Einspritzleitung (25) in den Verdichter (21) strömende Kältemittel in eine Verdichtungskammer (7) des Verdichters (21) geleitet wird,
die Einspritzleitung (25) die Beziehungen $\phi port \leq \phi inj \leq \phi d1 \leq \phi muff$ und $\phi inj \leq \phi d2 \leq \phi muff$ erfüllt, wobei ϕport ein Innendurchmesser der Einspritzöffnung (1b), ϕinj ein Innendurchmesser des distalen Endes (250a), ϕd1 der Innendurchmesser des Verdichterverbindungsteils (25a), ϕd2 der Innendurchmesser des Expansionsventilverbindungsteils (25b) und ϕmuff der Innendurchmesser des Einspritzschalldämpfers (25c) ist.

2. Verdichtereinheit (101) nach Anspruch 1, wobei die Einspritzleitung (25) an vier Punkten gebogen ist und der Einspritzschalldämpfer (25c) an mindestens zwei Punkten am Verdichter (21) befestigt ist.

3. Verdichtereinheit (101) nach einem der Ansprüche 1 oder 2, ferner umfassend einen Befestigungsme-

chanismus (30), der den Einspritzschalldämpfer (25c) am Verdichter (21) befestigt, wobei der Befestigungsmechanismus (30) einen befestigten Teil (31), der an der Seite des Verdichters (21) befestigt ist, und einen haltenden Teil (32), der den Einspritzschalldämpfer (25c) hält, umfasst, und
der haltende Teil (32) lösbar am befestigten Teil (31) angebracht ist.

4. Verdichtereinheit (101) nach Anspruch 3, wobei der befestigte Teil (31) an die Seite des Verdichters (32) geschweißt ist.

5. Verdichtereinheit (101) nach Anspruch 3 oder 4, wobei der haltende Teil (32) an den befestigten Teil (31) geschraubt ist.

6. Verdichtereinheit (101) nach einem der Ansprüche 1 bis 5, wobei das Kältemittel ein Kohlendioxidkältemittel ist.

Revendications

1. Unité de compresseur (101) comprenant :

un compresseur (21) ;
un condenseur (22) ; et
un tuyau d'injection (25) constituant une partie d'un tuyau de fluide frigorigène reliant le compresseur (21) et le condenseur (22), le tuyau d'injection permettant qu'une partie du fluide frigorigène s'écoulant hors du condenseur (22) soit séparée et s'écoule dans le compresseur (21),
dans laquelle le tuyau d'injection (25) comprend :

une partie de raccordement de compresseur (25a) raccordée au compresseur (21) ;
une partie de raccordement de vanne de détente (25b) raccordée à une vanne de détente (23) disposée dans le tuyau d'injection (25) ; et
un silencieux d'injection (25c) disposé entre la partie de raccordement de compresseur (25a) et la partie de raccordement de vanne de détente (25b),

caractérisée en ce que le silencieux d'injection (25c) a un diamètre intérieur plus grand qu'un diamètre intérieur de la partie de raccordement de compresseur (25a) et qu'un diamètre intérieur de la partie de raccordement de vanne de détente (25b), et satisfait à une relation $3 \leq Vrat \leq 5$, où Vst est un volume de déplacement de compresseur, Vmuff est un volume de silencieux d'injection et Vrat est un rapport entre le volume de silencieux d'injection et le volume de déplacement de compresseur (Vmuff / Vst), et
le silencieux d'injection (25c) est fixé à un côté du compresseur (21), dans laquelle
le tuyau d'injection (25) comprend une extrémité distale (250a) s'étendant de la partie de raccordement de compresseur (25a) et disposée à l'intérieur du compresseur (21),
le compresseur (21) comprend un orifice d'injection (1b) à travers lequel le fluide frigorigène s'écoulant dans le compresseur (21) à travers l'extrémité distale (250a) du tuyau d'injection (25) est amené dans une chambre de compression (7) du compresseur (21),
le tuyau d'injection (25) satisfait aux relations $\phi port \leq \phi inj \leq \phi d1 \leq \phi muff$ et $\phi inj \leq \phi d2 \leq \phi muff$, où $\phi port$ est un diamètre intérieur de l'orifice d'injection (1b), ϕinj est un diamètre intérieur de l'extrémité distale (250a), $\phi d1$ est le diamètre intérieur de la partie de raccordement de compresseur (25a), $\phi d2$ est le diamètre intérieur de la partie de raccordement de vanne de détente (25b) et $\phi muff$ est le diamètre intérieur du silencieux d'injection (25c).

