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(54) SCROLL COMPRESSOR

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(57) **ABSTRACT**

A scroll compressor comprises a fixed scroll, an orbiting scroll engaged with the fixed scroll to form a compression chamber therebetween, a back pressure chamber arranged at a back side of an end plate of the orbiting scroll, a back pressure hole formed in the end plate of the orbiting scroll to form a fluidal communication between the compression chamber and the back pressure chamber, and a release valve mechanism for discharging the fluid from the compression chamber to the discharge space when a pressure in the compression chamber is higher than the pressure in the discharge space, wherein the back pressure hole and the release flow path are arranged to prevent both of the fluidal communication and the another fluidal communication from being formed simultaneously.

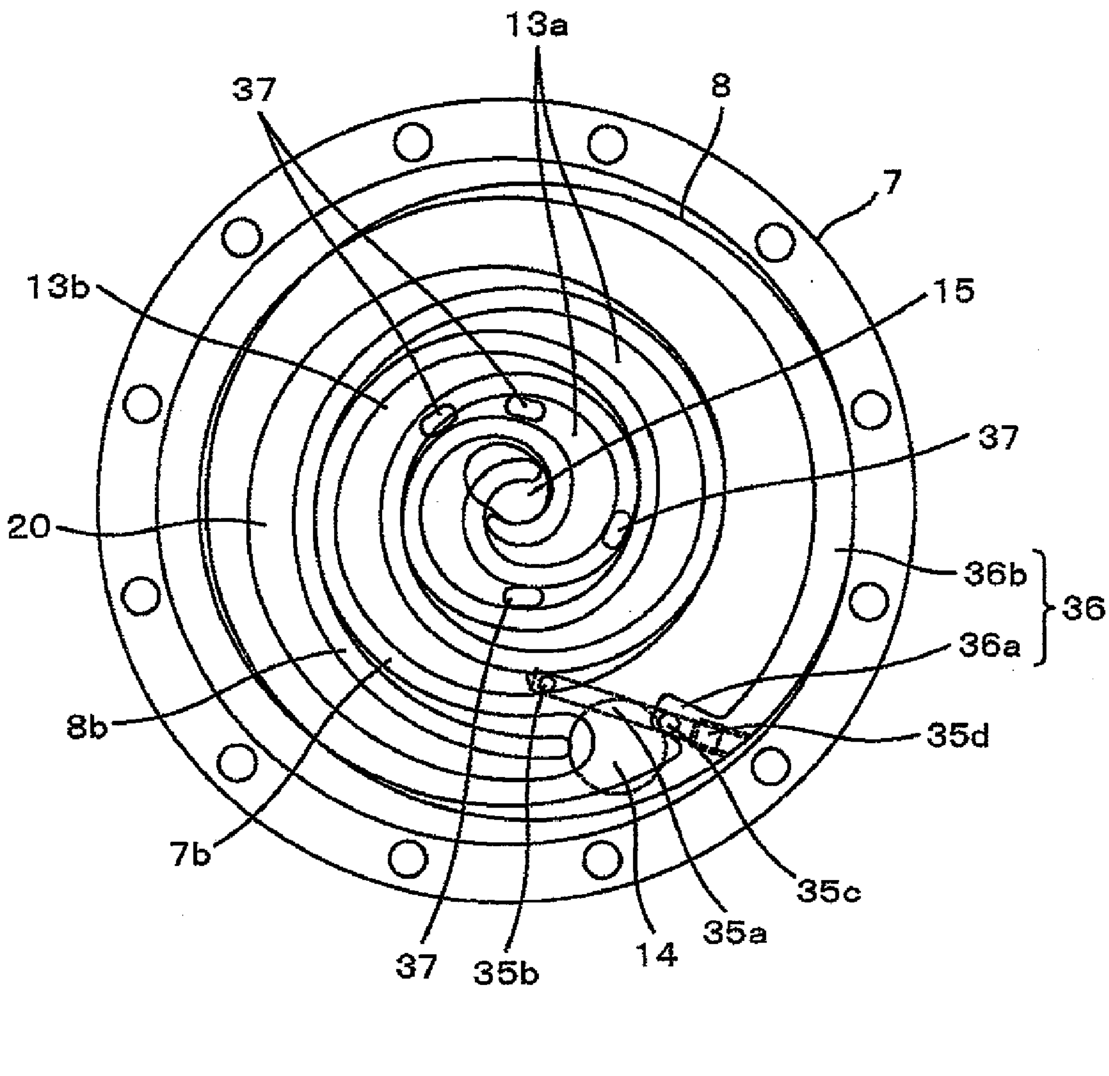
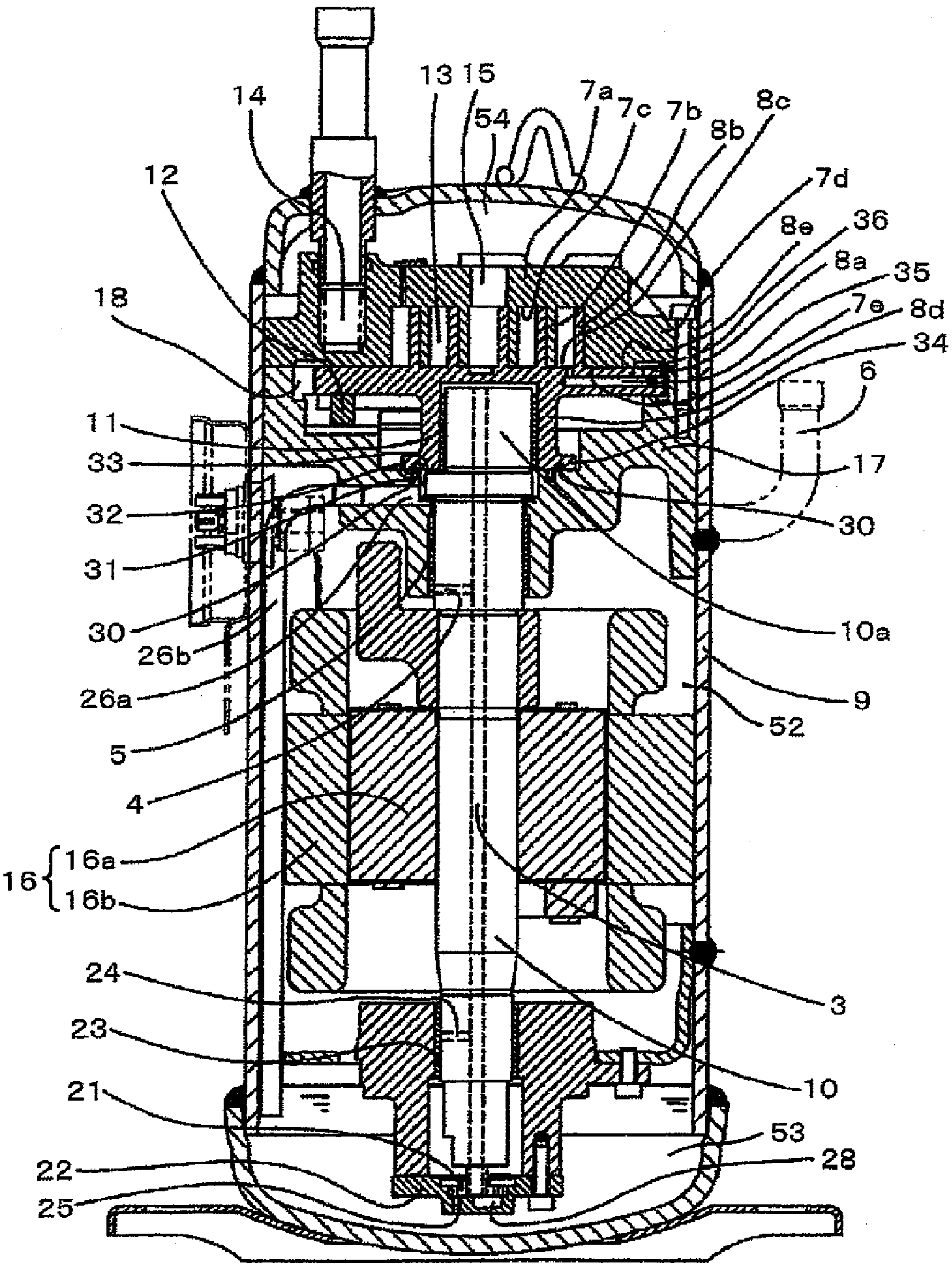


