US 20040241010A1

(19) United States
(12) Patent Application Publication
Cho et al.
(10) Pub. No.: US 2004/0241010 A1
(43) Pub. Date: Dec. 2, 2004

(54) VARIABLE CAPACITY ROTARY COMPRESSOR

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(21) Appl. No.: **10/804,171**

(22) Filed: **Mar. 19, 2004**

(30) **Foreign Application Priority Data**

Mar. 27, 2003 (KR) 2003-19060
Mar. 8, 2004 (KR) 2004-15385

Publication Classification

(51) **Int. Cl.**^{7} **F04B 49/00**; F04B 35/04

(52) **U.S. Cl.** **417/274**; 417/410.3

(57) **ABSTRACT**

A variable capacity rotary compressor capable of varying a compression capacity thereof. The variable capacity rotary compressor includes a housing defined therein with first and second compressing chambers having different volumes, a rotating shaft adapted to rotate in the first and second compressing chambers, a compressing unit arranged in the first and second compressing chambers, and adapted to perform a compression operation in a selected one of the first and second compressing chambers in accordance with a change of a rotating direction of the rotating shaft, and a drive motor adapted to rotate the rotating shaft in a first direction or in a second direction, the drive motor being variable in rotating speed in accordance with an electrical control operation. The variable capacity rotary compressor can achieve a multi-stage variation in capacity thereof within a wide range while reducing a variation range of rotating speed, as compared to conventional cases, because it is possible not only to mechanically vary the capacity of the compressing device in accordance with a change of the rotating direction of the drive motor, but also to control the rotating speed of the drive motor in accordance with an electrical control method.

