

ROTARY COMPRESSOR HAVING A RELIEF VALVE

This invention relates to rotary compressors.

A typical rotary hermetic compressor is one of two types. One type is the high side compressor and the other is the low side compressor. In a high side compressor, the motor which operates the compression portion of the system is disposed in the discharge or high-pressure portion of the hermetic shell, while in a low side compressor, the motor is disposed in the suction or low pressure portion of the hermetic shell.

A common problem with rotary compressors is the tendency of compressed refrigerant to flow from the discharge portion of the hermetic shell through the compression portion of the compressor system to the suction side of the hermetic shell and hence to repressurize the low-side of the system. This tendency may be eliminated by preventing reverse rotation of the compression portion of the system so that refrigerant may not pass through the compressor to the low-side portion of the hermetic shell. This is typically accomplished by the inclusion in the compressor system of a check valve such as a reed valve or ball valve to prevent reverse flow of the refrigerant. It is also possible to accomplish this by the inclusion of a solenoid operated shut off valve

in the refrigerant system to which the compressor is connected.

5 In a refrigeration system having a compressor which is protected from reverse rotation by a check valve, a separate additional problem arises in the event that the compressor is operated in reverse rotation for some reason such as improper wiring of the driving motor. This problem was recognized in US Patent Number 4,560,330, directed toward the high side
10 compressor. In the high side compressor, a suction line check valve was included to prevent reverse rotation of the compressor due to pressure differential between discharge and suction line pressure, however, in the event of driven reverse
15 rotation, discharge pressure refrigerant would be pumped from the discharge port to the suction line valve. This results in excessively high pressure tending to breakdown the exterior portion of the wraps in the scroll compressor described in the patent. The
20 solution lay in providing a check valve to release this abnormally high pressure refrigerant to the discharge pressure portion of the hermetic shell.

It is impractical to apply the type of relief valve used in a high-side compressor to a low-side
25 compressor. For example, if the check valve were placed on the suction line of the low-side compressor,

refrigerant gas at discharge pressure would fill the entire hermetic shell upon each cessation of compressor operation, due to reverse rotation of the compressor elements. This would require that the entire hermetic shell, including that portion normally at suction pressure, be constructed to withstand discharge pressure refrigerant. This would require an unnecessarily heavy and expensive hermetic shell. Furthermore, in the event of intentional or accidental reverse rotation by reverse action of the motor, the entire hermetic shell could be subject to refrigerant at pressure equal to or exceeding the normal discharge pressure of the refrigerant. This could result in a bursting of the hermetic shell, with possible attendant injury and expense, or alternatively, the necessity of providing an unduly heavy and expensive hermetic shell. Finally, this design would necessitate the pumping down by the compressor of the entire suction portion of the hermetic shell to suction pressure before the check valve would open to admit refrigerant from the suction line, resulting in an unnecessary period of recompression of refrigerant at the beginning of each cycle of operation. This would adversely affect the efficiency of the system introducing unnecessary time lag into the system response to demand for cooling and an unnecessary cost

for recompressing the refrigerant.

It is an object of the invention to provide a rotary compressor having a relief valve for preventing damage to the compressor elements during reverse
5 rotation.

Accordingly, the invention provides a rotary compressor comprising a discharge port for discharging working fluid into a discharge portion of the compressor, a means of preventing back flow of working
10 fluid from said discharge portion into said discharge port and passage means for permitting passage of working fluid at suction pressure to said discharge port when the compressor is operated with reverse rotation, and closable for preventing passage of
15 working fluid through said passage means when the compressor is operated with correct rotation.

The invention further provides a hermetic scroll compressor comprising:

a scroll compressor element disposed in a
20 hermetic shell to divide said shell into a suction pressure portion and a discharge pressure portion, said scroll compressor element having a discharge port defined therethrough for discharging refrigerant into said discharge pressure portion and a relief passage
25 means for interconnecting a source of suction pressure refrigerant to said discharge port;

means for preventing a back flow of refrigerant

from said discharge pressure portion into said discharge port;

means for closing said relief passage means in a flow preventing manner disposed in said relief passage means, said relief passage closing means being refrigerant pressure responsive to selectively prevent or permit a flow of refrigerant through said relief passage means whereby said relief passage means is closed by said relief passage closing means when the scroll compressor is operated with the correct rotation to prevent passage of discharge pressure refrigerant through said relief passage means and said relief passage means is open to permit passage of suction pressure refrigerant to said discharge port when the scroll compressor is operated in reverse rotation.

