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(54) **SCROLL COMPRESSOR**

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(57) **ABSTRACT**

A scroll compressor includes a sealed container, a compression mechanism portion for a refrigerant, a compliant frame and a guide frame which support an orbiting scroll, an electric motor which drives the orbiting scroll, balance weights, a refrigerant flow path which introduces a refrigerant gas discharged through a discharge port of a fixed scroll to a bottom portion of the sealed container, cup-shaped members provided on both upper and lower surfaces of the rotor of the electric motor and contain the balance weights, a penetrating flow path through which the refrigerant gas containing a refrigerating machine oil flows from a lower side of the rotor of the electric motor through the interiors of the cup-shaped members to an upper side of the rotor, and
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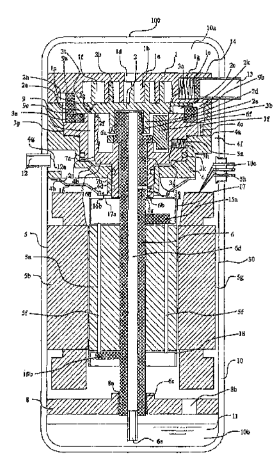

a discharge cover which is provided at a lower portion of the frame, and which introduces the refrigerant gas to a discharge pipe.

**6 Claims, 6 Drawing Sheets**

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USPC ....................................................... 417/410.5
See application file for complete search history.

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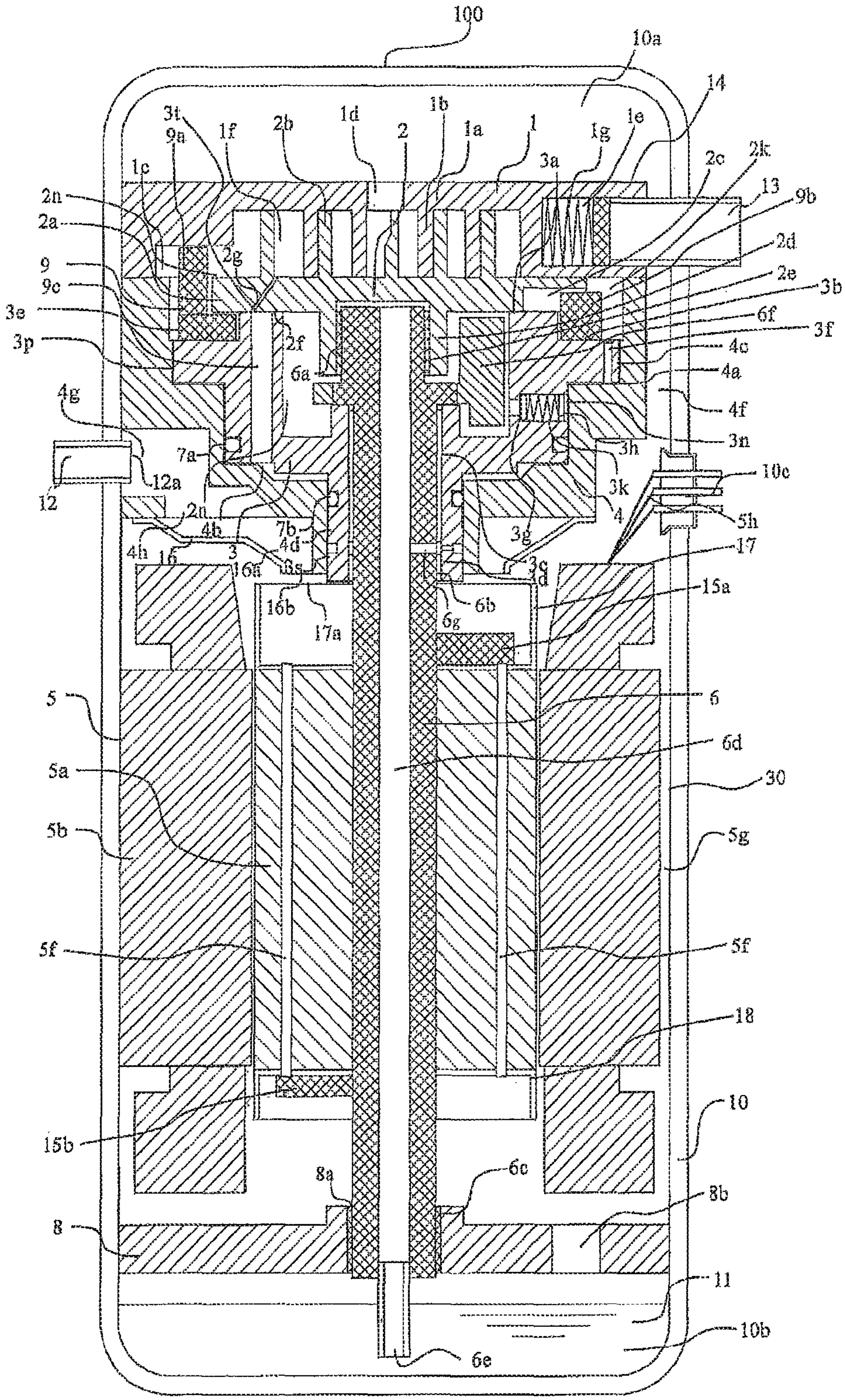
F I G. 1



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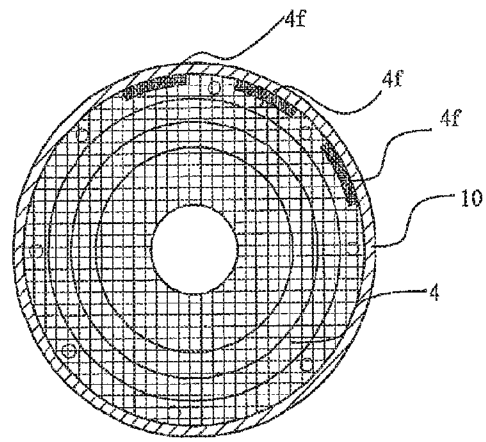


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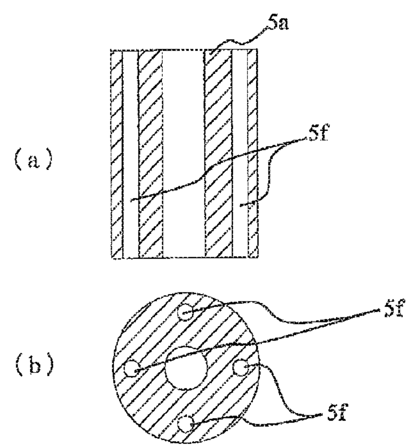


