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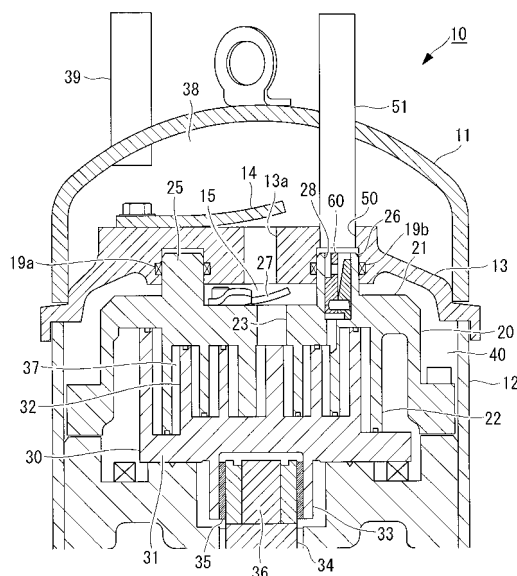
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(54) **REFRIGERANT COMPRESSOR AND VALVE UNIT**

(57) A refrigerant compressor and a valve unit having a check valve structure that reduces recompression loss and noise, that is not limited by the installation position and the installation method, and that has excellent responsiveness are provided. A refrigerant compressor (a scroll-type compressor (10)) (10) includes an injection port that communicates with a compression chamber (37) through a through-hole (28) and introduces fluid from the outside into the compression chamber (37); and a check valve (60) provided at the through-hole (28). The check valve (60) is composed of a reed valve (62) that is provided in the through-hole (28) parallel to the axial direction thereof and opens and closes in a direction perpendicular to the axial direction.

FIG. 1



Description

{Technical Field}

[0001] The present invention relates to refrigerant compressors and valve units used in refrigeration, air-conditioning apparatuses, etc.

{Background Art}

[0002] For example, a scroll-type compressor used in refrigeration, air-conditioning apparatuses, etc., includes a fixed scroll and an orbiting scroll disposed such that spiral-shaped wall members, having a spiral shape, are meshed with each other. By causing the orbiting scroll to perform orbital revolution movement relative to the fixed scroll, the volume of a compression chamber formed between the spiral-shaped wall members is gradually reduced to compress refrigerant in the compression chamber.

[0003] Some of such compressors employ an injection cycle to improve the efficiency and the performance of the refrigeration cycle, in which refrigerant is subjected to two-stage expansion between a condenser and an evaporator, and the refrigerant at an intermediate pressure is injected into the compression chamber of the compressor (for example, see Patent Literature 1). In compressors employing the injection cycle, refrigerant is injected into the compression chamber of the compressor through an injection port communicating with the compression chamber, by utilizing the difference between the pressure in the compression chamber and the pressure of the refrigerant to be injected. The injection port has a check valve that prevents backflow of the refrigerant to reduce recompression loss and noise.

{Citation List}

{Patent Literature}

{PTL 1}

[0004] Japanese Unexamined Patent Application, Publication No. Hei 9-105386

{Summary of Invention}

{Technical Problem}

[0005] However, the above-described check valve is provided in an end plate of the fixed scroll and has a configuration in which a coil spring, a ball or spool, and a stopper constituting the check valve are disposed in sequence in the injection port, in the axial direction thereof, and perform an opening/closing operation in the axial direction. Therefore, a space in the axial direction for allowing the ball or spool to perform an opening/closing operation in the axial direction needs to be ensured. Ac-

cordingly, installation of a check valve, even though the check valve uses a ball or spool, inevitably increases the thickness of the end plate of the fixed scroll.

In addition, in general, check valves using a ball or spool, described above, are considered to have poor responsiveness and reliability compared with check valves using a reed valve, and are required to be improved in responsiveness, etc. However, in reed valves, because it is necessary to install a long, plate-like valve body, there are limitations on the installation position and installation method. Thus, when the reed valves are employed, there is room for improvement in the installation position and installation method.

[0006] The present invention has been made in view of the above-described circumstances, and an object thereof is to provide a refrigerant compressor and a valve unit having a check valve structure that reduces recompression loss and noise, that is not limited by the installation position and the installation method, and that has excellent responsiveness.

{Solution to Problem}

[0007] To solve the above-described problems, the refrigerant compressor and the valve unit of the present invention employ the following solutions.

That is, a refrigerant compressor of the present invention is equipped with a housing; a compression mechanism provided in the housing and having a compression chamber that compresses refrigerant taken thereinto and discharges the refrigerant; and an injection port communicating with the inside of the compression chamber through a through-hole provided in the compression mechanism to introduce the intermediate-pressure refrigerant from the outside into the compression chamber. The refrigerant compressor includes a check valve provided at the through-hole, the check valve being provided in the through-hole parallel to the axial direction thereof and being composed of a reed valve that opens and closes in a direction perpendicular to the axial direction.

[0008] The check valve provided at the injection port is composed of a reed valve that is provided in the through-hole in the compression mechanism, parallel to the axial direction thereof, and opens and closes in the direction perpendicular to the axial direction. Thus, limitations on the installation position and installation method for installing the check valve, which is composed of a reed valve, are eliminated. This enables a reed valve, which has excellent responsiveness and reliability, to be employed as the check valve, and, by preventing backflow of refrigerant with this check valve, recompression loss and noise can be reduced, and the compression efficiency can be increased. Furthermore, because the reed valve opens and closes in the direction perpendicular to the axial direction of the through-hole, there is no need to ensure a space in the axial direction for the opening/closing operation of the valve. Thus, it is easy to ensure the installation space.

[0009] The above-described refrigerant compressor of the present invention may be configured such that the compression mechanism is a scroll-compression mechanism that is securely installed in the housing and includes a fixed scroll having a spiral-shaped wall member provided upright on one side surface of an end plate; and an orbiting scroll having a spiral-shaped wall member provided upright on one side surface of an end plate, the spiral-shaped wall member of the orbiting scroll being meshed with the spiral-shaped wall member of the fixed scroll to form the spiral-shaped compression chamber, the compression mechanism compressing the refrigerant taken into the compression chamber by an orbital revolution movement of the orbiting scroll and then discharging it to a discharge chamber through a discharge port. The refrigerant compressor may include: the injection port that communicates with the inside of the compression chamber through the through-hole provided in the end plate of the fixed scroll to introduce the refrigerant from the outside into the compression chamber; and the check valve provided at the through-hole, the check valve being composed of the reed valve.