The invention also provides a hermetic scroll compressor comprising:

a scroll compressor element disposed in a hermetic shell to divide said shell into a suction pressure portion and a discharge pressure portion, said scroll compressor element having a discharge port defined therethrough for directing refrigerant at discharge pressure to the discharge pressure portion and a relief passage means for interconnecting said suction pressure portion to said discharge port, said

relief passage means having an inlet disposed in said suction pressure portion;

means for preventing a back flow of refrigerant into said discharge port from said discharge pressure portion;

means for closing said relief passage means in a flow preventing manner to prevent flow of refrigerant from said discharge port to said suction pressure portion, said relief passage closing means comprising a pressure responsive, free-moving valve member having a closed, flow-preventing position and an open, flow-permitting position whereby said relief passage means is closed by said relief passage closing means when the scroll compressor is operated with correct rotation to prevent passage of discharge pressure refrigerant through said relief passage means, and said relief passage means is open to permit passage of suction pressure refrigerant to said discharge port when the scroll compressor is operated in reverse rotation.

The invention also provides a hermetic scroll compressor comprising:

a scroll compressor element disposed in a hermetic shell, said scroll compressor element comprising:

a surface dividing said shell into a suction

pressure portion and a discharge pressure portion, a discharge port defined therethrough for discharging refrigerant into said discharge pressure portion, a relief passage defined therethrough and having an inlet in said suction pressure portion, and a further passage defined therethrough from said discharge port to said scroll compressor element surface;

means for preventing a back flow of refrigerant from said discharge pressure portion into said discharge port, said back flow preventing means being disposed on said scroll compressor element surface in said discharge pressure portion;

a refrigerant pressure responsive, free-moving valve member, having an open, flow-permitting position and a closed, flow-preventing position, wherein said valve member contacts said scroll compressor element surface to prevent refrigerant flow through said relief passage in said closed position;

a valve containment member for containing said valve member, said valve containment member cooperating with said valve compressor element surface to define a chamber for directing refrigerant from said relief passage to said further passage when said valve member is in the open position; and

means disposed in said valve containment member for guiding said valve member between the open

position and the closed position.

The invention also provides a hermetic scroll compressor comprising:

5 a first scroll compressor element disposed in a hermetic shell to divide said shell into a suction pressure portion and a discharge pressure portion, said scroll compressor element having a discharge port defined therethrough for directing refrigerant to the discharge pressure portion, said scroll compressor
10 element further including a relief passage means comprising a relief passage having an inlet in said suction pressure portion and a further passage having an outlet in said discharge port, said scroll compressor element further comprising a first,
15 upstanding involute wrap disposed thereon;

a second scroll compressor element disposed in said hermetic scroll compressor for orbital non-rotating movement with respect to said first scroll compressor element, said second scroll compressor
20 element having a second upstanding involute wrap disposed thereon for interleaving engagement with said first upstanding involute wrap;

means for driving said second scroll compressor element disposed in said hermetic scroll compressor,
25 said driving means disposed in said suction pressure portion;

means for preventing a back flow of refrigerant into said discharge port from said discharge pressure portion;

5 means for closing said relief passage in a flow preventing manner to prevent flow of refrigerant through said relief passage means from said discharge port to said suction pressure portion, said relief passage closing means comprising a pressure responsive, free-moving valve member having a closed, 10 flow-preventing position and an open, flow-permitting position whereby said relief passage is closed by said relief passage closing means when the scroll compressor is operated with correct rotation to prevent passage of discharge pressure refrigerant 15 through said relief passage means, and said relief passage means is open to permit passage of suction pressure refrigerant to said discharge port when the scroll compressor is operated in reverse rotation.