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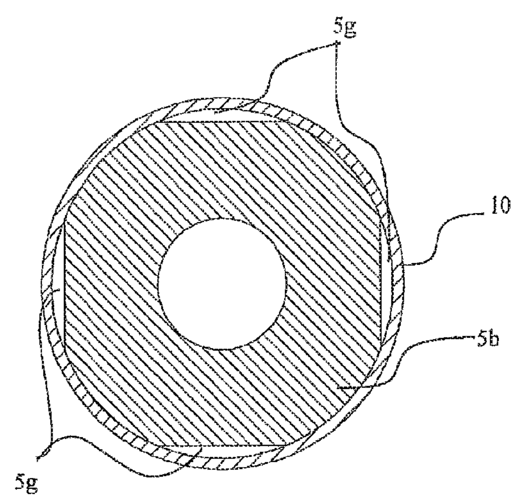
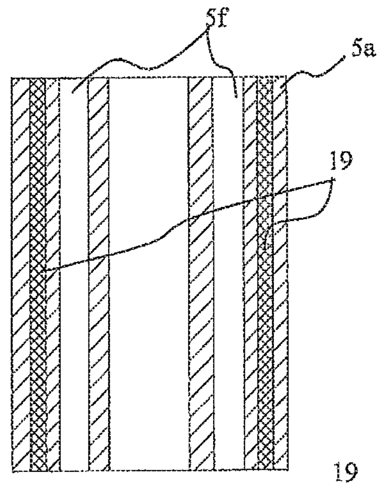


F I G. 5

(a)

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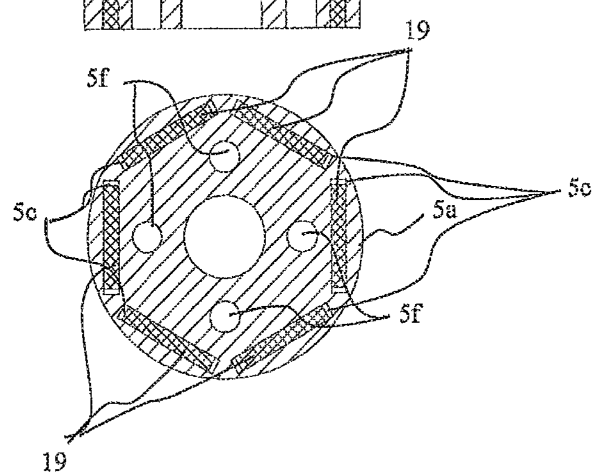
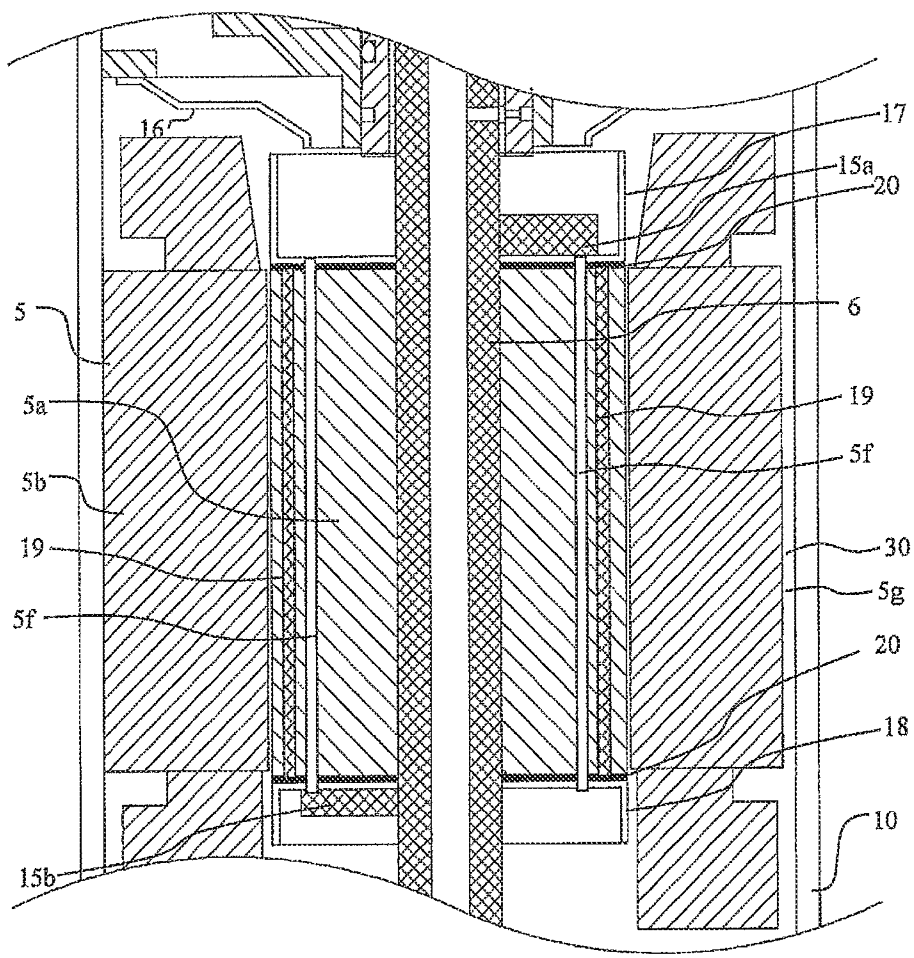