[0010] In this configuration, the check valve provided at the injection port is composed of a reed valve that is provided in the through-hole in the end plate of the fixed scroll, parallel to the axial direction thereof, and opens and closes in the direction perpendicular to the axial direction. Thus, limitations on the installation position and installation method for installing the check valve, which is composed of a reed valve, are eliminated. This enables a reed valve, which has excellent responsiveness and reliability, to be employed as the check valve, and, by preventing backflow of refrigerant with this check valve, recompression loss and noise can be reduced, and the compression efficiency can be increased. Furthermore, because the reed valve opens and closes in the direction perpendicular to the axial direction of the through-hole, there is no need to ensure a space in the axial direction for the opening/closing operation of the valve. Thus, the end plate of the fixed scroll does not need to be increased in thickness to ensure the space.

[0011] The above-described refrigerant compressor of the present invention may be configured such that the fixed scroll has a ring-like protrusion formed on the other side surface of the end plate and fitted into a discharge cover defining the discharge chamber, the through-hole is provided at the position corresponding to the protrusion, and the reed valve is provided in the through-hole.

[0012] In this configuration, by providing the through-hole at the position corresponding to the protrusion formed on the other side surface of the end plate of the fixed scroll and providing the reed valve in the through-hole, the reed valve having a long, plate-like valve body can be installed in the through-hole penetrating through the end plate of the fixed scroll, parallel to the axial direction thereof, while keeping the thickness of the end plate small.

[0013] Any one of the above-described refrigerant

compressors of the present invention may be configured such that the reed valve has a plate-like reed valve one end of which serves as a fixed end and the other end of which serves as a free end, and the other end of the reed valve is provided so as to open and close in a direction perpendicular to an orbital axis of the orbiting scroll.

[0014] In this configuration, because the reed valve can open and close in the direction perpendicular to wraps of the fixed scroll and orbiting scroll, it becomes unnecessary to ensure a space in a direction parallel to the wraps for allowing the reed valve to perform an opening/closing operation (the axial direction of the through-hole).

[0015] The above-described refrigerant compressor of the present invention may be configured such that, in the reed valve, a direction connecting the one end serving as the fixed end and the other end serving as the free end is parallel to the axial direction of the through-hole in the protrusion.

[0016] In this configuration, the reed valve is provided such that the other end serving as the free end opens and closes in the direction perpendicular to the orbital axis of the orbiting scroll. Furthermore, the direction connecting the one end serving as the fixed end and the other end serving as the free end is parallel to the axial direction of the through-hole in the protrusion. Thus, it is easy to ensure that the reed valve has a large length from one end to the other end, even in a small space. Accordingly, the limitations on the installation position and installation method can be relaxed.

[0017] Any one of the above-described refrigerant compressors of the present invention may be configured such that, in the scroll-compression mechanism, the height of the spiral-shaped wall members of the fixed scroll and orbiting scroll is larger on the outer circumference side than on the inner circumference side to enable compression in the circumferential direction and height direction of the spiral-shaped wall members.

[0018] In this configuration, by making the scroll-compression mechanism a compression mechanism that can perform compression in the circumferential direction and height direction of the spiral-shaped wall members, a high compression ratio can be achieved. In addition, even if the pressure difference increases, by forming the check valve provided at the injection port from a reed valve with excellent responsiveness and reliability, backflow of the refrigerant can be effectively prevented. Thus, it is possible to reduce the refrigerant leakage, reduce the recompression loss as much as possible, and increase the compression efficiency.

[0019] Any one of the above-described refrigerant compressors of the present invention may be configured such that the scroll-compression mechanism includes: a multi-port communicating with the inside of the compression chamber, provided in the end plate of the fixed scroll at a position on the outer circumference side of the discharge port in a spiral direction, through which the compressed gas is discharged to the discharge chamber

when the pressure in the compression chamber exceeds a preset pressure; and a multi-port valve provided on the other side surface of the end plate to open and close the multi-port.

[0020] In this configuration, even in the scroll-compression mechanism configured to include the multi-port and the multi-port valve, by reducing the installation space for the check valve provided at the injection port, the installation of the multi-port valve can be made easy. Accordingly, an over-compression prevention function of the multi-port can be easily added.

[0021] The present invention may also be regarded as a valve unit. A valve unit of the present invention is provided at a hole through which fluid flows in an axial direction from one end toward the other end. The valve unit includes: a unit body that is inserted into the hole and forms an inflow space and an outflow space for the fluid at one end and at the other end; a communication hole formed in the unit body, allowing the inflow space and the outflow space to communicate with each other; and a reed valve, with a plate-like shape, provided so as to close the communication hole, one end of which serves as a fixed end and the other end of which serves as a free end, the reed valve opening the communication hole when the pressure exerted by the fluid moves the other end away from the communication hole. In the reed valve, a direction connecting the one end serving as the fixed end and the other end serving as the free end is parallel to the axial direction of the hole.

[0022] In such a valve unit, it is easy to ensure that the reed valve has a large length from one end to the other end, even in a small space. Accordingly, the limitations on the installation position and installation method can be relaxed. The above-described valve unit may be widely used as a discharge valve, a multi-port valve, a relief valve, a capacity control valve, etc., that are used for various purposes, besides the check valve for the injection port of the refrigerant compressor.

{Advantageous Effects of Invention}

[0023] According to the refrigerant compressor of the present invention, limitations on the installation position and installation method for installing the check valve, which is composed of a reed valve, are eliminated, and, by employing a reed valve, which has excellent responsiveness and reliability, the function of the check valve can be improved. Accordingly, by preventing backflow of refrigerant with this check valve, recompression loss and noise can be reduced, and the compression efficiency can be increased. Furthermore, because the reed valve opens and closes in the direction perpendicular to the axial direction of the through-hole, there is no need to ensure a space in the axial direction for the opening/closing operation of the valve. Thus, it is easy to ensure the installation space.

[0024] According to the valve unit of the present invention, it is easy to ensure that the reed valve has a large

length from one end to the other end, even in a small space. As a result, responsiveness of the reed valve can be increased.

5 {Brief Description of Drawings}

[0025]

{FIG. 1} FIG. 1 is a longitudinal sectional view of a scroll-type compressor, which is an example of a refrigerant compressor according to an embodiment of the present invention.

{FIG. 2A} FIG. 2A is a plan view of a fixed scroll, showing a state in which a valve unit is mounted.

{FIG. 2B} FIG. 2B is a sectional view of a portion provided with the valve unit, showing a state in which the valve unit is mounted.

{FIG. 3A} FIG. 3A is a perspective view of the valve unit.

{FIG. 3B} FIG. 3B is a perspective view of the valve unit.

{FIG. 4A} FIG. 4A is a plan view of a fixed scroll, showing another example of a state in which the valve unit is mounted.

{FIG. 4B} FIG. 4B is a sectional view of a portion provided with the valve unit, showing another example of a state in which the valve unit is mounted.

{FIG. 5A} FIG. 5A is a plan view of the fixed scroll, showing another example of a state in which the valve unit is mounted.

