



(51) International Patent Classification:

F04C 29/00 (2006.01) *F04C 18/00* (2006.01)
F04C 23/02 (2006.01) *H02K 5/04* (2006.01)

(21) International Application Number:

PCT/US2015/042479

(22) International Filing Date:

28 July 2015 (28.07.2015)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

62/029,864 28 July 2014 (28.07.2014) US
14/809,786 27 July 2015 (27.07.2015) US

(71) Applicant: EMERSON CLIMATE TECHNOLOGIES, INC. [US/US]; 1675 W. Campbell Road, Sidney, Ohio 45365 (US).

(72) Inventors: IGNATIEV, Kirill M.; 661 Ridgeway Drive, Sidney, Ohio 45365 (US). PEREVOZCHIKOV, Michael M.; 688 Heatherstone Court, Tipp City, Ohio 45371 (US). SEIBEL, Stephen M.; 1675 W. Campbell Road, Sidney, Ohio 45365 (US).

(74) Agents: MALINZAK, Michael et al.; Harness, Dickey & Pierce, P.L.C., P.O. Box 828, Bloomfield Hills, Michigan 48303 (US).

(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: COMPRESSOR MOTOR WITH CENTER STATOR

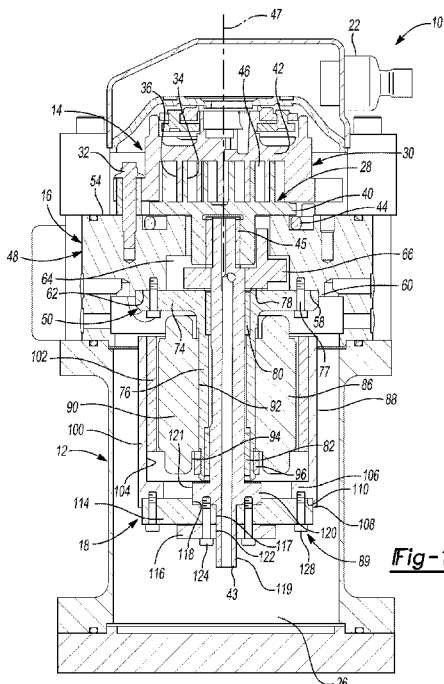


Fig-1

(57) Abstract: A compressor is provided and may include a shell, a compression mechanism, a driveshaft, and a motor assembly. The compression mechanism may be disposed within the shell. The driveshaft is drivingly engaged with the compression mechanism. The motor assembly may be disposed within the shell and drivingly engaged with the driveshaft. The motor assembly may include a rotor, a stator, and a rotor support subassembly. The rotor may be disposed radially outwardly relative to the stator and fixed for rotation with the driveshaft. The rotor support subassembly may include a first support member coupled to the driveshaft and coupled to the rotor such that the driveshaft is operable to rotate with the rotor.

**Declarations under Rule 4.17:**

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:

- *with international search report (Art. 21(3))*

COMPRESSOR MOTOR WITH CENTER STATOR

CROSS-REFERENCE TO RELATED APPLICATIONS

5 **[0001]** This application claims priority to U.S. Utility Patent Application No. 14/809,786, filed on July 27, 2015 and also claims the benefit of U.S. Provisional Application No. 62/029,864, filed on July 28, 2014. The entire disclosures of the above applications are incorporated herein by reference.

FIELD

10 **[0002]** The present disclosure relates to a compressor, and more particularly to a scroll or rotary compressor including a motor having a rotor surrounding a stator.

BACKGROUND

15 **[0003]** The statements in this section merely provide background information related to the present disclosure and may not constitute prior art.

[0004] To provide a heating and/or cooling effect, a compressor may be used in a refrigeration, heat pump, HVAC, or chiller system (generically, "climate control system") to circulate a working fluid therethrough. The compressor may
20 be one of a variety of compressor types. For example, the compressor may be a scroll compressor, a rotary-vane compressor, a reciprocating compressor, a centrifugal compressor, or an axial compressor. During operation of the compressor, a motor assembly may be used to rotate a driveshaft. In this regard, compressors often utilize a motor assembly that includes a stator surrounding a
25 central rotor that is coupled to the driveshaft. Regardless of the exact type of compressor employed, consistent and reliable construction and assembly of the motor assembly is desirable to ensure that the compressor can effectively and efficiently circulate the working fluid through the climate control system.

SUMMARY

30 **[0005]** This section provides a general summary of the disclosure, and is not a comprehensive disclosure of its full scope or all of its features.

[0006] A compressor is provided and may include a shell, a compression mechanism, a driveshaft, and a motor assembly. The compression

mechanism may be disposed within the shell. The driveshaft may be drivingly engaged with the compression mechanism and may include a first outer surface and a second outer surface. The second outer surface may extend radially beyond the first outer surface. The motor assembly may be disposed within the
5 shell and drivingly engaged with the driveshaft. The motor assembly may include a rotor, a stator, and a rotor support subassembly. The rotor may be disposed radially outwardly relative to the stator and fixed for rotation with the driveshaft. The rotor support subassembly may include a first support member coupled to the second outer surface of the driveshaft and coupled to the rotor such that the
10 driveshaft is operable to rotate with the rotor.

[0007] In some configurations, the compressor may include a bearing housing assembly supporting the compression mechanism thereon.

[0008] In some configurations, the bearing housing assembly may include a first housing and a second housing. The first housing may be coupled
15 to the compression mechanism, and the stator may be coupled to the second housing.