20 In order that the invention may be well understood, some embodiments thereof, which are given by way of example only, will now be described with reference to the accompanying drawings, in which:

Figure 1 is a cross-sectional view of a low-side hermetic scroll compressor having a relief valve;

25 Figure 2 is an enlarged partial cross-sectional view of the compressor portion of the compressor of

Figure 1;

Figure 3 is a cross-sectional view of the compressor of Figure 2 taken along section line 3-3;

5 Figure 4 is a partial cross-sectional view of the compressor of Figure 2;

Figure 5 is a partial cross-sectional view of the compressor taken along section line 5-5 of Figure 4 showing a position of the relief valve when the compressor operates with correct rotation;

10 Figure 6 shows the compressor as seen in Figure 5 and the position of the relief valve when the compressor operates with reverse rotation;

15 Figure 7 is a cross-sectional view of a valve housing for the relief valve taken through section line 7-7 of Figure 4;

Figure 8 is a cross-sectional view corresponding to the view shown in Figure 3 of a part of a further embodiment;

20 Figure 9 is a partial cross-sectional view of the compressor of Figure 8 taken along section line 9-9;

Figure 10 is a cross-sectional view corresponding to the view shown in Figure 3 of a part of a further embodiment;

25 Figure 11 is a cross-sectional view of a valve housing shown in Figure 10 taken along section line 11-11.

A refrigerant compressor system generally denoted by reference numeral 20 is shown in Figure 1. Refrigerant compressor system 20 comprises a rotary compressor housed in a hermetic shell 22. The
5 refrigerant compressor system 20 is not shown in Figure 1 in detail since details regarding the compressor system need not be disclosed to understand the form and function of the embodiment. The rotary compressor illustrated is a scroll-type refrigerant
10 compressor. However, it is understood that a rolling piston or other rotary compressor would be equally suitable for application in the compressor system.

Reference may be had to US Patent Numbers 801,182; 3,924,977; 4,082,484 and 4,415,318, for a
15 more complete discussion of scroll-type fluid compressor apparatus, its principles of operation and particulars of construction.

Disposed within the hermetic shell 22 is a fixed scroll 24 having a centrally located aperture defining
20 a discharge port 26. An orbiting scroll 28 is disposed in a parallel spaced relationship with respect to the fixed scroll 24. A fixed involute wrap 30 is disposed on the fixed scroll 24, and an orbiting involute wrap 32 is disposed on the orbiting scroll 28
25 such that the respective involute wraps are in interleaving engagement defining a plurality of

pockets having volume decreasing toward the centre of the respective wraps. A swing-link mechanism 34 provides for compliant orbital non-rotating motion of the orbiting scroll 28.

5 The fixed scroll member 24 further serves to divide the hermetic shell 22 into a discharge pressure portion 36 and a suction pressure portion 38. It is to be understood that the division of the hermetic shell 22 into the discharge pressure portion 36 and
10 the suction pressure portion 38 could be accomplished in the rotary compressor by other means such as an independent barrier member, and that the use of the fixed scroll member 24 is not to be taken as limiting. A suction port 40 is provided to admit suction
15 pressure refrigerant to the suction pressure portion 38 of the hermetic shell 22, and a discharge port 42 is provided to remove discharge pressure refrigerant from the discharge pressure portion 36 of the hermetic shell 22.

20 The refrigerant compressor system 20 is driven by an internal electric motor 50 disposed within the suction pressure portion 38 of the hermetic shell 22. The electric motor 50 includes a stator 52 and a rotor 54. A drive shaft 56 passes through the rotor 54,
25 with its lower end extending into a reservoir of oil 58. Disposed at the lower distal end of the drive

shaft 56 is a centrifugal oil pump 60 operative to cause oil 58 to flow upward through an internal bore 62 within the drive shaft 56. The oil thus forced upward through the internal bore 62 lubricates surfaces subject to friction within the compressor system 20 such as the lower drive shaft main bearing 64. The drive shaft bearing 64 is supported in a framework 66 which is attached to the hermetic shell 22 and includes other bearings and structure necessary to support the orbiting scroll member 28. The oil pump 60, motor 50, components of the motor 50 and the structures for supporting the motor 50 are not disclosed in detail, as they are believed to be generally understood in the art. It is understood, for example, that oil pump 60 would be equally suitable if a gear-type or similar pump were used.

The scroll compressor of refrigerant compressor system 20 further comprises means for preventing a back flow of refrigerant from the discharge pressure portion 36 into the discharge port 26 when the pressure of refrigerant in the discharge pressure portion 36 exceeds the pressure of refrigerant in the discharge port 26. Preferably this is accomplished by a compressor discharge valve assembly 100, which is generally shown disposed atop the fixed scroll member 24 adjacent the discharge port 26. This discharge

valve assembly 100 may be a ball-type valve, a pressure relief valve, or other suitable valve.