FIG. 6



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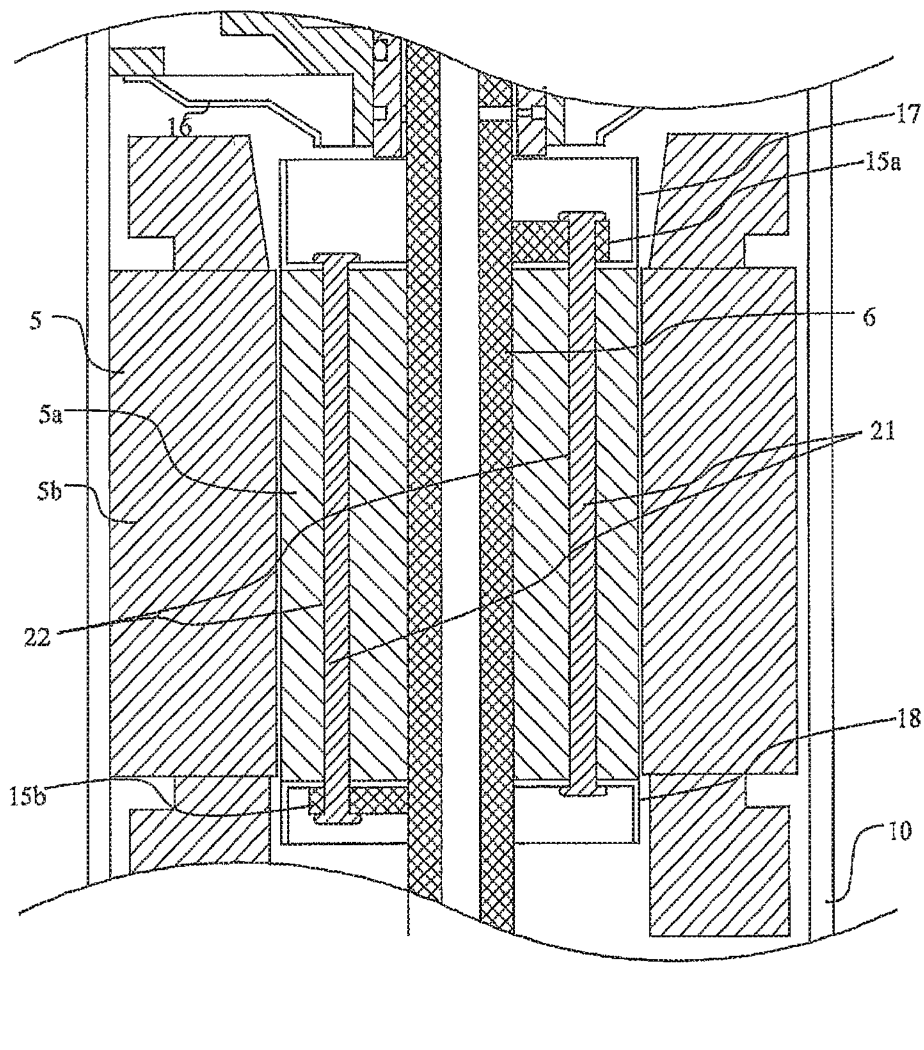
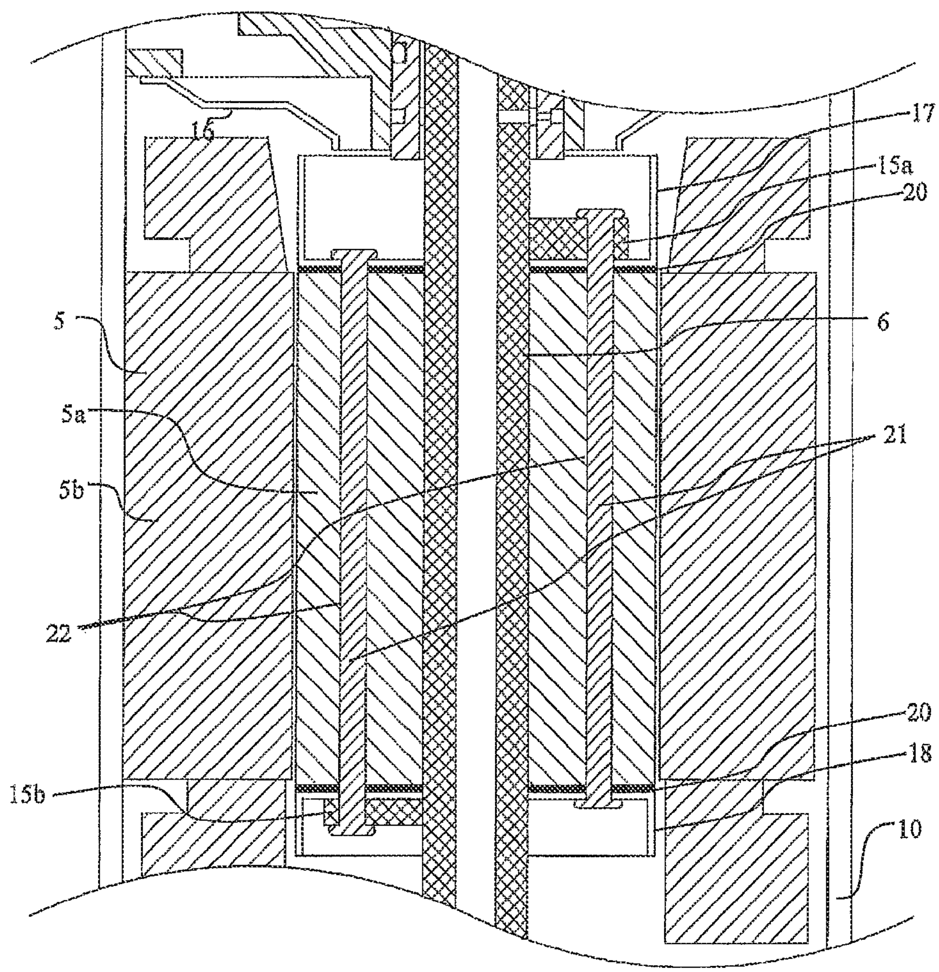


F I G. 8



# SCROLL COMPRESSOR

## CROSS REFERENCE TO RELATED APPLICATIONS

This application is a U.S. national stage application of International Application No. PCT/JP2013/076961 filed on Oct. 3, 2013, which claims priority to Japanese Patent Application No. 2012-262313 filed on Nov. 30, 2012, the disclosures of which are incorporated herein by reference.

## TECHNICAL FIELD

The present invention relates to a scroll compressor, and particularly relates to a device which prevents a refrigerating machine oil from flowing out of a sealed container at start of operation of a scroll compressor and during operation of the scroll compressor.

## BACKGROUND ART

A scroll compressor includes a sealed container, a compression mechanism portion which includes a fixed scroll and an orbiting scroll, and an electric motor element which rotationally drives the orbiting scroll of the compression mechanism portion. When a high-pressure refrigerant gas which has been compressed by the compression mechanism portion and discharged through a discharge port of the fixed scroll is discharged out of the sealed container as it is, since a refrigerating machine oil which lubricates a bearing portion of a drive portion is contained in the refrigerant gas, the refrigerating machine oil is taken out of the sealed container with the refrigerant gas. Therefore, the refrigerating machine oil stored at a bottom portion of the sealed container is decreased, seizure or the like of a bearing portion of a main shaft which rotationally drives the orbiting scroll occurs due to oil insufficiency, and thus breakdown or the like of the scroll compressor is caused.

As a scroll compressor which solves such a problem, a scroll compressor has been proposed which includes a device which reduces an amount of a refrigerating machine oil that flows out of a sealed container thereof (e.g., see Patent Literature 1). The scroll compressor includes refrigerant guide means for guiding a high pressure refrigerant gas discharged through a discharge port of a fixed scroll, to a rotor side of an electric motor, and oil separation means formed through the rotor of the electric motor for separating oil contained in the refrigerant gas by a centrifugal force caused by rotation of the rotor simultaneously with cooling the electric motor by the refrigerant gas guided by the refrigerant guide means while the refrigerant gas is caused to flow therethrough.

## CITATION LIST

### Patent Literature

Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2006-105123

## SUMMARY OF INVENTION

### Technical Problem

In the oil outflow reduction device disclosed in Patent Literature 1, a gas mixture of the refrigerant gas and the refrigerating machine oil discharged from the compression mechanism portion is guided by the refrigerant guide means to an upper surface side of the rotor of the electric motor and moves down through a penetrating flow path provided at the rotor and upper and lower end rings. The refrigerating machine oil contained in the refrigerant gas is separated by a centrifugal force caused by rotation of the rotor while the gas mixture moves down through the penetrating flow path. However, balance weights are fixed to upper and lower surfaces of the rotor for cancelling out unbalance of force associated with revolution movement of the orbiting scroll. The balance weights rotate like vanes of a fan, thereby agitating the refrigerating machine oil and the refrigerant gas discharged from the lower surface of the rotor. Thus, there is the problem that it is not possible to effectively reduce the amount of the oil taken out and the oil outflow prevention effect is not sufficiently achieved.

The present invention has been made in order to solve the problem as described above, and it is an object of the present invention to obtain a scroll compressor which prevents agitation of a refrigerant gas and a refrigerating machine oil by a balance weight, improves oil separation efficiency, and has high reliability.