[0009] In some configurations, the second housing may include a generally tubular portion and a flange portion. The flange portion may be coupled to the first housing, and the stator may be coupled to an outer circumference of
20 the shaft portion.

[0010] In some configurations, the generally tubular portion may extend around the driveshaft.

[0011] In some configurations, the motor assembly may be free from direct attachment to the shell.

[0012] In some configurations, the first housing may be fixed to the
25 shell.

[0013] In some configurations, the rotor may include a flange portion, and the first support member may be coupled to the flange portion.

[0014] In some configurations, the compressor may include a second
30 support coupled to at least one of the driveshaft and the first support member.

[0015] In some configurations, the second support member may be threadably engaged with the driveshaft.

[0016] In some configurations, a magnet may be fixed to a radially inner surface of the rotor.

[0017] In some configurations, the magnet may be a ferrite permanent magnet.

5 [0018] In some configurations, the magnet may be coupled to the rotor with an adhesive.

[0019] In some configurations, the second outer surface may include a conically shaped outer surface, and the first support member may include an aperture having a conically shaped inner surface engaged with the conically
10 shaped outer surface.

[0020] In some configurations, the second outer surface may be operable to define an axially extending distance between the first support member and the stator.

[0021] In some configurations, the first support member may define an
15 aperture therethrough, and the driveshaft may be disposed within the aperture in a press-fit configuration.

[0022] In another configuration, a compressor is provided and may include a shell, a bearing housing assembly, a compression mechanism, a driveshaft, and a motor assembly. The bearing housing assembly may be
20 disposed within the shell and may include a first housing and a second housing. The second housing may include a shaft portion and a flange portion. The flange portion may be coupled to the first housing. The compression mechanism may be coupled to the first housing. The driveshaft may be drivingly engaged with the compression mechanism. The motor assembly may be drivingly engaged with
25 the driveshaft. The motor assembly may include a rotor and a stator. The stator may be coupled to the shaft portion of the second housing. The rotor may be disposed radially outwardly relative to the stator and fixed for rotation with the driveshaft.

[0023] In yet another configuration, a compressor is provided and may
30 include a shell, a bearing housing, a compression mechanism, a driveshaft, a motor assembly, and a first rotor support member. The bearing housing may be disposed within the shell and may include a shaft portion and a flange portion. The compression mechanism may be disposed within the shell and may be

supported by the bearing housing. The driveshaft may be drivingly engaged with the compression mechanism and may include a first outer surface and a second outer surface. The second outer surface may extend radially beyond the first outer surface. The motor assembly may be drivingly engaged with the driveshaft and may include a rotor and a stator. The stator may be coupled to the shaft portion of the bearing housing. The rotor may be disposed radially outwardly relative to the stator and may include a radially extending flange portion. The first rotor support member may be coupled to the second outer surface and to the radially extending flange portion.

[0024] In yet another form, the present disclosure provides a compressor that may include a shell, a compression mechanism, a driveshaft, a bearing housing, and a motor assembly. The compression mechanism is disposed within the shell. The driveshaft is rotatably supported by a first bearing and a second bearing and is drivingly engaged with the compression mechanism. The bearing housing may include a tubular portion in which the first and second bearings are disposed. The motor assembly is disposed within the shell and is drivingly engaged with the driveshaft. The motor assembly includes a rotor and a stator. The stator may engage an outer diametrical surface of the tubular portion. The rotor may be disposed radially outwardly relative to the stator and is fixed for rotation with the driveshaft.

[0025] In yet another form, the present disclosure provides a compressor that may include a shell, a compression mechanism, a driveshaft, a bearing housing, and a motor assembly. The bearing housing assembly may include a first housing and a second housing. The second housing may include a tubular portion and a flange portion. The flange portion may be mounted to the first housing and may be integrally formed with the tubular portion. The compression mechanism may be axially supported by the first housing. The driveshaft is drivingly engaged with the compression mechanism. The motor assembly may drivingly engage the driveshaft and includes a rotor and a stator. The stator may extend circumferentially around the tubular portion and may include a radially inner surface coupled to the tubular portion. The flange portion may be disposed axially between the stator and the compression mechanism.

The rotor may be disposed radially outwardly relative to the stator and is fixed for rotation with the driveshaft.

5 **[0026]** Further areas of applicability will become apparent from the description provided herein. It should be understood that the description and specific examples are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

DRAWINGS

10 **[0027]** The drawings described herein are for illustrative purposes only of selected embodiments and not all possible implementations, and are not intended to limit the scope of the present disclosure.

[0028] FIG. 1 is a cross-sectional view of a compressor including a motor assembly according to the principles of the present disclosure;

15 **[0029]** FIG. 2 is a cross-sectional view of another compressor including another motor assembly according to the principles of the present disclosure; and

[0030] FIG. 3 is a cross-sectional view of another compressor including another motor assembly according to the principles of the present disclosure;

[0031] Corresponding reference numerals indicate corresponding parts throughout the several views of the drawings.

20

DETAILED DESCRIPTION

[0032] Example embodiments will now be described more fully with reference to the accompanying drawings. Example embodiments are provided so that this disclosure will be thorough, and will fully convey the scope to those who are skilled in the art. Numerous specific details are set forth such as examples of specific components, devices, and methods, to provide a thorough understanding of embodiments of the present disclosure. It will be apparent to those skilled in the art that specific details need not be employed, that example embodiments may be embodied in many different forms and that neither should be construed to limit the scope of the disclosure. In some example embodiments, well-known processes, well-known device structures, and well-known technologies are not described in detail.

