

Description

This invention relates to a hermetically sealed scroll type compressor.

A hermetically sealed scroll type compressor is disclosed in Japanese Patent Application Publication No. 59-110,883 and is shown in Figure 2. Hermetically sealed housing 200 includes inner chamber 210 which is maintained at discharge pressure. The compression mechanism, including inner fitting scrolls 220, 230 and the upward end of the drive mechanism including drive shaft 240, are disposed between partition 250 and the end plate of stationary scroll 220, and are isolated from inner chamber 210. Drive shaft 240 is rotatably and closely supported by partition 250 through fixed plain bearing 251. A plurality of fluid pockets 300 are formed between the spiral portions of inner fitting scrolls 220 and 230. Channel 260 extends through the end plate of orbiting scroll 230 and links intermediate fluid pocket 301 with isolated chamber 270 formed between the end plate of orbiting scroll 230 and partition 250.

In operation, refrigerant gas flows through inlet port 280 and is compressed inwardly by scrolls 220 and 230 towards central fluid pocket 302 due to orbital motion of orbiting scroll 230. Compressed fluid in central fluid pocket 302 is discharged into discharge chamber 211 through hole 221 extending through the end plate of stationary scroll 220. Compressed refrigerant gas flows from discharge chamber 211 into inner chamber 210 through cavity 210a, and thereafter flows out of the compressor to the external fluid circuit through outlet port (not shown). After circulating through the refrigerating system, the refrigerant gas which exits through the outlet port returns to the compressor.

In the prior art, channel 260 extends through the end plate of orbiting scroll 230 and links intermediate fluid pocket 301 with isolated chamber 270. Thereby, a part of the intermediately compressed refrigerant gas is conducted into isolated chamber 270. Consequently, isolated chamber 270 is maintained at intermediate pressure which generates the appropriate upwardly axial urging force acting on orbiting scroll 230. Accordingly, the axial seal of fluid pockets 300 can be well done without generation of excessive friction between the spiral portion and the end plate of scrolls 220 and 230.

Even though drive shaft 240 is closely supported by partition 250 through fixed plain bearing 251, slight air gaps are created between drive shaft 240 and fixed plain bearing 251 due to manufacturing and assembling errors of the compressor, and frictional abrasion of both drive shaft 240 and fixed plain bearing 251. This may allow leakage of discharge refrigerant gas from inner chamber 210 into isolated chamber 270, thereby causing increase of pressure in isolated chamber 270. Therefore, the upwardly axial urg-

ing force acting on orbiting scroll 230 may exceed the certain value which can maintain the appropriate axial seal of fluid pockets 300. Eventually, excessive friction between the spiral portion and the end plate of scrolls 220 and 230 occurs, thereby causing serious damage to the compressor.

Furthermore, a hermetically sealed scroll type compressor as another prior art of this invention was imagined by an inventor of this invention. The imagined compressor comprises an isolated chamber formed between a stationary scroll and a partition both which are substantially identical to stationary scroll 220 and partition 250 in Figure 2, respectively. The isolated chamber is maintained suction pressure due to suction pressure refrigerant gas being conducted therein from an external refrigeration circuit through a pipe member. In this prior art, slight air gaps are created between a drive shaft and a fixed plain bearing as well as the above mentioned prior art. This may allow leakage of discharge refrigerant gas from an inner chamber, which is substantially identical to inner chamber 210 in Figure 2, into the isolated chamber, thereby causing increase of pressure in the isolated chamber, that is, causing a rise in temperature of suction refrigerant gas. Eventually, the defects of the compressor, such as, a decline of compression efficiency and an excessive rise in temperature of discharged refrigerant gas may be occurred.

DE-A-3422389 discloses a scroll type compressor with a hermetically sealed housing; a fixed scroll disposed within the housing and having a first end plate from which a first spiral element extends; an orbiting scroll having a second end plate from which a second spiral element extends, the first and second spiral elements interfitting at an angular and radial offset to form a plurality of line contacts which define at least one pair of sealed fluid pockets; a drive mechanism operatively connected to the orbiting scroll to effect orbital motion of the orbiting scroll; a rotation preventing means for preventing the rotation of the orbiting scroll during orbital motion whereby the volume of the fluid pockets changes to compress fluid in the pockets; the drive mechanism including a drive shaft, the axis of which is substantially vertical when the compressor is in use, and which is rotatably supported within an inner block member which is fixed to the housing; the first end plate of the fixed scroll and the inner block member forming an isolated cavity therebetween; a discharge chamber formed exterior to the isolated cavity between the outer surface of the first end plate the inner block member and the interior surface of the housing, the first and second spiral elements being disposed in the isolated cavity; and the discharge chamber being provided with an outlet portion, which, in use, conducts discharged refrigerant gas to the external refrigeration circuit from the discharge chamber, and, according to the present invention, such a compressor is characterised by shaft seal

means disposed within the isolated cavity around the drive shaft, the shaft seal means being arranged to insulate the isolated cavity from discharge pressure in the discharge member; and by the isolated cavity being connected to a suction gas inlet so as to be, in use, at inlet pressure.