FIG.1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13
15
54
7a
7c
7b
8b
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12
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8e
36
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8d
34
6
11
33
17
32
30
31
30
10a
26b
26a
9
52
5
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16
16a
16b
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24
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10
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FIG.2

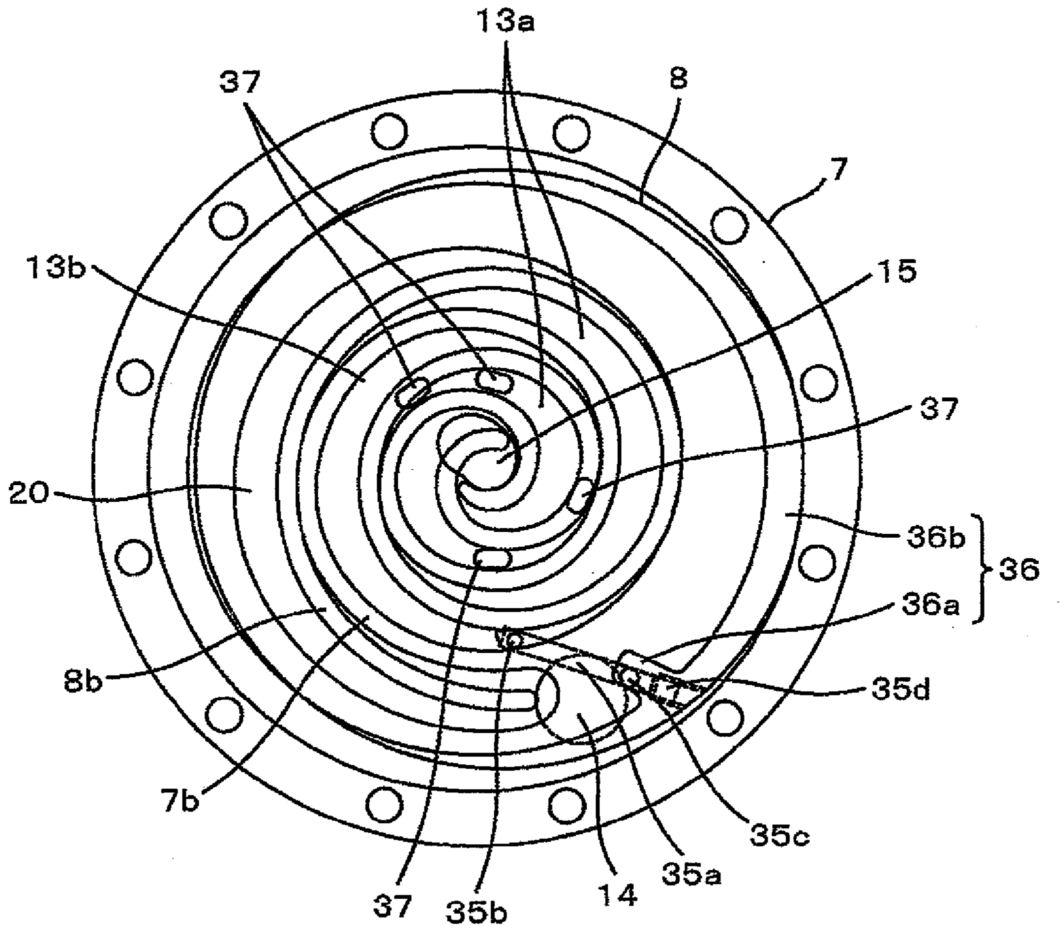
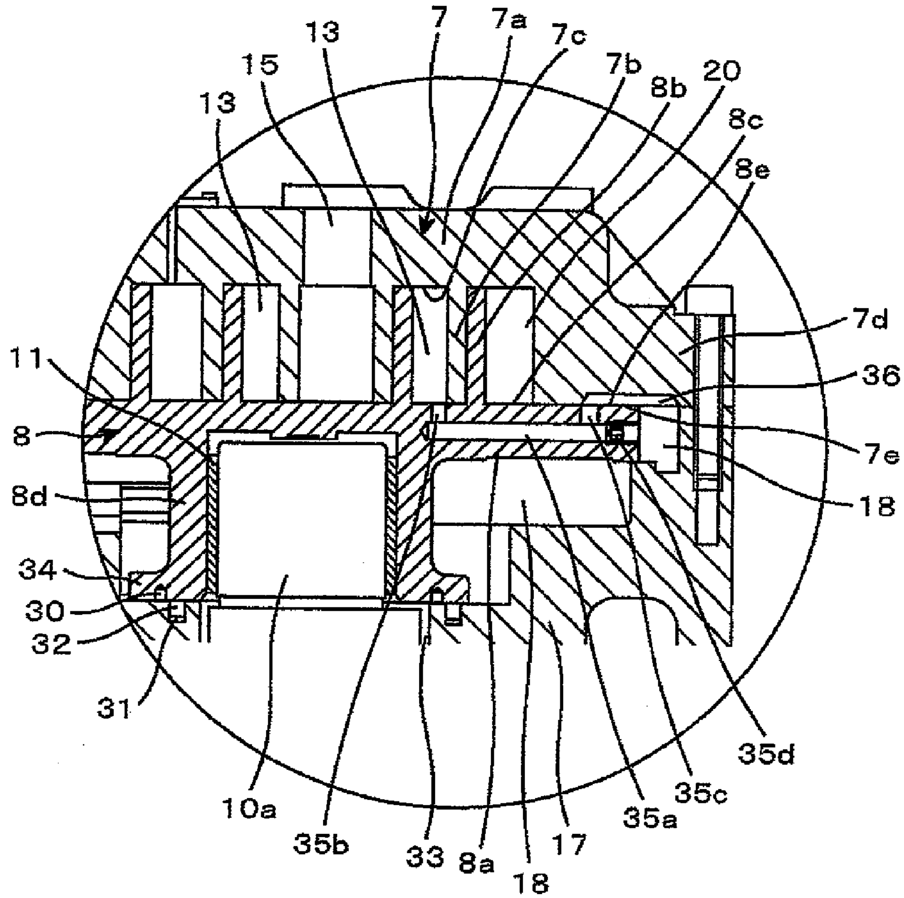


