United States Patent [19]

Sawai et al.

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[45] **Mar. 27, 1973**

[54] REVERSIBLE ROTARY COMPRESSOR FOR REFRIGERATORS

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[73] Assignee: **Daikin Kogyo Co., Ltd.,** Osaka, Japan

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[21] Appl. No.: **102,383**

[30] **Foreign Application Priority Data**

Dec. 30, 1969 Japan 44/293

[52] **U.S. Cl.** **418/159,** 137/625.21, 137/625.46

[51] **Int. Cl.** **F01c 21/12,** F04c 15/02, F04c 29/08

[58] **Field of Search** 418/159, 160, 239, 270; 417/326, 410, 902; 137/625.21, 625.46; 62/84, 470

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[57] **ABSTRACT**

A reversible rotary compressor for use in refrigerators, in which a suction mechanism and a discharge mechanism are provided in a rotary member which is rotated in the same direction by a rotor of the compressor in frictional engagement therewith, and sucking and discharging operations of said mechanisms are automatically switched by changing the direction of rotation of said rotor; and which, therefore, is completely free of back flow of gas, is operable with minimum power consumption, has a constant compressing ability in both the counterclockwise rotation and the clockwise rotation of the rotor, has a minimum number of suction ports and hence a minimum top clearance volume, and is high in compressing efficiency. By employing the compressor in heat pump-type air conditionars, there can be obtained such an advantage that the operation of the air conditioner can be switched from cooling operation to heating operation or vice versa, only by changing the direction of rotation of the compressor rotor without using a directional control valve in a refrigerant circuit, which has been indispensable heretofore.

11 Claims, 16 Drawing Figures

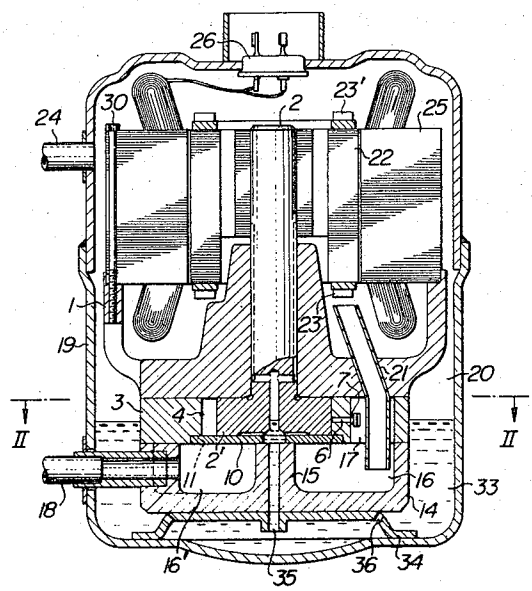
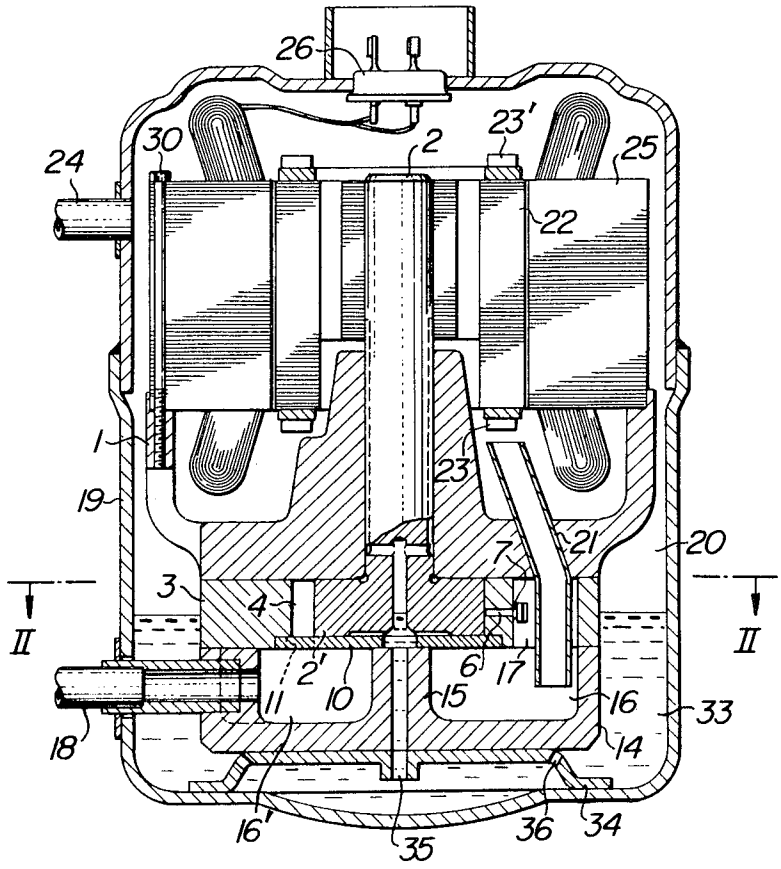


FIG. 1



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FIG. 2

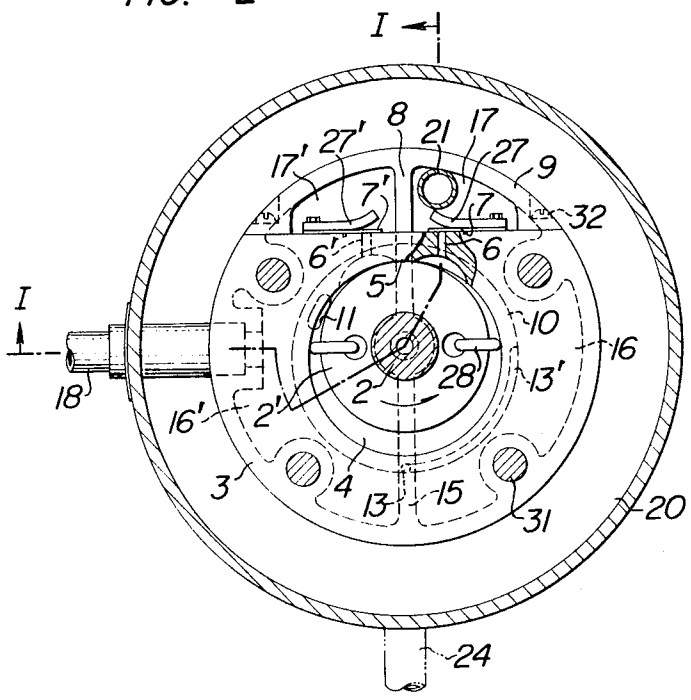
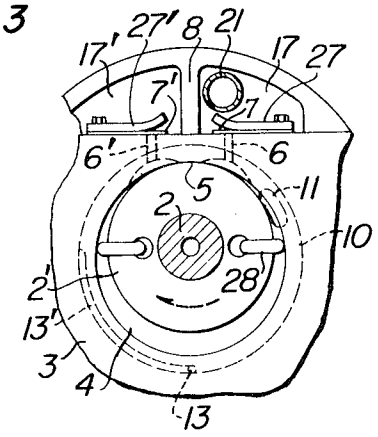