2. Unité de compresseur (101) selon la revendication 1, dans laquelle le tuyau d'injection (25) est cintré au niveau de quatre points, et le silencieux d'injection (25c) est fixé au compresseur (21) au niveau d'au moins deux points.

3. Unité de compresseur (101) selon l'une quelconque des revendications 1 et 2, comprenant en outre un mécanisme de fixation (30) fixant le silencieux d'injection (25c) au compresseur (21), dans laquelle le mécanisme de fixation (30) comprend une partie fixe (31) fixée au côté du compresseur (21), et une partie de maintien (32) maintenant le silencieux d'injection (25c), et
la partie de maintien (32) est attachée de manière détachable à la partie fixe (31).

4. Unité de compresseur (101) selon la revendication 3, dans laquelle la partie fixe (31) est soudée au côté du compresseur (32).

5. Unité de compresseur (101) selon la revendication 3 ou 4, dans laquelle la partie de maintien (32) est vissée à la partie fixe (31).

6. Unité de compresseur (101) selon l'une quelconque des revendications 1 à 5, dans laquelle le fluide frigorigène est un fluide frigorigène à base de dioxyde de carbone.

FIG. 1

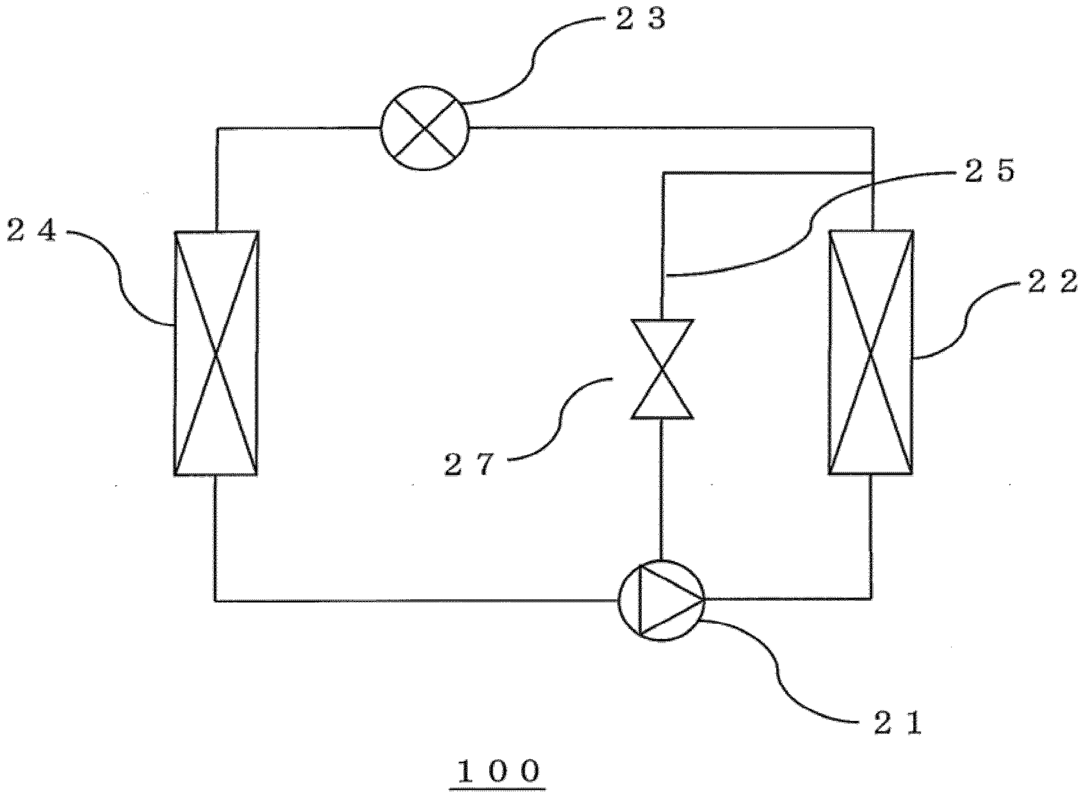


FIG. 2

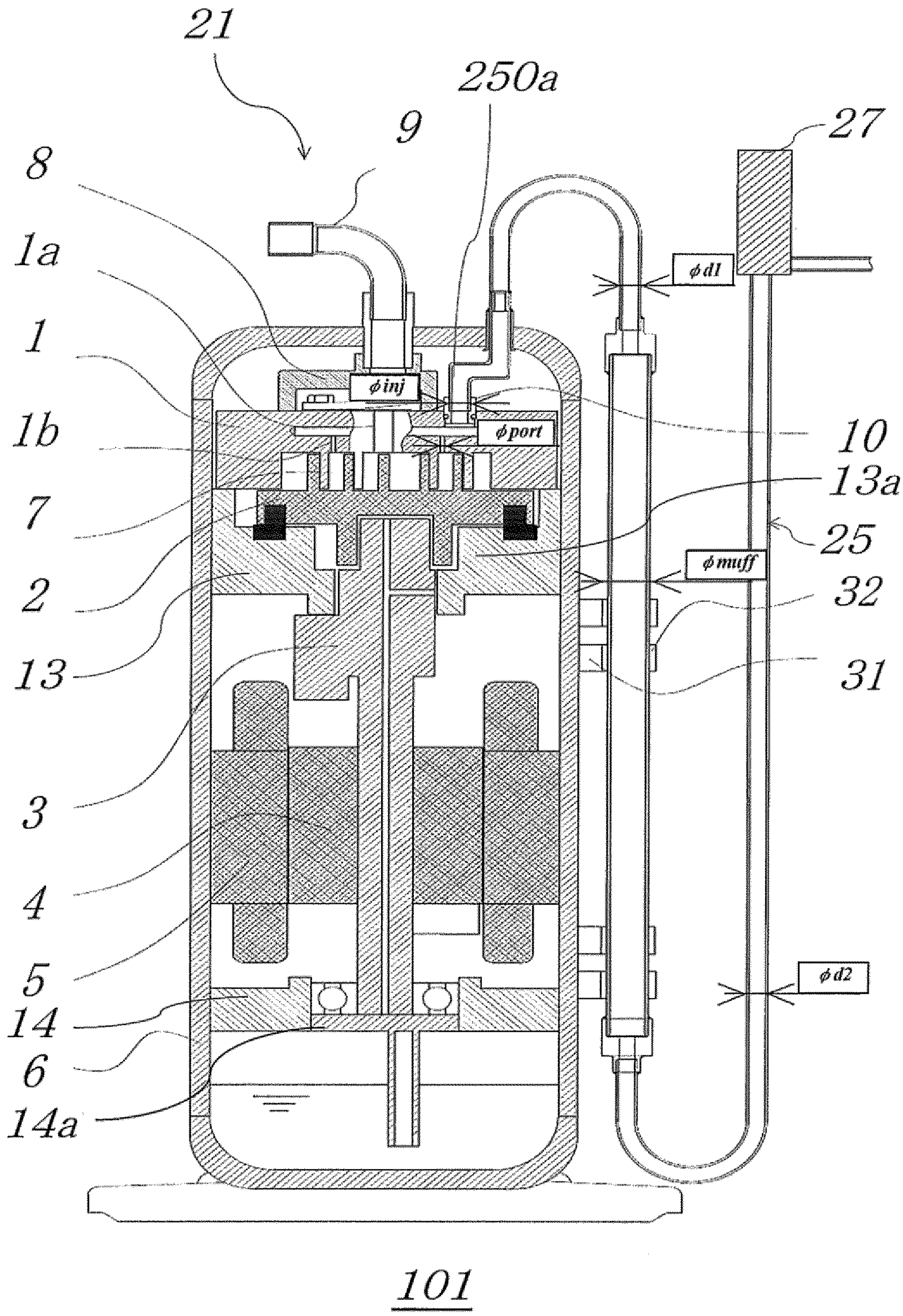

21
250a
9
27
8
1a
φd1
1
φinj
φport
10
1b
13a
7
25
φmuff
2
32
13
31
3
4
5
φd2
14
6
14a
101