25

30

[0033] With reference to FIG. 1, a compressor 10 is shown to include a hermetic shell assembly 12, a compression mechanism 14, a bearing housing assembly 16 and a motor assembly 18. While the present disclosure is suitable for incorporation in many different types of compressors, including hermetic machines, open drive machines and non-hermetic machines, for exemplary purposes it will be described herein incorporated in a hermetic scroll refrigerant motor-compressor 10 of the "low side" type (i.e., where the motor and compressor are cooled by suction gas in the hermetical shell, as illustrated in the vertical section shown in FIG. 1).

[0034] The shell assembly 12 may house the motor assembly 18, the compression mechanism 14, and the bearing housing assembly 16. The shell assembly 12 may include a suction inlet port (not shown) receiving a working fluid at a suction pressure from one of an indoor and outdoor heat exchanger (not shown) and a discharge outlet port 22 discharging the working fluid to the other of the indoor and outdoor heat exchanger after it has been compressed by the compression mechanism 14. A discharge valve (not shown) may allow compressed fluid to flow from the compression mechanism 14 to the discharge outlet port 22 and may restrict or prevent fluid-flow from the discharge outlet port 22 to the compression mechanism 14. A bottom portion of the shell assembly 12 may form a reservoir or sump 26 containing a volume of a lubricant (e.g., oil).

[0035] The compression mechanism 14 may include an orbiting scroll member 28 and a non-orbiting scroll member 30. The non-orbiting scroll member 30 may be fixed to the bearing housing assembly 16 by a plurality of fasteners 32, such as threaded bolts or similar attachment features. The orbiting and non-orbiting scroll members 28, 30 include orbiting and non-orbiting spiral wraps 34, 36, respectively, that meshingly engage each other and extend from orbiting and non-orbiting end plates 40, 42, respectively. A driveshaft 43 may rotatably engage the orbiting scroll member 28, via a bushing 45, to cause orbital movement of the orbiting scroll member 28 relative to the non-orbiting scroll member 30 as the driveshaft 43 rotates about an axis 47. An Oldham coupling 44 may be keyed to the orbiting scroll member 28 and a stationary structure (e.g., the bearing housing assembly 16 or the non-orbiting scroll member 30) to prevent relative rotation between the orbiting and non-orbiting scroll members 28, 30

while allowing the orbiting scroll member 28 to move in an orbital path relative to the non-orbiting scroll member 30. Moving fluid pockets 46 are formed between the orbiting and non-orbiting spiral wraps 34, 36 that decrease in size as they move from a radially outer position to a radially inner position, thereby
5 compressing the working fluid therein from the suction pressure to the discharge pressure.

[0036] The bearing housing assembly 16 may include a first or upper support housing 48 and a second or lower housing 50. The upper housing 48 may include a first or upper side 54 and a second or lower side 58. The upper
10 side 54 may support the non-orbiting scroll member 30 and may define a thrust bearing surface for the orbiting scroll 28. The lower side 58 of the upper housing 48 may include an annular flange 60. The annular flange 60 may extend axially from the lower side 58 to define a recess 62. The upper housing 48 may define a counterweight cavity 64 between the upper and lower sides 54, 58. A
15 counterweight 66, coupled to the driveshaft 43, may rotate within the counterweight cavity 64. The counterweight 66 can be fixed to the driveshaft 43 by a press fit, welding and/or fasteners, for example.

[0037] The lower housing 50 may include a flange or plate portion 74 and a generally tubular portion 76. The plate portion 74 may be integrally formed
20 with the tubular portion 76, such that the lower housing 50 is a monolithic construct. The plate portion 74 may be at least partially disposed and secured within the recess 62 of the upper housing 48. In this regard, in one configuration, a plurality of bolts 77 or other suitable mechanical fasteners may be used to couple the lower housing 50 to the upper housing 48. It will be appreciate,
25 however, that the lower housing 50 may be coupled to the upper housing 48 using other techniques, such as welding or press-fitting the plate portion 74 within the recess 62, for example. A thrust support member 78, such as a washer, may be disposed between the counterweight 66 and the plate portion 74. The thrust support member 78 may provide thrust support between the counterweight 66
30 and the lower housing 50 in the axial direction.

[0038] The tubular portion 76 may include a generally tubular construct extending axially from the plate portion 74. The tubular portion 76 may house

and support a first or upper bearing 80 and a second or lower bearing 82, which rotatably support the driveshaft 43.

[0039] The motor assembly 18 may include a motor stator 86, a rotor 88, and a rotor support subassembly 89. In some configurations, the motor assembly 18 may include an induction motor. In other configurations, the motor assembly 18 may include a switched reluctance motor. In other configurations, the motor stator 86 may be of a segmented stator design where the segments of the motor stator 86 may interlock to help prevent the stator 86 from disassembling during assembly and operation of the compressor 10. In this regard, in some configurations, the motor stator 86 may include a plurality of wire-wound radially extending poles 90. The radially extending poles 90 may define an axially extending aperture 92 therethrough. The aperture 92 may receive the tubular portion 76 of the lower housing 50, such that the motor stator 86 may be coupled to the lower housing 50. In one configuration, the motor stator 86 may be press-fit over the tubular portion 76. In other configurations, a lower end of the aperture 92 may include a key slot or portion 94 sized to receive a support member 96, such as a hexagonal nut. In this regard, a lower end of the tubular portion 76 may threadably engage the support member 96 to secure the motor stator 86 to the tubular portion 76. It will be also be appreciated that the motor stator 86 may be secured to the tubular portion 76 using other techniques, such as press-fitting or threaded engagement. The use of the tubular portion 76 for both securing the motor stator 86 and securing the bearings 80, 82 can improve the alignment of the motor assembly 18 relative to the driveshaft 43 and the axis 47.