### Solution to Problem

A scroll compressor according to the present invention includes: a sealed container; a compression mechanism portion provided within the sealed container and having a compression chamber in which plate-like scroll teeth of a fixed scroll and an orbiting scroll are meshed with each other to compress a refrigerant; an electric motor provided within the sealed container and configured to rotationally drive the orbiting scroll; a rotary shaft configured to transfer a drive force of the electric motor to the orbiting scroll; a frame configured to rotatably support the rotary shaft; balance weights fixed to an upper surface and a lower surface of a rotor of the electric motor and configured to cancel out unbalance of a force generated in the compression mechanism portion; a refrigerant flow path configured to introduce a refrigerant gas discharged through a discharge port provided in the fixed scroll of the compression mechanism portion, to a bottom portion of the sealed container; cup-shaped members provided on the upper surface and the lower surface of the rotor of the electric motor and containing the balance weights; a penetrating flow path through which the refrigerant gas containing a refrigerating machine oil flows from a lower side of the rotor of the electric motor through interiors of the cup-shaped members to an upper side of the rotor; and a discharge cover provided at a lower portion of the frame, having an opening opposed to an opening of one of the cup-shaped members respectively provided on the upper surface of the rotor of the electric motor, and configured to introduce the refrigerant gas having passed through the penetrating flow path, to a discharge pipe mounted to the sealed container.

### Advantageous Effects of Invention

In the scroll compressor according to the present invention, since the cup-shaped members contain the balance weights and are provided on both upper and lower surfaces of the rotor, the refrigerant gas and the refrigerating machine oil discharged from the compression mechanism portion are allowed to be introduced to the bottom portion of the sealed container without being agitated by the balance weights. While a gas mixture of the refrigerant gas and the refrigerating machine oil moves up through the penetrating flow path provided in the rotor, the refrigerating machine oil is separated from the gas mixture by a centrifugal force caused by rotation of the rotor. The refrigerant gas from which the refrigerating machine oil has been separated flows from the interior of the cup-shaped member on the upper surface of the rotor through the interior of the discharge cover and is discharged through the discharge pipe to the outside of the sealed container. In addition, since the discharge cover is provided at the lower portion of the frame and separated from a space filled with the gas mixture of the refrigerant gas and the refrigerating machine oil discharged from the compression mechanism portion, the refrigerant gas from which the refrigerating machine oil has been separated is allowed to be introduced to the outside of the sealed container without being mixed with the refrigerating machine oil again. Therefore, according to the present invention, an effect is obtained that agitation of the refrigerant gas and the refrigerating machine oil by the balance weights is prevented, the oil separation efficiency is improved, and a scroll compressor having high reliability is obtained.

## BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a longitudinal cross-sectional view showing a scroll compressor according to Embodiment 1 of the present invention.

FIG. **2** is a transverse cross-sectional view showing a first path provided at an outer peripheral portion of a guide frame in FIG. **1**.

FIG. **3** shows a longitudinal cross-sectional view (a) and a transverse cross-sectional view (b) of a rotor of an electric motor in FIG. **1**.

FIG. **4** is a transverse cross-sectional view of a stator of the electric motor in FIG. **1**.

FIG. **5** shows a longitudinal cross-sectional view (a) and a transverse cross-sectional view (b) showing a rotor of an electric motor according to Embodiment 2 of the present invention.

FIG. **6** is a partial cross-sectional view showing elements around a rotor of an electric motor according to Embodiment 3 of the present invention.

FIG. **7** is a partial cross-sectional view showing elements around a rotor of an electric motor according to Embodiment 4 of the present invention.

FIG. **8** is a partial cross-sectional view showing elements around a rotor of an electric motor according to Embodiment 5 of the present invention.

## DESCRIPTION OF EMBODIMENTS

Hereinafter, Embodiments of a scroll compressor according to the present invention will be described with reference to the drawings. The scroll compressor described here is shown as an example of a vertical type, but the present invention is applicable to a horizontal type. In addition, the drawings described below including FIG. **1** are schematically shown, and a relationship in size between each component is sometimes different from actual one.

### Embodiment 1

FIG. **1** is a longitudinal cross-sectional view of a scroll compressor **100** according to Embodiment 1 of the present invention. With reference to FIG. **1**, the configuration and operation of the scroll compressor **100** which is a vertical type will be described.

The scroll compressor **100** is one of components of a refrigeration cycle used in various industrial machines such as a refrigerator, a freezer, an air-conditioning apparatus, a refrigerating apparatus, and a water heater.

The scroll compressor **100** sucks a refrigerant circulating through the refrigeration cycle, compresses the refrigerant into a high-temperature and high-pressure state, and discharges the refrigerant. The scroll compressor **100** includes, within a sealed container **10**, a compression mechanism portion **14** which is a combination of a fixed scroll **1** and an orbiting scroll **2** which revolves (swings) relative to the fixed scroll **1**. In addition, the scroll compressor **100** includes, within the sealed container **10**, an electric motor **5** which connects the orbiting scroll **2** to a main shaft **6** and drives the orbiting scroll **2**. In the case of the vertical type scroll compressor **100**, within the sealed container **10**, for example, the compression mechanism portion is disposed at the upper side, and the electric motor **5** is disposed at the lower side.

The fixed scroll **1** includes a base plate portion **1***a* and a plate-like scroll tooth **1***b* which is a scroll lap provided on one surface (the lower side in FIG. **1**) of the base plate portion **1***a*. In addition, the orbiting scroll **2** includes a base plate portion **2***a* and a plate-like scroll tooth **2***b* which is a scroll lap which is provided on one surface (the upper side in FIG. **1**) of the base plate portion **2***a* and has substantially the same shape as the plate-like scroll tooth **1***b*. The plate-like scroll tooth **1***b* of the fixed scroll **1** and the plate-like scroll tooth **2***b* of the orbiting scroll **2** mesh with each other, thereby forming a compression chamber **1***f* whose volume relatively changes.

The fixed scroll **1** is fastened at an outer peripheral portion thereof to a guide frame **4** by means of bolts (not shown). A suction pipe **13** for introducing a refrigerant gas from a suction port **1***e* through a suction check valve **1***g* to the compression chamber **1***f* is provided at an outer peripheral portion of the base plate portion **1***a* of the fixed scroll **1**. A center portion of the base plate portion **1***a* of the fixed scroll **1** has a discharge port **1***d* through which the refrigerant gas compressed into a high pressure gas is discharged. The refrigerant gas compressed into a high pressure gas is discharged to an upper space **10***a* within the sealed container **10**. As described later, the refrigerant gas discharged to the upper space **10***a* is introduced through a refrigerant flow path to an oil separation mechanism, and the refrigerant gas from which oil has been separated is discharged through a discharge pipe **12**, whereby the refrigeration cycle is formed.

The orbiting scroll **2** is configured to revolve (swing) relative to the fixed scroll **1** without rotating relative to the fixed scroll **1**, by an Oldham mechanism **9** for preventing rotation. The outer peripheral portion of the base plate portion **1***a* of the fixed scroll **1** has a pair of Oldham guide grooves **1***c* each formed substantially on a straight line. A pair of fixed-side keys **9***a* of the Oldham mechanism **9** are engaged with the Oldham guide grooves **1***c* so as to be slidable back and forth. In addition, an outer peripheral portion of the base plate portion **2***a* of the orbiting scroll **2** has a pair of Oldham guide grooves **2***c* which have a phase difference of 90 degrees with respect to the Oldham guide grooves **1***c* of the fixed scroll **1** and are each formed substantially on a straight line. A pair of swing-side keys **9***b* of the Oldham mechanism **9** are engaged with the Oldham guide grooves **2***c* so as to be slidable back and forth.