FIG.3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7
7a
7c
15
7b
8b
20
13
8c
8e
7d
11
36
8
7e
18
8d
34
30
32
31
35d
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35b
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8a
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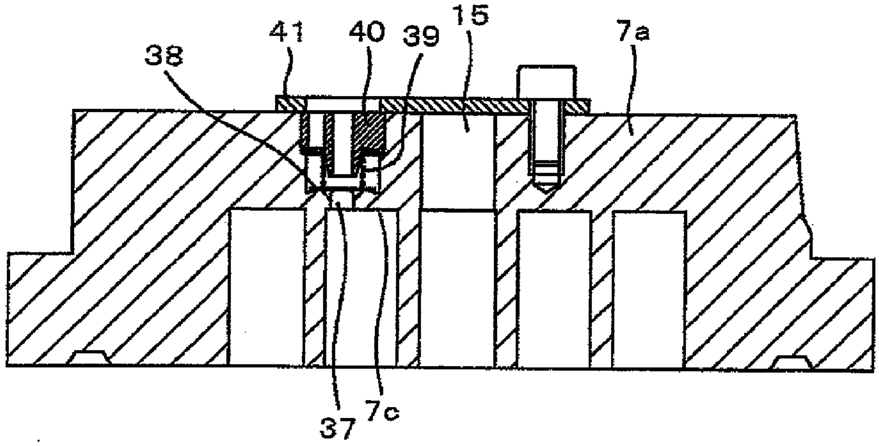
FIG.4


38
41
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7a
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7c

FIG.5

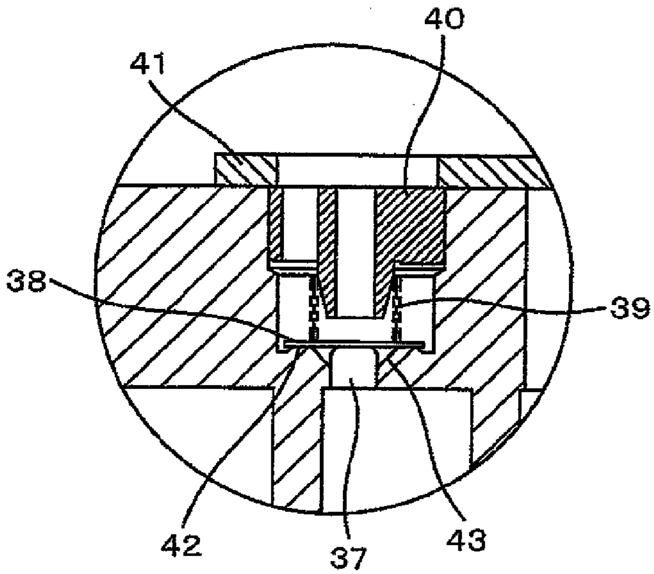
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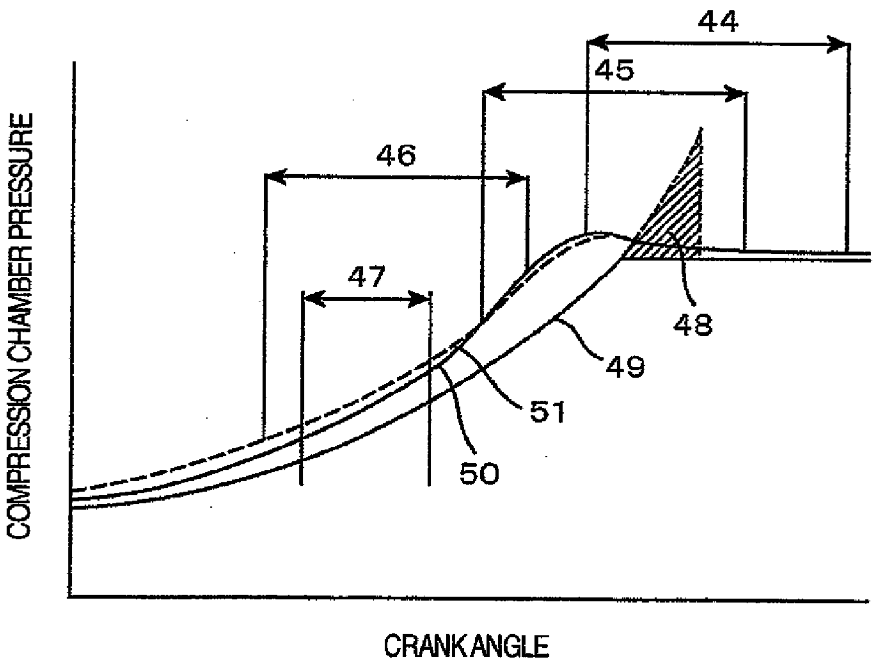
FIG.6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COMPRESSION CHAMBER PRESSURE
CRANK ANGLE

SCROLL COMPRESSOR

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a scroll compressor including a back pressure chamber on a back side of an orbiting scroll or a fixed scroll to press one of the scrolls against the other one of the scrolls with a back pressure.