{FIG. 5B} FIG. 5B is a sectional view of a portion provided with the valve unit, showing another example of a state in which the valve unit is mounted.

35 {Description of Embodiments}

[0026] An embodiment of the present invention will be described below with reference to the drawings.

FIG. 1 is a sectional view showing the configuration of a scroll-type compressor 10, which is an example of a refrigerant compressor according to this embodiment.

In FIG. 1, in the scroll-type compressor 10, a sealed internal space is formed by an upper housing 11, a middle housing 12, and a lower housing (not shown). The upper housing 11 and the middle housing 12 are connected, with the outer circumferential end of a discharge cover 13 interposed therebetween. The discharge cover 13 divides the internal space of the housing to form a discharge chamber 38 in the upper housing 11 and an intake chamber 40 in the middle housing 12.

[0027] An outlet tube 39 for discharging refrigerant is provided in the wall surface of the upper housing 11 to allow the discharge chamber 38 to communicate with the outside and discharge the refrigerant to, for example, an outdoor heat exchanger (condenser). Furthermore, the sealed space in the middle housing 12 accommodates a fixed scroll 20 fitted into a recessed wall surface of the discharge cover 13 and an orbiting scroll 30 having an-

other spiral-shaped wall member 32 that is meshed with a spiral-shaped wall member 22 provided upright on an end plate 21 of the fixed scroll 20.

[0028] As shown in FIG. 1, the fixed scroll 20 and the orbiting scroll 30 according to this embodiment have a stepped portion in the top surface of the spiral-shaped wall member 22 and in the bottom surface of the spiral-shaped wall member 32, respectively, at a predetermined position in the spiral direction. In the top surface of the spiral-shaped wall member, the top surface on the outer circumference side of the stepped portion in the axial direction is high, and the top surface on the inner circumference side of the stepped portion is low. Furthermore, in the bottom surface of the spiral-shaped wall member, the bottom surface on the outer circumference side in the axial direction is low, and the bottom surface on the inner circumference side is high. Thus, the height of the spiral-shaped wall members 22 and 32 is larger on the outer circumference side than on the inner circumference side, thereby forming a scroll-compression mechanism capable of compression in the circumferential direction and height direction of the spiral-shaped wall members 22 and 32.

[0029] A protruding boss 33 is formed on an end plate 31 of the orbiting scroll 30, and a shaft 34 having an eccentric pin 36 for causing the orbiting scroll 30 to perform orbital revolution movement is connected to the boss 33 through a bearing 35. Although the shaft 34 is configured to be connected to the rotor of an electric motor accommodated at the lower part of the middle housing 12 to drive the compressor, the configurations thereof will not be shown and descriptions thereof will be omitted.

[0030] The fixed scroll 20 has the above-described end plate 21 and the spiral-shaped wall member 22 provided upright thereon. A discharge port 23 for discharging compressed refrigerant is provided at substantially the central portion of the end plate 21, and it penetrates through the end plate 21 and communicates with a compression chamber 37 formed by the spiral-shaped wall members 22 and 32. The discharge port 23 is open to the discharge chamber 38 and is formed such that it is substantially coaxial with a second discharge port 13a formed in the discharge cover 13. Furthermore, a discharge valve 14 is provided at an opening, on the discharge chamber 38 side, of the second discharge port 13a formed in the discharge cover 13.

[0031] A ring-like protrusion 25 that can be fitted into the recess in the discharge cover 13 is formed on the surface of the end plate 21 opposite the surface on which the spiral-shaped wall member 22 is provided upright. O-rings 19a and 19b are provided on the outer circumferential portion of the protrusion 25. By fitting the protrusion 25 into the recess in the discharge cover 13 with these O-rings 19a and 19b therebetween, a back pressure chamber 15 surrounded by the discharge cover 13 and the protrusion 25 of the fixed scroll 20 is formed, and the air-tightness of the back pressure chamber 15 and the intake chamber 40 is ensured.

[0032] The above-described discharge port 23 is open to the back pressure chamber 15, and the back pressure chamber 15 communicates with the discharge chamber 38 through the second discharge port 13a. Furthermore, a plurality of through-holes (multi-ports) 27a communicating with the compression chamber 37 are provided in the back pressure chamber 15, at positions on the outer circumference side of the discharge port 23 in the spiral direction. These multi-ports 27a have a multi-port valve 27 composed of a reed valve.

[0033] As shown in FIGS. 1, 2A, and 2B, a through-hole 50 is formed in the discharge cover 13, at a predetermined position in a recess to which the ring-like protrusion 25 of the fixed scroll 20 is fitted. An end of an injection tube 51 penetrating through the upper housing 11 from the outside is connected to the through-hole 50. Refrigerant at an intermediate pressure between the condenser and evaporator of the refrigeration cycle system, configured by using the scroll-type compressor 10, is introduced into the injection tube 51.

[0034] On the other hand, a through-hole 28 having a circular cross section and penetrating from top to bottom to communicate with the compression chamber 37 is formed in the protrusion 25. This through-hole 28 is formed at a portion between the outer circumferential portion and the central portion of the spiral-shaped wall members 22 and 32. The compression chamber 37 has an intermediate pressure that is higher than the low-pressure refrigerant taken into the compression chamber 37 and lower than the high-pressure refrigerant compressed and discharged from the discharge port 23 eventually. The inside diameter of this through-hole 28 is constant up to a portion at a predetermined depth and is reduced at a position at the predetermined depth where a stepped portion 28a is formed. This through-hole 28 serves as an injection port. Then, a valve unit (check valve) 60 is provided in the through-hole 28.

[0035] As shown in FIGS. 2A, 2B, 3A, and 3B, the outer shape of the valve unit 60, as a whole, is substantially cylindrical corresponding to the inner shape of the through-hole 28. The valve unit 60 includes a unit body 61, a reed valve 62, a valve holding member 63, and stopper 64.

[0036] The unit body 61 has a valve face surface 61a on which the reed valve 62 is disposed. The valve face surface 61a is formed parallel to the axis of the through-hole 28, in other words, parallel to the orbital axis of the orbiting scroll 30. Furthermore, a flat portion 61b parallel to the valve face surface 61a is formed on the outer circumferential surface of the unit body 61. A through-hole 65 that penetrates the valve face surface 61a and the flat portion 61b facing the inner wall surface of the through-hole 28 is formed in the unit body 61. The plate-like reed valve 62 is disposed along the valve face surface 61a so as to close the through-hole 65 with one end 62a thereof. This reed valve 62 is held such that the other end 62b is sandwiched between the valve holding member 63 and the unit body 61.