The orbiting scroll **2** is able to swing (revolve) without rotating, by the Oldham mechanism **9** configured as described above. In addition, a boss portion **2***d* having a hollow cylindrical shape is formed at a center of a surface (at the lower side in FIG. **1**) of the orbiting scroll **2** which is opposite to the surface on which the plate-like scroll tooth **2***b* is formed. An eccentric shaft portion (swing shaft portion) **6***a* provided at an upper end portion of the main shaft **6** is inserted in the boss portion **2***d*. In addition, a thrust surface **2***f* which is slidable relative to a thrust bearing **3***a* of a compliant frame **3** in a pressure contact therewith is formed in the surface of the base plate portion **2***a* of the orbiting scroll **2** which is opposite to the plate-like scroll tooth **2***b* (at the lower side in FIG. **1**). Moreover, a bleeding hole **2***g* is provided in the base plate portion **2***a* of the orbiting scroll **2** so as to extend through the compression chamber **1***f* and the thrust surface **2***f*, thereby providing a structure to extract the refrigerant gas being compressed and introduce the refrigerant gas to the thrust surface **2***f*.

The compliant frame **3** is housed within the guide frame **4**. The compliant frame **3** is provided with an upper cylindrical surface **3***p* and a lower cylindrical surface **3***s* on an outer peripheral portion thereof. An inner peripheral portion of the guide frame **4** is provided with an upper cylindrical surface **4***c* and a lower cylindrical surface **4***d* to which the upper cylindrical surface **3***p* and the lower cylindrical surface **3***s* of the compliant frame **3** are fitted, respectively. The compliant frame **3** is radially supported within the guide frame **4** by fitting the upper cylindrical surface **3***p* and the upper cylindrical surface **4***c* to each other and fitting the lower cylindrical surface **3***s* and the lower cylindrical surface **4***d* to each other. In addition, at a center portion of the lower cylindrical surface **3***s* of the compliant frame **3**, a main bearing **3***c* and an auxiliary main bearing **3***d* are provided which radially supports the main shaft **6** which is rotationally driven by a rotor **5***a* of the electric motor **5**. In addition, a communication hole **3***e* is provided so as to extend in an axial direction from a surface of the thrust bearing **3***a* through the outer peripheral portion of the compliant frame **3**. A thrust bearing opening **3***t* opened at an upper end of the communication hole **3***e* is opposed to the bleeding hole **2***g* extending through the base plate portion **2***a* of the orbiting scroll **2**.

In addition, a surface (reciprocation slide surface) **3***b* on which an Oldham mechanism annular portion **9***c* is slidable back and forth is formed at an outer peripheral side of the thrust bearing **3***a* of the compliant frame **3**, and a communication hole **3***f* which provides communication between a base plate outer peripheral portion space **2***k* and a frame upper space **4***a* is formed so as to communicate with the inner side of the Oldham mechanism annular portion **9***c*. Furthermore, in the compliant frame **3**, between the frame upper space **4***a* and a boss portion outer space **2***n*, an intermediate pressure regulating valve space **3***n* is provided for housing an intermediate pressure regulating valve **3***g* which regulate the pressure in the boss portion outer space **2***n*, an intermediate pressure regulating valve holder **3***h*, and an intermediate pressure regulating spring **3***k*. The intermediate pressure regulating spring **3***k* is housed such that the intermediate pressure regulating spring **3***k* is contracted to be shorter than its natural length.

In Embodiment 1, the compliant frame **3** and the guide frame **4** are configured as separate components, but are not limited thereto, and both frames may be configured as a single integrate frame.

A frame lower space **4***b* is defined by the inner surface of the guide frame **4** and the outer surface of the compliant frame **3** and sealed at an upper portion and a lower portion thereof by ring-shaped sealing materials **7***a* and **7***b*. Here, ring-shaped sealing grooves for receiving the ring-shaped sealing materials **7***a* and **7***b* are formed at two locations on the inner peripheral surface of the guide frame **4**, but these sealing grooves may be formed on the outer peripheral surface of the compliant frame **3**. The frame lower space **4***b* communicates only with the communication hole **3***e* of the compliant frame **3** and is structured to enclose the refrigerant gas which is being compressed and is supplied from the bleeding hole **2***g*. In addition, a space which is at the outer side of the thrust bearing **3***a* and is surrounded at an upper portion and a lower portion thereof by the base plate portion **2***a* of the orbiting scroll **2** and the compliant frame **3**, namely, the base plate outer peripheral portion space **2***k*, is a low-pressure space having a suction gas atmosphere (suction pressure).

FIG. **2** is a transverse cross-sectional view showing first paths **4***f* provided at the outer peripheral portion of the guide frame **4** in FIG. **1**. As shown in FIG. **2**, the guide frame **4** is secured at an outer peripheral surface thereof to the sealed container **10** by means of shrinkage fitting, welding, or the like. The first paths **4***f* are provided on the guide frame **4** and the fixed scroll **1**, namely, an outer peripheral portion of the compression mechanism portion **14**, in the form of cuts. The refrigerant gas discharged through the discharge port **1***d* to the upper space **10***a* of the sealed container **10** flows downward through the first paths **4***f* in the sealed container **10**. A bottom portion of the sealed container **10** is an oil reservoir portion **10***b* in which a refrigerating machine oil **11** is stored.

The discharge pipe **12** through which the refrigerant gas is discharged to the outside is provided to the sealed container **10**. The first paths **4***f* are provided at a side opposite to the discharge pipe **12**. In addition, a first discharge path **4***g* is provided so as to extend from a lower end center of the guide frame **4** to a lateral surface of the guide frame **4** and leads to the discharge pipe **12**. Moreover, a discharge cover **16** having an opening **16***b* so as to surround a lower cylindrical portion (a portion on which the lower cylindrical surface **4***d* is formed) is provided at a lower end of the guide frame **4**. A second discharge path **16***a* within the discharge cover **16** communicates with the first discharge path **4***g*.

The electric motor **5** rotationally drives the main shaft **6**, and includes the rotor **5***a* fixed to the main shaft **6**, a stator **5***b* fixed to the sealed container **10**, and the main shaft **6** which is a rotary shaft. The rotor **5***a* is fixed to the main shaft **6** by means of shrinkage fitting, and is configured to be rotationally driven by start of energization of the stator **5***b* to rotate the main shaft **6**. In addition, the upper end portion of the main shaft **6** has the eccentric shaft portion **6***a* which is rotatably engaged with a swing bearing **2***e* of the orbiting scroll **2**, and a main shaft balance weight **6***f* is fixed at a lower side of the eccentric shaft portion **6***a* by means of shrinkage fitting.