[0002] The scroll compressor has the fixed scroll with a spiral wrap set upright on a base plate and the orbiting scroll with a spiral wrap set upright on an end plate. The scroll compressor compresses a fluid (e.g., a gas coolant in a refrigeration cycle) by arranging the wraps of both of the scrolls to be engaged with each other and opposed to each other, and making the orbiting scroll orbit to reduce volumes of a plurality of compression chambers formed between the wraps.

[0003] This compression operation produces a force in an axial direction for separating the fixed scroll and the orbiting scroll from each other. When the scrolls are separated from each other, a gap is produced between tooth tip and bottom of the respective wraps to reduce an efficiency of the compressor. Therefore, the back pressure chamber is formed on the back of the end plate of the orbiting scroll to produce a pressure difference between a discharge pressure and an intake pressure and the orbiting scroll is pressed against the fixed scroll with the back pressure.

[0004] However, this pressing force produces sliding friction between the fixed scroll and the end plate surface of the orbiting scroll, and when the pressing force becomes excessively large, a seizing phenomenon occurs on the end plate surface and the reliability of the compressor is lost. That is, when the back pressure is excessively large, sliding loss increases and the efficiency decreases, and the reliability is also lost. On the contrary, when the back pressure is excessively small, the hermeticity of the compression chamber deteriorates, thermal fluid loss thereby increases and the efficiency deteriorates. Therefore, the back pressure chamber needs to be kept to an appropriate pressure and it is important to stably keep the back pressure to an optimum value in improving the performance and reliability of the compressor.

[0005] Furthermore, as shown in JP-A-2006-9781, a scroll compressor having a release valve apparatus (release mechanism) provided with a release channel on an end plate of a fixed scroll is also known.

BRIEF SUMMARY OF THE INVENTION

[0006] Although the release valve apparatus of the scroll compressor according to JP-A-2006-9781 gives consideration to a reduction of channel resistance in the release channel and prevention of delays in opening of the release valve, it gives no consideration to the fact that the provision of the release valve apparatus causes the pressure of the back pressure chamber to fluctuate.

[0007] That is, while the release valve is not in operation, leakage from the discharge space to the compression chamber occurs in the gap between the valve seat and the valve body, and this leakage causes the pressure of the compression chamber to rise. When a back pressure hole communicates with this compression chamber, the pressure of the back pressure chamber also rises. The pressure rise of the back pressure chamber varies depending on the amount of leakage at the valve seat of the release valve and the amount of leakage at the valve seat varies under the influences of dimensional accuracy of the valve body and valve seat, the amount of deformation of the valve body, and a pressure difference before and after the valve or the like. This also increases a pressure variation of the back pressure chamber and when the leakage from the release valve is extremely large, the pressure of the back pressure chamber becomes excessively large, leading to an increase of sliding loss and deterioration of reliability due to seizing of the end plate.

[0008] Furthermore, when the release valve is in operation, that is, under a condition that the pressure of the compression chamber becomes excessive compression, the pressure of the compression chamber increases by the pressure loss corresponding to the channel resistance at the release valve, and therefore if the back pressure hole communicates with the compression chamber, the pressure of the back pressure chamber increases. Therefore, the pressure of the back pressure chamber also becomes excessively large even when the pressure loss is large, resulting in a problem of causing an increase of sliding loss and deterioration of reliability due to seizing of the end plate.

[0009] An object of the present invention is to decrease an influence of a pressure variation in the back pressure chamber caused by the release mechanism in the scroll compressor including the back pressure chamber at the back side of the end plate of the scroll and the release mechanism.

[0010] In order to solve the above mentioned problems, a scroll compressor according to the invention, comprises a fixed scroll including a base plate and a spiral wrap projecting from the base plate, an orbiting scroll including an end plate and another spiral wrap projecting from the end plate and engaged with the fixed scroll to form a compression chamber therebetween, a discharge space for receiving a compressed fluid from the compression chamber, a back pressure chamber arranged at a back side of at least one of the fixed scroll and the orbiting scroll to press the fixed scroll and the orbiting scroll against each other, a back pressure hole formed in at least one of the base plate and the end plate to enable a fluidal communication to be formed between the compression chamber and the back pressure chamber so that a pressure in the back pressure chamber is kept between an intake pressure and a pressure in the discharge space, and a release valve mechanism including a release flow path to enable another fluidal communication to be formed between the compression chamber and the discharge space, and a valve arranged between the release flow path and the discharge space to open the release flow path to enable the fluid to be discharged from the compression chamber to the discharge space when a pressure in the compression chamber is higher than the pressure in the discharge space, so that an excessive compression in the compression chamber is prevented, wherein the back pressure hole and the release flow path are arranged to prevent both of the fluidal communication and the another fluidal communication from being formed simultaneously during each orbital revolution.

[0011] According to another aspect of the invention, a scroll compressor comprises a fixed scroll, an orbiting scroll engaged with the fixed scroll to form a compression chamber therebetween and capable of orbiting, a discharge space for receiving a compressed fluid from the compression chamber, a back pressure chamber arranged at a back side of an end plate of the orbiting scroll to press the orbiting scroll against the fixed scroll, a back pressure hole formed in the end plate of the orbiting scroll to enable a fluidal communication to be formed between the compression chamber and the back pressure chamber, and a release valve mechanism including a release flow path in a base plate of the fixed scroll to enable another fluidal communication to be formed between the compression chamber and the discharge space, and a valve arranged between the release flow path and the discharge space to open the release flow path to enable the fluid to be discharged from the compression chamber to the discharge space when a pressure in the compression chamber is higher than the pressure in the discharge space, so that an excessive compression in the compression chamber is prevented, wherein the back pressure hole and the release flow path are arranged to prevent both of the fluidal communication and the another fluidal communication from being formed simultaneously during each orbital revolution.

[0012] According to the other aspect of the invention, a scroll compressor comprises a fixed scroll, an orbiting scroll engaged with the fixed scroll to form a compression chamber therebetween, a discharge space for receiving a compressed fluid from the compression chamber, a back pressure chamber arranged at a back side of an end plate of the orbiting scroll, a back pressure hole formed in the end plate of the orbiting scroll to enable a fluidal communication to be formed between the compression chamber and the back pressure chamber, and a release valve mechanism including a release flow path in a base plate of the fixed scroll to enable another fluidal communication to be formed between the compression chamber and the discharge space so that the fluid is discharged from the compression chamber to the discharge space when a pressure in the compression chamber is higher than the pressure in the discharge space, wherein the back pressure hole and the release flow path are arranged to prevent both of the fluidal communication and the another fluidal communication from being formed simultaneously during an orbital motion of the orbiting scroll.