[0037] The valve holding member 63, the reed valve 62, and the unit body 61 are fixed integrally by the stopper 64. The valve holding member 63, the reed valve 62, and the unit body 61 have holes 66, 67, and 68 formed so as to be located coaxially, into which the stopper 64 is inserted. The pinshaped stopper 64 is inserted into these holes 66, 67, and 68. The stopper 64 can be fixed to the holes 66 and 68 by, for example, press-fitting. Other than press-fitting, the stopper 64 can be fixed by screwing, by forming a threaded groove in the outer circumferential surface of the stopper 64 and by forming threaded grooves in the holes 66 and 68. Other than the above, the stopper 64 may be prevented from falling off by forming a continuous ring groove in the circumferential direction in the hole 66 at a position near the head of the stopper 64, and fitting a C-shaped ring into the ring groove.

[0038] The reed valve 62 sandwiched between the valve holding member 63 and the unit body 61 at the other end 62b, as described above, can deform in a cantilever-like manner such that the other end 62b serves as a fixed end and the one end 62a serves as a free end. At this time, the reed valve 62 can be deformed by the external force from a state in which it extends along the valve face surface 61a and closes the through-hole 65 in a direction in which the one end 62a moves away from the valve face surface 61a toward the valve holding member 63. At this time, the valve holding member 63 mechanically restricts the amount of deformation of the reed valve 62 in the direction away from the valve face surface 61a. Therefore, the valve holding member 63, while being integrated with the reed valve 62 and the unit body 61 by the stopper 64, preferably has a curved surface 63a on the surface facing the reed valve 62, which conforms to the shape of the reed valve 62 when it is deformed with the other end 62b serving as the fixed end.

[0039] Herein, the through-hole 65 is formed such that it has the axis extending in the direction perpendicular to the valve face surface 61a, i.e., in the direction perpendicular to the axis of the through-hole 28 and the orbital axis of the orbiting scroll 30. Then, the flat portion 61b forms a space (inflow space) S1 between the inner circumferential surface of the through-hole 28 and the valve unit 60, and the space S1 communicates with the through-hole 50 through a gap formed between the protrusion 25 of the fixed scroll 20 and the recess in the discharge cover 13. Furthermore, in the valve holding member 63, flat portions 63b and 63b are formed on both sides of the curved surface 63a, forming a space (outflow space) between the inner circumferential surface of the through-hole 28 and the valve holding member 63. This space communicates with the compression chamber 37. Accordingly, the pressure of the refrigerant sent from the injection tube 51 into the space S1 opens the reed valve 62, allowing the refrigerant to flow into the compression chamber 37.

[0040] This valve unit 60 can be fixed to the through-hole 28 by, for example, press-fitting, to ensure the seal-

ing property. Furthermore, other than press-fitting, the valve unit 60 can be fixed to the through-hole 28 by screwing, by forming threaded grooves in the outer circumferential surfaces of the unit body 61 and valve holding member 63 and by forming a threaded groove in the inner circumferential surface of the through-hole 28. In such a case, an adhesive or a threadlocking adhesive is preferably used to prevent the valve unit 60 from loosening and to ensure the sealing property. Other than these, as shown in FIGS. 4A and 4B, a fixing bolt 70 may be screwed in near the through-hole 28 to hold the head of the valve unit 60 with a flange portion 71 at the head of the fixing bolt 70. Furthermore, as shown in FIGS. 5A and 5B, the shape of the valve unit 60 may be partly changed. That is, instead of the flat portion 61b, a hole 80 extending in the axial direction and connecting to the through-hole 65 may be provided in the unit body 61 to form the space S1, and an O-ring 81 may be provided between the outer circumference of the unit body 61 and the through-hole 28 to ensure the sealing property.

[0041] The scroll-type compressor 10 according to this embodiment, having the above-described configuration, operates as follows. By driving an electric motor (not shown), the orbiting scroll 30 is driven through the shaft 34, the eccentric pin 36, the bearing 35, the boss 33, etc. The orbiting scroll 30, while being prevented from self rotation, performs orbital revolution movement on the circular orbit of the orbital revolution radius. As a result, the refrigerant gas enters the intake chamber 40 from the outside and is taken into the compression chamber 37 formed by the fixed scroll 20 and the orbiting scroll 30 on the outer circumference side.

[0042] Then, as the volume of the compression chamber 37 is decreased by the orbital revolution movement of the orbiting scroll 30, the refrigerant gas, while being compressed in the circumferential direction and height direction of the spiral-shaped wall members 22 and 32, reaches the central portion, passes through the discharge port 23, the back pressure chamber 15, and the second discharge port 13a, pushes up the discharge valve 14, is discharged into the discharge chamber 38, and is then discharged outside through the outlet tube 39. Furthermore, depending on the operating conditions, when the pressure in the compression chamber 37 rises early and exceeds the preset pressure before communication with the discharge port 23 is established, the multi-port valve 27 opens. Thus, the compressed gas is discharged through the multi-ports 27a to the back pressure chamber 15, preventing over-compression.

[0043] During this time, when it has a pressure equal to or larger than a predetermined value, the refrigerant sent from the injection tube 51 opens the reed valve 62 and is injected into the compression chamber 37 at an intermediate pressure. As is known, the efficiency and the performance of the refrigeration cycle can be improved by this injection effect. This reed valve 62 serves as a check valve that blocks the flow of refrigerant from the compression chamber 37 toward the through-hole 28.

[0044] As described above, the scroll-type compressor 10 according to this embodiment provides the following advantages.

The valve unit 60 constituting the check valve of the injection port is installed in the through-hole 28, in the axial direction thereof, which is provided in the protrusion 25 for fitting the fixed scroll 20 to the discharge cover 13. This eliminates the need to ensure a special space for providing the valve unit 60. Thus, the dead volume can be reduced. As a result, the recompression loss can be reduced, increasing the compression efficiency. At the same time, the opening/closing operation of the reed valve 62 of the valve unit 60 becomes quicker, whereby the check valve function can be improved. Furthermore, because there is no need to ensure a special space for providing the valve unit 60, it can contribute to a reduction in size of the scroll-type compressor 10.

[0045] Furthermore, the reed valve 62 of the valve unit 60 opens and closes in the direction perpendicular to the axis of the through-hole 28 and the orbital axis of the orbiting scroll 30. That is, because the length direction of the reed valve 62 (the length in the direction in which the one end 62a, serving as the free end, and the other end 62b, serving as the fixed end, are connected) is parallel to the axis of the through-hole 28 and the orbital axis of the orbiting scroll 30, it is easy to ensure that the reed valve 62 has sufficient length. As a result, it becomes possible to increase the responsiveness of the reed valve 62, whereby the check valve function can be improved.