FIG. 3

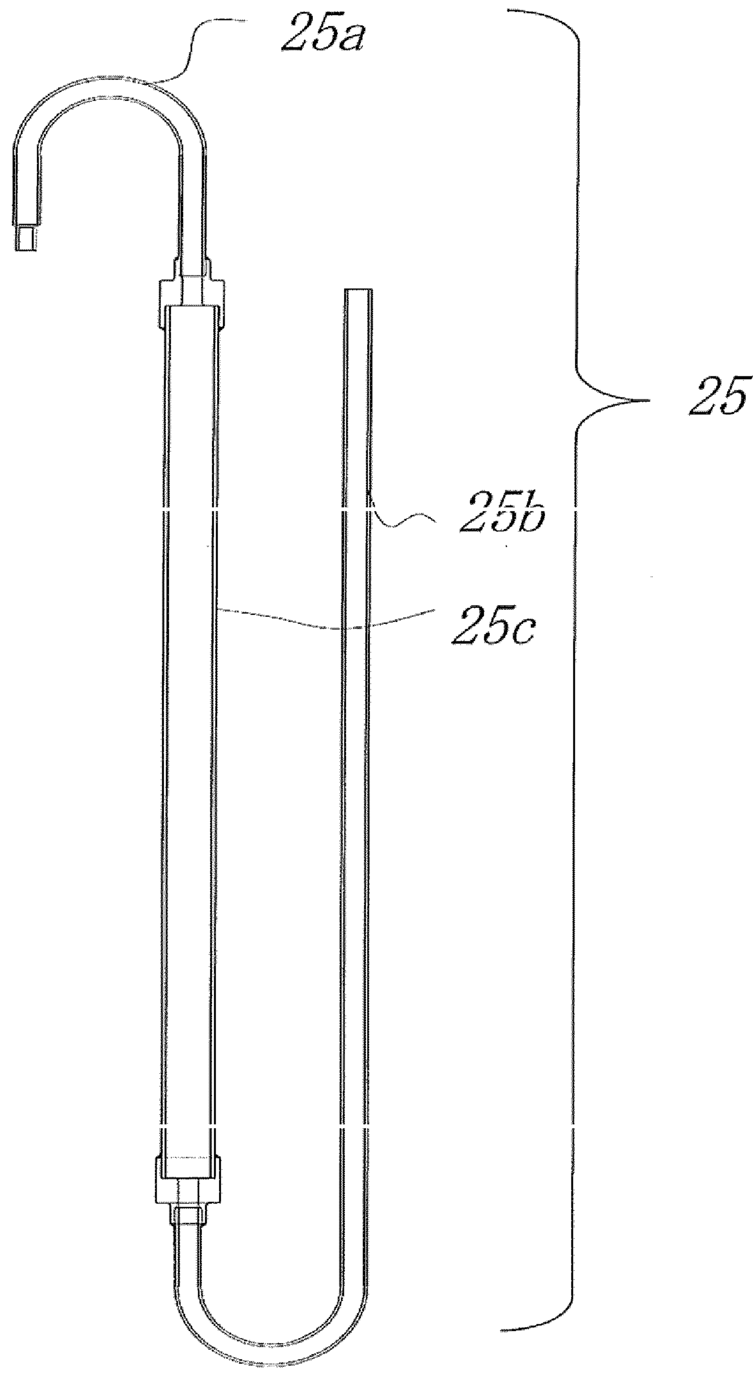