[0040] The rotor 88 may be disposed about the motor stator 86 and coupled to the driveshaft 43. In this regard, the rotor 88 may transmit rotational power to the driveshaft 43. As illustrated, the rotor 88 may be annularly disposed between the motor stator 86 and the shell assembly 12. The rotor 88 may include a housing 100 and a plurality of magnets 102. The housing 100 may be made from a single piece, stacked steel laminations, or other materials with magnetic properties suitable for use in a motor. The housing 100 may include a generally cylindrical construct defining a cylindrical inner surface 104. The magnets 102 may be coupled to, and supported by, the inner surface 104. The

centripetal forces generated by the rotor 88 may help to secure the magnets 102 to the inner surface 104. In this regard, in some configurations the magnets 102 may be secured to the inner surface using only an adhesive. In one configuration, the magnets 102 may be ferrite permanent magnets. The motor stator 86 may
5 be concentrically disposed within the housing 100 and the magnets 102.

[0041] A flange 106 may extend radially inwardly from the inner surface 104 of the housing 100. In one configuration, the flange 106 may extend annularly about the inner surface 104, such that the flange 106 at least partially defines an axially extending lip portion 108 of the housing 100. The flange 106
10 and the lip portion 108 may at least partially define a recess 110.

[0042] The rotor support subassembly 89 may include a first or upper support member or plate 114 and a second or lower support member or plate 116. The upper support plate 114 may include a generally disk-shaped member defining a bore or aperture 117 therethrough, and a counterbore or recess 118.
15 As illustrated, the aperture 117 may be concentrically formed relative to the recess 118. In an assembled configuration, the driveshaft 43 may be disposed within the aperture 117. The driveshaft 43 may include a first outer surface 119 and a second outer surface 121. The second outer surface 121 may extend radially outwardly relative to the first outer surface 119, such that the second
20 outer surface 121 includes a radially extending portion 120 that can be disposed within the recess 118. As illustrated in FIG. 1, in some configurations, the radially extending portion 120 may define a stepped or flanged portion 120 of the driveshaft.

[0043] The lower support plate 116 may include a generally disk-shaped member (e.g., a washer) defining an aperture 122 therethrough. In an assembled configuration, the aperture 122 may be concentrically aligned with the aperture 117. Accordingly, the driveshaft 43 may be disposed within the aperture 122 and the aperture 117. In this regard, the lower support plate 116 may be eccentrically disposed about the driveshaft 43, or constructed in such a way that
25 the lower support plate 116 acts as a counterweight upon rotation of the driveshaft 43.
30

[0044] The rotor support subassembly 89 may be secured to the driveshaft 43 using various techniques. In one configuration, a plurality of

fasteners 124 (e.g., bolts) may extend through the lower support plate 116, the upper support plate 114, and the radially extending portion 120 of the driveshaft 43 to prevent axial movement of the rotor support subassembly 89 relative to the driveshaft 43, and allow the driveshaft to rotate with the rotor support subassembly 89. In other configurations, the rotor support subassembly 89, including the upper and/or lower support plates 114, 116 may be press-fit onto the driveshaft 43. For example, the driveshaft 43 may be press-fit into the aperture 117 and/or the aperture 122 of the upper and/or lower support plates 114, 116, respectively. Similarly, the radially extending portion 120 may be press-fit into the recess 118 of the upper support plate 114.

[0045] The rotor support subassembly 89 and the driveshaft 43 may be further fixed for rotation with the rotor 88. The rotor support subassembly 89 may be secured to the rotor 88 using various techniques. In one configuration, a plurality of fasteners 128 (e.g., bolts) may extend through the upper support plate 114 and the flange 106 of the housing 100. In other configurations, the upper support plate 114 may be press-fit into the housing 100. For example, the upper support plate 114 may be press-fit into the recess 110, such that the upper support plate 114 engages the lip portion 108 of the housing. Securing the rotor support subassembly 89 to the rotor 88 and the driveshaft 43 ensures that when power is supplied to the motor assembly 18, the rotor 88 may transmit rotational power, or drive torque, to the rotor support subassembly 89 and the driveshaft 43. Because the counterweight 66 is fixed to the driveshaft 43, the counterweight 66 and the thrust support member 78 may axially support the driveshaft 43, rotor 88 and rotor support subassembly 89. That is, the thrust support member 78 may rest on the plate portion 74 of the lower housing 50 to axially support the driveshaft 43, rotor 88 and rotor support subassembly 89.

[0046] The configuration of the motor assembly 18, the tubular portion 76, and the rotor support subassembly 89 can simplify the process of assembling the compressor 10. In this regard, the motor assembly 18 and the rotor support subassembly 89 can be pre-assembled and/or secured to the tubular portion 76, before securing the lower housing 50 to the upper housing 48, and before securing the upper housing 48 to the shell assembly 12.