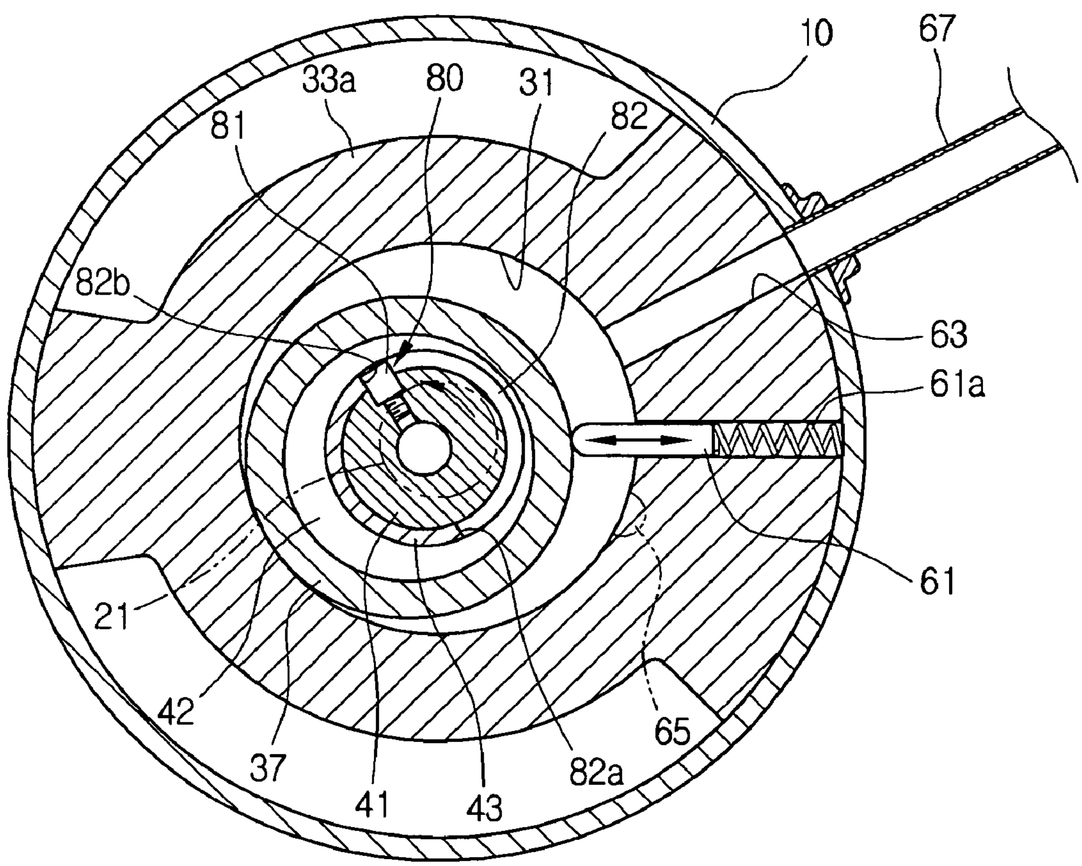

FIG 1

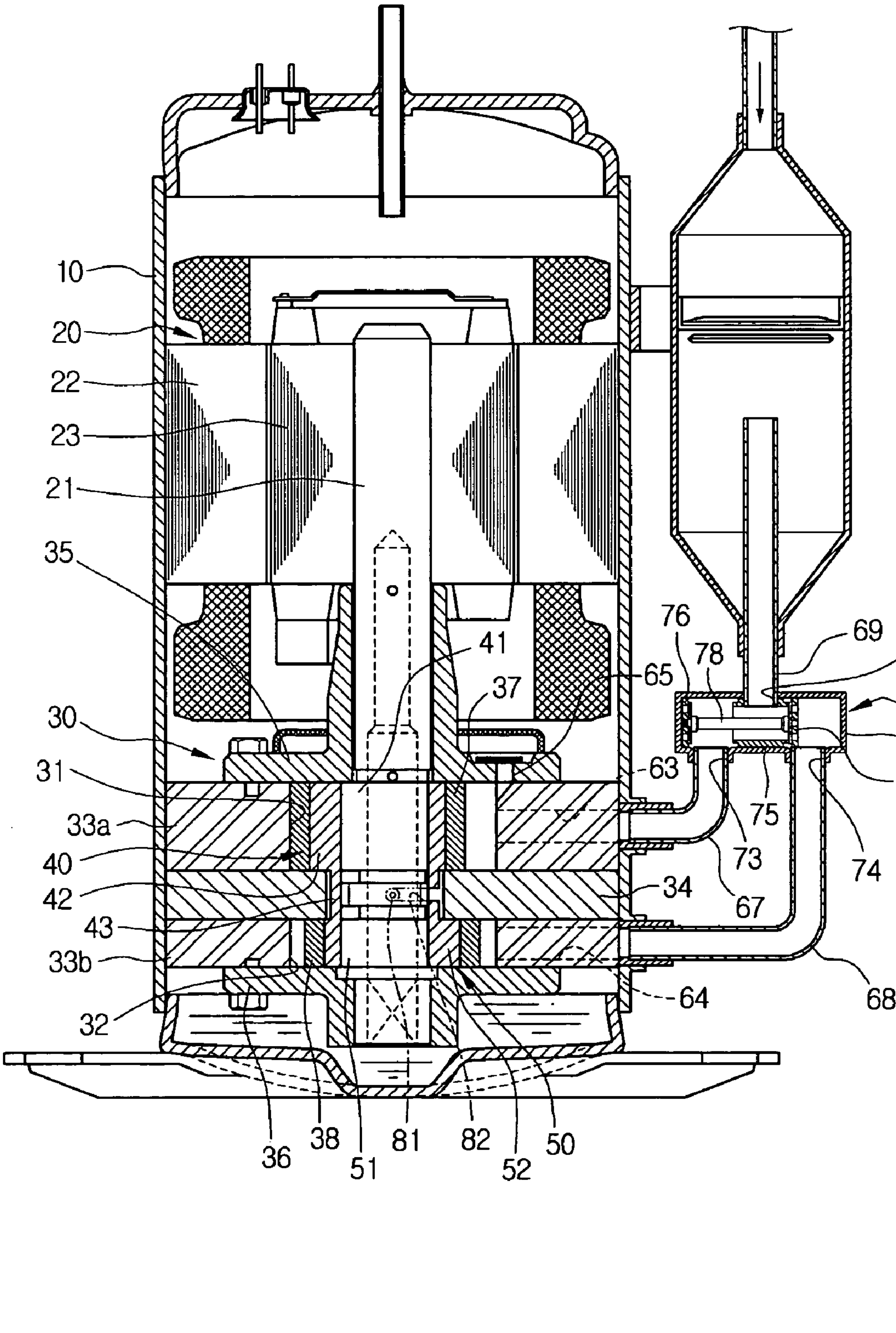

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FIG 2

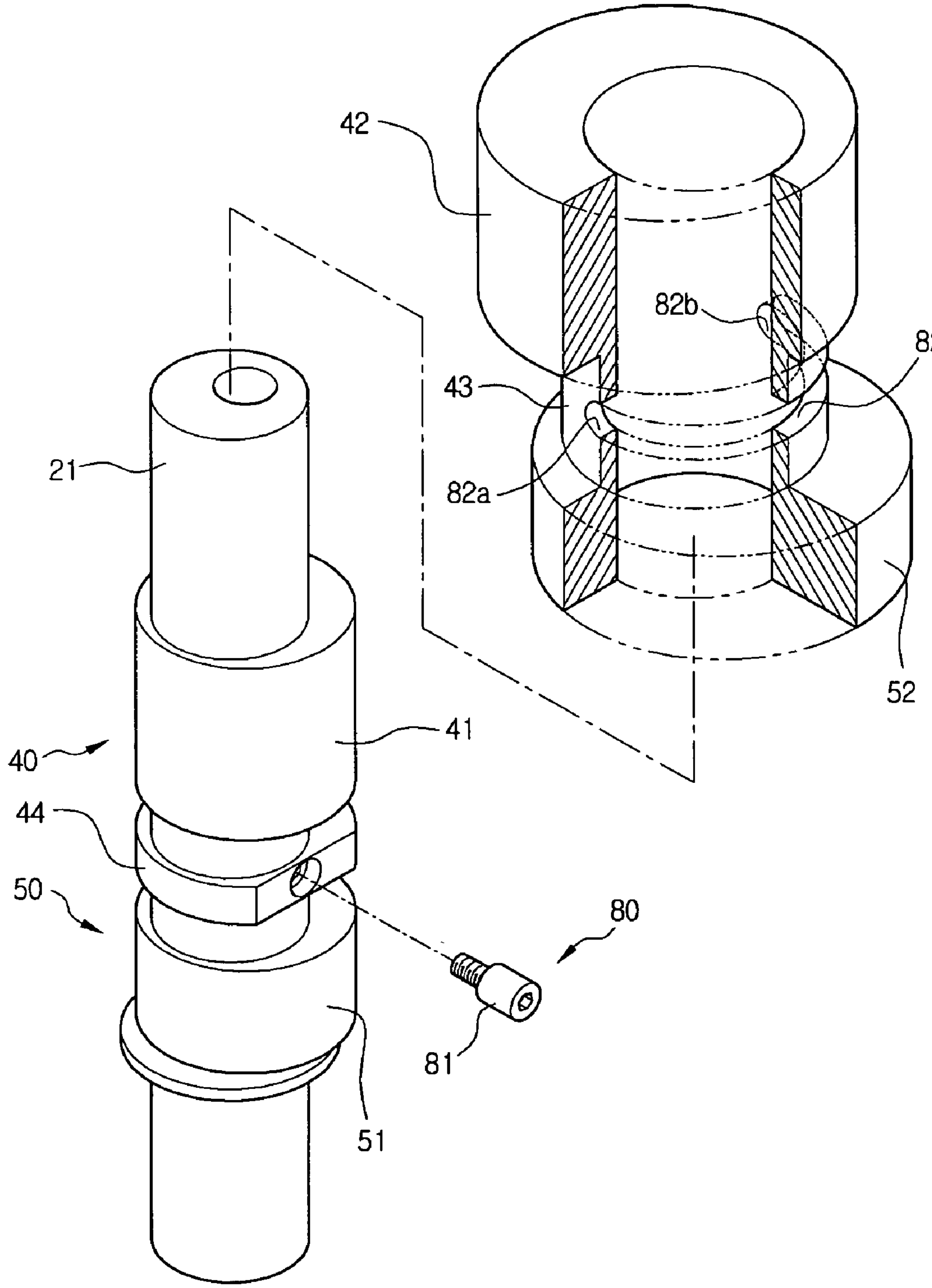

FIG 3

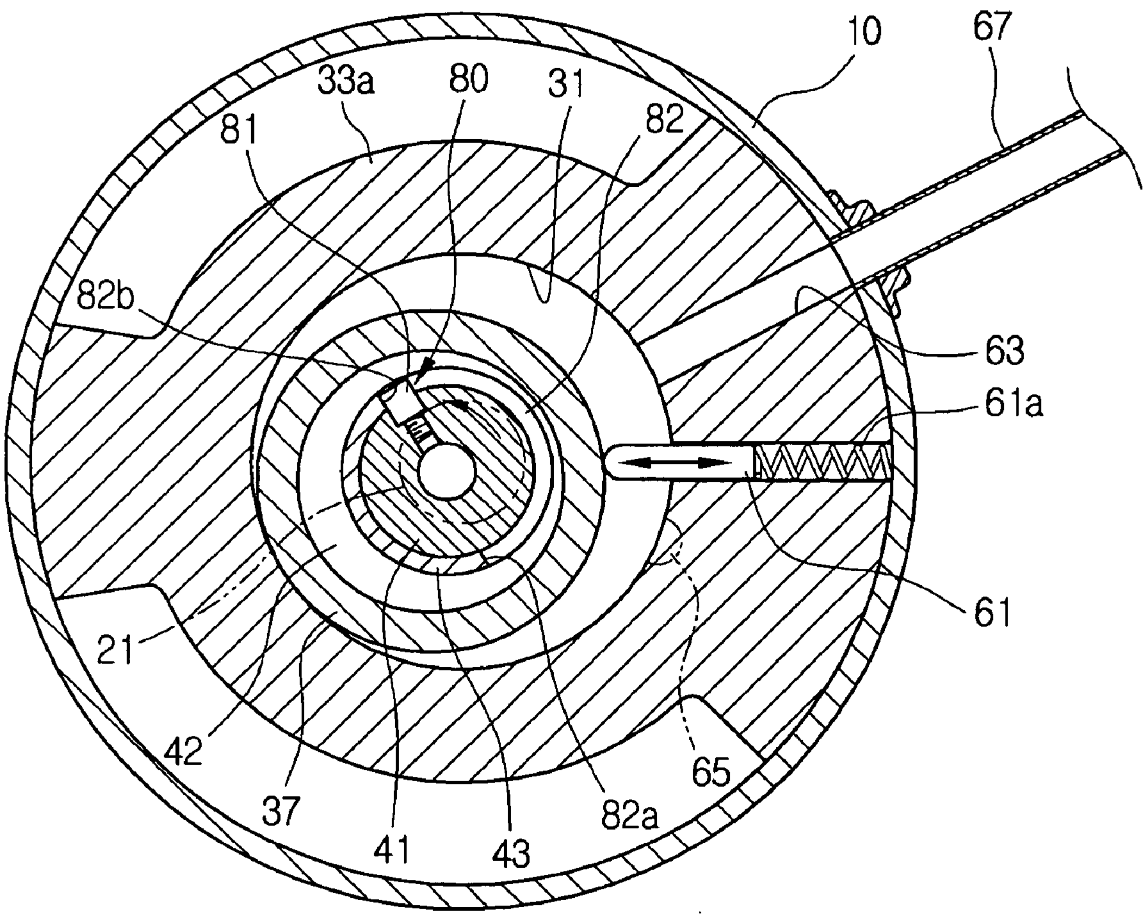

FIG 4

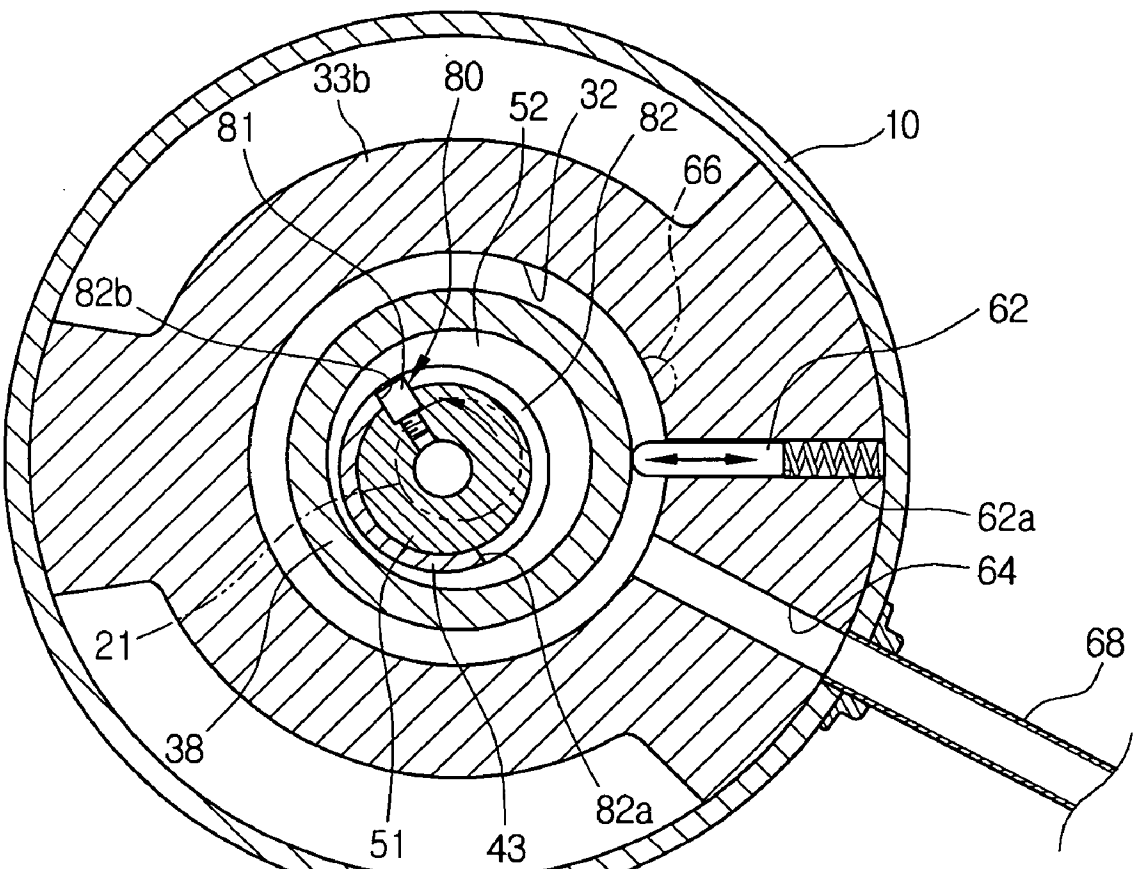

FIG 5

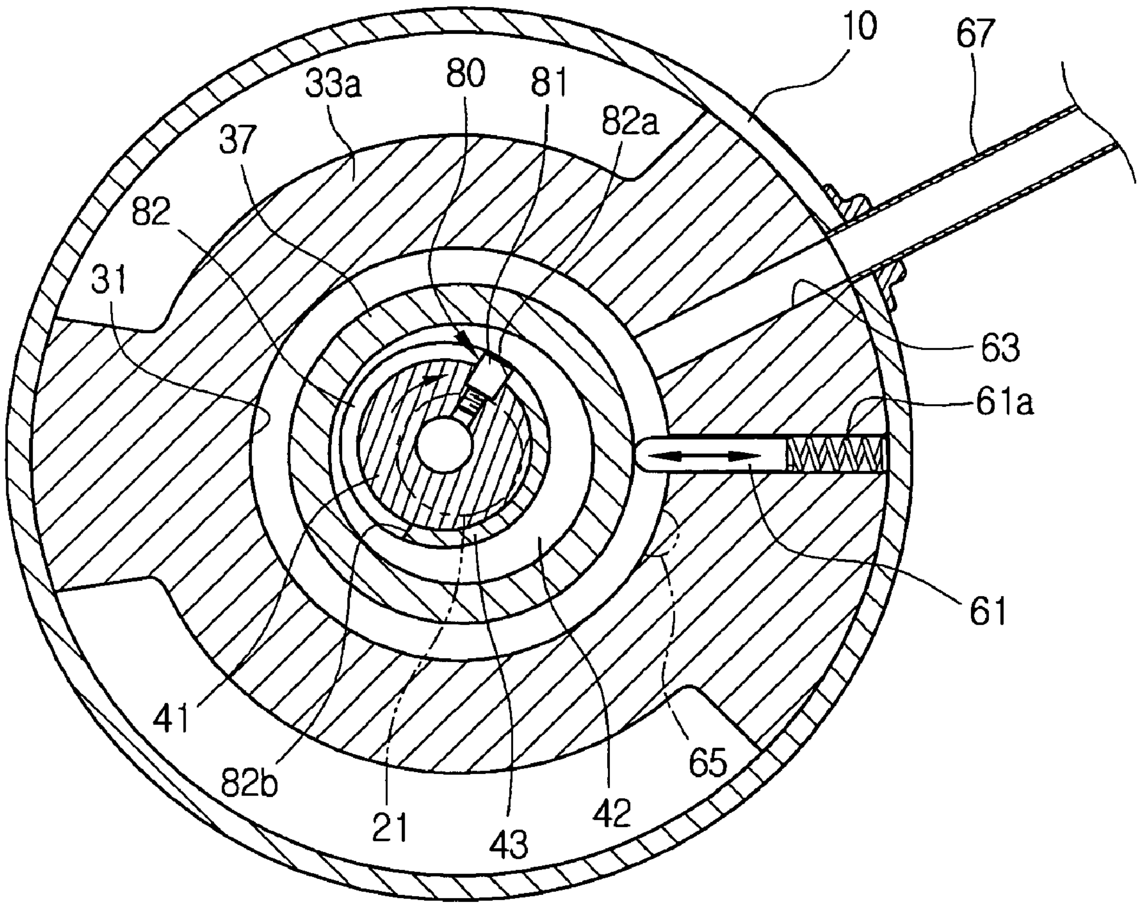

FIG 6

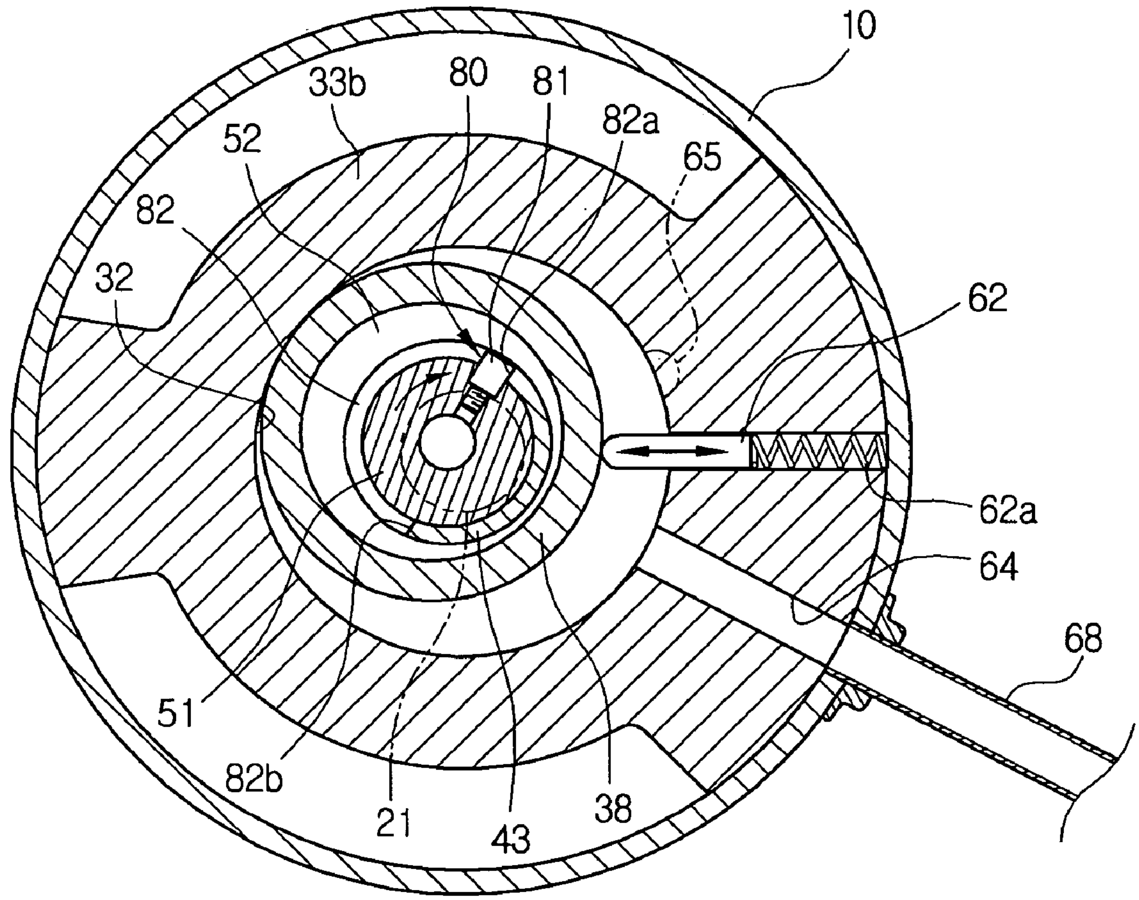

FIG 7

	Rotating Direction	Frequency	Rotating Speed	Compression Capacity
First Example	First Direction	20Hz	Low Speed	33.3%
Second Example	First Direction	60Hz	Medium Speed	100%
Third Example	First Direction	120Hz	High Speed	200%
Fourth Example	Second Direction	20Hz	Low Speed	16.6%
Fifth Example	Second Direction	60Hz	Medium Speed	50%
Sixth Example	Second Direction	120Hz	High Speed	100%

VARIABLE CAPACITY ROTARY COMPRESSOR

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of Korean Application No. 2003-19060, filed Mar. 27, 2003 and Korean Application No. 2004-15385, filed Mar. 8, 