[0013] In these structures, it is preferable that the fluidal communication between the compression chamber and the back pressure chamber is formed intermittently by the back pressure hole. As an embodiment of such operation, for example, the back pressure hole is formed in the end plate of the orbiting scroll, an end of the back pressure hole is arranged to be intermittently opened in accordance with the orbital motion of the orbiting scroll to a notch portion formed on a surface of the end plate of the fixed scroll at its radially outer side to fluidly communicate with the back pressure chamber, and the other end of the back pressure hole is arranged to fluidly communicate with the compression chamber before the fluid is discharged from the compression chamber to the discharge space.

[0014] Further, it is preferable that the release valve mechanism is of a flapper valve type arranged on the base plate of the fixed scroll, and the valve has a valve body, an elastic member for urging the valve body toward the release flow path, a stopper for holding the elastic member, and a retainer for restraining a movable range of the stopper.

[0015] Further, it is preferable that the release flow path has a cross-sectional shape of elongated hole, and a tapered shape at a side of the valve body to increase its cross-sectional area in a direction from the compression chamber toward the discharge space, and the valve body has a flat plate.

[0016] According to the invention, since the back pressure hole and the release flow path are arranged to prevent both of the fluidal communication and the another fluidal communication from being formed simultaneously during an orbital motion of the orbiting scroll, the pressure variation in the back pressure chamber caused by a fluidal leakage from the release valve mechanism is decreased to keep the pressure in the back pressure chamber stably at an optimum degree, so that high performance and reliability of the scroll compressor are obtained.

[0017] Other objects, features and advantages of the invention will become apparent from the following description of the embodiments of the invention taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0018] FIG. **1** is a longitudinal cross-sectional view of a scroll compressor showing an embodiment of the present invention;

[0019] FIG. **2** is a plan view showing a condition of engagement between a fixed scroll and a orbiting scroll;

[0020] FIG. **3** is an enlarged cross-sectional view of main parts showing an enlarged view of a scroll section made up of the fixed scroll and the orbiting scroll in FIG. **1**;

[0021] FIG. **4** is a longitudinal cross-sectional view of the fixed scroll shown in FIG. **1**, illustrating a release valve mechanism;

[0022] FIG. **5** is an enlarged cross-sectional view showing an enlarged view of the part of the release valve mechanism in FIG. **4**; and

[0023] FIG. **6** is an indicator diagram showing a relationship between a crank angle and a compression chamber pressure of the scroll compressor.

DETAILED DESCRIPTION OF THE INVENTION

[0024] Hereinafter, specific embodiments of the present invention will be explained with reference to the accompanying drawings.

Embodiment 1

[0025] FIG. **1** is a longitudinal cross-sectional view of an entire scroll compressor illustrating Embodiment 1 of the present invention and FIG. **3** is an enlarged cross-sectional view of main parts showing an enlarged view of a scroll section made up of the fixed scroll member and the orbiting scroll member shown in FIG. **1**.

[0026] As shown in FIG. **1** and FIG. **3**, a fixed scroll (fixed scroll member) **7** includes a disk-shaped base plate **7***a*, a wrap **7***b* set upright in a spiral shape on the base plate **7***a* and a cylindrical support section **7***d* located on the outer peripheral side of the base plate **7***a*, that has an end plate surface contiguous to a distal end face of the wrap **7***b* and surrounds the wrap **7***b*.

[0027] The surface of the base plate **7***a* on which the wrap **7***b* is set upright is called a “tooth bottom **7***c*” because of its location between the wraps **7***b*.

[0028] Furthermore, the surface on which the support section **7***d* contacts an end plate **8***a* of a orbiting scroll (orbiting scroll member) **8** constitutes an end plate surface **7***e* of the fixed scroll **7**. The fixed scroll **7** has its support section **7***d* fixed to a frame **17** by means of a bolt or the like and the frame **17** united with the fixed scroll **7** is fixed to a case (hermetically sealed container) **9** by fixing means such as welding.

[0029] The orbiting scroll **8** is disposed opposed to the fixed scroll **7**, and the wrap **7***b* of the fixed scroll and the wrap **8***b* of the orbiting scroll are engaged with each other and rotatably provided inside the frame **17**. The orbiting scroll **8** includes the disk-shaped end plate **8***a*, spiral wrap **8***b* set upright from a tooth bottom **8***c* which is the surface of this end plate **8***a* and a boss section **8***d* provided in the center of the back surface of the end plate **8***a*. Furthermore, the surface of the outer periphery of the end plate **8***a* contacting the fixed scroll **7** constitutes an end plate surface **8***e* of the orbiting scroll **8**.

[0030] The case **9** has a hermetically sealed container structure containing a scroll section made up of the fixed scroll **7** and the orbiting scroll **8**, a motor section **16** (**16***a*: rotor, **16***b*: stator) and a lubricant or the like. A shaft (rotational axis) **10** fixed to the rotor **16***a* of the motor section **16** as one body is rotatably supported to the frame **17** via a main bearing **5** and is coaxial with the center line of the fixed scroll **7**.

[0031] A crank section **10***a* is provided at a distal end of the shaft **10**, this crank section **10***a* is inserted into a rotary bearing **11** provided at the boss section **8***d* of the orbiting scroll **8** and the orbiting scroll **8** is configured to be rotatable as the shaft **10** rotates. The center axial line of the orbiting scroll **8** is decentered with respect to the center axial line of the fixed scroll **7** by a predetermined distance. Furthermore, the wrap **8***b* of the orbiting scroll **8** is superimposed on the wrap **7***b* of the fixed scroll **7** shifted by a predetermined angle in the circumferential direction. Reference numeral **12** denotes an Oldham's ring to cause the orbiting scroll **8** to make rotating motion relative to the fixed scroll **7** while restraining the orbiting scroll **8** from turning on its axis.

[0032] FIG. **2** is a plan view showing a condition of engagement between the fixed scroll and orbiting scroll and as shown in the figure, a plurality of falcate compression chambers **13** (**13***a*, **13***b*) are formed between the wraps **7***b* and **8***b*, and when the orbiting scroll **8** is made to make rotating motion, the volume of each compression chamber is continuously reduced as each compression chamber moves toward the central part. That is, an internal line side compression chamber **13***a* and an external line side compression chamber **13***b* are formed on the internal line side and external line side of the orbiting scroll wrap **8***b* respectively. Reference numeral **20** denotes an intake chamber, which is a midway space where a fluid is taken in. This intake chamber **20** becomes the compression chamber **13** when the phase of rotating motion of the orbiting scroll **8** advances and trapping of the fluid is completed.