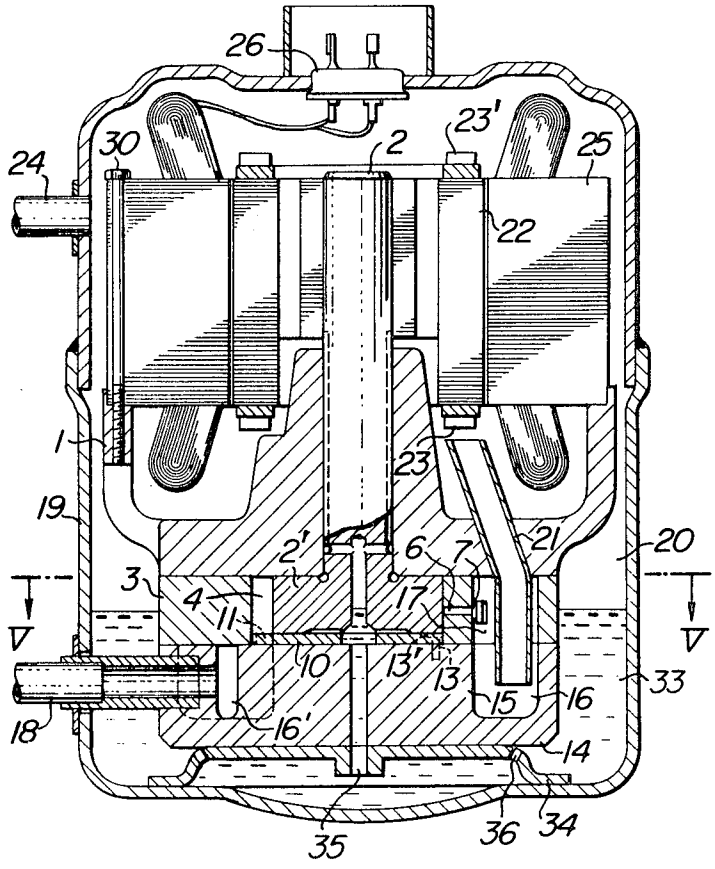
FIG. 3



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FIG. 4



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FIG. 5

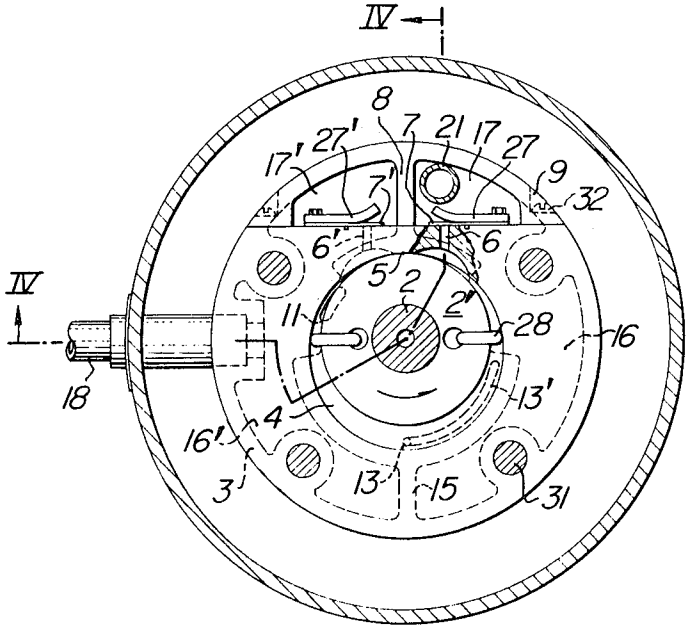
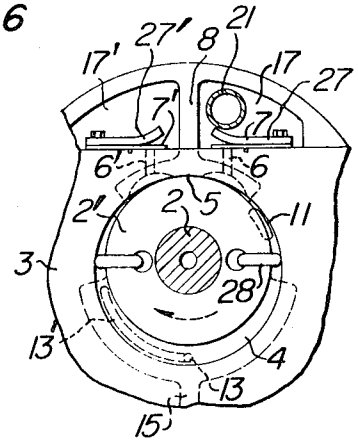


FIG. 6



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FIG. 8

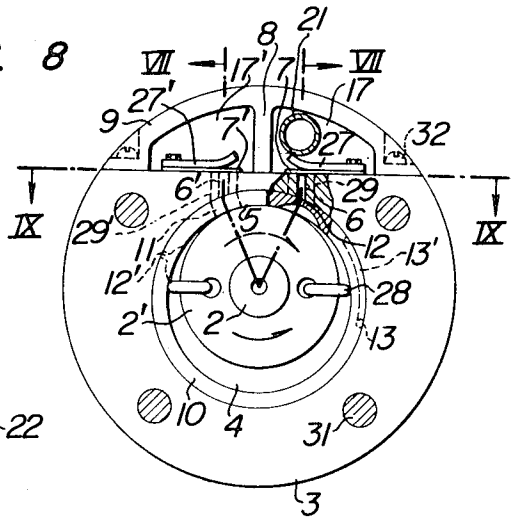


FIG. 7

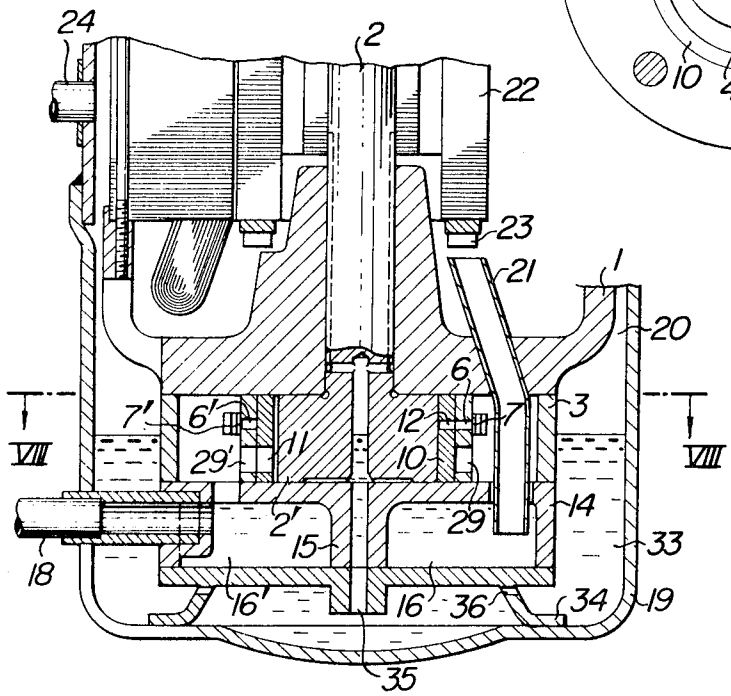


FIG. 9

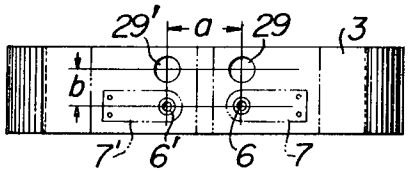
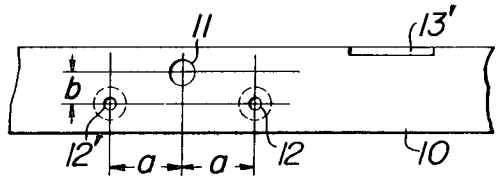