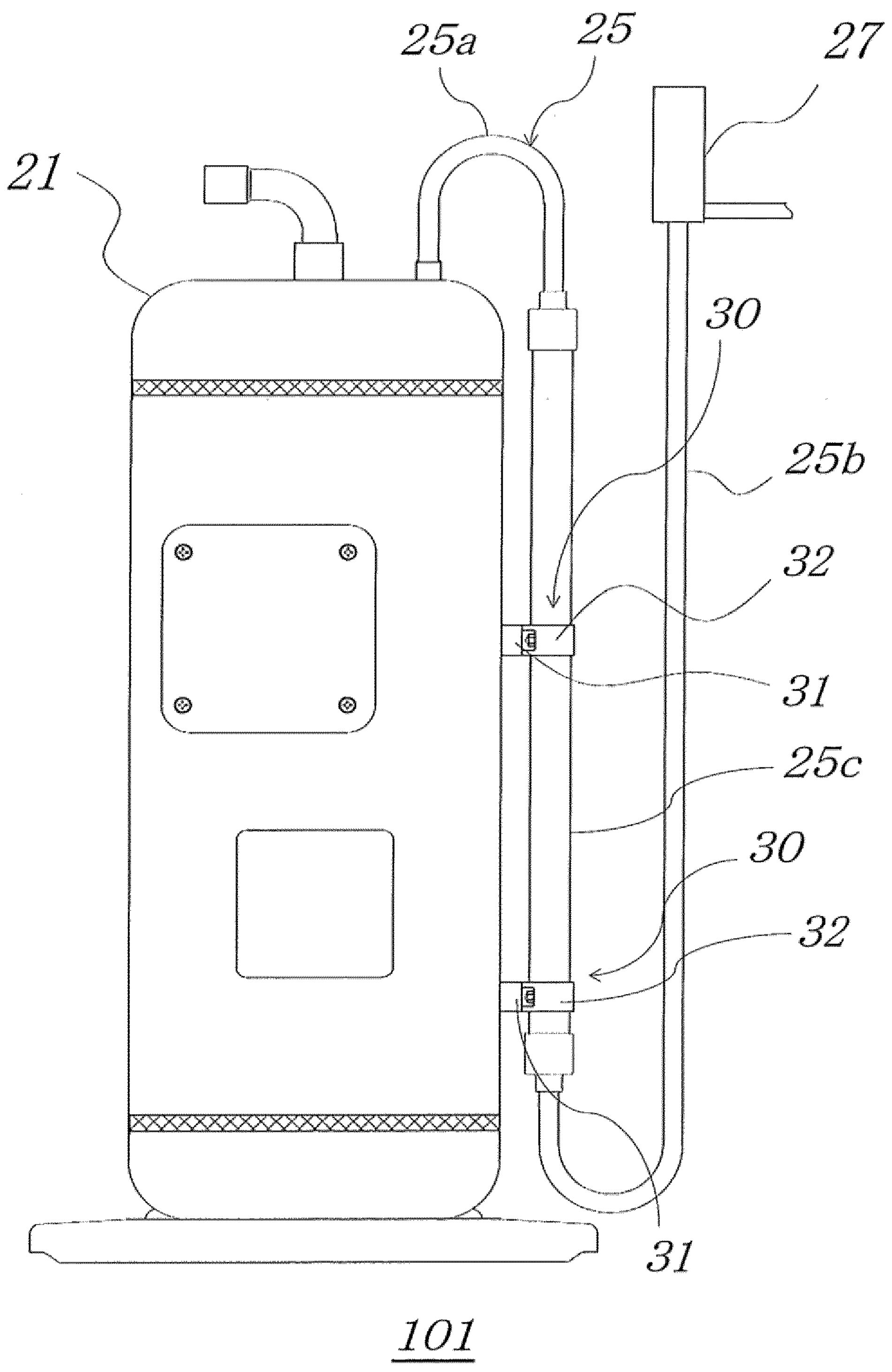