[0033] As shown in FIG. **1** and FIG. **2**, an intake port **14** is provided for the fixed scroll **7**. This intake port **14** is perforated on the outer peripheral side of the base plate **7***a* so as to communicate with the intake chamber **20**. Furthermore, a discharge port **15** is perforated in the vicinity of the center of the scroll of the base plate **7***a* of the fixed scroll **7** so as to communicate with the compression chamber **13** on the innermost peripheral side.

[0034] When the shaft **10** is driven to rotate by the motor section **16**, the torque is transmitted from the crank section **10***a* of the shaft **10** to the orbiting scroll **8** via the rotary bearing **11** and the orbiting scroll **8** makes rotating motion around the center axial line of the fixed scroll **7** with a rotation radius of a predetermined distance. During this rotating motion, the Oldham's ring **12** restrains the orbiting scroll **8** from turning on its axis.

[0035] The rotating motion of the orbiting scroll **8** causes the compression chambers **13** produced between the wraps **7***b* and **8***b* to continuously move toward the center and the volumes of the compression chambers **13** continuously reduce according to their movement. In this way, the fluid (e.g., coolant gas circulating in a refrigeration cycle) taken in from the intake port **14** is sequentially compressed in each compression chamber **13** and the compressed fluid is discharged from the discharge port **15** into a discharge space **54** at the top. The discharged fluid is introduced from the discharge space **54** into a motor chamber **52** in the case **9** and supplied from a discharge pipe **6** to the outside of the compressor, for example, the refrigeration cycle.

[0036] A lubricant is stored at the bottom of the case **9**, a cavity type or centrifugal type lubrication pump **21** provided at the bottom of the shaft **10** is made to run together with the rotation of the shaft and the lubricant is thereby taken in from a lubricant intake port **25** provided in a lubrication pump case **22** and supplied to the upper part from a discharge port **28** of the lubrication pump through a through hole **3** provided in the shaft. Part of the lubricant passes through a cave hole **4** from the through hole **3**, lubricates the main bearing and then flows into a first space **33** formed of the frame **17**, shaft **10**, orbiting scroll **8** and a collar-shaped boss member **34** provided in the boss section **8***d* of the orbiting scroll **8**.

[0037] The other part of the lubricant reaches the top of the crank **10***a* of the shaft **10** through the through hole **3**, lubricates the rotary bearing **11** and then flows into the first space **33**. The remaining lubricant passes through a cave hole **24** provided in the shaft **10**, lubricates a sub bearing **23** and returns to an oil reservoir **53** at the bottom of the case. Most of the lubricant that has flown into the first space **33** after lubricating the main bearing **5** and rotary bearing **11** returns to the bottom of the case passing through a drain oil hole **26***a* and drain oil pipe **26***b*. The minimum amount of the other lubricant necessary for lubrication of the Oldham's ring **12**, lubrication of the sliding section between the fixed scroll and the orbiting scroll and sealing, which has flown into the first space **33**, enters a back pressure chamber **18** via oil leakage means between the top end face of a sealing member **32** and an end face of the rotary boss member **34**. The sealing member **32** is inserted into an annular groove **31** provided in the frame **17** together with an undulate spring (not shown) and partitions between the first space **33** having a discharge pressure and the back pressure chamber **18** having a pressure intermediate between the intake pressure and the discharge pressure. The oil leakage means is made up of a plurality of holes **30** (see FIG. **3**) provided in the rotary boss member **34** and the sealing member **32** and the plurality of holes **30** perform circular motion across the sealing member **32** accompanying the rotating motion of the orbiting scroll **8** and moves between the first space **33** and the back pressure chamber **18**. In this way, the lubricant of the first space **33** is stored in the holes **30**, intermittently transferred to the back pressure chamber **18** and discharged, and it is thereby possible to guide the minimum necessary oil to the back pressure chamber **18**.

[0038] When the back pressure increases, the lubricant that has entered the back pressure chamber **18** passes through a back pressure hole **35** that communicates between the back pressure chamber **18** and the compression chamber **13**, enters the compression chamber **13**, is discharged from the discharge port **15**, part of the lubricant is discharged together with, for example, a coolant gas from the discharge pipe **6** to the refrigeration cycle and the rest is separated from the coolant gas in the case **9** and stored in the oil reservoir **53** at the bottom of the case.

[0039] The compression operation of the scroll compressor produces a force in an axial direction that separates the fixed scroll **7** from the orbiting scroll **8**. When the force in this axial direction separates both scrolls from each other, or a so-called phenomenon of separation of the orbiting scroll **8** occurs, the hermeticity of the compression chamber deteriorates and the efficiency of the compressor decreases. Therefore, the back pressure chamber **18** whose pressure becomes a pressure between the discharge pressure and intake pressure is provided on the back side of the end plate of the orbiting scroll **8**, the separation force is canceled out by the back pressure and the orbiting scroll **8** is pressed against the fixed scroll **7**. In this case, when the pressing force is excessively large, sliding loss between the end plate surface **8***e* of the orbiting scroll **8** and the end plate surface **7***e* of the fixed scroll **7** increases and the compressor efficiency decreases. That is, there is an optimum value for the back pressure; when the back pressure is too small, the hermeticity of the compression chamber deteriorates and thermal fluid loss increases, and when the back pressure is too large, sliding loss increases. Therefore, it is important to stably keep the back pressure to an optimum value in increasing performance and reliability of the compressor.

[0040] However, the scroll compressor provided with a release valve mechanism (release valve apparatus) gives no consideration to the fact that provision of the conventional release valve mechanism causes the back pressure to vary thereby producing a variation in the back pressure and preventing the back pressure from being kept to an appropriate value. The present embodiment also allows a scroll compressor provided with a release valve mechanism to keep the back pressure to a stable and optimum value.

[0041] The configuration of the back pressure hole **35** in the present embodiment will be explained in detail using FIG. **1** to FIG. **3**. Channel-shaped back pressure holes **35** (**35***a*, **35***b*, **35***c*) are provided in the end plate of the orbiting scroll **8**. Furthermore, a notch **36***a* that communicates with the back pressure chamber **18** is provided in the end plate surface **7***e* on the outer peripheral side of the fixed scroll **7**. One end **35***c* of the channel-shaped back pressure hole **35** is communicated with the notch **36***a* by intermittently being opened through rotating motion and the opening thereof is closed by the end plate surface **7***e* of the fixed scroll **7** when not communicated with the notch **36***a*. The other end **35***b* of the back pressure hole **35** communicates with the compression chamber **13** of the compressor. Since the channel-shaped back pressure hole **35** is formed, the end of the passage **35***a* is closed by a plug **35***d*.