FIG. 10



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FIG. 11

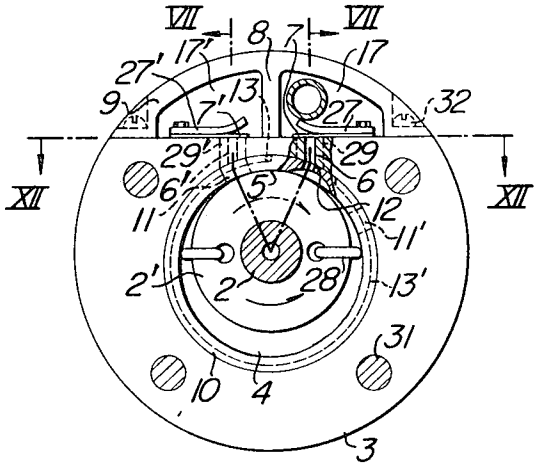


FIG. 12

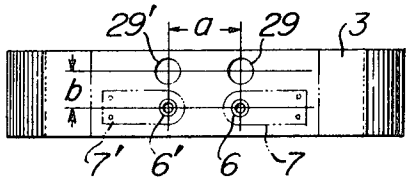
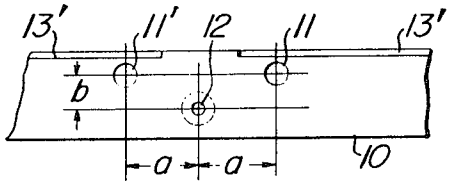


FIG. 13



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FIG. 14
PRIOR ART

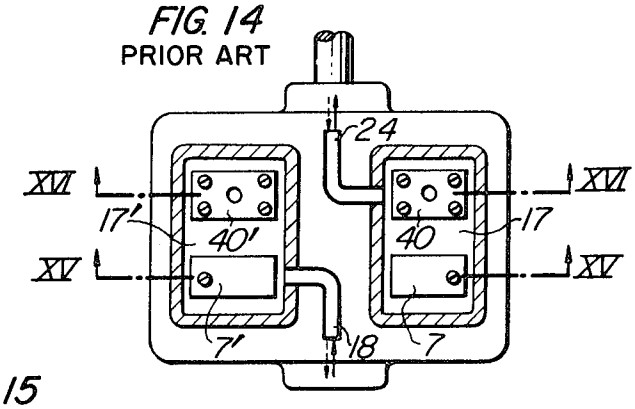


FIG. 15
PRIOR ART

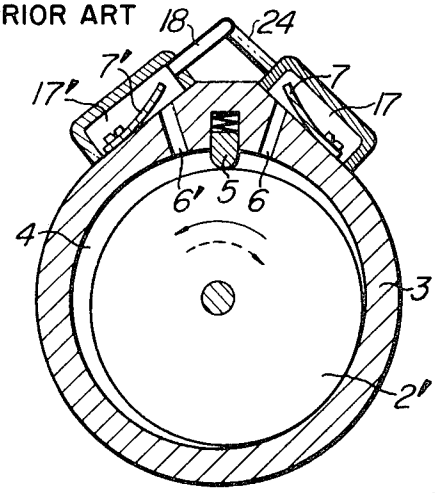
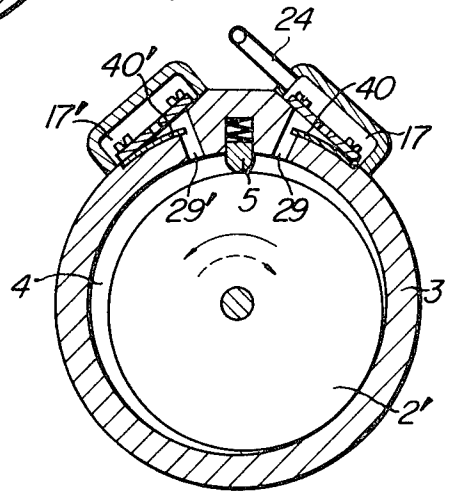


FIG. 16 PRIOR ART



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REVERSIBLE ROTARY COMPRESSOR FOR REFRIGERATORS

This invention relates to a reversible rotary compressor adapted for use in refrigerators, particularly in heat pump-type air conditioners, with which the operation of the cooling and heating apparatus can automatically be switched from cooling operation to heating operation or vice versa, without using a directional control valve which has been indispensable for conventional heat pump-type air conditioners for changing the direction of flow of a refrigerant passing through a refrigerant circuit, by reason of the fact that the compressor used in the conventional apparatus is rotated in one direction only.

The most important problem encountered in reversing the rotating direction of the rotor in a compressor is that the positions of the suction mechanism and the discharge mechanism must alternately be changed to left or right with respect to the pressure transition point, and this problem has not been solved as yet. It is for this reason that a reversible rotary compressor has not been in use. The reversible rotary compressor of the present invention has been achieved by making a special device such that the suction mechanism and discharge mechanism can automatically be switched. Conventional compressors for refrigerators for example, are classified into a reciprocating type and a rotary type. The reciprocating type compressor had the disadvantage that the flowing direction of a refrigerant cannot be reversed, while the rotary type compressor had the disadvantage that, since a suction port only is provided on the suction side and a discharge port only is provided on the discharge side with respect to the pressure transition point, the sucking and discharging directions are inevitably fixed and the practical use of the compressor as a reversible compressor is impossible.