In the accompanying drawings:

Figure 1 is a vertical longitudinal section of a hermetically sealed scroll type compressor in accordance with one embodiment of the present invention; and,

Figure 2 is a vertical longitudinal section of a hermetically sealed scroll type compressor in accordance with one prior art.

With reference to Figure 1, a hermetically sealed scroll type compressor in accordance with one embodiment of the present invention is shown. As illustrated in Figure 1, the compressor is designed to locate an axis of a drive shaft generally perpendicular to a horizontal plane, when installed. Accordingly, in general, the compressor is called a vertically installed type compressor.

The compressor includes hermetically sealed casing 10' comprising cup-shaped casings 12' and 13' hermetically fixed to each other at the opening end thereof, fixed and orbiting scrolls 20 and 30, inner block member 40 and motor 50. Fixed scroll 20 includes circular end plate 21 and spiral element or wrap 22 extending downwardly from one end surface of end plate 21. Orbiting scroll 30 includes circular end plate 31 and spiral element or wrap 32 extending upwardly from one end surface of circular end plate 31. Spiral element 22 of fixed scroll 20 and spiral element 32 of orbiting scroll 30 interfit at an angular and radial offset to form a plurality of line contacts which define at least one pair of sealed off fluid pockets 71 therebetween. Annular projection 33 projects axially from the other end surface of circular end plate 31.

Inner block member 40 includes central portion 43 and upward annular wall 41 axially projecting from central portion 43 at a peripheral location. Downward annular wall 45 projects axially from central portion 43 of block member 40 at a peripheral location and is fixedly disposed on the interior side surface of cup-shaped casing 13' by forcible insertion. Axial annular projection 42 projects downwardly from central portion 43 at a central location. The upward end surface of upward annular wall 41 is fixed by a plurality of screws 26 to the peripheral one end surface of circular end plate 21 of fixed scroll 20. Isolated cavity 70' is thereby created between annular wall 41 of inner block member 40, and fixed scroll 20. Orbiting scroll 30 is disposed entirely within isolated cavity 70'. On the other hand, interior chamber 61 is created between inner block member 40 and casing 13'.

Motor 50 includes stator 51 and rotor 52. Ring member 46 is disposed on the peripheral end surface of stator 51 and includes an outer surface which ex-

tends beyond the side surfaces of stator 51. Bolts 27 fit through a plurality of holes formed through the peripheral outer surface of ring member 46 and are fixedly secured within corresponding threaded receiving holes of downward annular wall 45. Stator 51 contacts the downward end surface of downward annular wall 45 on its upward end surface. Therefore, stator 51 of motor 50 is secured between ring member 46 and downward annular wall 45 of inner block member 40. Rotor 52 of motor 50 is disposed within stator 51 and is fixed to drive shaft 130 extending there-through. Drive shaft 130 extends through axial annular projection 42. Axial annular projection 42 extends within an opening in rotor 52. Drive shaft 130 is rotatably supported within axial annular projection 42 through fixed plain bearing 14 disposed between the exterior surface of drive shaft 130 and the interior surface of axial annular projection 42. Drive shaft 130 extends through central portion 43 of inner block member 40 and fixed plain bearing 14 extends partly within central portion 43 to support drive shaft 13 at that location.

Pin member 15 is integrated with and projects axially from upward end surface of drive shaft 130. Pin member 15 is radially offset from the axis of drive shaft 130. Bushing 17 is rotatably disposed within downward axial annular projection 33 of orbiting scroll 30 and is supported therein by bearing 34. Pin member 15 is inserted in hole 19 of bushing 17 which is offset from the center of bushing 17.

Rotation preventing device 16' is disposed between a downward peripheral surface of circular end plate 31, exterior of annular projection 33, and an upward surface of inner block member 40 to prevent rotation of orbiting scroll 30 during orbital motion. Rotation preventing device 16' used in this embodiment is substantially identical to the device disclosed in US-A-4,492,543. O-ring seal 23 is disposed between an inner peripheral surface of upward annular wall 41 and a part of the exterior peripheral surface of circular end plate 21 to seal the mating surfaces therebetween. Rotation preventing device 16', pin member 15 and bushing 17, as well as spiral elements 22 and 32, are all contained in isolated cavity 70'.