[0046] Furthermore, by making the reed valve 62 open and close in the direction perpendicular to the axis of the through-hole 28 and the orbital axis of the orbiting scroll 30, there is no need to ensure a space required for an opening/closing operation in the axial direction of the through-hole 28. Accordingly, the thickness of the end plate 21 of the fixed scroll 20 can be restricted. Furthermore, because the through-hole 28 in which the valve unit 60 is installed is provided at a position corresponding to the protrusion 25 formed on the other side surface of the end plate 21 of the fixed scroll 20, the length in the axial direction of the through-hole 28 in which the valve unit 60 having the plate-like long reed valve 62 is installed can be ensured by the protrusion 25. Accordingly, the valve unit 60 having the reed valve 62 can be installed in the end plate 21 without particularly increasing the thickness of the end plate 21 of the fixed scroll 20.

[0047] Furthermore, even if the pressure difference increases by making the scroll-compression mechanism a compression mechanism in which the height of the spiral-shaped wall members 22 and 32 of the fixed scroll 20 and orbiting scroll 30 is made larger on the outer circumference side than on the inner circumference side to enable compression in the circumferential direction and height direction of the spiral-shaped wall members 22 and 32 to achieve a high compression ratio, backflow of the refrigerant can be effectively prevented by forming the check valve 60, provided at the injection port, of the reed valve 62 having excellent responsiveness and reli-

ability. Thus, it is possible to reduce refrigerant leakage, reduce the recompression loss as much as possible, and increase the compression efficiency.

[0048] Furthermore, even in a scroll-compression mechanism configured to have the multi-ports 27a and the multi-port valve 27, by reducing the installation space for the check valve 60 provided at the injection port as described above, the installation of the multi-port valve 27, which is composed of a reed valve, on the back surface of the fixed scroll end plate 21 can be made easy. Accordingly, an over-compression prevention function of the multi-ports 27a can be easily added.

[0049] Note that, in the above-described embodiment, although an example of the refrigerant compressor has been described on the basis of the scroll-type compressor 10, the present invention is not limited thereto, and the present invention may be applied to refrigerant compressors having other structures, for example, rotary compressors and reciprocating compressors. In such cases, the configuration is such that a rotary or reciprocating compression mechanism provided in the housing of the compressor and having a compression chamber that compresses refrigerant taken thereto and discharges the refrigerant is provided with a through-hole communicating with the compression chamber and an injection port that introduces the intermediate-pressure refrigerant from the outside into the compression chamber through the through-hole, and the above-described valve unit (check valve) 60 is provided at the through-hole.

This also provides the same advantage as above.

[0050] Furthermore, the valve unit (check valve) 60 may be applied to a discharge valve, a multi-port valve, a check valve, a capacity control valve, etc., besides the injection port of the scroll-type compressor 10 and other refrigerant compressors.

[0051] Furthermore, in the above-described embodiment, the valve unit 60 is composed of the unit body 61, the reed valve 62, the valve holding member 63, and the stopper 64. However, it is not limited thereto, and the configuration thereof can be appropriately modified within a scope not departing from the spirit of the present invention. For example, the valve holding member 63 may be formed integrally on the through-hole 28 side, rather than on the valve unit 60 side.

[0052] Furthermore, the above-described reed valve 62 has a structure in which the side surfaces of the other end 62b, serving as the fixed end, are in contact with the inner wall surface of the through-hole 28 so that displacement of the reed valve 62 is restricted, and the projection of the one end 62a, serving as the free end, always covers the through-hole 65 provided in the unit body 61.

{Reference Signs List}

[0053]

10 scroll-type compressor

11 upper housing
 12 middle housing
 13 discharge cover
 14 discharge valve
 20 fixed scroll
 21 end plate
 22 spiral-shaped wall member
 25 protrusion
 28 through-hole
 30 orbiting scroll
 31 end plate
 32 spiral-shaped wall member
 37 compression chamber
 38 discharge chamber
 39 outlet tube
 40 intake chamber
 50 through-hole
 51 injection tube
 60 valve unit (check valve)
 61 unit body
 61a valve face surface
 61b flat portion
 62 reed valve
 62a one end
 62b other end
 63 valve holding member
 64 stopper

Claims

1. A refrigerant compressor comprising:

a housing;
 a compression mechanism provided in the housing and having a compression chamber that compresses refrigerant taken thereinto and discharges the refrigerant;
 an injection port communicating with the inside of the compression chamber through a through-hole provided in the compression mechanism to introduce the intermediate-pressure refrigerant from the outside into the compression chamber; and
 a check valve provided at the through-hole, wherein the check valve is provided in the through-hole parallel to the axial direction thereof and being composed of a reed valve that opens and closes in a direction perpendicular to the axial direction.

2. The refrigerant compressor according to claim 1, wherein
 the compression mechanism is a scroll-compression mechanism that is securely installed in the housing and includes a fixed scroll having a spiral-shaped wall member provided upright on one side surface of an end plate; and an orbiting scroll having a spiral-

shaped wall member provided upright on one side surface of an end plate, the spiral-shaped wall member of the orbiting scroll being meshed with the spiral-shaped wall member of the fixed scroll to form the spiral-shaped compression chamber, the compression mechanism compressing the refrigerant taken into the compression chamber by an orbital revolution movement of the orbiting scroll and then discharging it to a discharge chamber through a discharge port, the refrigerant compressor further comprising: the injection port that communicates with the inside of the compression chamber through the through-hole provided in the end plate of the fixed scroll to introduce the refrigerant from the outside into the compression chamber; and the check valve provided at the through-hole, wherein the check valve is composed of the reed valve.

3. The refrigerant compressor according to claim 2, wherein the fixed scroll has a ring-like protrusion formed on the other side surface of the end plate and fitted into a discharge cover defining the discharge chamber, the through-hole is provided at the position corresponding to the protrusion, and the reed valve is provided in the through-hole.

4. The refrigerant compressor according to claim 2 or 3, wherein the reed valve has a plate-like reed valve one end of which serves as a fixed end and the other end of which serves as a free end, and the other end of the reed valve is provided so as to open and close in a direction perpendicular to an orbital axis of the orbiting scroll.

5. The refrigerant compressor according to claim 4, wherein in the reed valve, a direction connecting the one end serving as the fixed end and the other end serving as the free end is parallel to the axial direction of the through-hole in the protrusion.

6. The refrigerant compressor according to any one of claims 2 to 5, wherein, in the scroll-compression mechanism, the height of the spiral-shaped wall members of the fixed scroll and orbiting scroll is higher on the outer circumference side than on the inner circumference side to enable compression in the circumferential direction and height direction of the spiral-shaped wall members.

7. The refrigerant compressor according to any one of claims 2 to 6, wherein the scroll-compression mechanism includes: a multi-port communicating with the inside of the compression chamber, provided in the end plate of the fixed scroll at a position on the outer circumference side of the discharge port in a spiral direction, through which the compressed gas is dis-

charged to the discharge chamber when the pressure in the compression chamber exceeds a preset pressure; and a multi-port valve provided on the other side surface of the end plate to open and close the multi-port.