However, the following type of reversible rotary compressor has been proposed: Namely, as shown in FIGS. **14** to **16** (wherein parts corresponding to those of the compressor according to the present invention are indicated by the same reference numerals), a pair of suction ports **29**, **29'** and a pair of discharge ports **6**, **6'** are provided through the wall of a cylinder **3** on both sides of a pressure transition point **5** in a compression chamber **4**, and a gas passage tube **24** or **18** is communicated with a chamber **17** or **17'** formed exterior of the compression chamber **4**, so as to provide for reversible operation of the compressor. With such a construction, however, where the compression ratio of gas is high as in case of a refrigeration cycle, the gas discharged from a discharge valve is so high in pressure that, when the high pressure gas is discharged from the compression chamber **4**, for example, through the discharge port **6**, a suction valve **40** is held in a closed position under the pressure of the gas, but in a suction stroke the suction valve **40** is opened by the force of the pressure gas in the chamber **17**, as both the suction valve **40** and the discharge valve **7** are in the same chamber **17**, and a considerable amount of gas flows back into the compression chamber to be re-compressed therein. Therefore, the gas compressing efficiency of the compressor becomes inevitably low. Furthermore, in the compressor of the type described above the suction port **6** or **6'** generally extends into the compression chamber **4** of the cylinder and is large in diameter, so that the top clearance volume is large and the degree of re-expansion of the high pressure gas remaining in such port is also high, making the practical use of the compressor impossible.

In the present invention a device is made so as to prevent the suction gas and discharge gas from being mixed only on one side of a pressure transition point, even when a suction mechanism and a discharge mechanism are provided on both sides of the pressure transition point as in the prior art compressor described above. Namely, according to the invention a required number of suction openings and discharge openings are formed in a rotary member which is rotatable through a predetermined limited angle along with a rotor, and when gas is sucked into the left side and discharged from the right side of the pressure transition point for example, the discharge opening only of the suction and discharge openings on the right side of the rotary member is communicated with a gas passage channel and a gas inlet channel is closed by the wall of said rotary member upon rotation of the rotor in a counterclockwise direction, whereby the back flow of gas as encountered in the prior art compressor is completely prevented, while upon rotation of the rotor in a clockwise direction, the rotary member is also rotated through the predetermined angle and the left side discharge opening and the right side suction opening only are respectively communicated with the gas passage channels, whereby the relative position of the suction mechanism and the discharge mechanism is switched.

An object of the present invention is to provide a reversible rotary compressor for use in refrigerators which is so designed that the relative position of a suction mechanism and a discharge mechanism is switched automatically by the rotation of a rotary member which is rotated in the same direction as a rotor in frictional engagement therewith when said rotor is reversibly rotated in a counterclockwise or clockwise direction; and which, therefore, is completely free of back flow of compressed gas, is operable with minimum power consumption and has a constant compressing ability in both the counterclockwise rotation and the clockwise rotation of the compressor.

Another object of the invention is to provide a reversible rotary compressor of the character described above, wherein said rotary member is provided with only one suction opening to constitute the suction mechanism, so as to eliminate excess suction openings on the high pressure side and thereby to minimize the top clearance and enhance the compressing efficiency.

Still another object of the invention is to provide a reversible rotary compressor of the character described above, wherein the position of said rotary member to switch the relative position of the suction mechanism and the discharge mechanism upon completion of its rotation through a predetermined angle in frictional engagement with said rotor is set by the abutting engagement of a stopper pin, provided on a cylinder or a rear head, with one end of an arcuate groove formed in the outer peripheral edge of said rotary member.

Still another object of the invention is to provide a reversible rotary compressor of the character described above, wherein a chamber having a silencing effect is

provided between said discharge mechanism and a gas passage tube through which compressed gas in the compression chamber is led to an external refrigeration circuit, whereby the noise of the compressor can be silenced without providing a separate silencer externally of the compressor.

A further object of the invention is to provide a reversible rotary compressor of the character described above, which when employed in a heat pump-type air conditioners, enables the operation of said apparatus to be switched from cooling operation to heating operation or vice versa by only changing the rotating direction of the compressor, without using a directional control valve in the refrigerant circuit, and further enable the heating rate to be accelerated in the heating operation of the apparatus by producing a low pressure dome in a housing of said apparatus and thereby minimizing the refrigerant gas dissolved in lubricating oil by evaporation and enabling the entire heat of compression to be utilized by a heat exchanger.

An additional object of the invention is to provide a reversible rotary compressor of the character described above, wherein the refrigerant gas is caused to flow adjacent radial blades of the rotor during its passage from the compression chamber to the external gas passage tube, whereby the separation of the lubricating oil and the refrigerant gas is promoted.

FIG. 1 is a cross-sectional side view, taken on the line I—I of FIG. 2, of an embodiment of the reversible rotary compressor for refrigerators according to the present invention, which comprises a disc-shaped rotary member;

FIG. 2 is a transverse cross-sectional view of the compressor rotating in a counterclockwise direction, taken on the line II—II of FIG. 1; and

FIG. 3 is a fragmentary transverse cross-sectional view of the compressor rotating a clockwise direction, similarly taken on the II—II of FIG. 1;

FIG. 4 is a cross-sectional side view, taken on the line of IV—IV of FIG. 5, of another embodiment of the invention, which is a modification of the embodiment shown in FIGS. 1 to 3;

FIG. 5 is a transverse cross-sectional view of the compressor of FIG. 4 rotating in a counterclockwise direction, taken on the line V—V of FIG. 4; and

FIG. 6 is a fragmentary transverse cross-sectional view of the compressor of FIG. 4 rotating in a clockwise direction, similarly taken on the line V—V of FIG. 4;

FIG. 7 is a cross-sectional side view, taken on the line VII—VII of FIG. 8, of still another embodiment of the invention, which comprises a ring-shaped rotary member;

FIG. 8 is a transverse cross-sectional view of the compressor of FIG. 7 taken on the line VIII—VIII of FIG. 7;

FIG. 9 is a side view of the cylinder looking in the direction of the arrows IX—IX of FIG. 8;

FIG. 10 is a developed side view of the ring-shaped rotary member;

FIG. 11 is a transverse cross-sectional view, taken on the line of VIII—VIII of FIG. 7, of still another embodiment of the invention which is a modification of the embodiment shown in FIGS. 7 to 10;

FIG. 12 is a side view of the cylinder looking in the direction of the arrows XII—XII of FIG. 11;

FIG. 13 is a developed side view of the rotary member used in the embodiment of FIG. 11;

FIG. 14 is a plan view, partially broken away, of a conventional rotary compressor; and

FIGS. 15 and 16 are cross-sectional side views of the conventional rotary compressor taken on the lines XV—XV and XVI—XVI of FIG. 14 respectively.