Suction gas inlet pipe 80 radially penetrates a side wall of casing 12' and annular wall 41, and opens into isolated cavity 70'. Therefore, isolated cavity 70' acts as a suction chamber and is, in use, at inlet pressure. O-ring seal 81 is disposed around the outer peripheral surface of inlet pipe 80 and seals the mating surfaces between inlet pipe 80 and annular wall 41. Hole 25 is formed through a central location of circular end plate 21 and links cavity 60 at the top of circular end plate 21 with the central fluid pocket 71c formed between the spiral elements. Thereby, cavity 60 is maintained at discharge pressure. Anti-wear plate 23A is disposed on the one end surface of circular end plate 21. Seal elements 221 and 321 are

disposed between the end surface of spiral element 22 and the surface of circular end plate 31, and the end surface of spiral element 32 and anti-wear plate 23, respectively.

Interior chamber 61 is linked to cavity 60 via cavity 60a located between the interior side surface of casing 12' and the exterior surface of annular wall 41. Therefore, interior chamber 61 is maintained at discharge chamber pressure. Discharge gas outlet pipe 90 penetrates a side wall of casing 13', and opens to interior chamber 61.

Drive shaft 130 includes axial bore 131 extending from an opening at the downward end surface of drive shaft 130 and terminating within drive shaft 130 at a downward end of axial annular projection 42. A downward end portion of drive shaft 130 is immersed in the accumulated pool of lubricating oil at the inner bottom portion of casing 10'. Helical groove 134 is formed on the exterior surface of drive shaft 130 within axial annular projection 42. Hole 134a radially extends through drive shaft 130 to link upward end of axial bore 131 with the downward end of helical groove 134. A plurality of communication holes 135 are formed through axial annular projection 42 and fixed plain bearing 14, and links the upward end of helical groove 134 with interior chamber 61. Lubricating oil which accumulates at the inner bottom portion of casing 10' flows through axial bore 131, hole 134a and helical groove 134 into the gap between fixed plain bearing 14 and the exterior surface of drive shaft 130 to lubricate the contact surfaces by virtue of the centrifugal force generated during operation of the compressor.

Cavity 44 is formed in central portion 43 of inner block member 40, at a location upward of axial annular projection 42. Drive shaft 130 extends into cavity 44. A shaft seal mechanism, for example, mechanical seals 18 is disposed within cavity 44, around drive shaft 130 to prevent gas from leaking from interior chamber 61 into suction chamber 70' due to the rotation of drive shaft 13. The mechanical seals 18 can be replaced with a lip type seal. Balance weight 35 is disposed on a downward extension of bushing 17 and serves to average the torque of drive shaft 130 acting on bushing 17 during rotation.

Opening 121 is formed in the side wall of casing 13'. Hermetic seal base 120 is secured within opening 121 of casing 13' and maintains the hermetic seal of casing 10'. Wires 110 extend from the bottom end of stator 51, and pass through hermetic seal base 120 for connection to an external electrical power source (not shown). Base 120 may be welded or brazed to the side wall of casing 13' to provide the hermetic seal therebetween.

In operation, stator 51 generates a magnetic field, causing rotation of rotor 52 to thereby rotate drive shaft 130. Rotation of drive shaft 130 is converted to orbital motion of orbiting scroll 30 by pin member

15 and bushing 17, and rotational motion of orbiting scroll 30 is prevented by rotation preventing device 16'. Refrigerant gas is introduced into suction chamber 70' from the external refrigeration circuit through suction gas inlet pipe 80 and is taken into the outer of fluid pockets 71a between fixed scroll 20 and orbiting scroll 30. Refrigerant gas is compressed inwardly toward the central fluid pocket 71c of spiral elements 22 and 32 due to the orbital motion of orbiting scroll 30. As the refrigerant gas moves towards the central fluid pocket 71c, it undergoes a resultant volume reduction and compression and is discharged from the central fluid pocket 71c to cavity 60 through hole 25 covered by a one way valve (not shown). Compressed refrigerant gas flows from cavity 60 into interior chamber 61 through cavity 60a. Compressed discharge gas in interior chamber 61 flows out of the compressor to the external fluid circuit through discharge gas outlet pipe 90.

Since leakage of refrigerant gas from interior chamber 61 into suction chamber 70' is prevented by mechanical seals 18, a rise in temperature of suction refrigerant gas causing the defects of the compressor, such as, a decline in the compression efficiency and an excessive rise in temperature of discharged refrigerant gas is prevented.