FIG. 4



101

FIG. 5

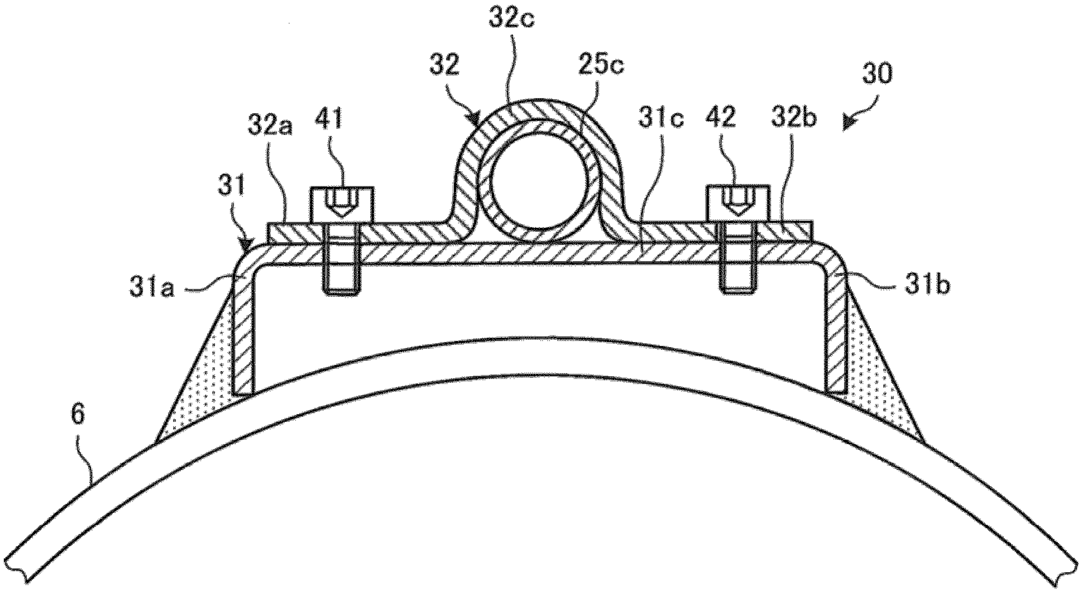

32c
32
25c
30
32a
41
31c
42
32b
31
31a
31b
6

FIG. 6

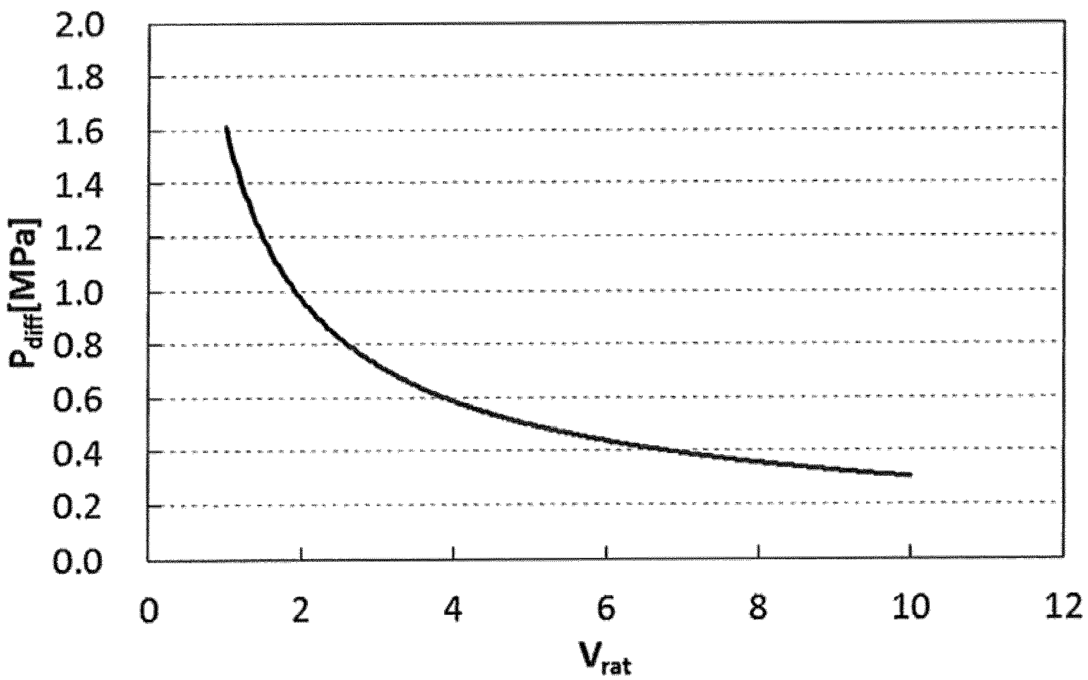

2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
P_{diff}[MPa]
0
2
4
6
8
10
12
V_{rat}