The present invention will be described in detail hereinafter with reference to the embodiments shown in the accompanying drawings. In FIGS. 1 to 3, there is shown an embodiment of the compressor according to the present invention in which a rotary guide plate having one suction opening formed therein is interposed as a rotary member between a rotor and a chamber so as to be driven by the friction with the rotating rotor. The suction opening may be shifted to the left or right by the rotation of the rotary guide plate. As shown in FIG. 1, an electric motor and a compressing mechanism are air-tightly accommodated in a housing 19 of the compressor. Namely, the compressor is a so-called sealed compressor. The electric motor is composed of a stator 25 and a rotor 22, while the compressing mechanism is composed of a front head 1 supporting the stator 25, a rear head 14 disposed below said front head, and a cylinder 3, a rotor 2′ and a disc-shaped rotary guide plate 10 which are interposed between said front head 1 and said rear head 14. A rotor shaft 2 is provided coaxially with the front head 1 and extended into the rotor 22 of the electric motor. The rotor 2′ integral with the rotor shaft 2 is eccentrically mounted in a compression chamber 4 defined by the cylinder 3. The rotor 2′ is in contact with the wall of the compression chamber 4 at a pressure transition point 5, dividing said compression chamber 4 into a low pressure side and a high pressure side. The cylinder 3 is provided with discharge ports 6, 6′ each on each side of the pressure transition point 5, and at the outer ends of said discharge ports 6, 6′ are respectively provided with discharge valves 7, 7′ to prevent back flow of discharge gas and valve guards 27, 27′ to limit the openings of said discharge valves 7, 7′. These two discharge ports, discharge valves and valve guards constitute a discharge mechanism. A side cover 9 is secured to the cylinder 3 by means of bolts 32 and the space defined by said side cover 9 and the cylinder 3 is divided into two chambers 17, 17′ by a partition wall 8 integral with said side cover 9. The discharge ports 6, 6′ are communicated with the chambers 17, 17′ through the discharge valves 7, 7′ respectively.

Reference numeral 10 designates a rotary member which constitutes a suction mechanism which is the essential portion of the present invention. The rotary member 10 consists of a disc-shaped rotary guide plate rotatably loosely mounted in the cylinder 3 and having one suction opening 11 axially bored therethrough. The rotary guide plate 10 is in plane contact with the lower surface of the rotor 2′, so as to be rotated in the same direction by the friction with the side surface of the rotor 2 and the side surfaces of blades 28. An arrangement is made such that the rotary guide plate is rotatably only through a predetermined angle so that the suction opening 11 may be shifted to the left or right of the pressure transition point 5 and positioned on the low pressure side of the compression chamber 4 when the rotor 2′ rotates in a counterclockwise direction as indicated by the solid line arrow or in a

clockwise direction as indicated by the dotted line arrow. Namely, in the embodiment of FIGS. 1 to 3 the rotary guide plate 10 is formed in the peripheral edge thereof with an arcuate groove 13' extending over the circumferential length corresponding to the aforesaid predetermined angle, while the cylinder 3 is provided with a fixed stopper pin 13 which is received in said arcuate groove 13' of the rotary guide plate 10, and the rotary guide plate 10 is positioned with the suction opening 11 located on the low pressure side of the compression chamber 4, by the abutting engagement of the stopper pin 13 with either end of the arcuate groove 13'. Modifications and changes are of course possible to the details of such arrangement.

Namely, the stopper pin 13 may be provided on the rear head 14 disposed below the cylinder 3, as shown in the embodiment of FIGS. 4 to 6. In this case, the rotor 2' is mounted interior of the cylinder 3 and the arcuate groove 13' of the rotary guide plate 10 is provided at a portion adjacent the outer periphery of the rotor 2'.

As stated, in the embodiment of FIGS. 1 to 3 the sliding blades 28 are provided on the rotor 2' and the rotary guide plate 10 is rotated by the friction with said rotor 2' and sliding blades 28. However, such sliding blades 28 are not essential and retractable partition blades (blades of the type indicated at 5 in FIGS. 15 and 16) may be provided instead of the sliding blades 28. In this case, the rotary guide plate 10 is rotated only by the friction with the rotor 2'.

The rear head 14 which is disposed below the cylinder 3 and axially supports the rotary guide plate 10, has a rib 15 by which the interior of the rear head 14 is divided at substantially the center thereof into two chambers 16, 16' which serve as silencer. The rib 15 is in sealing contact with the partition wall 8 of the side cover 9 which is secured to the cylinder 3, and the chambers 16, 16' in the rear head 14 are communicated with the chambers 17, 17' in the side cover 9 respectively. Thus, when the rotor 2' rotates, the suction opening 11 bored axially through the rotary guide plate 10 is rotated in the same direction and brought into communication with the chamber 16 or 16' in the rear head 14. Reference numeral 31 designates bolts by which the cylinder 3 and the rear head 14 are secured to the front head 1, and 34 designates a member by which the electric motor and the compressing mechanism are securely mounted in the housing 19. The member 34 is formed with an oil passage hole 35 at the center thereof, through which lubricating oil 33 stored in the lower portion of the cavity 20 in the housing 19 is sucked upwardly, and also provided with a suitable number of refrigerant gas releasing holes 36 at a shoulder thereof. The lubricating oil 33 sucked up through the oil passage hole 35 is supplied to the front head 1 and other portions to be lubricated, through oil passage holes formed in the center of the rear head 14, the rotary guide plate 10 and the rotor 2' respectively and thence through oil passage channels formed in the outer peripheral surface of the shaft of the rotor 2.

Reference numeral 18 designates a gas passage tube which extends air-tightly into the housing 19 and communicates with the chamber 16' in the rear head 14 but does not communicate with the cavity 20 in the housing 19. Another gas passage tube 24 extends air-tightly into the housing 19 and communicates with the cavity 20 in the housing 19. A gas passage tube 21 disposed interior of the housing 19 has its lower end communicated with the chamber 16 and its open upper end located adjacent lower radial blades 23 fixed to the rotor 22 of the electric motor. Reference numeral 23' designates upper radial blades fixed to the rotor 22. The stator 25 of the electric motor is secured to the front head 1 by bolts 30 and supplied with a power from an external power source through a terminal 26 which is air-tightly fitted in the housing 19.

When the rotor shaft 2 is driven in the direction of the solid line arrow (FIG. 2), the rotary guide plate 10 is rotated in the same direction by the friction with the side surface of the rotor 2' and the side surfaces of the sliding blades 28, and is brought into a position as determined by one end of the arcuate groove 13' of said rotary guide plate 10 and the stopper pin 13 provided on the rear head 14, in which the suction opening 11 is located on the low pressure side of the compression chamber 4 (on the left side of the pressure transition point 5 as viewed in FIG. 2). Under such condition, the gas sucked into the compressor through the gas passage tube 18 flows into the low pressure side of the compression chamber 4 of the cylinder 3 through the rear head chamber 16' and the suction opening 11. The gas compressed in the compression chamber 4 by the ordinary means is led into the rear head chamber 16 through the discharge port 6 on the high pressure side and the chamber 17, wherein it is expanded and silenced, and then introduced into the internal gas passage tube 21. Then, the gaseous refrigerant is separated from the lubricating oil by the radial blades 23 of the rotor 22, and discharged through the other gas passage tube 24 after passing through the cavity 20 in the housing 19.