Furthermore, a main shaft portion **6***b* which is rotatably engaged with the main bearing **3***c* and the auxiliary main bearing **3***d* of the compliant frame **3** is formed at the lower side of the eccentric shaft portion **6***a*. In addition, a sub-shaft portion **6***c* which is rotatably engaged with a sub-bearing **8***a* of a sub-frame **8** is formed at a lower end portion of the main shaft **6**. An inflow hole **8***b* through which the refrigerating machine oil **11** flows into the oil reservoir portion **10***b* is provided in the sub-frame **8**. Also, the rotor **5***a* of the electric motor **5** is fixed between the sub-shaft portion **6***c* and the main shaft portion **6***b* by means of shrinkage fitting. An oil supply path **6***d* is provided in the main shaft **6** as a hole extending therethrough in the axial direction, and an oil supply port **6***e* at a lower end of the oil supply path **6***d* is soaked in the refrigerating machine oil **11** stored in the bottom portion of the sealed container **10**. Therefore, the refrigerating machine oil **11** is sucked up through the oil supply port **6***e* by an oil supply mechanism or a pump mechanism provided at a lower portion of the main shaft **6**. An upper end of the oil supply path **6***d* is opened within the boss portion **2***d* of the orbiting scroll **2**, and the sucked-up refrigerating machine oil **11** flows out through the upper end opening of the oil supply path **6***d* to the swing bearing **2***e* to lubricate the eccentric shaft portion **6***a* and the swing bearing **2***e*. In addition, an oil supply hole **6***g* is provided at the oil supply path **6***d* so as to laterally branch therefrom, and the refrigerating machine oil **11** is supplied through the oil supply hole **6***g* to the auxiliary main bearing **3***d* to lubricate the auxiliary main bearing **3***d* and the main shaft portion **6***b*. It should be noted that an oil supply hole to the main bearing **3***c* is omitted in FIG. **1**.

A first balance weight **15***a* and a second balance weight **15***b* are fixed to an upper end surface and a lower end surface, respectively, of the rotor **5***a* and at eccentric positions opposed to each other. In addition, in a space outside the boss portion **2***d*, the aforementioned main shaft balance weight **6***f* is fixed to the main shaft **6** and at the lower side of the eccentric shaft portion **6***a*. These three balance weights **15***a*, **15***b*, and **6***f* cancel out unbalance of a force of moment and a centrifugal force caused by the orbiting scroll **2** swinging via the eccentric shaft portion **6***a* of the main shaft **6**, whereby static balance and dynamic balance are attained.

Furthermore, a first cup-shaped member **17** which contains the first balance weight **15***a* is fixed to the upper end surface of the rotor **5***a*, and a second cup-shaped member **18** which contains the second balance weight **15***b* is fixed to the lower end surface of the rotor **5***a*. In addition, the first cup-shaped member **17** is provided such that an opening **17***a* at an upper portion thereof is opposed to the opening **16***b* of the aforementioned discharge cover **16**. The second cup-shaped member **18** is mounted such that an opening thereof faces downward.

FIG. **3** shows a longitudinal cross-sectional view (a) and a transverse cross-sectional view (b) of the rotor **5***a* of the electric motor **5** in FIG. **1**.

As shown in FIGS. **1** and **3**, a plurality of penetrating flow paths **5***f* are provided in the rotor **5***a* so as to extend therethrough in the axial direction. In addition, the penetrating flow paths **5***f* are provided so as to avoid the installation positions of the first balance weight **15***a* and the second balance weight **15***b* and extend through bottom portions of the first cup-shaped member **17** and the second cup-shaped member **18** (see FIG. **1**). Moreover, the first cup-shaped member **17** and the second cup-shaped member **18** are preferably made of a non-magnetic material. It should be noted that the penetrating flow paths **5***f* may be formed so as to extend through the first balance weight **15***a* and the second balance weight **15***b*, and may be provided so as to avoid the positions of the first cup-shaped member **17** and the second cup-shaped member **18**. Furthermore, the plurality of penetrating flow paths **5***f* are formed so as to be symmetrical or point-symmetrical with respect to an axis.

FIG. **4** is a transverse cross-sectional view of the stator **5***b* of the electric motor **5** in FIG. **1**.

The stator **5***b* of the electric motor **5** is fixed at an outer peripheral surface thereof to the sealed container **10** by means of shrinkage fitting, welding, or the like. As shown in FIG. **4**, second paths **5***g* are provided at the outer peripheral portion of the stator **5***b* in the form of cuts.

The aforementioned first paths **4***f* and second paths **5***g* form a refrigerant flow path **30** which introduces the refrigerant gas discharged from the discharge port **1***d*, to the bottom portion of the sealed container **10**.

In addition, as shown in FIG. **1**, a glass terminal **10***c* is provided at the lateral surface of the sealed container **10**, and the glass terminal **10***c* and the stator **5***b* of the electric motor **5** are connected to each other via a lead wire **5***h*.

Next, an operation of the scroll compressor **100** according to Embodiment 1 will be described.

At start of the scroll compressor **100** and during operation of the scroll compressor **100**, the refrigerant is sucked through the suction pipe **13** and enters the compression chamber **1***f* which is formed by meshing the plate-like scroll tooth **1***b* of the fixed scroll **1** and the plate-like scroll tooth **2***b* of the orbiting scroll **2**. The orbiting scroll **2** driven by the electric motor **5** decreases the volume of the compression chamber **1***f* with an eccentric revolution movement thereof. Because of the compression process, the sucked refrigerant becomes a high-pressure refrigerant. In the compression process, the intermediate-pressure refrigerant gas being compressed is introduced from the bleeding hole **2***g* of the orbiting scroll **2** through the communication hole **3***e* of the compliant frame **3** to the frame lower space **4***b* to maintain an intermediate-pressure atmosphere in the frame lower space **4***b*.

A gas mixture of the refrigerating machine oil and the refrigerant discharged from the discharge port **1***d* of the fixed scroll **1** to the upper space **10***a* of the sealed container **10** through the compression process is introduced through the refrigerant flow path **30**, which is made of the first paths **4***f* provided at the outer peripheral portion of the compression mechanism portion **14** and the second paths **5***g* provided at the outer peripheral portion of the stator **5***b* of the electric motor **5**, to a lower space below the electric motor **5**, that is, the bottom portion of the sealed container **10**. The gas mixture is separated while being introduced to the bottom portion of the sealed container **10**. The refrigerant gas separated from the refrigerating machine oil **11** enters through the opening of the second cup-shaped member **18** mounted on the lower end surface of the rotor **5***a* of the electric motor **5**, into the second cup-shaped member **18**, and flows into the penetrating flow paths **5***f* provided in the rotor **5***a*. The refrigerant gas from which the refrigerating machine oil **11** has been separated moves up in the interior of the first cup-shaped member **17** mounted on the upper end surface of the rotor **5***a* and flows into the discharge cover **16**. Furthermore, the refrigerant gas from which the refrigerating machine oil **11** has been separated flows through the first discharge path **4***g* via the second discharge path **16***a* within the discharge cover **16** and is discharged through the discharge pipe **12** to the outside of the sealed container **10**.