Preferably, the discharge valve assembly 100 is comprised of a valve stop member 120, two guide collars 130, and a detached valve element 140 operating between a closed position and an open position. In the open position, the valve element 140 rests against the valve stop member 120, thus permitting refrigerant to flow from the discharge port 26 to the discharge pressure portion 36 of the hermetic shell, while in a closed position the valve element 140 coveringly seals the discharge port 26 to prevent a flow of refrigerant from the discharge pressure portion 36 into the discharge port 26. As will be described more fully herein, the valve element 140 assumes the closed position under either of two conditions, the first being the inoperative state of the compressor, and the second being the reverse rotation operation of the compressor.

A relief passage means for interconnecting a source of suction pressure refrigerant to the discharge port is provided and comprises a relief, or suction source, passage 260, a relief chamber 210 and a further, or intermediate passage 270. A means for closing the relief passage means in a flow preventing manner comprises a relief valve assembly 200 which is

shown in Figures 1 to 7 disposed on the upper surface 190 of the fixed scroll member 24. The relief valve assembly 200 comprises a valve containment member or relief housing 220 and a relief valve element or member 240. The housing 220 cooperates with the upper surface 190 to define the relief chamber 210 wherein the relief valve element 240 operates to freely move between an open flow-permitting position and a closed flow-preventing position in response to any pressure differential acting upon the valve element 240.

The relief passage 260 extends through the scroll member 24 and comprises a bore having a first end, or inlet, disposed in the suction pressure portion 38 of the hermetic shell 22 and a second end disposed in the relief chamber 210 defined by housing 220 and upper surface 190. The passage 260 provides a means by which refrigerant may flow from the suction pressure portion 38 to the relief chamber 210. The intermediate refrigerant flow passage 270 comprises a bore in the scroll member 24 having a first end in the relief chamber 210 and a second end flowably intersecting the aperture defining the discharge port 26 of the fixed scroll member 24.

The relief housing 220 is secured to the fixed scroll member 24 by two guide bolts 250 which extend through suitable guide bolt apertures 222 in the

relief housing 220. A preferred location of the guide bolts 250 is most readily apparent in Figures 3 and 4. The guide bolts 250 are disposed at opposite sides of the relief housing 220 to accommodate the relief valve element 240 therebetween, thereby serving the dual purpose of guiding the relief valve element 240 between the open and closed position whilst simultaneously positionally securing the relief housing 220. The guide bolts 250 provide a means for limiting the travel of the relief valve element 240 to prevent misalignment and ensure proper sealing of the relief valve element 240 over the aperture in the upper surface 190 defining the second end of the suction pressure source passage 260.

Preferably, the guide bolts 250 comprise a means for guiding the valve element in the form of smooth guide portions, and threaded end portions extending into suitable threaded apertures (not shown) in the fixed scroll member 24. It will be apparent to those skilled in the art that the relief housing 220 may be secured to the upper surface 190 by such means as welding and, likewise, that the guide bolt holes 222 could be threaded to accommodate a mating threaded portion of the guide bolts 250, and that it would not therefore be necessary to provide apertures in the fixed scroll member 24.

The relief housing 220, as generally shown in Figures 1-7, is comprised of a generally rectilinear body with a downwardly extending wall portion 224 extending about the terminal end of the housing 220.

5 The wall portion 224 extends to a wall end 226 which is planar for sealing engagement with the planar upper surface 190. No separate seal is required between the housing 220 and the upper surface 190, however, it
10 will be apparent to those skilled in the art that a suitable elastomer seal or a sealing material such as a suitable caulk could be disposed therebetween to further enhance the sealing effect if desired.

A cavity which when the housing 220 is secured by bolts 250 to the upper surface 190 comprises the
15 relief chamber 210, is defined within the relief housing 220 by a generally planar inner surface 228 and the downwardly extending wall 226. The inner surface 228 is generally parallel to the upper surface 190 of the fixed scroll member 24, and includes a
20 plurality of relief valve engaging protuberances 230. The protuberances 230 serve to stop the relief valve element 240 in the open position. As illustrated in Figure 7, there are three such protuberances. These protuberances 230 are in parallel disposition, each
25 such protuberance 230 being rectilinear in shape. Although these protuberances 230 are shown

perpendicularly disposed with respect to the longer axis of the relief valve element 240 as viewed in Figure 3, they could equally well be disposed in parallel orientation with respect to this axis. Furthermore, these protuberances 230 need not be rectilinear in shape, but may be downwardly extending dimples of hemispheric or conical shape.