On the other hand, when the rotor shaft 2 rotates reversely in the direction of the dotted line arrow (FIG. 3), the rotary guide plate 10 is rotated in the reverse direction and positioned on the opposite side to the preceding case with respect to the pressure transition point 5 (on the right side as viewed in FIG. 3), by the abutting engagement between the other end of the arcuate groove 13' and the stopper pin 13. In this case, the gas is sucked into the cavity 20 of the housing 19 through the other gas passage tube 24 and after being separated from the lubricating oil by the radial blades 23 of the rotor, introduced into the rear head chamber 16 through the internal gas passage tube 21 and thence into the low pressure side of the compression chamber 4 through the suction opening 11 in the rotary guide plate 10. The gas compressed in the compression chamber 4 by the ordinary means flows from the high pressure side of said compression chamber 4 into the rear head chamber 16' through the discharge port 6' and the chamber 17' and is discharged through the gas passage tube 18. In the cavity 20 of the housing 19, a high pressure appears when the compressor is driven in the direction of the solid line arrow, and a low pressure appears when the same is driven reversely in the direction of the dotted line arrow.

In the above-described operation, since the only one suction opening 11 formed in the rotary guide plate 10 is located on the low pressure side and not on the high pressure side of the compression chamber 4, no compressed gas is allowed to flow backward from the com-

pression chamber. Further, since the discharge port **6** or **6'** is provided with the discharge valve **7** or **7'** and the discharge valve on the low pressure side which is not used then acts as a check valve, a smooth operation can be obtained.

Although in the embodiment described above, the rotary guide plate **10** is rotatably mounted between the lower end of the rotor **2'** and the rear head **14**, another embodiment of the invention shown in FIGS. **7** to **13** comprises different types of the cylinder and rotary member as the discharge mechanism and the suction mechanism. In this embodiment of the compressor, a ring-shaped rotary guide plate **10** coaxially loosely mounted in the cylinder and a rotor is eccentrically disposed within said rotary guide plate **10**, said rotary guide plate **10** being rotated by the friction with said rotor, whereby the suction and discharge operations are accomplished. The other portions of the construction are the same as in the embodiment shown in FIGS. **1** to **6**, and the corresponding parts are designated by the same reference numerals.

Namely, FIGS. **7** to **10** shows another embodiment of the invention in which the rotary guide plate **10** is formed therein with one suction opening and two discharge openings. As shown, the cylinder **3** is provided with a suction port **29** and a discharge port **6** which are open into the chamber **17** on one side of the partition wall **8** of the side cover **9**, a discharge valve **7** and a valve guard **17** to limit the degree of opening of said discharge valve **7**; and also with a suction port **29'** and a discharge port **6'** which are open into the chamber **17'** on the other side of the partition wall **8**, a discharge valve **7'** and a valve guard **27'** to limit the degree of opening of said discharge valve **7'**. As shown in FIG. **9**, the suction ports **29**, **29'** and the discharge ports **6**, **6'** are respectively provided in the same horizontal planes perpendicular to the axis of rotation, i.e. the discharge ports **6**, **6'** are provided in one horizontal plane and the suction ports **29**, **29'** are provided in another horizontal plane; and the suction port **29** and the discharge port **6**, and the suction port **29'** and the discharge port **6'** are respectively provided in the same vertical planes parallel to the axis of rotation. On the other hand, the rotary guide plate **10** rotatably loosely mounted in the cylinder **3** is provided therethrough with one suction opening **11** and two discharge openings **12**, **12'** on both sides of said suction opening **11** in the manner shown in FIG. **10**, i.e. the discharge openings **12**, **12'** are located in two different vertical planes parallel to the axis of rotation respectively but on the same horizontal plane perpendicular to the axis of rotation. The circumferential distance *a* between the suction opening **11** and the discharge opening **12** and between the suction opening **11** and the discharge opening **12'** is equal to the circumferential distance *a* between the discharge ports **6**, **6'** and between the suction ports **29**, **29'** in the cylinder **3**. Further, the axial distance *b* between the suction opening **11** and the discharge opening **12** and between the suction opening **11** and the discharge opening **12'** is equal to the axial distance *b* between the suction ports **29**, **29'** and the discharge ports **6**, **6'** in the cylinder **3** (FIGS. **9** and **10**). The two suction ports **29**, **29'** in the cylinder **3** and the suction opening **11** in the rotary guide plate **10** constitute a suction mechanism, while the two discharge ports **6**, **6'** in the cylinder **3** and the two discharge openings **12**, **12'** in the rotary guide plate **10** constitute a discharge mechanism. The other arrangement is identical with the preceding embodiment.

With the construction described above, when the rotor shaft **2** rotates in the direction of the solid line arrow in FIG. **8**, the rotary guide plate **10** is rotated in the same direction by the friction with the outer peripheral surface of the rotor **2'** and the outer edge surfaces of the sliding blades **28**, and is set in a position as determined by the stopper pin **13** provided on the rear head **14** and abutting against one end of the arcuate groove **13'** formed in the peripheral edge of said rotary guide plate **10** over a circumferential length corresponding to a predetermined angle of rotation of said rotary guide plate **10**. In this position of the rotary guide plate **10**, the discharge port **6'** on the low pressure side and the suction port **29** on the high pressure side of the cylinder **3** are closed by the wall of said rotary guide plate **10**, and the suction opening **11** and the discharge opening **12** of said rotary guide plate **10** are communicated with the suction port **29'** and the discharge port **6** of the cylinder **3** respectively. On the other hand, when the rotor shaft **2** rotates in a reverse direction indicated by the dotted line arrow in FIG. **8**, the rotary guide plate **10** is set in a position by the stopper pin **13** abutting against the other end of the arcuate groove **13'**, and in this position the discharge port **6** on the low pressure side and the suction port **29'** on the high pressure side of the cylinder **3** are closed by the wall of said rotary guide plate **10**, and the suction opening **11** and the discharge opening **12'** of said rotary guide plate are communicated with the suction port **29** and the discharge port **6'** of the cylinder **3** respectively. The other function of the compressor is identical with the case of the preceding embodiment.