2004 in the Korean Intellectual Property Office, the disclosures of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a variable capacity rotary compressor, and more particularly to a variable capacity rotary compressor capable of varying a refrigerant compression ability thereof in a multi-stage fashion within a wide range.

[0004] 2. Description of the Related Art

[0005] Recently developed air conditioners and coolers of refrigerators have a function capable of varying a cooling capacity in accordance with a variation in cooling conditions (for example, the temperature of a confined space to be cooled, etc.) in order to achieve an optimal cooling operation while reducing energy consumption. For this function, such devices typically use a variable capacity rotary compressor configured to vary a refrigerant compression ability thereof.

[0006] Known variable capacity rotary compressors generally include a compressing device adapted to compress a refrigerant, and then to discharge the compressed refrigerant, and a drive motor adapted to drive the compressing device. For the drive motor of such a compressor, a general inverter motor or brushless DC (BLDC) motor may be used which can vary a rotating speed thereof, depending on a variation in input electric power. That is, such a compressor can vary a refrigerant compression ability thereof, that is, a refrigerant compression capacity thereof, by varying the rotating speed of the drive motor in accordance with an operation for controlling input electric power to be applied to the drive motor.

[0007] However, such a variable capacity rotary compressor has a problem in that it is difficult to control the refrigerant compression capacity in a multi-stage fashion within a wide range because the control to vary the refrigerant compression capacity is carried out, using a method of operating the compressing device at a speed controlled by control of the rotating speed of the drive motor.