[0047] With reference to FIG. 2, another configuration of a compressor 10a is shown. The structure and function of the compressor 10a may be substantially similar to that of the compressor 10 illustrated in FIG. 1, apart from any exceptions described below and/or shown in the figures. Therefore, the structure and/or function of similar features will not be described again in detail. Furthermore, like reference numerals may be used to describe like features and components, while like reference numerals containing letter extensions (i.e., "a") may be used to identify those components that have been modified.

[0048] The compressor 10a may include a motor assembly 18a having the motor stator 86, a rotor 88a, and a rotor support subassembly 89a. The rotor 88a may be disposed about the motor stator 86 and coupled to a driveshaft 43a. The rotor 88a may include a housing 100a and the plurality of magnets 102. A flange 106a may extend radially inwardly from an inner surface 104a of the housing 100a. In one configuration, the flange 106a may extend annularly about the inner surface 104a. The flange 106a may define a plurality of axially extending drain holes or apertures 130 for allowing lubricant (e.g., oil) to drain from the housing 100a and into the shell assembly 12.

[0049] The rotor support subassembly 89a may include a first or upper support plate 114a and a second or lower support plate 116a. The upper support plate 114a may include a base plate portion 132, a first axially extending shoulder or step portion 134 and a second axially extending shoulder or step portion 136. The first step portion 134 may extend eccentrically from the base plate portion 132, such that the base plate portion 132 defines a counterweight portion of the upper support plate. The second step portion 136 may further extend from the first step portion 134, such that the upper support plate 114a is generally frustoconically shaped and at least partially defined by a stepped outer wall 138. In an assembled configuration, the upper support plate 114a may be disposed within the housing 100a, such that the flange 106a engages the base plate portion 132 and concentrically surrounds the first step portion 134. In this regard, the first and/or second step portions 134, 136 may concentrically surround the driveshaft 43a, while the base plate portion 132 may eccentrically surround the driveshaft 43a, such that the base plate portion 132 can serve as a counterweight upon rotation of the driveshaft 43a.

[0050] The upper support plate 114a may further define an axially extending bore or aperture 117a therethrough. The aperture 117a may include a tapered or frustoconically shaped wall, such that a cross-sectional area of the aperture 117a decreases from the second step portion 136 to the base plate portion 132. In an assembled configuration, the driveshaft 43a may be disposed within the aperture 117a. The driveshaft 43a may include a first outer surface 119a and a second outer surface 121a. The second outer surface 121a may extend radially outwardly relative to the first outer surface 119a, such that the second outer surface 121a includes a radially extending portion 120a. As illustrated in FIG. 2, in some configurations, the second outer surface 121a may include a tapered or frustoconically shaped portion, such that the frustoconically shaped aperture 117a engages (e.g., a press-fit configuration) the second outer surface 121a of the driveshaft 43.

[0051] The lower support plate 116a may include a generally disk-shaped member (e.g., a washer, a nut, etc.) defining an aperture 122a therethrough. In an assembled configuration, the aperture 122a may be concentrically aligned with the aperture 117a, such that the driveshaft 43 can be disposed within the aperture 122a and the aperture 117a.

[0052] The rotor support subassembly 89a may be secured to the driveshaft 43a using various techniques. In one configuration, the upper and/or lower support plates 114a, 116a may be press-fit onto the driveshaft 43a, in the manner described above. In other configurations, the aperture 122a may be a threaded aperture, and the driveshaft 43a may include a threaded portion 144 for threadably engaging the aperture 122a.

[0053] The rotor support subassembly 89a and the driveshaft 43a may be further fixed for rotation with the rotor 88a using various techniques. In one configuration, a plurality of fasteners 128a (e.g., bolts) may extend through the upper support plate 114a and the flange 106a of the housing 100a. In other configurations, the upper support plate 114a may be press-fit into the housing 100a such that the flange 106a concentrically surrounds the first step portion 134, as described above. Securing the rotor support subassembly 89a to the rotor 88a and the driveshaft 43a ensures that when power is supplied to the motor

assembly 18a, the rotor 88a may transmit rotational power, or drive torque, to the rotor support subassembly 89a and the driveshaft 43a.

5 **[0054]** With reference to FIG. 3, another configuration of a compressor 200 is shown. The compressor 200 may be a rotary compressor and may include a shell assembly 212, a bearing housing assembly 214, a compression mechanism 216, and a motor assembly 218.

10 **[0055]** The shell assembly 212 may house the compression mechanism 216, the bearing housing assembly 214 and the motor assembly 218, and may include one or more a suction inlet port (not shown), a discharge outlet port 220 and a fluid-injection fitting 222. The suction fittings may receive suction-pressure working fluid from a low-side component (e.g., an evaporator) of a climate-control system in which the compressor 200 may be incorporated. The suction fittings may provide the suction-pressure working fluid to the compression mechanism 216. The discharge outlet port 220 may receive compressed working fluid (e.g., at a discharge pressure) from the compression mechanism 216 and provide the compressed working fluid to a high-side component (e.g., a condenser or a gas cooler) of the climate-control system. The fluid-injection fitting 222 may receive working fluid from a fluid-injection source 224 at an intermediate pressure (i.e., a pressure higher than suction pressure and lower than discharge pressure) and provide the intermediate pressure working fluid to the compression mechanism 216. The fluid-injection source 224 may include an economizer, a flash tank or a plate-heat-exchanger, for example. The intermediate-pressure working fluid could be a vapor, a liquid or a mixture of vapor and liquid.