In Embodiment 1, since the first cup-shaped member **17** is provided to contain the first balance weight **15***a* and the second cup-shaped member **18** is provided to contain the second balance weight **15***b*, the penetrating flow paths **5***f* are able to prevent the refrigerant gas, from which the refrigerating machine oil **11** has been separated, from being agitated by rotation of the first balance weight **15***a* and the second balance weight **15***b*. Furthermore, since the opening **17***a* of the first cup-shaped member **17** is opposed to the opening **16***b* of the discharge cover **16** and the discharge cover **16** is separated from the space between the guide frame **4** and the electric motor **5**, the refrigerant gas from which the refrigerating machine oil **11** has been separated is not mixed with the gas mixture (the refrigerant gas containing the refrigerating machine oil **11**) within the sealed container **10** again. Therefore, it is possible to prevent the refrigerating machine oil **11** from being taken out of the sealed container **10**, and thus it is possible to prevent a decrease in reliability of the scroll compressor **100** which is caused by insufficient oil supply.

Embodiment 2

FIG. **5** shows a longitudinal cross-sectional view (a) and a transverse cross-sectional view (b) showing the rotor **5***a* of the electric motor **5** according to Embodiment 2 of the present invention.

In Embodiment 2, except for the rotor **5***a*, the scroll compressor **100** has a configuration as shown in FIG. **1**. In addition, the first cup-shaped member **17** and the second cup-shaped member **18** are made of a non-magnetic material.

As shown in FIG. **5**, the rotor **5***a* of Embodiment 2 is provided with a plurality of magnet insertion holes **5***c* in the axial direction in addition to the penetrating flow paths **5***f*, and a permanent magnet **19** is inserted and housed in each magnet insertion hole **5***c*. In addition, the operation and effect of oil separation in Embodiment 2 are the same as in Embodiment 1.

In Embodiment 2, the first balance weight **15***a* is fixed to the upper end surface of the rotor **5***a* of the electric motor **5**, the second balance weight **15***b* is fixed to the lower end surface of the rotor **5***a*, the first cup-shaped member **17** made of a non-magnetic material is provided on the upper end surface of the rotor **5***a* of the electric motor **5**, and the second cup-shaped member **18** made of a non-magnetic material is provided on the lower end surface of the rotor **5***a*. Furthermore, the rotor **5***a* is provided with a plurality of permanent magnets **19** inserted therein, in addition to the penetrating flow paths **5***f*. In addition, although not shown, the first cup-shaped member **17** and the second cup-shaped member **18** are preferably formed in a regular hexagonal outer shape so as to match the arrangement and the shape of the permanent magnets **19** shown in FIG. **5**. It should be noted that the permanent magnets **19** may be arranged in a regular polygon such as a square. Since the first cup-shaped member **17** and the second cup-shaped member **18** are formed in such an outer shape, it is possible to prevent the permanent magnets **19** from projecting from the interior of the rotor **5***a*. In addition, not the entirety of the rotor core end surface is covered, and part of the end surface is exposed. Thus, it is possible to perform assembling on the basis of the core end surface and it is possible to manufacture a rotor having less distortion or the like and high accuracy.

As described above, in Embodiment 2, since the first cup-shaped member **17** and the second cup-shaped member **18** are made of a non-magnetic material, it is possible to prevent a magnetic flux of each permanent magnet **19** from leaking to the upper end surface and the lower end surface of the rotor **5***a* of the electric motor **5**, and it is possible to prevent the performance of the scroll compressor **100** from being diminished.

Embodiment 3

FIG. **6** is a partial cross-sectional view showing elements around the rotor **5***a* of the electric motor **5** according to Embodiment 3 of the present invention.

In Embodiment 3, the rotor **5***a* of the electric motor **5** includes permanent magnets **19** inserted in the axial direction and arranged in a regular polygon, a first cup-shaped member **17** and a second cup-shaped member **18** fixed to both end surfaces and made of a magnetic material, and a plate **20** disposed between each of the cup-shaped members **17** and **18** and the rotor **5***a* and made of a non-magnetic material. That is, in the rotor **5***a* of Embodiment 2, the permanent magnets **19** are inserted and arranged in a shape as shown in FIG. **5** of Embodiment 2, the first cup-shaped member **17** and the second cup-shaped member **18** are made of a magnetic material, and the plate **20** made of a non-magnetic material is provided between each of the cup-shaped members **17** and **18** and the rotor **5***a*. The other configuration of the scroll compressor **100** is the same as in Embodiment 1. In addition, the operation and effect of oil separation in Embodiment 3 are the same as in Embodiment 1.

As described above, in Embodiment 3, since the plate **20** made of a non-magnetic material is provided between each of the first cup-shaped member **17** and the second cup-shaped member **18** made of a magnetic material and the end surface of the rotor **5***a* of the electric motor **5**, it is possible to prevent the magnetic flux of each permanent magnet **19** from leaking to the upper end surface and the lower end surface of the rotor **5***a* of the electric motor **5** and it is possible to prevent the performance of the scroll compressor **100** from being diminished.

Embodiment 4

FIG. **7** is a partial cross-sectional view showing elements around the rotor **5***a* of the electric motor **5** according to Embodiment 4 of the present invention.

Embodiment 4 is characterized in that, in the scroll compressor **100** of Embodiment 2, the first cup-shaped member **17**, the second cup-shaped member **18**, the first balance weight **15***a*, the second balance weight **15***b*, and the rotor **5***a* of the electric motor **5** are fixed by rivets **21**. The other configuration is the same as in Embodiment 2. In FIG. **7**, for simplification of the drawing, the aforementioned penetrating flow paths **5***f* and permanent magnets **19** are omitted. In addition, the operation and effect of oil separation in Embodiment 4 are the same as in Embodiment 1.

As shown in FIG. **7**, in a state where the first cup-shaped member **17**, the second cup-shaped member **18**, the first balance weight **15***a*, the second balance weight **15***b*, and the rotor **5***a* of the electric motor **5** are fitted to each other, rivet insertion holes **22** are provided in these components and extend from the first balance weight **15***a* to the second balance weight **15***b*. The first cup-shaped member **17**, the second cup-shaped member **18**, the first balance weight **15***a*, the second balance weight **15***b*, and the rotor **5***a* of the electric motor **5** are fixed by a single rivet **21** at each rivet insertion hole.

As described above, in Embodiment 4, since the first cup-shaped member **17**, the second cup-shaped member **18**, the first balance weight **15***a*, the second balance weight **15***b*, and the rotor **5***a* of the electric motor **5** are fixed by a single rivet **21** at each rivet insertion hole, it is possible to reduce the number of components and it is possible to reduce the manufacturing cost of the scroll compressor **100**.

Embodiment 5

FIG. **8** is a partial cross-sectional view showing elements around the rotor **5***a* of the electric motor **5** according to Embodiment 5 of the present invention.

Embodiment 5 is characterized in that, in the scroll compressor **100** of Embodiment 3, the first cup-shaped member **17**, the second cup-shaped member **18**, the first balance weight **15***a*, the second balance weight **15***b*, the plates **20**, the rotor **5***a* of the electric motor **5** are fixed by rivets **21**. The other configuration is the same as in Embodiment 3. In FIG. **8**, for simplification of the drawing, the aforementioned penetrating flow paths **5***f* and permanent magnets **19** are omitted. In addition, the operation and effect of oil separation in Embodiment 5 are the same as in Embodiment 1.