[0008] Since, when it is required to increase the compression capacity of the rotary compressor, the drive motor must rotate at high speed to operate the compressing device at high speed, rotational elements of the rotary compressor may be correspondingly rapidly worn. As a result, the lifespan of the drive motor and compressing device may be shortened. Also, where the rotating speed of the drive motor varies abruptly, the entire system of the rotary compressor may abnormally operate because the operating condition of the compressing device must vary abruptly. For example, supply of oil to the compressing device may be ineffectively achieved because the oil supply conditions in high-speed and low-speed operations are different from each other.

SUMMARY OF THE INVENTION

[0009] Therefore, it is an aspect of the invention to provide a variable capacity rotary compressor which is configured to achieve a variation in the capacity thereof by electrically controlling a drive motor thereof while using a particular mechanical structure of a compressing device thereof, thereby being capable of achieving the capacity variation in a multi-stage fashion within a wide range while reducing a variation in the rotating speed of a drive motor thereof.

[0010] Another aspect of the invention is to provide a variable capacity rotary compressor capable of achieving a variation in capacity in a multi-stage fashion within a wide range without any overload to a drive motor thereof and a compressing device thereof.

[0011] In accordance with one aspect, the present invention provides a variable capacity rotary compressor comprising: a housing defined therein with first and second compressing chambers having different volumes; a rotating shaft adapted to rotate in the first and second compressing chambers; a compressing unit arranged in the first and second compressing chambers, and adapted to perform a compression operation in a selected one of the first and second compressing chambers in accordance with a change of a rotating direction of the rotating shaft; and a drive motor adapted to rotate the rotating shaft in a first direction or in a second direction, the drive motor being variable in rotating speed in accordance with an electrical control operation.

[0012] The compressing unit may comprise first and second sleeves respectively arranged in the first and second compressing chambers, first and second eccentric units mounted on the rotating shaft, and adapted to operate in opposite manners such that one of the first and second eccentric units selectively rotates an associated one of the first and second sleeves in an eccentric state in accordance with the rotating direction change of the rotating shaft, thereby causing the associated sleeve to perform a compression operation in an associated one of the first and second compressing chambers, while the other eccentric unit idly rotates the other sleeve associated therewith in the other compressing chamber associated therewith during the compression operation caused by the one eccentric unit, and first and second vanes respectively arranged in the first and second compressing chambers to be radially movable between extended positions thereof and retracted positions thereof.

[0013] The drive motor may be a brushless DC motor.

[0014] The drive motor may be an inverter motor.

[0015] The first eccentric unit may comprise a first eccentric cam fixedly fitted around an outer surface of the rotating shaft in the first compressing chamber, and a first eccentric bush rotatably fitted around an outer surface of the first eccentric cam. The second eccentric unit may comprise a second eccentric cam fixedly fitted around the outer surface of the rotating shaft in the second compressing chamber, and a second eccentric bush rotatably fitted around an outer surface of the second eccentric cam. The compressing unit may further comprise a locking unit adapted to lock the first and second eccentric bushes in opposite states in accordance with the rotating direction change of the rotating shaft such that one of the first and second eccentric bushes is locked in an eccentric state, while the other eccentric bush is locked in an eccentricity-released state.

[0016] The compressing unit may further comprise a cylindrical connecting member adapted to connect the first and second eccentric bushes such that the first and second eccentric bushes have opposite eccentric directions. The locking unit may comprise a locking slot provided at the connecting member to extend circumferentially, and a locking pin extending radially through the locking slot to be coupled to the rotating shaft such that the locking pin is engagable with the locking slot.

[0017] The first vane may be arranged between suction and discharge ports of the first compressing chamber to be radially movable between an extended position thereof and a retracted position thereof while being in contact with an outer surface of the first sleeve. The second vane may be arranged between suction and discharge ports of the second compressing chamber to be radially movable between an extended position thereof and a retracted position thereof while being in contact with an outer surface of the second sleeve.

[0018] In accordance with another aspect, the present invention provides a variable capacity rotary compressor comprising: a housing defined therein with first and second compressing chambers having different volumes; a rotating shaft adapted to rotate in the first and second compressing chambers; first and second sleeves respectively arranged in the first and second compressing chambers; an eccentric unit mounted on the rotating shaft, and adapted to operate the first and second sleeves such that one of the first and second sleeves rotates in an eccentric state when the rotating shaft rotates in a first direction, thereby performing a compression operation, while the other sleeve idly rotates during the compression operation, whereas, when the rotating shaft rotates in a second direction, the first and second sleeves perform operations opposite to the operations carried out when the rotating shaft rotates in the first direction, respectively; and a drive motor adapted to rotate the rotating shaft in a first direction or in a second direction, the drive motor being variable in rotating speed in accordance with an electrical control operation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The above aspects, and other features and advantages of the present invention will become more apparent after reading the following detailed description when taken in conjunction with the drawings, in which:

[0020] **FIG. 1** is a sectional view illustrating a configuration of a variable capacity rotary compressor according to the present invention;

[0021] **FIG. 2** is a perspective view illustrating a configuration of an eccentric unit included in the variable capacity rotary compressor according to the present invention;

[0022] **FIG. 3** is a cross-sectional view illustrating a compression operation in a first compressing chamber when a rotating shaft of the variable capacity rotary compressor according to the present invention rotates in a first direction;

[0023] **FIG. 4** is a cross-sectional view illustrating an idle rotation in a second compressing chamber when the rotating shaft of the variable capacity rotary compressor according to the present invention rotates in the first direction;

[0024] **FIG. 5** is a cross-sectional view illustrating an idle rotation in the first compressing chamber when the rotating shaft of the variable capacity rotary compressor according to the present invention rotates in a second direction;

[0025] **FIG. 6** is a cross-sectional view illustrating a compression operation in the second compressing chamber when the rotating shaft of the variable capacity rotary compressor according to the present invention rotates in the second direction; and

[0026] **FIG. 7** is a table showing a variation in compression capacity depending on a variation in the operation condition of the variable capacity rotary compressor according to the present invention.

DETAILED DESCRIPTION OF ILLUSTRATIVE, NON-LIMITING EMBODIMENTS OF THE INVENTION

[0027] An illustrative, non-limiting embodiment of the present invention will now be described in detail with reference to the annexed drawings.

[0028] Referring to **FIG. 1**, a variable capacity rotary compressor according to an exemplary embodiment of the present invention is illustrated. The variable capacity rotary compressor includes a hermetic casing **10**, a drive motor **20** installed in the casing **10** at an upper portion of the casing **10**, and adapted to generate a rotating force, and a compressing device **30** installed in the casing **10** at a lower portion of the casing **10**, and connected to the drive motor **20** via a rotating shaft **21**.

[0029] The drive motor **20** includes a cylindrical stator **22** fixedly mounted to an inner surface of the casing **10**, and a rotor **23** rotatably mounted in the stator **22**, and coupled, at a central portion thereof, to the rotating shaft **21**. The drive motor **20** may comprise a variable speed motor configured to be rotatable in forward and reverse directions while being capable of controlling a rotating speed thereof. For such a variable speed motor, an inverter motor or BLDC motor may be used which can vary a rotating speed thereof in accordance with an electrical control operation. As the rotating speed of the drive motor **20** increases or decreases in accordance with the electrical control operation, the operating speed of the compressing device **30** is controlled to vary the compression capacity of the rotary compressor.