25 **[0056]** The bearing housing assembly 214 may include upper and lower member 226, 227. The upper and lower members 226, 227 may be fixed relative to the shell assembly 212 and may house bearings (not shown) that rotatably support a driveshaft 229. The structure and function of the upper member 226 may be substantially similar to that of the lower housing 50 associated with the compressor 10, apart from any exceptions described below and/or shown in the figures. Accordingly, like reference numerals may be used to describe similar features and components, and similar features and components

30

may not be described again in detail. In this regard, the upper member 226 may include the tubular portion 76.

[0057] The compression mechanism 216 may include first and second cylinder housings 228, 230, first and second rotors 232, 234, and a divider plate 236. The first and second cylinder housings 228, 230 may be fixed relative to the shell assembly 212 and may include first and second cylindrical recesses 238, 240, respectively. The first cylinder housing 228 may be disposed between the upper member 226 and the divider plate 236. The second cylinder housing 230 may be disposed between the divider plate 236 and the lower member 227. The first and second rotors 232, 234 may be disposed within the first and second cylindrical recesses 238, 240, respectively, and may engage first and second eccentric portions 244, 246, respectively, of the driveshaft 229. Accordingly, rotation of the driveshaft 229 about a rotational axis A causes the first and second rotors 232, 234 to rotate in an orbital path within the first and second cylindrical recesses 238, 240.

[0058] Each of the first and second cylinder housings 228, 230 may reciprocatingly receive a vane (not shown). The vanes may extend radially into the first and second cylindrical recesses 238, 240 and may be spring-biased into contact with a radially outer circumferential surface 252 of the rotors 232, 234. The vanes may reciprocate relative to the cylinder housings 228, 230 as the rotors 232, 234 rotate within the cylindrical recesses 238, 240. The vanes may separate a suction chamber 254 from a compression chamber 256 within each of the first and second cylindrical recesses 238, 240 between the circumferential surface 252 of each rotor 232, 234 and a diametrical circumferential surface 258 of each cylindrical recess 238, 240. Each suction chamber 254 may be defined between one side of the vane and a point of sealing contact between the circumferential surfaces 252, 258 (or a point at which the clearance between the circumferential surfaces 252, 258 is at its smallest). Each compression chamber 256 may be defined between the other side of the vane and the point of sealing contact (or the point at which the clearance between the circumferential surfaces 252, 258 is at its smallest) between the circumferential surfaces 252, 258.

[0059] Suction openings (not shown) may be formed in the divider plate 236 and/or the cylinder housings 228, 230. Each suction opening may provide

suction-pressure working fluid from a corresponding suction fitting to a corresponding suction chamber 254. Working fluid may be compressed in the compression chambers 256 and discharged into corresponding discharge mufflers 260, 262 through discharge openings 264. Each of the discharge openings 264 may be formed in a corresponding one of the upper and lower member 226, 227. Each cylinder housing 228, 230 may include a discharge recess (not shown) in communication with a corresponding one of the discharge openings 264. The discharge recesses may increase flow areas into the discharge openings 264. Discharge valves (not shown) may restrict or prevent working fluid in the discharge mufflers 260, 262 from flowing back into the compression chambers 256. From the discharge mufflers 260, 262, working fluid may exit the compressor 200 through the discharge outlet port 220.

[0060] The divider plate 236 may include a fluid-injection passageway 268 in communication with first and second fluid-injection openings 270, 272 formed therein. The fluid-injection passageway 268 may be fluidly coupled with the fluid-injection fitting 222. The fluid-injection openings 270, 272 may be at least partially aligned with the discharge openings 264 in radial, angular and/or axial directions. For example, a plane may be defined that extends through the rotational axis A and the fluid-injection openings 270, 272 and the discharge openings 264. In some embodiments, the fluid-injection openings 270, 272 may be at least partially disposed angularly between the discharge openings 264 and the vanes. The fluid-injection openings 270, 272 may extend radially inward and radially outward relative to the circumferential surfaces 258 of the cylindrical recesses 238, 240. In some embodiments, the fluid-injection openings 270, 272 may be substantially concentric with the discharge openings 264.

[0061] A first valve member 274 may be disposed between the fluid-injection passageway 268 and the first fluid-injection opening 270. A second valve member 276 may be disposed between the fluid-injection passageway 268 and the second fluid-injection opening 270. The first and second valve members 274, 276 may be movably received within respective first and second recesses 278, 280 formed in the first and second cylinder housings 228, 230, respectively. Each of the first and second valve members 274, 276 may independently move between a first position in which the valve member 274, 276 engages a

corresponding one of first and second valve seats 282, 284 formed on the divider plate 236 and a second position in which the valve member 274, 276 is spaced apart from the corresponding one of the first and second valve seats 282, 284. Springs (not shown) may bias the first and second valve members 274, 276 toward the first position, where the valve members 274, 276 may restrict or prevent fluid flow between the fluid-injection passageway 268 and corresponding fluid-injection openings 270, 272. In the second position, the valve members 274, 276 may allow fluid flow between the fluid-injection passageway 268 and the corresponding fluid-injection openings 270, 272.

[0062] The motor assembly 218 may include a motor stator 286 and a rotor 288. The structure and function of the motor stator and rotor 286, 288 may be generally similar to that of the motor stator and rotor 86, 88 apart from any exceptions described below and/or shown in the figures. Accordingly, like reference numerals may be used to describe similar features and components, and similar features and components will not be described again in detail.