[0042] When the shape of the notch **36***a* and the positions of both ends **35***b* and **35***c* of the back pressure hole **35** are determined, the section where the back pressure hole **35** communicates between the compression chamber **13** and back pressure chamber **18** (opening section of back pressure holes) is determined and the pressure of the back pressure chamber **18** becomes a value corresponding to the compression chamber pressure in this opening section.

[0043] This will be explained in further detail using FIG. **6**. In the diagram of FIG. **6**, the horizontal axis shows a crank angle (phase of rotating movement of orbiting scroll) and the vertical axis shows a pressure of the compression chamber, schematically illustrating the relationship between the crank angle and pressure. The diagram in FIG. **6** illustrates the compression chamber pressure of any one of the external line side compression chamber **13***b* and the internal line side compression chamber **13***a*. Reference numeral **49** denotes an adiabatic compression line, and with respect to this adiabatic compression line **49**, the actual indicator diagram expands upward due to thermal fluid loss as indicated by reference numeral **50** or **51** and the back pressure chamber pressure deriving from the back pressure hole **35** is affected by the compression chamber pressure shown in this expanded indicator diagram. This will be explained by taking a case where the back pressure chamber **18** and the compression chamber **13** communicate with each other in a section **47** on the indicator diagram **50** or **51** by determining the shape of the notch **36***a* and the positions of both ends **35***b* and **35***c* of the back pressure hole **35**. While the compression chamber pressure varies in this section **47**, the back pressure is set to a pressure resulting from averaging the compression chamber pressure in this section though there is a certain degree of variation. Therefore, the back pressure chamber pressure deriving from the back pressure hole **35** can be set as described above.

[0044] The scroll compressor of the present embodiment is also provided with a release mechanism (release valve mechanism) and the present embodiment will explain a case where the release mechanism is assumed to be a release valve mechanism including a valve body. The compressor is operated under various operation conditions, and with regard to pressure conditions, the compressor is operated under a condition with excessive compression or insufficient compression. However, the scroll compressor basically has a predetermined operation pressure ratio and the pressure condition range within which the scroll compressor can keep its high performance is limited to the vicinity of the operation pressure ratio. This is determined by the shape of the scroll wrap and the position of the discharge port **15**. Under the condition of excessive compression, since the compression chamber pressure exceeds the discharge pressure before the compression chamber **13** communicates with the discharge port **15**, the compressor performs extra compression work corresponding to a shaded area **48** shown in FIG. **6** and the efficiency deteriorates. It is therefore known that the release valve mechanism is provided to prevent the efficiency from deteriorating under an excessive compression condition.

[0045] The valve body making up the release valve mechanism is a kind of check valve, and the valve opens only under an excessive compression condition that the pressure in the compression chamber exceeds the discharge pressure and functions to discharge the gas in the compression chamber to the discharge space **54** and suppress a pressure rise in the compression chamber **13**. Hereinafter, a release valve mechanism using a flapper valve type valve body will be explained using FIG. **4** and FIG. **5**.

[0046] A release flow path (release hole) **37** is provided in the base plate **7***a* of the fixed scroll **7** and the release hole is formed such that one end thereof communicates with the compression chamber **13** and the other end communicates with the discharge space **54**. Furthermore, a valve seat **42** is formed on the discharge space side of the release flow path **37** of the fixed scroll **7** and a space for housing the release valve mechanism is further provided. The release valve mechanism is made up of a valve body **38** set in the part of the valve seat **42**, an elastic body **39** that presses this valve body **38** against the valve seat, a stopper **40** that holds this elastic body **39** and a retainer **41** that restricts the moving range of the stopper **40** or the like. The stopper **40** is inserted into a hole provided in the base plate **7***a* of the fixed scroll **7** (space for accommodating the release valve mechanism) with a small gap and its upward movement is restricted by the retainer **41**. The retainer **41** is fixed to the fixed scroll **7** by restraining means such as a bolt.

[0047] When the compressor is operated under a condition with excessive compression, the compression chamber pressure exceeds the discharge pressure, the operation fluid in the compression chamber **13** pushes up the valve body **38** and flows into the discharge space **54** and thereby alleviates the excessive compression. If pressure loss is large when the operation fluid passes through the valve body, the excessive compression remains and the compression chamber pressure rises uselessly.

[0048] Next, when the compressor is operated under a condition under which excessive compression does not occur, the compression chamber pressure is always lower than the discharge pressure, and therefore the valve body **38** is pressed against the valve seat **42** by a force caused by a pressure difference between the upper and lower surfaces and the elastic force of the elastic body **39**. Here, the valve body **38** and the valve seat **42** constitute a small leakage channel. The amount of leakage varies depending on the dimensional accuracy of the valve body **38** and the valve seat **42**, a degree of deformation by the pressure of the valve body **38** and a pressure difference at the inlet and outlet of the leakage channel or the like.

[0049] The opening section of the aforementioned back pressure hole **35** and release flow path **37** will be explained below using FIG. **6**.

[0050] First, a case where the opening section of the release flow path **37** is **45** and **46** and any one of **45** and **46** overlaps with the opening section **47** of the back pressure hole **35** will be considered. Here, the "opening section" of the release flow path **37** refers to a section where the release flow path **37** communicates with the compression chamber **13**, that is, the section where the release flow path **37** forms part of the compression chamber **13**, and is not necessarily the section where the valve body opens and discharges the operation fluid from the compression chamber **13** to the discharge space **54** in the case of excessive compression.

[0051] Due to the above described leakage at the valve seat **42** of the release valve mechanism (leakage from the discharge space **54** to the compression chamber **13**), the indicator diagram expands upward over the entire opening section of the release flow path **37** as shown by the curve **51** in FIG. **6**. Since the opening section **47** of the back pressure hole **35** overlaps with the opening section **46** of the release flow path **37**, the expansion of the indicator diagram due to leakage from the valve seat **42** of the release valve mechanism has a direct influence on the back pressure chamber **18** and also increases the pressure of the back pressure chamber **18**.

[0052] To improve the influence of the leakage from the valve seat **42** of the release valve mechanism on the back pressure chamber **18**, the present embodiment arranges the opening section of the release flow path **37** and the opening section **47** of the back pressure hole **35** so as not to overlap with each other. That is, the opening section of the release flow path **37** is configured to become **44** and **45** shown in FIG. **6** and not to overlap with the opening section **47** of the back pressure hole **35**. In such a configuration, the indicator diagram becomes as shown in the curve **50** in FIG. **6** and the indicator diagram expands upward due to leakage from the valve seat **42** in the opening sections **44** and **45** of the release flow path **37**, whereas in the section where the release flow path **37** is not opened, that is, over the range left to the section **45**, the expansion of the indicator diagram is improved over substantially the entire range, the influence of the leakage from the valve seat **42** can be improved over a wide range. According to the present embodiment, the expansion of the indicator diagram **50** in the opening section **47** of the back pressure hole **35** becomes relatively smaller than the case with the conventional indicator diagram **51**. That is, the leakage from the valve seat **42** of the release valve mechanism with a small variation is less likely to influence the back pressure chamber **18** and can suppress variations in the pressure of the back pressure chamber **18** to a small value.