The relief valve element 240 preferably is a substantially thin, planar element having oppositely disposed ends 244, each comprised of two hemispheric lobes 245 with an arcuate portion 246 of a circle defined therebetween for closely fitting about the guide bolt 250. The radius of the arcuate portion 246 of the end 244 is sized to provide a clearance of several thousandths of one inch between the valve element 240 and the guide bolts 250, for free movement of the relief valve element 240. The disposition of the valve element 240 in the relief valve assembly 200 is depicted in Figure 2 through 6.

In operation, the electric motor 50 is energised causing the rotor 54 and the drive shaft 56 to rotate. This rotation is translated by the swing-link mechanism 34 to cause orbital non-rotating movement of the orbiting scroll member 28 with respect to the fixed scroll member 24. The interleaving fixed involute wrap 30 and orbiting involute wrap 32 thus

generate a plurality of pockets of decreasing volume from the radially outer ends of the respective wraps toward the centre of the respective wraps.

During the operation of the electric motor 50, refrigerant gas is drawn into the suction pressure portion 38 through the suction port 40 from the refrigeration system (not shown). The refrigerant gas then circulates through the components of the electric motor 50 and entrains in the refrigerant gas flow a portion of the oil in the reservoir of oil 58. The oil entraining refrigerant is then compressed in the plurality of pockets defined by the interleaving wraps of the respective scrolls and discharged through the discharge port 26. The discharged oil entraining refrigerant gas forces the valve element 140 of the back flow preventing means to the open position, permitting the now discharge pressure refrigerant to be exhausted to the discharge pressure portion 36 and returned to the refrigeration system through the discharge port 42.

A portion of the discharge pressure refrigerant enters the intermediate passage 270 and flows therethrough to fill the relief chamber 210 defined in the relief housing 220 with refrigerant at discharge pressure. As the refrigerant in the passage 260 is at suction pressure, the relief valve element 240 is

forced by the weight of gravity and the pressure differential between the discharge pressure refrigerant and the suction pressure refrigerant to the closed position. In this position, the relief valve element 240 sealingly covers the passage 260, preventing a flow of discharge pressure refrigerant therethrough.

Upon de-energization of the electric motor 50, the valve element 140 immediately moves to a closed position, whereby the valve element is disposed about the discharge port 26 in a covering, sealing manner. This prevents a back flow of refrigerant from the discharge pressure portion 36 into the discharge port 26. The discharge pressure refrigerant prevented from flowing from the discharge port to the discharge portion by valve element 140 may force some slight reverse rotation of the orbiting scroll member 28 until the refrigerant pressure in the discharge port 26, intermediate passage 270 and relief chamber 210 in the housing 220 is reduced to a point where it is insufficient to cause reverse rotation. However, the volume of refrigerant therein is substantially small. In this state, both the valve element 140 and the relief valve element 240 remain in the closed positions due to the action of the pressure differential upon the respective valve elements in

combination with the action of gravity upon the valve element mass.

In the event of accidental or intentional reverse rotation of the orbiting scroll member 28 with respect to the fixed scroll member 24, the fixed wrap 30 and the orbiting wrap 32 function as expanders, removing refrigerant from the discharge port 26. The pressure of refrigerant in the discharge port 26 is reduced below that of refrigerant at suction pressure, and refrigerant is drawn from the intermediate passage 270 and the relief chamber 210 and pumped to the suction portion 38. As the refrigerant is withdrawn therefrom, the pressure of refrigerant in the relief housing 220 is reduced below that of the refrigerant at suction pressure in suction portion 38. The pressure of refrigerant in the passage 260 then exceeds that of the refrigerant in the relief chamber 210, thereby forcing the relief valve element 240 to the open position along the guide bolts 250 to engage the protuberances 230. The refrigerant thus entering the relief chamber 210 in the housing 220 from the passage 260 flows through the relief chamber 210 and the intermediate passage 270 into the discharge port 26, supplying suction pressure refrigerant to the scroll wraps 30 and 32. This oil entrained refrigerant provides lubrication to the wraps to

prevent damage due to lack of lubrication, in addition to providing a source of refrigerant to prevent breakdown of the wraps 30 and 32 due to excessively low pressure at the inner ends thereof.