[0063] The rotor 288 may include a housing 290. The housing 290 may include a generally cylindrical construct defining a cylindrical inner surface 292. The magnets 102 may be coupled to, and supported by, the inner surface 292. A flange or rotor support 294 may extend radially inwardly from the inner surface 292 of the housing 290. In one configuration, the rotor support 294 may extend annularly about the inner surface 292, defining a central aperture 296.

[0064] The rotor 288 may be fixed for rotation with the driveshaft 229 using various techniques. In one configuration, the driveshaft 229 may be press-fit into the aperture 296 or welded to the rotor support 294. Securing the rotor 288 to the driveshaft 229 ensures that when power is supplied to the motor assembly 218, the rotor 288 may transmit rotational power, or drive torque, through the rotor support 294 to the driveshaft 229.

[0065] The foregoing description of the embodiments has been provided for purposes of illustration and description. It is not intended to be exhaustive or to limit the disclosure. Individual elements or features of a particular embodiment are generally not limited to that particular embodiment, but, where applicable, are interchangeable and can be used in a selected embodiment, even if not specifically shown or described. The same may also be

varied in many ways. Such variations are not to be regarded as a departure from the disclosure, and all such modifications are intended to be included within the scope of the disclosure.

[0066] The terminology used herein is for the purpose of describing particular example embodiments only and is not intended to be limiting. As used herein, the singular forms "a," "an," and "the" may be intended to include the plural forms as well, unless the context clearly indicates otherwise. The terms "comprises," "comprising," "including," and "having," are inclusive and therefore specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof. The method steps, processes, and operations described herein are not to be construed as necessarily requiring their performance in the particular order discussed or illustrated, unless specifically identified as an order of performance. It is also to be understood that additional or alternative steps may be employed.

[0067] When an element or layer is referred to as being "on," "engaged to," "connected to," or "coupled to" another element or layer, it may be directly on, engaged, connected or coupled to the other element or layer, or intervening elements or layers may be present. In contrast, when an element is referred to as being "directly on," "directly engaged to," "directly connected to," or "directly coupled to" another element or layer, there may be no intervening elements or layers present. Other words used to describe the relationship between elements should be interpreted in a like fashion (e.g., "between" versus "directly between," "adjacent" versus "directly adjacent," etc.). As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

[0068] Although the terms first, second, third, etc. may be used herein to describe various elements, components, regions, layers and/or sections, these elements, components, regions, layers and/or sections should not be limited by these terms. These terms may be only used to distinguish one element, component, region, layer or section from another region, layer or section. Terms such as "first," "second," and other numerical terms when used herein do not imply a sequence or order unless clearly indicated by the context. Thus, a first element, component, region, layer or section discussed below could be termed a

second element, component, region, layer or section without departing from the teachings of the example embodiments.

[0069] Spatially relative terms, such as "inner," "outer," "beneath," "below," "lower," "above," "upper," and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. Spatially relative terms may be intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is turned over, elements described as "below" or "beneath" other elements or features would then be oriented "above" the other elements or features. Thus, the example term "below" can encompass both an orientation of above and below. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly.

15

CLAIMS

What is claimed is:

1. A compressor comprising:
5 a shell;
a compression mechanism disposed within said shell;
a driveshaft rotatably supported by a first bearing and a second bearing
and drivingly engaged with said compression mechanism;
a bearing housing including a tubular portion in which said first and second
10 bearings are disposed; and
a motor assembly disposed within said shell and drivingly engaged with
said driveshaft, said motor assembly including a rotor and a stator, said stator
engaging an outer diametrical surface of said tubular portion, said rotor disposed
radially outwardly relative to said stator and fixed for rotation with said driveshaft.
15
2. The compressor of claim 1, further comprising a support housing
having a first side supporting said compression mechanism, wherein said bearing
housing is removably mounted to a second side of said support housing.
- 20 3. The compressor of claim 2, wherein said bearing housing includes
a flange portion integrally formed with said tubular portion, and wherein said
flange portion is coupled to said support housing.
4. The compressor of claim 3, further comprising a counterweight fixed
25 to said driveshaft between said compression mechanism and said flange portion
of said bearing housing, wherein said flange portion axially supports said
counterweight, said driveshaft and said motor assembly.
5. The compressor of claim 1, wherein said driveshaft includes a first
30 outer surface and a second outer surface, said second outer surface extending
radially beyond said first outer surface.

6. The compressor of claim 5, wherein said motor assembly includes a rotor support subassembly having a first support member coupled to said second outer surface and to a radially inwardly extending flange of said rotor such that said driveshaft is fixed to said rotor for rotation therewith.

5

7. The compressor of claim 6, wherein said stator is disposed axially between said first support member and said compression mechanism.

8. The compressor of claim 7, further comprising a second support member extending around said driveshaft and coupled to at least one of said driveshaft and said first support member.

10

9. The compressor of claim 8, wherein said second support member is threadably engaged with said driveshaft.

15

10. The compressor of claim 8, wherein said second outer surface includes a conically shaped outer surface, and said first support member includes an aperture having a conically shaped inner surface engaged with said conically shaped outer surface.

20

11. The compressor of claim 1, further comprising a magnet fixed to a radially inner surface of said rotor.

12. A compressor comprising:

25

a shell;

a bearing housing assembly disposed within said shell, said bearing housing assembly including a first housing and a second housing, said second housing including a tubular portion and a flange portion, said flange portion mounted to said first housing and integrally formed with said tubular portion;

30

a compression mechanism axially supported by said first housing;

a driveshaft drivingly engaged with said compression mechanism; and

a motor assembly drivingly engaged with said driveshaft, said motor assembly including a rotor and a stator, said stator extending circumferentially

around said tubular portion and including a radially inner surface coupled to the tubular portion, said flange portion disposed axially between said stator and said compression mechanism, said rotor disposed radially outwardly relative to said stator and fixed for rotation with said driveshaft.