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8. A valve unit provided at a hole through which fluid flows in an axial direction from one end toward the other end, the valve unit comprising:

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a unit body that is inserted into the hole and forms an inflow space and an outflow space for the fluid at one end and at the other end;

a communication hole formed in the unit body, allowing the inflow space and the outflow space to communicate with each other; and

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a reed valve, with a plate-like shape, provided so as to close the communication hole, one end of which serves as a fixed end and the other end of which serves as a free end, the reed valve opening the communication hole when the pressure exerted by the fluid moves the other end away from the communication hole,

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wherein, in the reed valve, a direction connecting the one end serving as the fixed end and the other end serving as the free end is parallel to the axial direction of the hole.

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FIG. 1

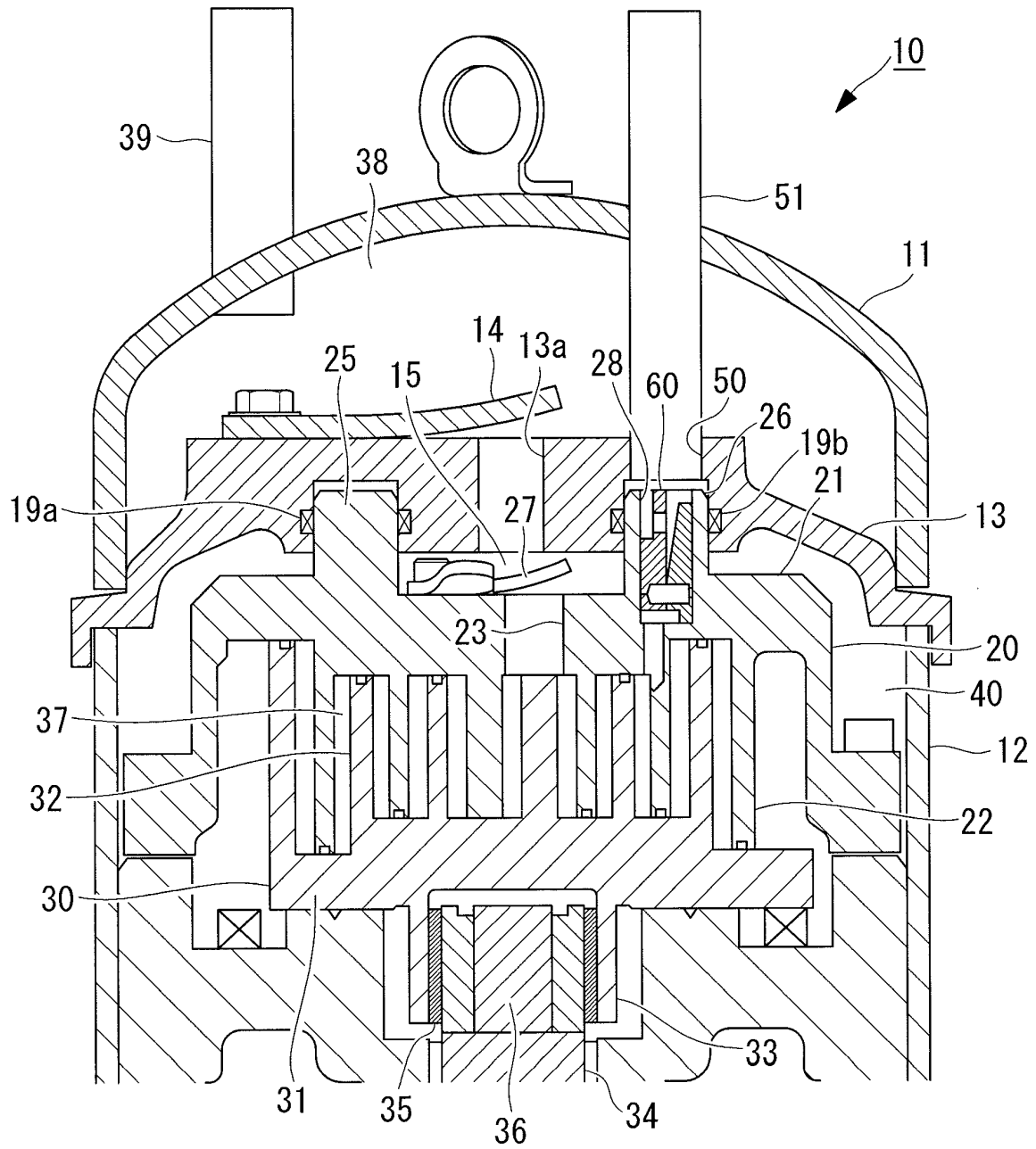


FIG. 2A

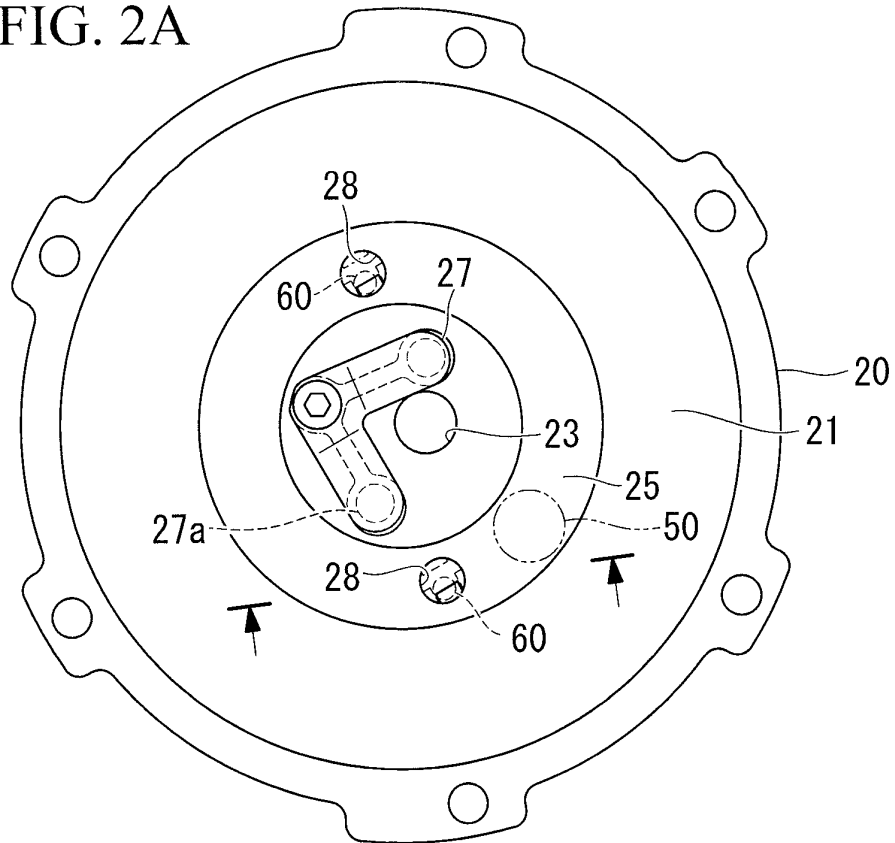


FIG. 2B

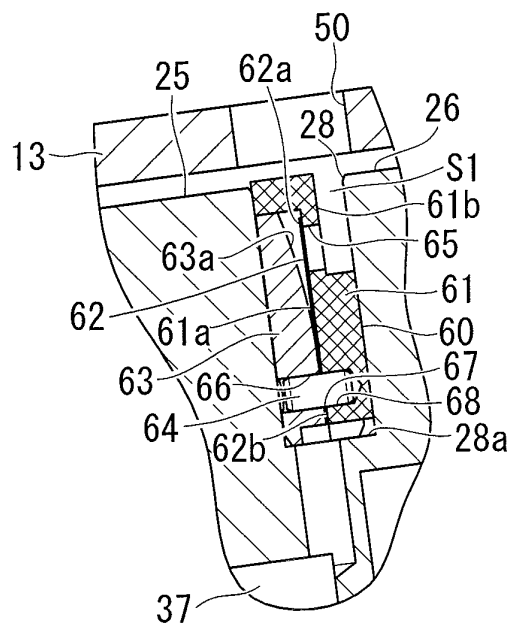


FIG. 3A