5 In an alternative embodiment, the rotary compressor may be provided with a relief valve assembly 200a as shown in Figures 8 and 9, disposed on the upper surface 190a of the fixed scroll member 24a. The relief valve assembly 200a is comprised of a
10 housing 220a cooperating with the upper surface 190a to define a relief chamber wherein a relief valve element 240a operates between an open and a closed position. The relief housing 220a is secured to the fixed scroll 24a by two guide bolts 250a which extend
15 through suitable guide bolt apertures 222a in the relief housing 220a. Two coil springs 280a are disposed in the relief housing 220a, each spring 280a being coaxially disposed about a respective guide bolt 250a between the relief valve element 240a and the
20 relief housing 220a. Alternatively, a lead spring 280a or a single coil spring 280a may be disposed between the guide bolts 250a. The springs 280a act to bias the relief valve element 240a to the closed position. Preferably, the springs 280a have a small
25 spring constant k to provide a minimal biasing force while causing the relief valve element 240a to move

rapidly to the closed position in response to changes in the refrigerant pressures.

In use, the relief valve assembly 200a operates in a manner substantially the same as that described above with reference to relief valve assembly 200. However, the springs 280a cause the relief valve element 240a to remain in or return to the closed position whenever the refrigerant pressure in the discharge port 26a in combination with the pressure applied by the spring 280a on the relief valve element 240a exceeds the refrigerant suction pressure.

In another embodiment a rotary compressor may be provided with a relief housing 220b as shown in Figures 10 and 11. The relief housing 220b comprises integral guide portions 225b disposed in the relief chamber. The guide portions 225b are integral with the downwardly extending wall 244b, being coplanar with the wall end surface 226b, and with the inner surface 228b. Preferably, the guide portions 225b are semi-cylindric, having an axis parallel to the axis of bolt holes 222b extending through the relief housing 220b. This embodiment is in operation, identical to previously described embodiment comprising valve assembly 200. However, there is no need to use guide bolts 250b, but instead the housing 220b may be secured to the fixed scroll member 24b by standard

threaded bolts, welding or an adhesive such as an epoxy resin. Hence a rotary compressor comprising the relief housing 220b may be more economical of manufacture in large quantities.

5 Preferably, the components of the relief valve assemblies 200, 200a and 200b are formed of suitable steel alloy. While it is possible that the relief housing 220, 220a, 220b may be a machined component in its entirety, the housing 220 is preferably forged,
10 cast, or formed from powdered metal and the bolt holes 222, 222a, 222b and the wall end 226, 226a, 226b machined by drilling or milling, as appropriate. The relief valve element 240 is preferably formed by die-press operations, although the relief valve element
15 240 may be formed by casting or forging if desired.

 In the embodiments, the first suction pressure passage 260 is preferably formed at an angle of 55° from the vertical and the intermediate passage 270 is preferably formed at an angle of 37° from the
20 vertical. It is, however, to be understood that these angles may be changed within a reasonable range, provided only that the ends of the respective passages are disposed to accomplish the proper flow.

 It will be apparent from the above-described
25 embodiments that the rotary compressors thereof are provided with means for preventing damage to the

compressor when operated in reverse rotation either accidentally or intentionally which is simple and economical in assembly, maintenance and operation. Furthermore it will be appreciated that this means comprises a relief valve assembly which, as described in the embodiments, offers the advantage of requiring little or no adjustment or maintenance and is virtually immune to failure due to fatigue, as there are no elastomeric or other components required to flex or bend and thus fatigue. Finally, the provision of a relief valve adds little weight to the compressor system and is not detrimental to the operating efficiency of the compressor system.