Claims

1. A scroll type compressor with a hermetically sealed housing (10'); a fixed scroll (20) disposed within the housing and having a first end plate (21) from which a first spiral element (22) extends; an orbiting scroll (30) having a second end plate (31) from which a second spiral element (32) extends, the first and second spiral elements (22,32) interfitting at an angular and radial offset to form a plurality of line contacts which define at least one pair of sealed fluid pockets (71); a drive mechanism operatively connected to the orbiting scroll (30) to effect orbital motion of the orbiting scroll; a rotation preventing means (16') for preventing the rotation of the orbiting scroll during orbital motion whereby the volume of the fluid pockets changes to compress fluid in the pockets; the drive mechanism including a drive shaft (130), the axis of which is substantially vertical when the compressor is in use, and which is rotatably supported within an inner block member (40) which is fixed to the housing; the first end plate (21) of the fixed scroll and the inner block member (40) forming an isolated cavity (70') therebetween; a discharge chamber (61) formed exterior to the isolated cavity between the outer surface of the first end plate (21) the inner block member (40) and the interior surface of the housing (10'), the first and second spiral elements



disposed between the end surface of spiral element 22 and the surface of circular end plate 31, and the end surface of spiral element 32 and anti-wear plate 23, respectively.

Interior chamber 61 is linked to cavity 60 via cavity 60a located between the interior side surface of casing 12' and the exterior surface of annular wall 41. Therefore, interior chamber 61 is maintained at discharge chamber pressure. Discharge gas outlet pipe 90 penetrates a side wall of casing 13', and opens to interior chamber 61.

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In operation, stator 51 generates a magnetic field, causing rotation of rotor 52 to thereby rotate drive shaft 130. Rotation of drive shaft 130 is converted to orbital motion of orbiting scroll 30 by pin member

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Since leakage of refrigerant gas from interior chamber 61 into suction chamber 70' is prevented by mechanical seals 18, a rise in temperature of suction refrigerant gas causing the defects of the compressor, such as, a decline in the compression efficiency and an excessive rise in temperature of discharged refrigerant gas is prevented.

Claims

1. A scroll type compressor with a hermetically sealed housing (10'); a fixed scroll (20) disposed within the housing and having a first end plate (21) from which a first spiral element (22) extends; an orbiting scroll (30) having a second end plate (31) from which a second spiral element (32) extends, the first and second spiral elements (22,32) interfitting at an angular and radial offset to form a plurality of line contacts which define at least one pair of sealed fluid pockets (71); a drive mechanism operatively connected to the orbiting scroll (30) to effect orbital motion of the orbiting scroll; a rotation preventing means (16') for preventing the rotation of the orbiting scroll during orbital motion whereby the volume of the fluid pockets changes to compress fluid in the pockets; the drive mechanism including a drive shaft (130), the axis of which is substantially vertical when the compressor is in use, and which is rotatably supported within an inner block member (40) which is fixed to the housing; the first end plate (21) of the fixed scroll and the inner block member (40) forming an isolated cavity (70') therebetween; a discharge chamber (61) formed exterior to the isolated cavity between the outer surface of the first end plate (21) the inner block member (40) and the interior surface of the housing (10'), the first and second spiral elements



(22,32) being disposed in the isolated cavity (70'); and the discharge chamber (61) being provided with an outlet portion (90), which, in use, conducts discharged refrigerant gas to the external refrigeration circuit from the discharge chamber; characterised by shaft seal means (18) disposed within the isolated cavity (70') around the drive shaft (130), the shaft seal means being arranged to insulate the isolated cavity from discharge pressure in the discharge chamber; and by the isolated cavity (70') being connected to a suction gas inlet (80) so as to be, in use, at inlet pressure.

2. A compressor according to claim 1, further comprising an annular seal element (23) disposed between the first end plate (21) and the inner block member (40) at an outer peripheral location.