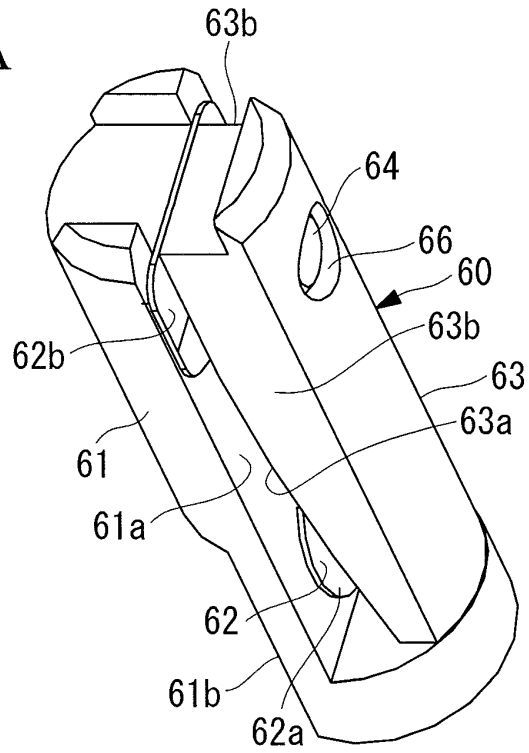


FIG. 3B

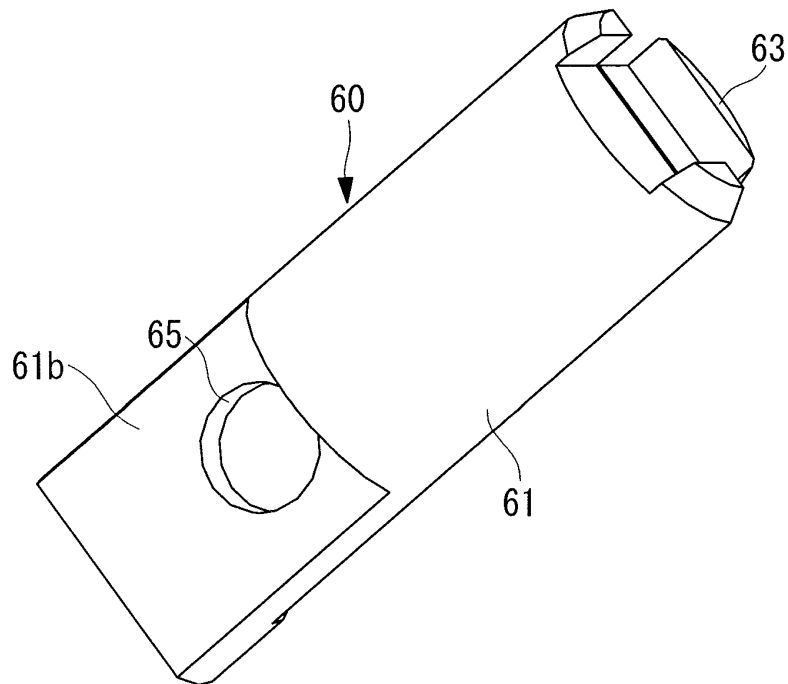


FIG. 4A

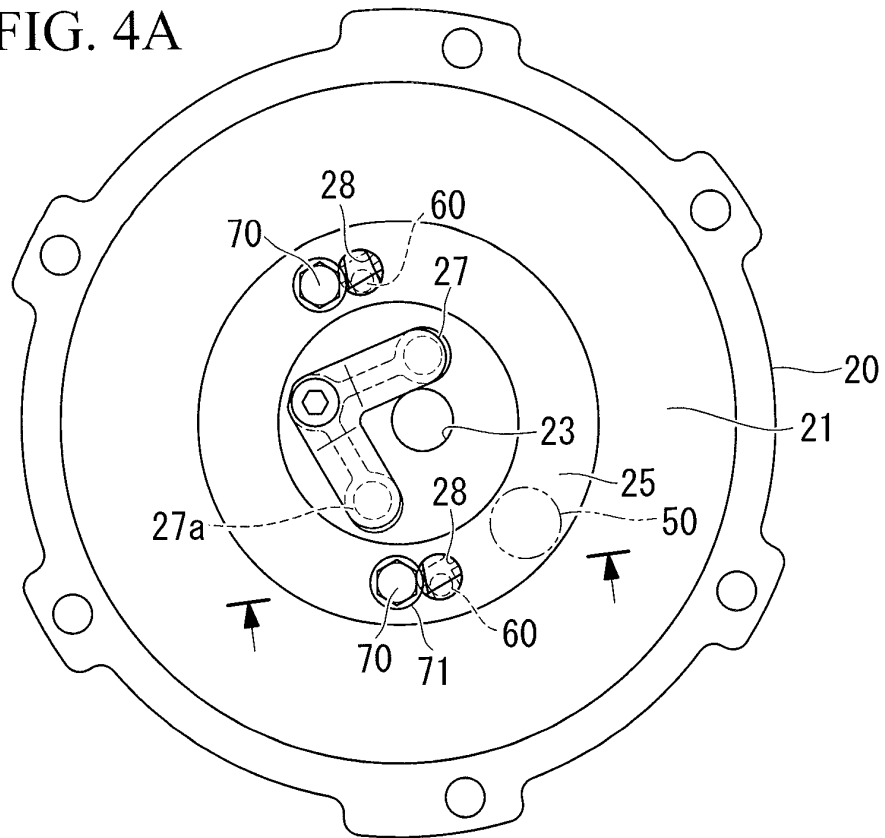


FIG. 4B

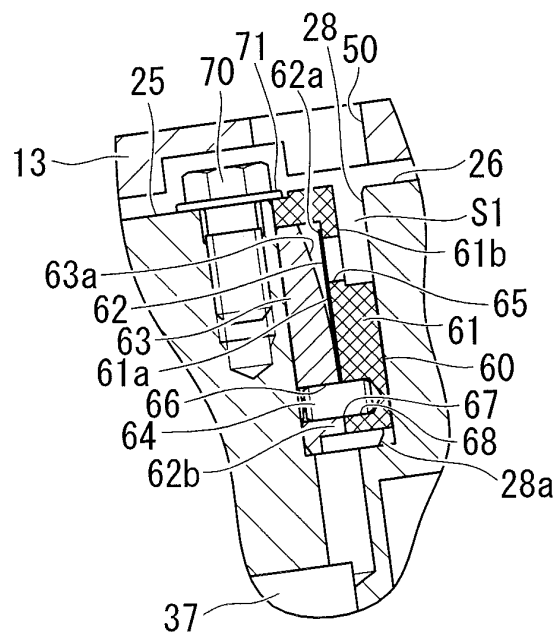


FIG. 5A

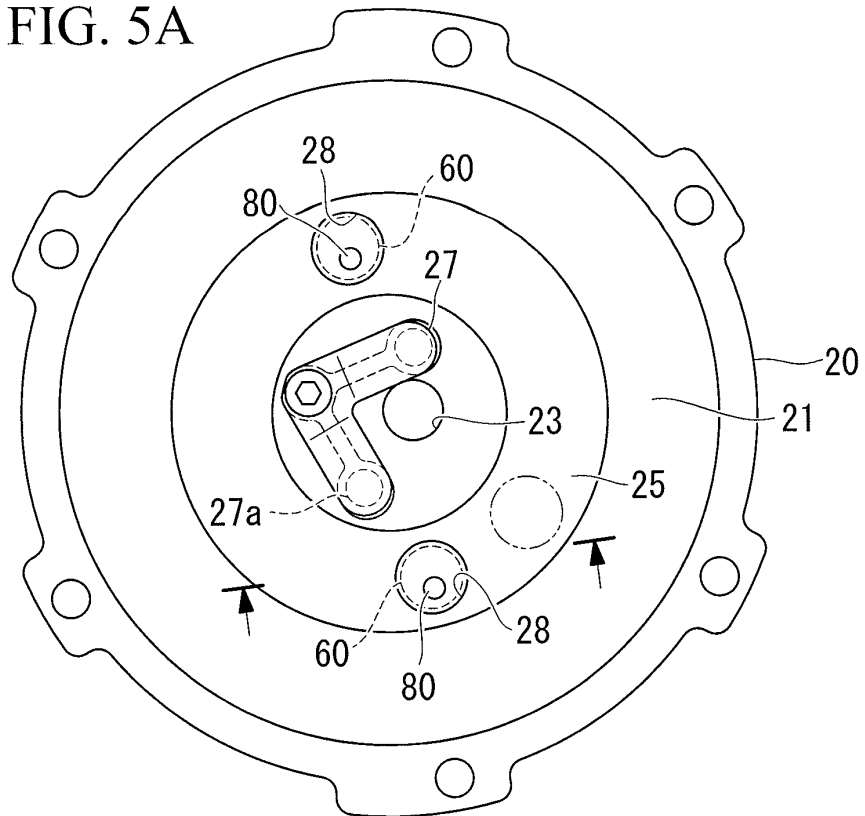
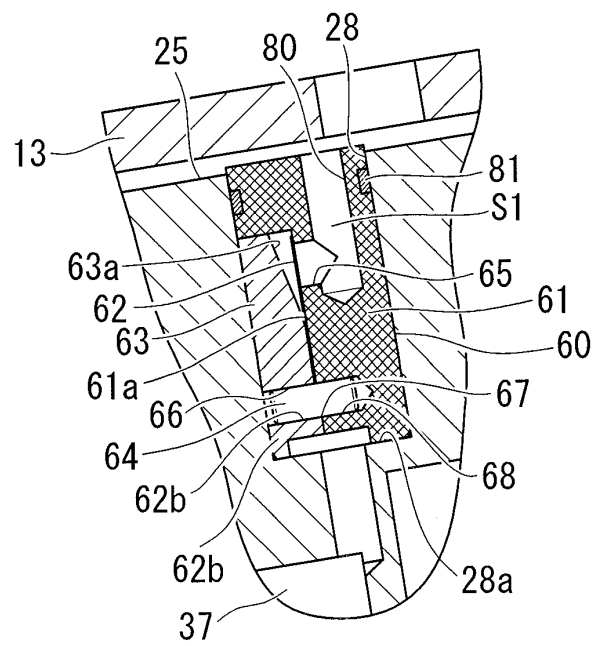


FIG. 5B



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/059858

A. CLASSIFICATION OF SUBJECT MATTER

F04B39/10 (2006.01) i, F04C29/12 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F04B39/10, F04C29/12

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2009

Kokai Jitsuyo Shinan Koho 1971-2009 Toroku Jitsuyo Shinan Koho 1994-2009

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 3764261 B2 (Matsushita Electric Industrial Co., Ltd.), 05 April, 2006 (05.04.06), Full text; all drawings (Family: none)	1-8
A	JP 3745801 B2 (Nippon Soken, Inc., Denso Corp.), 15 February, 2006 (15.02.06), Full text; all drawings & US 5722257 A & EP 768464 A2	1-8



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T"

later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X"

document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y"

document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"

document member of the same patent family

Date of the actual completion of the international search

17 August, 2009 (17.08.09)

Date of mailing of the international search report

25 August, 2009 (25.08.09)

Name and mailing address of the ISA/

Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/059858

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 41915/1975 (Laid-open No. 122206/1976) (Mitsubishi Heavy Industries, Ltd.), 04 October, 1976 (04.10.76), Description, page 6, line 8 to page 8, line 11; Figs. 3, 4 (Family: none)	8
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 145721/1984 (Laid-open No. 61382/1986) (Toshiba Corp.), 25 April, 1986 (25.04.86), Full text; all drawings (Family: none)	8

Form PCT/ISA/210 (continuation of second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/059858

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

The inventions of claims 1-7 are a group of inventions relating to a refrigerant compressor having a check valve provided to an injection port. The invention of claim 8 is an invention relating to a general check valve the application of which is not limited. Accordingly, the inventions of claims 1-7 and the invention of claim 8 are not so linked as to form a single general inventive concept.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest
the

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (April 2007)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP HEI9105386 B [0004]