[0030] The compressing device **30** includes upper and lower housings **31** and **32** vertically arranged while defining therein first and second cylindrical compressing chambers **31** and **32** having different volumes, an intermediate plate **34** arranged between the upper and lower housings **33***a* and **33***b* to partition the first and second compressing chambers **31** and **32**. The compressing device **30** also includes upper and lower flanges **35** and **36** adapted to close the top of the first compressing chamber **31** and the bottom of the second compressing chamber **32**, respectively, while rotatably supporting the rotating shaft **21**. The upper and lower flanges **35** and **36** are mounted to an upper end of the upper housing **33***a* and a lower end of the lower housing **33***b*, respectively.

[0031] The compressing device **30** further includes a compressing unit arranged in the first and second compressing chambers **31** and **32**, and adapted to perform a compression operation in the first or second compressing chambers **31** and **32** in accordance with rotation of the rotating shaft **21** in such a manner that the compression operation is carried out in only a selected one of the first and second compressing chambers **31** and **32**, depending on the rotating direction of the rotating shaft **21**. As shown in FIGS. **2** to **4**, the compressing unit includes first and second eccentric units **40** and **50** vertically arranged to be disposed in the first and second compressing chambers **31** and **32**, respectively, while being mounted on the rotating shaft **21**, and first and second sleeves **37** and **38** rotatably arranged around the eccentric units **40** and **50**. The compressing unit also includes a first vane **61** arranged between suction and discharge ports **63** and **65** of the first compressing chamber **31** such that it moves radially to extend into or retract from the first compressing chamber **31** in a state of being in contact with an outer surface of the sleeve **37** during a compression operation carried out in the first compressing chamber **31**. The compressing unit further includes a second vane **62** arranged between suction and discharge ports **64** and **66** of the second compressing chamber **32** such that it moves radially to extend into or retract from the second compressing chamber **32** in a state of being in contact with an outer surface of the sleeve **38** during a compression operation carried out in the second compressing chamber **32**. The vanes **61** and **62** are elastically supported by first and second vane springs **61***a* and **62***a*. The suction and discharge ports **63** and **65** of the first compressing chamber **31** are arranged at opposite sides of the vane **61**, respectively, whereas the suction and discharge ports **64** and **66** of the second compressing chamber **32** are arranged at opposite sides of the vane **62**, respectively.

[**0032**] The first eccentric unit **40** includes a first eccentric cam **41** fixedly fitted, in an eccentric state, around a portion of the rotating shaft **21** arranged in the first compressing chamber **31**, and an upper or first eccentric bush **42** rotatably fitted around the eccentric cam **41**. Similarly, the second eccentric unit **50** includes a second eccentric cam **51** fixedly fitted, in an eccentric state, around a portion of the rotating shaft **21** arranged in the second compressing chamber **32** while having the same eccentric direction as the first eccentric cam **41**, and a lower or second eccentric bush **52** rotatably fitted around the eccentric cam **51**. As shown in **FIG. 2**, the first and second eccentric bushes **42** and **52** are connected by a cylindrical connecting member **43** such that they are integral while having opposite eccentric directions, respectively. The first and second sleeves **37** and **38** are rotatably fitted around the first and second eccentric bushes **42** and **52**, respectively.

[**0033**] As shown in **FIG. 2**, an eccentric member **44** is also fixedly fitted, in an eccentric state, around the rotating shaft **21** between the first and second eccentric cams **41** and **51** while having the same eccentric direction as that of the eccentric cams **41** and **51**. The connecting member **43** is rotatably fitted around the eccentric member **44**. A locking unit **80** is arranged between the connecting member **43** and the eccentric member **44** to cause one of the eccentric bushes **42** and **52** to be rotated along with the rotating shaft **21** in an eccentric state while causing the other eccentric bush to be rotated along with the rotating shaft **21** in an eccentricity-released state, in accordance with the rotation direction of the rotating shaft **21**. The locking unit **80** includes a locking pin **81**, and a locking slot **82**. The locking slot **82** is formed at the connecting member **43** such that it extends circumferentially by a desired length. The locking pin **81** extends radially through the locking slot **82**, and is threadedly coupled with a threaded hole formed at a flat portion of the outer surface of the eccentric member **44** at one side of the eccentric member **44**. In accordance with rotation of the rotating shaft **21**, the locking pin **81** is engaged with the locking slot **82** at a position where the first eccentric bush **42** is locked in an eccentric state, and the second eccentric bush **52** is locked in an eccentricity-released state, or at another position where the first eccentric bush **42** is locked in an eccentricity-released state, and the second eccentric bush **52** is locked in an eccentric state. That is, when the rotating shaft **21** rotates by a certain angle under the condition in which the locking pin **81** is coupled to the eccentric member **44**, and thus, the rotating shaft **21**, through the locking slot **82**, the locking pin **81** is engaged with one of opposite ends **82***a* and **82***b* of the locking slot **82**, so that both the eccentric bushes **42** and **52** are rotated, along with the rotating shaft **21**. In accordance with such an engagement of the locking pin **81** with the locking slot **82**, one of the eccentric bushes **42** and **52** is locked in an eccentric state thereof, whereas the other eccentric bush is locked in an eccentricity-released state thereof. As a result, a compression operation is carried out in one compressing chamber **31** or **32** associated with the eccentric bush **42** or **52** locked in an eccentric state thereof, whereas an idle rotation is carried out in the other compressing chamber **32** or **31** associated with the eccentric bush **52** or **42** locked in an eccentricity-released state thereof. When the rotating direction of the rotating shaft **21** is changed, respective locked states of the eccentric bushes **42** and **52** are reversed.

[**0034**] As shown in **FIG. 1**, the variable capacity rotary compressor according to the illustrated embodiment of the present invention also includes a flow path change device **70** adapted to change a suction flow path so that a refrigerant from a suction conduit **69** can be sucked into the suction port of the compressing chamber where a compression operation is carried out, that is, the suction port **63** of the first compressing chamber **31** or the suction port **64** of the second compressing chamber **32**.

[**0035**] The flow path change device **70** includes a cylindrical body **71**, and a valve unit arranged in the cylindrical body **71**. The cylindrical body **71** is provided, at a central portion thereof, with an inlet **72**, to which the suction conduit **69** is connected. The cylindrical body **71** is also provided, at opposite sides thereof, with first and second outlets **73** and **74**, to which conduits **67** and **68** connected to respective suction ports **63** and **64** of the first and second compressing chambers **31** and **32** are connected, respectively. The valve unit arranged in the cylindrical body **71** includes a cylindrical valve seat **75** arranged at the central portion of the cylindrical body **71**, first and second valve members **76** and **77** respectively arranged at opposite lateral portions of the cylindrical body **71** such that they are movable toward or away from opposite ends of the valve sheet **75** to close or open the opposite ends of the valve sheet **75**, and a connecting member **78** adapted to connect the first and second valve members **76** and **77** such that the first and second valve members **76** and **77** are movable together. When a compression operation is carried out in the first or second compressing chamber **31** or **32**, a pressure difference is generated between the outlets **73** and **74**, thereby causing the first and second valve members **76** and **77** to move toward a lower pressure side in the cylindrical body **71**. Thus, the flow path change device **70** automatically changes the suction flow path.