FIG. 7

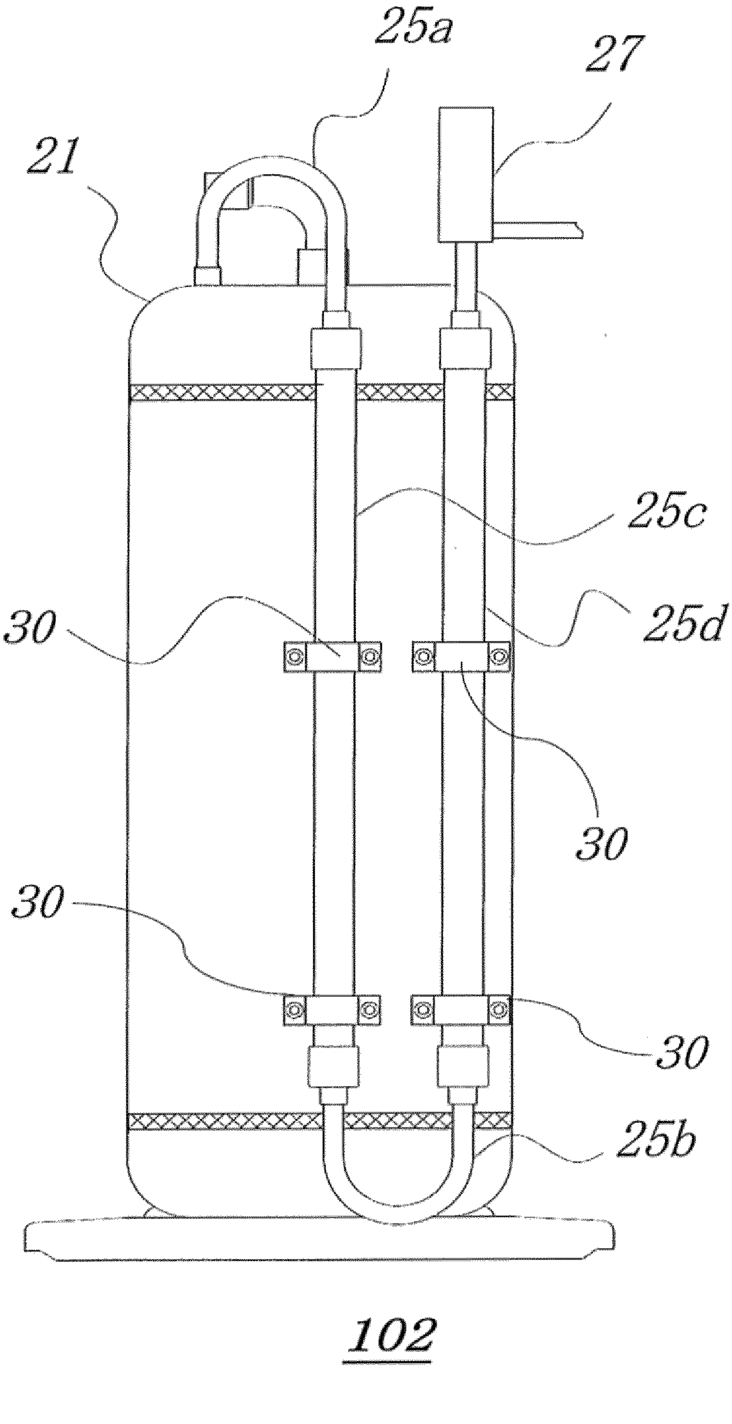
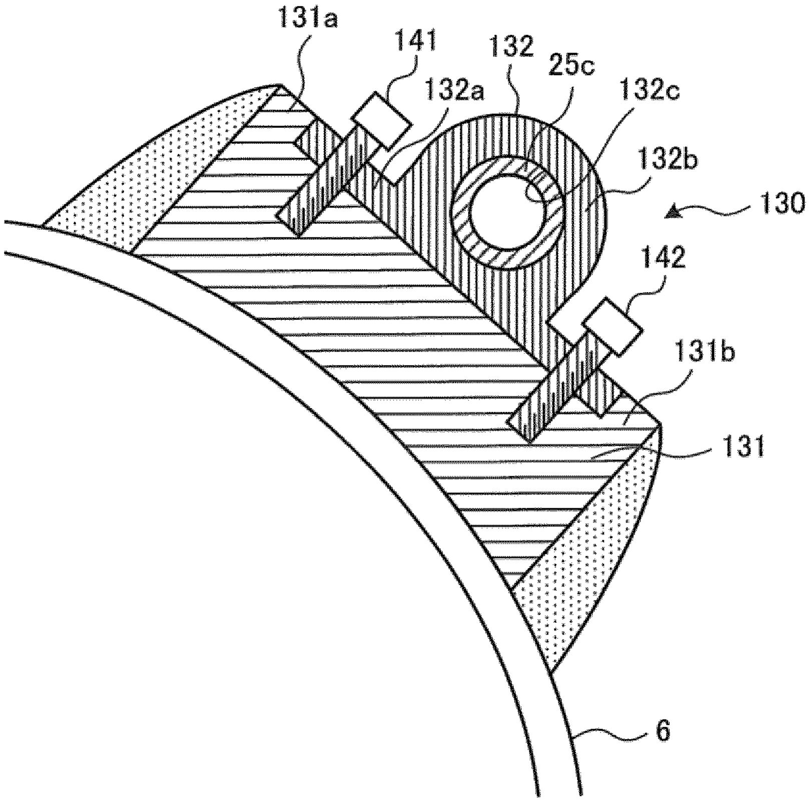


FIG. 8



REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- JP 5683075 B **[0004]**
- EP 2634432 A1 **[0004]**