It will further be apparent from the description of the embodiments, that in a low-side rotary compressor which comprises a means for providing refrigerant at suction pressure to the discharge port thereof when the compressor is operated in reverse rotation many of the disadvantages described above in relation to a low-side rotary compressor are at least reduced. This is accomplished by the provision of a relief passage means having a pressure responsive relief valve installed therein. This relief passage means may comprise a body defining a chamber, a relief passage extending from the chamber to a source of refrigerant at suction pressure and a further passage

extending from the chamber to a discharge port. A detached valve element of the relief valve operates within the chamber to cover and close the relief passage when discharge pressure refrigerant from the discharge port enters the chamber by way of the further passage. The valve element opens to permit the flow of suction pressure refrigerant into the chamber and through the further passage when the pressure of the refrigerant in the suction pressure portion exceeds that of the refrigerant in the discharge port. This condition occurs when the compressor is operated in reverse, as a discharge check valve for preventing flow from a discharge pressure portion of the compressor to the discharge port is then closed and the pressure of refrigerant in the discharge port becomes substantially low. In this condition, the opening of the relief valve allows passage of oil-entraining refrigerant at suction pressure to the discharge port so that the compressor elements are not deprived of lubrication or the cooling effect of the refrigerant passing therethrough.

Modification to the above-described embodiments that the rotary compressor will be apparent to those skilled in the art within the scope of the claims that follow herein.

CLAIMS:

1. A hermetic scroll compressor comprising:

a scroll compressor element disposed in a hermetic shell to divide said shell into a suction pressure portion and a discharge pressure portion, said scroll compressor element having a discharge port defined therethrough for discharging refrigerant into said discharge pressure portion and a relief passage means for interconnecting a source of suction pressure refrigerant to said discharge port;

means for preventing a backflow of refrigerant from said discharge pressure portion into said discharge port;

means for closing said relief passage means in a flow preventing manner disposed in said relief passage means, said relief passage closing means being refrigerant pressure responsive to selectively prevent or permit a flow of refrigerant through said relief passage means whereby said relief passage means is closed by said relief passage closing means when the scroll compressor is operated with the correct rotation to prevent passage of discharge pressure refrigerant through said relief passage means and said relief passage means is open to permit passage of suction pressure refrigerant to said discharge port



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when the scroll compressor is operated in reverse rotation.

2. A scroll compressor as claimed in claim 1,
wherein said relief passage closing means comprises a
5 refrigerant pressure responsive free-moving valve
member having an open position and a closed position.

3. A scroll compressor as claimed in claim 1,
wherein said relief passage closing means comprises a
refrigerant pressure responsive valve member having an
10 open position and a closed position, and means for
biasing said valve member to said closed position.

4. A scroll compressor as claimed in claim 2 or 3
further comprising a valve containment member disposed
on said scroll compressor element for containing said
15 valve member.

5. A scroll compressor as claimed in claim 4 wherein
said relief passage means comprises a further passage
of said scroll compressor element between said
discharge port and said valve containment member.

20 6. A scroll compressor as claimed in claim 5,
wherein said valve containment member comprises a



chamber which forms part of said relief passage means.

7. A scroll compressor as claimed in claim 4, 5 or 6, wherein said valve containment member comprises means for limiting the travel of said valve member.

5 8. A scroll compressor as claimed in claim 7, wherein said travel limiting means comprises means for guiding said valve member between said open position and said closed position and means for stopping said valve member in said open position.

10 9. A hermetic scroll compressor comprising:
a scroll compressor element disposed in a hermetic shell to divide said shell into a suction pressure portion and a discharge pressure portion, said scroll compressor element having a discharge port defined therethrough for directing refrigerant at
15 discharge pressure to the discharge pressure portion and a relief passage means for interconnecting said suction pressure portion to said discharge port, said relief passage means having an inlet disposed in said
20 suction pressure portion;

means for preventing a back flow of refrigerant into said discharge port from said discharge pressure portion;



means for closing said relief passage means in a flow preventing manner to prevent flow of refrigerant from said discharge port to said suction pressure portion, said relief passage closing means comprising
5 a pressure responsive, free-moving valve member having a closed, flow-preventing position and an open, flow-permitting position whereby said relief passage means is closed by said relief passage closing means when the scroll compressor is operated with correct
10 rotation to prevent passage of discharge pressure refrigerant through said relief passage means, and said relief passage means is open to permit passage of suction pressure refrigerant to said discharge port when the scroll compressor is operated in reverse
15 rotation.

10. A scroll compressor as claimed in claim 9, further comprising a valve containment member disposed on said scroll compressor element, said valve
20 containment member defining a chamber therein for containing said valve member.

11. A scroll compressor as claimed in claim 10, wherein said relief passage means comprises a further passage of said scroll compressor element between said discharge port and said valve containment member.