[0036] Now, the mechanical capacity varying operation of the compressing device carried out depending on a change in the rotating direction of the rotating shaft in the above described variable capacity rotary compressor will be described.

[0037] When the rotating shaft **21** rotates in a first direction (counterclockwise direction), as shown in **FIG. 3**, the locking pin **81** is engaged with the end **82***b* of the locking slot **82** in a state in which the outer surface of the first eccentric bush **42** in the first compressing chamber **31** is eccentric to the rotating shaft **21**. Accordingly, the first sleeve **37** rotates while coming into contact with the inner surface of the first compressing chamber **31**. Thus, a compression operation is carried out in the first compressing chamber **31**. In this case, the outer surface of the second eccentric bush **52** in the second compressing chamber **32** is concentric to the rotating shaft **21**, so that the second sleeve **38** is maintained in a state of being spaced apart from the inner surface of the second compressing chamber **32**. Thus, an idle rotation is carried out in the second compressing chamber **32**. During the compression operation in the first compressing chamber **31**, a refrigerant is sucked only into the first compressing chamber **31** through the suction port **63** in accordance with the operation of the flow path change device **70**.

[0038] These operations are enabled because the first and second eccentric cams **41** and **51** have the same eccentric direction, whereas the first and second eccentric bushes **42** and **52** have opposite eccentric directions, respectively, that is, because when the maximum eccentric portions of the first eccentric cam **41** and first eccentric bush **42** have the same direction, the maximum eccentric portions of the second eccentric cam **51** and second eccentric bush **52** have opposite directions, respectively.

[0039] On the other hand, when the rotating shaft **21** rotates at the same speed as that of the above case in a second direction (clockwise direction) reverse to that of the above case to perform a compression operation, as shown in **FIG. 5**, the locking pin **81** is engaged with the end **82***a* of the locking slot **82** in a state in which the outer surface of the first eccentric bush **42** in the first compressing chamber **31** is released from the eccentric state thereof to the rotating shaft **21**. Accordingly, the first sleeve **37** is maintained in a state of being spaced apart from the inner surface of the first compressing chamber **31**, so that an idle rotation is carried out in the first compressing chamber **31**. In this case, the outer surface of the second eccentric bush **52** in the second compressing chamber **32** is eccentric to the rotating shaft **21**, as shown in **FIG. 6**. Accordingly, the second sleeve **38** rotates while coming into contact with the inner surface of the second compressing chamber **32**. Thus, a compression operation is carried out in the second compressing chamber **32**. During the compression operation in the second compressing chamber **32**, a refrigerant is sucked only into the second compressing chamber **32** in accordance with the operation of the flow path change device **70**.

[0040] Thus, it is possible to achieve a variation in capacity in accordance with the mechanical operation of the compressing device **30** caused by simply changing the rotating direction of the rotating shaft **21** in accordance with the present invention. That is, where a compression operation is carried out in the second compressing chamber **32** as the rotating shaft **21** rotates in the second direction, a reduction in compression capacity is achieved even under the condition in which the drive motor **20** rotates at the same speed as that in the compression operation in the first compressing chamber **31**. This is because the second compressing chamber **32** has a volume smaller than that of the first compressing chamber **31**. For example, where the second compressing chamber **32** has a volume corresponding to 50% of the volume of the first compressing chamber **31**, it has a compression capacity corresponding to 50% of the compression capacity of the first compressing chamber **31** under the condition in which the rotating speed of the drive motor **20** is constant.

[0041] In accordance with the present invention, it is also possible to control the variation in the compression capacity of the rotary compressor in a multi-stage fashion within a wide range by not only implementing the above described mechanical capacity variation of the compressing device **30**, but also implementing a variation in capacity through control of the rotating speed of the drive motor **20**. That is, the compression capacity of the rotary compressor can be controlled in a multi-stage fashion with a wide range by varying the frequency of input electric power, to be applied to the drive motor **20**, within a range of 20 to 120 Hz to control the rotating speed of the drive motor **20**, while changing the rotating direction of the drive motor **20**.

[0042] For example, where the volume of the second compressing chamber **32** corresponds to 50% of the volume of the first compressing chamber **31**, the frequency of input electric power to be applied to the drive motor **20** is controlled to be 20 Hz, 60 Hz, and 120 Hz, in order to control the rotating speed of the drive motor **20** to be a low speed, a medium speed, and a high speed, respectively, and the rotating direction of the drive motor **20** is controlled to be a first or second direction, a multi-stage capacity variation within a wide range may be achieved, as described in a table of **FIG. 7**. The results of **FIG. 7** represent relative compression capacity variations under various operation conditions achieved when a compression operation is carried out in the first compressing chamber **31** as the drive motor **20** rotates in the first direction, and it is assumed that the compression capacity obtained at the medium rotating speed (60 Hz) corresponds to 100%.

[0043] The first example in **FIG. 7** corresponds to the case in which a compression operation is carried out in the first compressing chamber **31** as the drive motor **20** rotates in the first direction (counterclockwise direction in **FIG. 3**), and the rotating speed of the drive motor **20** is controlled to be the low speed (20 Hz). In this case, a compression capacity corresponding to 33% of the second example in **FIG. 7** is obtained.

[0044] The second example corresponds to the case in which a compression operation is carried out in the first compressing chamber **31** as the drive motor **20** rotates in the first direction, and the rotating speed of the drive motor **20** is controlled to be the medium speed (60 Hz). In this case, a compression capacity of 100% is obtained.

[0045] The third example corresponds to the case in which a compression operation is carried out in the first compressing chamber **31** as the drive motor **20** rotates in the first direction, and the rotating speed of the drive motor **20** is controlled to be the high speed (120 Hz). In this case, a compression capacity corresponding to 200% of the second example is obtained.

[0046] The fourth example corresponds to the case in which a compression operation is carried out in the second compressing chamber **32** as the drive motor **20** rotates in the second direction (clockwise direction in **FIG. 6**), and the rotating speed of the drive motor **20** is controlled to be the low speed (20 Hz). In this case, a compression capacity corresponding to 16.6% of the second example is obtained.

[0047] The fifth example corresponds to the case in which a compression operation is carried out in the second compressing chamber **32** as the drive motor **20** rotates in the second direction, and the rotating speed of the drive motor **20** is controlled to be the medium speed (60 Hz). In this case, a compression capacity corresponding to 50% of the second example is obtained.

[0048] The sixth example corresponds to the case in which a compression operation is carried out in the second compressing chamber **32** as the drive motor **20** rotates in the second direction, and the rotating speed of the drive motor **20** is controlled to be the high speed (120 Hz). In this case, a compression capacity corresponding to 100% of the second example is obtained.