In the above-described operation, since the suction port **29** or **29'** on the high pressure side of the cylinder **3** is closed by the wall of the rotary guide plate **10** as stated above, the back flow of the compressed gas is completely prevented. A still another embodiment of the invention, which is similar to the embodiment of FIGS. **7** to **10**, is shown in FIGS. **11** to **13**, in which the rotary guide plate **10** is provided with one discharge opening and two suction openings on both sides of said discharge opening. In this embodiment, the two discharge ports **6**, **6'** and two suction ports **29**, **29'** provided in and the two discharge valves **7**, **7'** provided on the cylinder **3** are the same as those in the embodiment of FIGS. **8** to **10** and, therefore, the description thereof will be omitted. The rotary guide plate **10** is provided with one discharge opening **12** and two suction openings **11**, **11'** on both sides of said discharge opening **12**, all of said ports extending perpendicularly of the axis of rotation. The circumferential distance *a* between the discharge opening **12** and the suction openings **11**, **11'** is equal to the circumferential distance *a* between the discharge ports **6**, **6'** and between the suction ports **29**, **29'** of the cylinder **3**, and the axial distance *b* between the discharge opening **12** and the suction openings **11**, **11'** of the rotary guide plate **10** is equal to the axial distance *b* between the discharge ports **6**, **6'** and the suction ports **29**, **29'** of the cylinder **3**. The two suction ports **29**, **29'** of the cylinder **3** and the suction openings **11**, **11'** of the ro-

tary guide plate **10** constitute a suction mechanism, and the two discharge ports **6**, **6'** of the cylinder **3** and the one discharge opening **12** of the rotary guide plate **10** constitute a discharge mechanism. The other arrangement is identical with the embodiment of FIGS. **7** to **10** and the embodiment of FIGS. **1** to **3**.

With such construction, when the rotor shaft **2** rotates in the direction indicated by the solid line arrow in FIG. **11**, the rotary guide plate **10** is rotated in the same direction by the frinction with the rotor **2'** and the sliding blades **28** and set in a position determined by the stopper pin **13** provided on the rear head **14** and abutting against one end of the arcuate groove **13'** formed in the outer peripheral edge of said rotary guide plate **10** over a circumferential length corresponding to a predetermined angle of rotation of said rotary guide plate. In this position of the rotary guide plate **10**, the discharge opening **12** and the suction opening **11'** of said rotary guide plate are communicated with the discharge port **6** and the suction port **29'** of the cylinder **3** respectively, and the suction port **29** on the high pressure side and the discharge port **6'** on the low pressure side of the cylinder **3** are closed by the wall of said rotary guide plate **10**.

On the other hand, when the rotor shaft **2** rotates in an opposite direction indicated by the dotted line arrow in FIG. **11**, the rotary guide plate **10** is set in such a position, by the abutting engagement between the stopper pin **13** and the other end of the arcuate groove **13'**, that the suction opening **11** and the discharge opening **12** of said rotary guide plate are communicated with the suction port **29** and the discharge port **6'** of the cylinder **3** respectively, and suction port **29'** on the high pressure side and the discharge port **6** on the low pressure side of the cylinder **3** are closed by the wall of the ring-shaped rotary guide plate **10**. The other function of the compressor is identical with the cases of the preceding embodiments.

According to the embodiment of the invention described and illustrated herein, it is possible to automatically control the direction of suction or discharge by the friction between rotor and rotary member, only by changing the rotating direction of the rotor of the compressor without the necessity of providing special parts. However, it should be understood that the present invention is not restricted only to the embodiments shown but many modification and changes are of course possible to the details of the construction without deviating from the spirit of the invention, for instance, by inverting the relative position between the rotor, and the rotary guide plate and the rear head in the embodiment of FIGS. **1** to **3**.

According to the present invention, as described hereinabove, a suction mechanism and a discharge mechanism are provided in the rotary member and the cylinder, which rotary member is mounted in cylinder and rotated by the friction with the rotor, and after rotation of the rotary member, the discharge mechanism and suction mechanism which were in use before the rotation are completely closed to the state wherein no suction port is present on the high pressure side or a suction port on the high pressure side is closed. Therefore, no compressed gas is ever allowed to flow backward from the high pressure side chamber into the compression chamber. Thus, a highly efficient compressing effect can be obtained with a minimum power consumption and constant compressing efficiency.

Further, the type of compressor shown in FIGS. **1** to **6** or FIGS. **7** to **10** which is provided with only one suction port or suction opening, enables an extremely high compressing efficiency to be obtained as no surplus suction ports are present on the high pressure side and the so-called top clearance volume, i.e., the phenomenone in which the high pressure compressed gas remaining in the suction port which is previously on the discharge side, re-expands in the suction stroke, can be completely eliminated.

The compressor according to the present invention is highly suitable for use in heat pump-type air conditioners. The air conditioners incorporating the compressor of this invention have such an advantage that the operation of the air conditioner can be switched from cooling operation to heating operation or vice versa by only changing the rotating direction of the compressor, without using a refrigerant circuit changeover valve which has been indispensable for the conventional air conditioners.

According to the present invention, since the compressed gas is expanded and silenced in the interior of the rear head before it is discharged from the compression chamber to the outside through the discharge port, there is no necessity for providing a separate silencer, and further, since the interior gas passage tube for communicating the cavity in the housing with the compression chamber therethrough is disposed adjacent the radial blades fixed to the rotor of the electric motor, the separation of the lubricating oil and the refrigerant gas is promoted.

In conventional high pressure dome-type air conditioners a large quantity of heat is radiated from the housing during heating operation. Moreover, a refrigerant contained in lubricating oil in a high pressure circuit is not evaporated until after the housing is sufficiently heated, so that a considerably long time is required before hot air heated to a predetermined temperature is obtained in the initial stage of the heating operation, due to a shortage in quantity of the circulating refrigerant. However, by employing the compressor of the invention as a heat pump, a low pressure dome is produced within the housing and the quantity of the refrigerant circulating in the initial stage of the heating operation can be increased, so that the effective use of the heat of condensation becomes possible and the time required before the hot air is obtained can be shortened. It is also to be noted that the compressor of the present invention can be easily produced only by slightly modifying the conventional ones and, therefore, is low in cost. Thus, the present invention is of great practical value.

What is claimed is:

1. A reversible rotary compressor, for use in refrigerators, of the type which has a compressing mechanism, including:

a front head;

a rear head;

a cylinder disposed between the front and rear heads;

a rotor disposed eccentrically in said cylinder to define a compression chamber between the rotor and the cylinder longitudinally divided by adjacen-

cy of the cylinder and rotor, at a pressure transition point, into a low pressure side and a high pressure side;

a motor driving the rotor for sucking refrigerant gas into and discharging refrigerant gas from the compression chamber;

said compressor comprising:

a rotary member in frictional engagement with the rotor for rotation through a predetermined limited angle with the rotor, irrespective of the angular sense of rotation of the rotor;

a first suction conduit mechanism communicated with the compression chamber angularly to one side of the pressure transition point;

a first discharge conduit mechanism communicated with the compression chamber angularly to the opposite side of the pressure transition point;

a second suction conduit mechanism communicated with the compression chamber angularly to said opposite side of the pressure transition point;

a second discharge conduit mechanism communicated with the compression chamber angularly to said one side of the pressure transition point; and

means responsive to the direction of rotation of said rotary member for closing both first conduit mechanisms and opening both said second conduit mechanisms, alternately, to respectively provide for normal and reverse rotation operation of the compressor.