12. A scroll compressor as claimed in claim 11, wherein said valve containment member cooperates with a surface of said scroll compressor element to enclose said chamber.

5 13. A scroll compressor as claimed in claim 10, 11 or 12, wherein said valve containment member comprises means for limiting the travel of said valve member.

10 14. A scroll compressor as claimed in claim 13, wherein said travel limiting means comprises means for guiding said valve member between said open position and said closed position and means for stopping said valve member in said open position.

15. A hermetic scroll compressor comprising:

15 a scroll compressor element disposed in a hermetic shell, said scroll compressor element comprising:

20 a surface dividing said shell into a suction pressure portion and a discharge pressure portion, a discharge port defined therethrough for discharging refrigerant into said discharge pressure portion, a relief passage defined therethrough and having an inlet in said suction pressure portion, and a further passage defined therethrough from said discharge port



to said scroll compressor element surface;

means for preventing a back flow of refrigerant from said discharge pressure portion into said discharge port, said back flow preventing means being
5 disposed on said scroll compressor element surface in said discharge pressure portion;

a refrigerant pressure responsive, free-moving valve member, having an open, flow-permitting position and a closed, flow-preventing position, wherein said
10 valve member contacts said scroll compressor element surface to prevent refrigerant flow through said relief passage in said closed position;

a valve containment member for containing said valve member, said valve containment member cooperating with said valve compressor element surface
15 to define a chamber for directing refrigerant from said relief passage to said further passage when said valve member is in the open position; and

means disposed in said valve containment member
20 for guiding said valve member between the open position and the closed position.

16. A hermetic scroll compressor comprising:

a first scroll compressor element disposed in a hermetic shell to divide said shell into a suction
25 pressure portion and a discharge pressure portion,



said scroll compressor element having a discharge port defined therethrough for directing refrigerant to the discharge pressure portion, said scroll compressor element further including a relief passage means comprising a relief passage having an inlet in said suction pressure portion and a further passage having an outlet in said discharge port, said scroll compressor element further comprising a first, upstanding involute wrap disposed thereon;

a second scroll compressor element disposed in said hermetic scroll compressor for orbital non-rotating movement with respect to said first scroll compressor element, said second scroll compressor element having a second upstanding involute wrap disposed thereon for interleaving engagement with said first upstanding involute wrap;

means for driving said second scroll compressor element disposed in said hermetic scroll compressor, said driving means disposed in said suction pressure portion;

means for preventing a back flow of refrigerant into said discharge port from said discharge pressure portion;

means for closing said relief passage in a flow preventing manner to prevent flow of refrigerant through said relief passage means from said discharge



port to said suction pressure portion, said relief
passage closing means comprising a pressure
responsive, free-moving valve member having a closed,
flow-preventing position and an open, flow-permitting
5 position whereby said relief passage is closed by said
relief passage closing means when the scroll
compressor is operated with correct rotation to
prevent passage of discharge pressure refrigerant
through said relief passage means, and said relief
10 passage means is open to permit passage of suction
pressure refrigerant to said discharge port when the
scroll compressor is operated in reverse rotation.

17. A scroll compressor as claimed in claim 16,
further comprising a valve containment member disposed
15 on said first scroll compressor element, said valve
containment member defining a chamber therein for
containing said valve member.

18. A scroll compressor as claimed in claim 17,
wherein said valve containment member cooperates with
20 a surface of said first scroll compressor element to
enclose said chamber.

19. A scroll compressor as claimed in claim 17 or 18,
wherein said valve containment member comprises means



for limiting the travel of said valve member.

20. A scroll compressor as claimed in claim 19,
wherein said travel limiting means comprises means for
guiding said valve member between said open position
5 and said closed position, and means for stopping said
valve member in said open position.

21. A rotary compressor comprising a discharge port
for discharging working fluid into a discharge portion
of the compressor, a means of preventing backflow of
10 working fluid from said discharge portion into said
discharge port and passage means for permitting
passage of working fluid at suction pressure to said
discharge port when the compressor is operated with
reverse rotation, and closable for preventing passage
15 of working fluid through said passage means when the
compressor is operated with correct rotation.

22. A refrigerant compressor substantially as
hereinbefore described with reference to Figures 1 to
7, or Figures 1 to 7 when modified by Figures 8 and 9
20 or Figures 10 and 11 of the accompanying drawings.