As shown in FIG. **8**, in a state where the first cup-shaped member **17**, the second cup-shaped member **18**, the first balance weight **15***a*, the second balance weight **15***b*, the plates **20**, and the rotor **5***a* of the electric motor **5** are fitted to each other, rivet insertion holes **22** are provided in these components and extend from the first balance weight **15***a* to the second balance weight **15***b*. The first cup-shaped member **17**, the second cup-shaped member **18**, the first balance weight **15***a*, the second balance weight **15***b*, the plates **20**, and the rotor **5***a* of the electric motor **5** are fixed by a single rivet **21** at each rivet insertion hole.

As described above, in Embodiment 5, since the first cup-shaped member **17**, the second cup-shaped member **18**, the first balance weight **15***a*, the second balance weight **15***b*, the plates **20**, and the rotor **5***a* of the electric motor **5** are fixed by a single rivet **21** at each rivet insertion hole, it is possible to reduce the number of components and it is possible to reduce the manufacturing cost of the compressor.

Next, specification of the axial dimensions (heights) of the first cup-shaped member **17**, the second cup-shaped member **18**, the first balance weight **15***a*, and the second balance weight **15***b* in the scroll compressor **100** according to any of Embodiments 1 to 5 will be described. The other configuration and operation are the same as in Embodiments 1 to 5, and the description thereof is omitted.

The first cup-shaped member **17** is formed such that the axial dimension thereof is larger than or equal to that of the first balance weight **15***a*, and the second cup-shaped member **18** is formed such that the axial dimension thereof is larger than or equal to that of the second balance weight **15***b*.

As described above, by specifying the axial dimensions of the first cup-shaped member **17** and the second cup-shaped member **18**, it is possible to completely surround projections and depressions at the first balance weight **15***a* and the second balance weight **15***b* by the first cup-shaped member **17** and the second cup-shaped member **18**. Thus, the penetrating flow paths **5***f* are able to prevent the refrigerant gas, from which the refrigerating machine oil **11** has been separated, from being agitated.

## REFERENCE SIGNS LIST

**1** fixed scroll **1***a* base plate portion **1***b* plate-like scroll tooth

**1***c* Oldham guide groove **1***d* discharge port **1***e* suction port **1***f* compression chamber **1***g* suction check valve **2**

orbiting scroll **2***a* base plate portion **2***b* plate-like scroll tooth

**2***c* Oldham guide groove **2***d* boss portion **2***e* swing bearing **2***f* thrust surface **2***g* bleeding hole **2***k* base plate outer peripheral portion space **2***n* boss portion outer space **3** compliant frame

**3***a* thrust bearing **3***b* reciprocation slide surface **3***c*

main bearing **3***d* auxiliary main bearing **3***e* communication hole **3***f* communication hole **3***g* intermediate pressure regulating valve **3***h* intermediate pressure regulating valve holder **3***k*

intermediate pressure regulating spring **3***n* intermediate pressure regulating valve space **3***p* upper cylindrical surface **3***s* lower cylindrical surface **3***t* thrust bearing opening **4** guide frame **4***a* frame upper space **4***b* frame lower space **4***c* upper cylindrical surface **4***d*

lower cylindrical surface **4***f* first path **4***g* first discharge path **4***h*

opening **5** electric motor **5***a* rotor **5***b* stator **5***c*

magnet insertion hole **5***f* penetrating flow path **5***g* second path **5***h* lead wire **6** main shaft **6***a* eccentric shaft portion **6***b*

main shaft portion **6***c* sub-shaft portion **6***d* oil supply path **6***e*

oil supply port **6***f* main shaft balance weight **6***g* oil supply hole **7***a* ring-shaped sealing material **7***b* ring-shaped sealing material

**8** sub-frame **8***a* sub-bearing **8***b* inflow hole **9** Oldham

mechanism **9***a* fixed-side key **9***b* swing-side key **9***c* Oldham

mechanism annular portion **10** sealed container **10***a* upper space **10***b*

oil reservoir portion **10***c* glass terminal **11** refrigerating machine oil **12** discharge pipe **12***a* discharge pipe leading end portion

**13** suction pipe **14** compression mechanism portion **15**

balance weight **15***a* first balance weight **15***b* second balance weight **16** discharge cover **16***a* second discharge path **16***b*

opening **17** first cup-shaped member **17***a* opening **18**

second cup-shaped member **19** permanent magnet **20** plate **21**

rivet **22** rivet insertion hole **30** refrigerant flow path **100** scroll compressor

The invention claimed is:

**1**. A scroll compressor comprising:

a sealed container;

a compression mechanism portion provided within the sealed container and having a compression chamber in which plate-like scroll teeth of a fixed scroll and an orbiting scroll are meshed with each other to compress a refrigerant;

an electric motor provided within the sealed container and configured to rotationally drive the orbiting scroll;

a rotary shaft configured to transfer a drive force of the electric motor to the orbiting scroll;

a frame configured to rotatably support the rotary shaft;

balance weights fixed to an upper surface and a lower surface of a rotor of the electric motor and configured to cancel out unbalance of a force generated in the compression mechanism portion;

a refrigerant flow path configured to introduce a refrigerant gas discharged from a discharge port provided to the fixed scroll of the compression mechanism portion, to a bottom portion of the sealed container;

cup-shaped members respectively provided on the upper surface and the lower surface of the rotor of the electric motor and containing the balance weights;

a penetrating flow path through which the refrigerant gas containing a refrigerating machine oil flows from a lower side of the rotor of the electric motor through interiors of the cup-shaped members to an upper side of the rotor, wherein the penetrating flow path includes a refrigerant passage formed in the rotor that extends from the interior of the cup-shaped member provided on the lower surface to the interior of the cup-shaped member provided on the upper surface; and

a discharge cover provided at a lower portion of the frame, having an opening opposed to an opening of one of the cup-shaped members provided on the upper surface of the rotor of the electric motor, and configured to introduce the refrigerant gas having passed through the penetrating flow path, to a discharge pipe provided to the sealed container.

**2**. The scroll compressor of claim **1**, wherein the upper surface and the lower surface of the rotor are end surfaces of the rotor, and the cup-shaped members are fixed to both the upper surface and the lower surface and are made of a non-magnetic material.

**3**. The scroll compressor of claim **1**, wherein the upper surface and the lower surface of the rotor are end surfaces of the rotor, and the cup-shaped members are fixed to both the upper surface and the lower surface and are made of a magnetic material, and a plate, which is made of a non-magnetic material, is located between each cup-shaped member and the rotor.

**4**. The scroll compressor of claim **2**, wherein the rotor of the electric motor, the balance weights, and the cup-shaped members are fixed by a rivet.

**5**. The scroll compressor of claim **3**, wherein the rotor of the electric motor, the balance weights, the cup-shaped members, and the plates are fixed by a rivet.

**6**. The scroll compressor of claim **1**, wherein each of the cup-shaped members has an axial dimension larger than or equal to that of each of the balance weights.

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