Patentansprüche

1. Spiralverdichter mit hermetisch dichtem Gehäuse (10'); einer feststehenden Spirale (20), die im Gehäuse angeordnet ist und eine erste Stirnplatte (21) aufweist, von der ein erstes Spiralteil (22) absteht; einer umlaufenden Spirale (30) mit einer zweiten Stirnplatte (31), von der ein zweites Spiralteil (32) absteht, wobei das erste und das zweite Spiralteil mit winkelmäßiger und radialer Versetzung zur Bildung einer Mehrzahl von Linienberührungen ineinandergreifen, die zumindest ein Paar von Fluidtaschen (71) umgrenzen; einer wirkungsmäßig mit der umlaufenden Spirale (30) gekoppelten Antriebsvorrichtung zur Erzeugung einer Umlaufbewegung der umlaufenden Spirale (30); einer Rotationssperrvorrichtung (16') zur Verhinderung der Rotation der umlaufenden Spirale bei der Umlaufbewegung, wodurch sich das Volumen der Fluidtaschen zur Verdichtung von Fluid in den Taschen ändert; wobei die Antriebsvorrichtung eine Antriebswelle (130) aufweist, deren Achse im Betrieb des Verdichters im wesentlichen vertikal angeordnet ist und die in einem im Gehäuse befestigten Innenblockteil (40) drehbar gelagert ist; wobei die erste Stirnplatte (21) der feststehenden Spirale und das Innenblockteil (40) einen isolierten Hohlraum (70') dazwischen bilden; einer Auslaßkammer (61), die außerhalb des isolierten Hohlraums zwischen der Außenfläche der ersten Stirnplatte (21), dem Innenblockteil (40) und der Innenfläche des Gehäuses (10') gebildet ist, wobei das erste und das zweite Spiralteil (22, 32) im isolierten Hohlraum (70') angeordnet sind; und wobei die Auslaßkammer (61) mit einem Auslaßbereich (90) versehen ist, der im Betrieb Auslaßkältemittelgas von der Auslaßkammer einem äußeren Kühlkreislauf zu-

führt; gekennzeichnet durch eine im isolierten Hohlraum (70') um die Antriebswelle (130) herum angeordnete Wellendichtvorrichtung (18), die den isolierten Hohlraum gegen den Auslaßdruck in der Auslaßkammer abdichtet; und durch Verbindung des isolierten Hohlraums (70') mit einem Ansauggaseinlaß (80), so daß dort im Betrieb Einlaßdruck herrscht.

2. Verdichter nach Anspruch 1, ferner umfassend ein zwischen der ersten Stirnplatte (21) und dem Innenblockteil (40) an einer äußeren Umfangsstelle angeordnetes Ringdichtelement (23).

Revendications

1. Compresseur du type à volutes comportant un carter hermétiquement étanche (10'); une volute fixe (20) montée à l'intérieur du carter et comportant une première plaque d'extrémité (21) sur laquelle fait saillie un premier élément de spirale (22); une volute orbitale (30) munie d'une seconde plaque d'extrémité (31) sur laquelle fait saillie un second élément de spirale (32), le premier élément de spirale et le second élément de spirale (22, 32) s'embôtant avec un décalage angulaire et radial pour former un certain nombre de lignes de contact qui définissent au moins une paire de poches à fluide étanches (71); un mécanisme d'entraînement relié en fonctionnement à la volute orbitale (30) pour produire le mouvement orbital de cette volute orbitale; un dispositif anti-rotation (16') destiné à empêcher la rotation de la volute orbitale pendant son mouvement orbital, de façon que le volume des poches à fluide change pour comprimer le fluide contenu dans ces poches; le mécanisme d'entraînement comprenant un arbre d'entraînement (130) dont l'axe est sensiblement vertical lorsqu'on utilise le compresseur, et qui se trouve supporté en rotation dans un élément de bloc intérieur (40) fixé au carter; la première plaque d'extrémité (21) de la volute fixe et l'élément de bloc intérieur (40) formant entre eux une cavité isolée (70'); une chambre de décharge (61) formée à l'extérieur de la cavité isolée entre la surface extérieure de la première plaque d'extrémité (21), l'élément de bloc intérieur (40) et la surface intérieure du carter (10'), le premier élément de spirale et le second élément de spirale (22, 32) étant montés dans la cavité isolée (70'); et la chambre de décharge (61) étant munie d'une partie de sortie (90) qui, en cours d'utilisation, conduit le gaz réfrigérant déchargé de la chambre de décharge vers le circuit de réfrigération extérieur; compresseur caractérisé en ce qu'un dispositif d'étanchéité d'arbre (18) est disposé à l'intérieur de la cavité isolée (70') autour



de l'arbre d'entraînement (130), ce dispositif d'étanchéité d'arbre étant monté pour isoler la cavité isolée de la pression de décharge régnant dans la chambre de décharge ; et en ce que la cavité isolée (70') est reliée à une entrée de gaz d'aspiration (80) de manière à se trouver, en cours d'utilisation, à la pression d'entrée.

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2. Compresseur selon la revendication 1, caractérisé en ce qu'il comprend en outre un élément d'étanchéité annulaire (23) monté entre la première plaque d'extrémité (21) et l'élément de bloc intérieur (40), dans une position périphériquement extérieure.

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