[0053] Furthermore, the volume of the release flow path **37** becomes a dead volume, but since the present embodiment uses the flapper valve type release valve mechanism, the dead volume can be reduced and re-expansion loss by the dead volume when the compressor is operated not under a condition with excessive compression can be reduced. Furthermore, since the use of the flapper valve type release valve mechanism can reduce channel resistance, it is possible to reduce pressure loss even during operation under a condition with excessive compression and suppress an increase of the compression chamber pressure. That is, the use of the flapper valve type release valve mechanism allows the expansion of the indicator diagram to be further reduced under any one of the condition with excessive compression and the condition without excessive compression.

[0054] Therefore, by arranging the opening section of the release flow path **37** and the opening section **47** of the back pressure hole **35** so as not to overlap with each other and adopting the flapper valve scheme as the release valve mechanism, it is possible to more stably suppress pressure variations of the back pressure chamber **18** and keep the back pressure to an appropriate value.

[0055] Furthermore, according to the present embodiment, the release flow path **37** is configured to have a cross-sectional shape of a long hole in the top view shown in FIG. **2** and has a tapered part **43** whose cross-sectional area increases from the compression chamber side to the discharge space side on the valve body **38** side as shown in FIG. **5**. Furthermore, a flat plate is used as the valve body **38** that makes up the release valve mechanism. This makes it possible to increase the channel area of the release flow path **37** to a maximum, drastically reduce channel resistance at the release flow path **37** when the valve body **38** is operating under the condition with excessive compression and reduce pressure loss. That is, since the pressure increase in the compression chamber caused by excessive compression can be suppressed to a smaller value, it is possible to suppress the expansion of the indicator diagram and stably keep the back pressure chamber pressure to an optimum value.

[0056] It should be further understood by those skilled in the art that although the foregoing description has been made on embodiments of the invention, the invention is not limited thereto and various changes and modifications may be made without departing from the spirit of the invention and the scope of the appended claims.

1. A scroll compressor, comprising

a fixed scroll including a base plate and a spiral wrap projecting from the base plate,

an orbiting scroll including an end plate and another spiral wrap projecting from the end plate and engaged with the fixed scroll to form a compression chamber therebetween,

a discharge space for receiving a compressed fluid from the compression chamber,

a back pressure chamber arranged at a back side of at least one of the fixed scroll and the orbiting scroll to press the fixed scroll and the orbiting scroll against each other, a back pressure hole formed in at least one of the base plate and the end plate to enable a fluidal communication to be formed between the compression chamber and the back pressure chamber so that a pressure in the back pressure chamber is kept between an intake pressure and a pressure in the discharge space, and

a release valve mechanism including a release flow path to enable another fluidal communication to be formed between the compression chamber and the discharge space, and a valve arranged between the release flow path and the discharge space to open the release flow path to enable the fluid to be discharged from the compression chamber to the discharge space when a pressure in the compression chamber is higher than the pressure in the discharge space, so that an excessive compression in the compression chamber is prevented,

wherein the back pressure hole and the release flow path are arranged to prevent both of the fluidal communication and the another fluidal communication from being formed simultaneously during each orbital revolution.

2. The scroll compressor according to claim **1**, wherein the fluidal communication between the compression chamber and the back pressure chamber is formed intermittently by the back pressure hole.

3. The scroll compressor according to claim **2**, wherein the back pressure hole is formed in the end plate of the orbiting scroll, an end of the back pressure hole is arranged to be intermittently opened in accordance with the orbital motion of the orbiting scroll to a notch portion formed on a surface of the end plate of the fixed scroll at its radially outer side to fluidly communicate with the back pressure chamber, and the other end of the back pressure hole is arranged to fluidly communicate with the compression chamber before the fluid is discharged from the compression chamber to the discharge space.

4. The scroll compressor according to claim **1**, wherein the release valve mechanism is of a flapper valve type arranged on the base plate of the fixed scroll, and the valve has a valve body, an elastic member for urging the valve body toward the release flow path, a stopper for holding the elastic member, and a retainer for restraining a movable range of the stopper.

5. The scroll compressor according to claim **4**, wherein the release flow path has a cross-sectional shape of elongated hole, and a tapered shape at a side of the valve body to increase its cross-sectional area in a direction from the compression chamber toward the discharge space, and the valve body has a flat plate.

6. A scroll compressor comprising a fixed scroll, an orbiting scroll engaged with the fixed scroll to form a compression chamber therebetween and capable of orbiting, a discharge space for receiving a compressed fluid from the compression chamber, a back pressure chamber arranged at a back side of an end plate of the orbiting scroll to press the orbiting scroll against the fixed scroll, a back pressure hole formed in the end plate of the orbiting scroll to enable a fluidal communication to be formed between the compression chamber and the back pressure chamber, and a release valve mechanism including a release flow path in a base plate of the fixed scroll to enable another fluidal communication to be formed between the compression chamber and the discharge space, and a valve arranged between the release flow path and the discharge space to open the release flow path to enable the fluid to be discharged from the compression chamber to the discharge space when a pressure in the compression chamber is higher than the pressure in the discharge space, so that an excessive compression in the compression chamber is prevented, wherein the back pressure hole and the release flow path are arranged to prevent both of the fluidal communication and the another fluidal communication from being formed simultaneously during each orbital revolution.

7. A scroll compressor comprising a fixed scroll, an orbiting scroll engaged with the fixed scroll to form a compression chamber therebetween, a discharge space for receiving a compressed fluid from the compression chamber, a back pressure chamber arranged at a back side of an end plate of the orbiting scroll, a back pressure hole formed in the end plate of the orbiting scroll to enable a fluidal communication to be formed between the compression chamber and the back pressure chamber, and a release valve mechanism including a release flow path in a base plate of the fixed scroll to enable another fluidal communication to be formed between the compression chamber and the discharge space so that the fluid is discharged from the compression chamber to the discharge space when a pressure in the compression chamber is higher than the pressure in the discharge space, wherein the back pressure hole and the release flow path are arranged to prevent both of the fluidal communication and the another fluidal communication from being formed simultaneously during an orbital motion of the orbiting scroll.

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