[0049] Thus, in accordance with the present invention, it is possible to achieve a multi-stage capacity variation within a wide range, as compared to conventional cases, by not only implementing a mechanical capacity variation of the compressing device **30** through a change of the rotating direction of the drive motor **20**, but also implementing a variation in capacity through control of the rotating speed of the drive motor **20**.

[0050] In particular, as shown in **FIG. 7**, the compression capacity obtained under the operation condition of the second example is equal to the compression capacity obtained under the operation condition of the sixth example. In either case, accordingly, the same result is obtained. However, it is preferred that the operation condition of the second example be selected in that it is possible, in this case, to prevent the elements of the compressor from being overloaded by virtue of a lower rotating speed of the drive motor **20**, thereby extending the lifespan of those elements, while obtaining the same compression capacity. Thus, in accordance with the present invention, it is possible to select, from a plurality of operation conditions providing the same compression capacity, an operation condition capable of minimizing an overload applied to the drive motor **20** and compressing device **30**.

[0051] Although not illustrated in **FIG. 7**, the rotating speed of the drive motor **20** may be controlled in a more diversified fashion, using various frequencies of input electric power, to be applied to the drive motor **20**, other than 20 Hz, 60 Hz, and 120 Hz. In this case, it is also possible to prevent the drive motor **20** and compressing unit **30** from being overloaded by setting an appropriate operation condition such that the same compression capacity is obtained without an excessively high or low-speed rotation of the drive motor **20**.

[0052] As apparent from the above description, the variable capacity rotary compressor according to the present invention can achieve a multi-stage variation in capacity thereof within a wide range while reducing a variation range of rotating speed, as compared to conventional cases, because it is possible not only to mechanically vary the capacity of the compressing device in accordance with a change of the rotating direction of the drive motor, but also to control the rotating speed of the drive motor in accordance with an electrical control method.

[0053] Since a multi-stage capacity variation within a wide range can be achieved without an excessively high or low-speed rotation of the drive motor, it is also possible to prevent the elements of the compressor from being overloaded, thereby achieving an extension of the lifespan of those elements and an improvement in the reliability of the compressor.

[0054] Although the preferred embodiments of the invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

1. A variable capacity rotary compressor comprising:

a housing defined therein with first and second compressing chambers having different volumes;

a rotating shaft adapted to rotate in the first and second compressing chambers;

a compressing unit arranged in the first and second compressing chambers, and adapted to perform a compression operation in a selected one of the first and second compressing chambers in accordance with a change of a rotating direction of the rotating shaft; and

a drive motor adapted to rotate the rotating shaft in a first direction or in a second direction, the drive motor being variable in rotating speed in accordance with an electrical control operation.

2. The variable capacity rotary compressor according to claim 1, wherein the compressing unit comprises:

first and second sleeves respectively arranged in the first and second compressing chambers;

first and second eccentric units mounted on the rotating shaft, and adapted to operate in opposite manners such that one of the first and second eccentric units selectively rotates an associated one of the first and second sleeves in an eccentric state in accordance with the rotating direction change of the rotating shaft, thereby causing the associated sleeve to perform a compression operation in an associated one of the first and second compressing chambers, while the other eccentric unit idly rotates the other sleeve associated therewith in the other compressing chamber associated therewith during the compression operation caused by the one eccentric unit; and

first and second vanes respectively arranged in the first and second compressing chambers to be radially movable between extended positions thereof and retracted positions thereof.

3. The variable capacity rotary compressor according to claim 1, wherein the drive motor is a brushless DC motor.

4. The variable capacity rotary compressor according to claim 1, wherein the drive motor is an inverter motor.

5. The variable capacity rotary compressor according to claim 2, wherein:

the first eccentric unit comprises a first eccentric cam fixedly fitted around an outer surface of the rotating shaft in the first compressing chamber, and a first eccentric bush rotatably fitted around an outer surface of the first eccentric cam;

the second eccentric unit comprises a second eccentric cam fixedly fitted around the outer surface of the rotating shaft in the second compressing chamber, and a second eccentric bush rotatably fitted around an outer surface of the second eccentric cam; and

the compressing unit further comprises a locking unit adapted to lock the first and second eccentric bushes in opposite states in accordance with the rotating direction change of the rotating shaft such that one of the first and second eccentric bushes is locked in an eccentric state, while the other eccentric bush is locked in an eccentricity-released state.

6. The variable capacity rotary compressor according to claim 5, wherein:

the compressing unit further comprises a cylindrical connecting member adapted to connect the first and second eccentric bushes such that the first and second eccentric bushes have opposite eccentric directions; and

the locking unit comprises a locking slot provided at the connecting member to extend circumferentially, and a locking pin extending radially through the locking slot to be coupled to the rotating shaft such that the locking pin is engagable with the locking slot.

7. The variable capacity rotary compressor according to claim 5, wherein:

the first vane is arranged between suction and discharge ports of the first compressing chamber to be radially movable between an extended position thereof and a retracted position thereof while being in contact with an outer surface of the first sleeve; and

the second vane is arranged between suction and discharge ports of the second compressing chamber to be radially movable between an extended position thereof and a retracted position thereof while being in contact with an outer surface of the second sleeve.

8. A variable capacity rotary compressor comprising:

a housing defined therein with first and second compressing chambers having different volumes;

a rotating shaft adapted to rotate in the first and second compressing chambers;

first and second sleeves respectively arranged in the first and second compressing chambers;

an eccentric unit mounted on the rotating shaft, and adapted to operate the first and second sleeves such that one of the first and second sleeves rotates in an eccentric state when the rotating shaft rotates in a first direction, thereby performing a compression operation, while the other sleeve idly rotates during the compression operation, whereas, when the rotating shaft rotates in a second direction, the first and second sleeves perform operations opposite to the operations carried out when the rotating shaft rotates in the first direction, respectively; and

a drive motor adapted to rotate the rotating shaft in a first direction or in a second direction, the drive motor being variable in rotating speed in accordance with an electrical control operation.

9. The variable capacity rotary compressor according to claim 8, wherein the eccentric unit comprises:

first and second eccentric cams fixedly fitted around an outer surface of the rotating shaft in the first and second compressing chambers, respectively;

first and second eccentric bushes rotatably fitted around respective outer surfaces of the first and second eccentric cams; and

a locking unit adapted to lock the first and second eccentric bushes in opposite states in accordance with a change of a rotating direction of the rotating shaft such that one of the first and second eccentric bushes is locked in an eccentric state, while the other eccentric bush is locked in an eccentricity-released state.

10. The variable capacity rotary compressor according to claim 8, wherein the eccentric unit further comprises:

a first vane arranged between suction and discharge ports of the first compressing chamber to be radially movable between an extended position thereof and a retracted position thereof while being in contact with an outer surface of the first sleeve; and

a second vane arranged between suction and discharge ports of the second compressing chamber to be radially movable between an extended position thereof and a retracted position thereof while being in contact with an outer surface of the second sleeve.

11. The variable capacity rotary compressor according to claim 8, wherein the drive motor is a brushless DC motor.

12. The variable capacity rotary compressor according to claim 8, wherein the drive motor is an inverter motor.

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