2. The reversible rotary compressor of claim 1 further comprising:

a first gas passage tube;

a second gas passage tube;

means alternately communicating the first discharge and second suction conduit mechanisms with the first gas passage tube; and

means alternately communicating the second suction and first discharge conduit mechanisms with the second gas passage tube.

3. The reversible rotary compressor of claim 2 wherein the discharge conduit mechanisms include:

a first discharge port provided through the cylinder angularly to one side of the pressure transition point; and a first discharge valve for opening and closing the first discharge port;

a second discharge port provided through the cylinder angularly to the opposite side of the pressure transition point; and a second discharge valve for opening and closing the second discharge port;

said rotary member being constituted by a disc-shaped rotary guide plate disposed in said cylinder and having means defining an opening axially therethrough for alternately forming a part of both of said suction conduit mechanisms, so that as said rotary guide plate is angularly shifted between the extremes of said predetermined limited angle, the axial opening is alternately communicated with the first compression chamber angularly clockwise from the pressure transition point and angularly counterclockwise from the pressure transition point, in both instances on the low pressure side of the pressure transition point.

4. The reversible rotary compressor of claim 3 wherein said rotary guide plate has means defining an arcuate groove formed in the outer periphery thereof and extending arcuately an amount corresponding to said predetermined limited angle, one of said cylinder and said rear head having pin means mounted thereon and received in said groove for limiting angular movement of said rotary guide plate to said predetermined, limited angle.

5. The reversible rotary compressor of claim 2, wherein the discharge conduit mechanisms include:

a first discharge port provided through the cylinder angularly to one side of the pressure transition point; and a first discharge valve for opening and closing the first discharge port;

a second discharge port provided through the cylinder angularly to the opposite side of the pressure transition point; and a second discharge valve for opening and closing the second discharge port;

a second suction port provided radially through the cylinder on the same side of the pressure transition point as the first discharge port;

a first suction port provided radially through the cylinder on the same side of the pressure transition point as the second discharge port;

the two discharge ports opening radially outwardly at a plane axially spaced from that of the two suction ports;

the first suction port and the second discharge port opening in a common plane parallel to the axis of rotation of the rotary member;

the second suction port and the first discharge port opening in another common plane parallel to the axis of rotation of the rotary member;

the rotary member being constituted by a ring-shaped rotary guide plate journalled in the cylinder for rotation around the rotor;

said guide plate having means defining:

one suction opening radially therethrough and two discharge openings radially therethrough, one disposed angularly to each side of the one suction opening; the relative spacing, angularly of said axis of rotation, of said one suction opening and each of said two discharge openings, being equal to that of said first and second suction ports and to that of said first and second discharge ports; the relative spacing, axially of said axis of rotation, of said one suction opening and said two discharge openings being equal to that of said the two discharge ports and the two suction ports, the rotary guide plate being rotated between the extremes thereof in dependence upon the direction of rotation of the rotor to align the respective ports and openings.

6. The reversible rotary compressor of claim 5 wherein said rotary guide plate has means defining an arcuate groove formed in the outer periphery thereof and extending arcuately an amount corresponding to said predetermined limited angle, one of said cylinder and said rear head having pin means mounted thereon and received in said groove for limiting angular movement of said rotary guide plate to said predetermined, limited angle.

7. The reversible rotary compressor of claim 2, wherein the discharge conduit mechanisms include:

a first discharge port provided through the cylinder angularly to one side of the pressure transition point; and a first discharge valve for opening and closing the first discharge port;

a second discharge port provided through the cylinder angularly to the opposite side of the pressure transition point; and a second discharge valve for opening and closing the second discharge port;

a second suction port provided radially through the cylinder on the same side of the pressure transition point as the first discharge port;

a first suction port provided radially through the cylinder on the same side of the pressure transition point as the second discharge port;

the two discharge ports opening radially outwardly at a plane axially spaced from that of the two suction ports;

the first suction port and the second discharge port opening in a common plane parallel to the axis of rotation of the rotary member;

the second suction port and the first discharge port opening in another common plane parallel to the axis of rotation of the rotary member;

the rotary member being constituted by a ring-shaped rotary guide plate journalled in the cylinder for rotation around the rotor;

said guide plate having means defining:

one discharge opening radially therethrough and two suction openings radially therethrough, one disposed angularly to each side of the one discharge opening; the relative spacing, angularly of said axis of rotation, of said one discharge opening and each of said two suction openings, being equal to that of said first and second discharge ports and to that of said first and second suction ports; the relative spacing, axially of said axis of rotation, of said one discharge opening and said two suction openings being equal to that of said the two discharge ports and the two suction ports, the rotary guide plate being rotated between the extremes thereof in dependence upon the direction of rotation of the rotor to align the respective ports and openings.

8. The reversible rotary compressor of claim **7** wherein said rotary guide plate has means defining an arcuate groove formed in the outer periphery thereof and extending arcuately an amount corresponding to said predetermined limited angle, one of said cylinder and said rear head having pin means mounted thereon and received in said groove for limiting angular movement of said rotary guide plate to said predetermined, limited angle.

9. The reversible rotary compressor of claim **2** further including:

means directly connecting said electric motor and said rotor;

a housing;

said electric motor, rotor and directly connecting means being sealed within said housing;

the first gas passage to be sealingly communicating alternately with the two respective conduit mechanisms via the cavity defined within said housing outside said electric motor, rotor and directly connecting means in dependence upon the direction of rotation of said rotor;

the second gas passage tube directly sealing communicating alternatively with the other two respective conduit mechanisms in sealed isolation from said cavity in dependence upon the direction of rotation of said rotor;

10. The reversible rotary compressor of claim **9** wherein the two discharge conduit mechanisms comprise two discharge ports provided through the cylinder on respective sides of the pressure transition point; means sealingly dividing the interior of the rear head into two chambers; one of the chambers and a respective one of said discharge ports being communicated with said first gas passage tube; and the other of said discharge ports, the other of said chambers, said cavity being communicated with the second gas passage tube, whereby the compressed gas from the high pressure side of the pressure transition line is expanded and silenced in a respective one of said chambers, depending on the direction of rotation of the rotor, before being discharged through a respective one of the discharge ports through the respective gas passage tube.

11. The reversible rotary compressor of claim **10**, wherein the electric motor includes a rotor having a plurality of radial blades; an interior gas passage tube having one end disposed adjacent said blades and the other end in communication with the first-mentioned of said chambers.

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