5

13. The compressor of claim 12, further comprising a counterweight fixed to said driveshaft between said compression mechanism and said flange portion of said bearing housing, wherein said flange portion axially supports said counterweight, said driveshaft and said motor assembly.

10

14. The compressor of claim 13, wherein said first housing includes a first side supporting said compression mechanism, and wherein said second housing is removably mounted to a second side of said first housing.

15

15. The compressor of claim 14, wherein said tubular portion extends around said driveshaft and houses first and second bearings that are spaced apart from each other and rotatably support said driveshaft.

20

16. The compressor of claim 15, wherein said driveshaft includes a first outer surface and a second outer surface, said second outer surface extending radially beyond said first outer surface.

25

17. The compressor of claim 16, wherein said motor assembly includes a rotor support subassembly having a first support member coupled to said second outer surface and to said rotor such that said driveshaft is fixed to said rotor for rotation therewith.

30

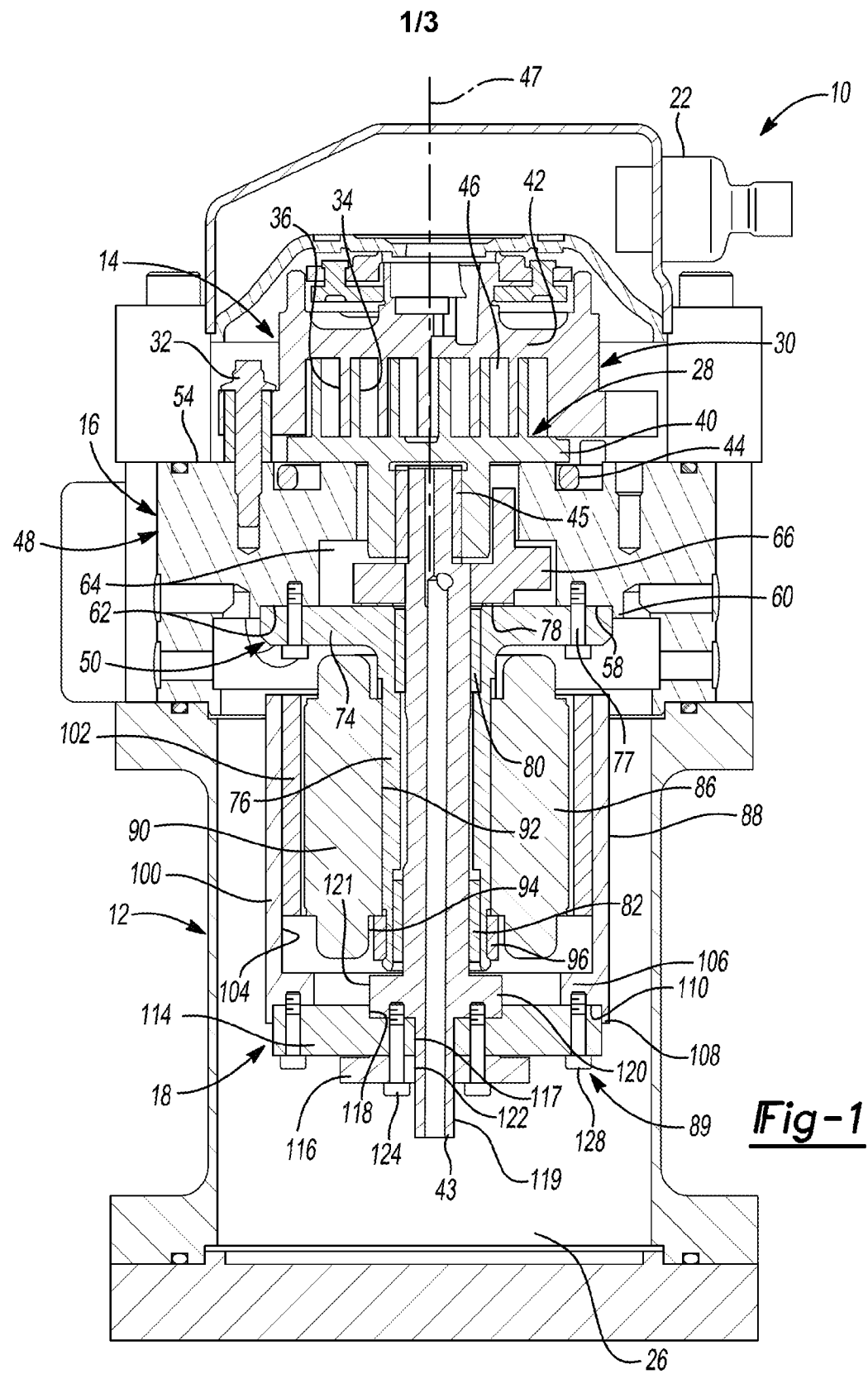
18. The compressor of claim 17, wherein said rotor includes a radially inwardly extending flange, and said first support member is coupled to said flange.

19. The compressor of claim 18, further comprising a second support member extending around said driveshaft and coupled to at least one of said driveshaft and said first support member.

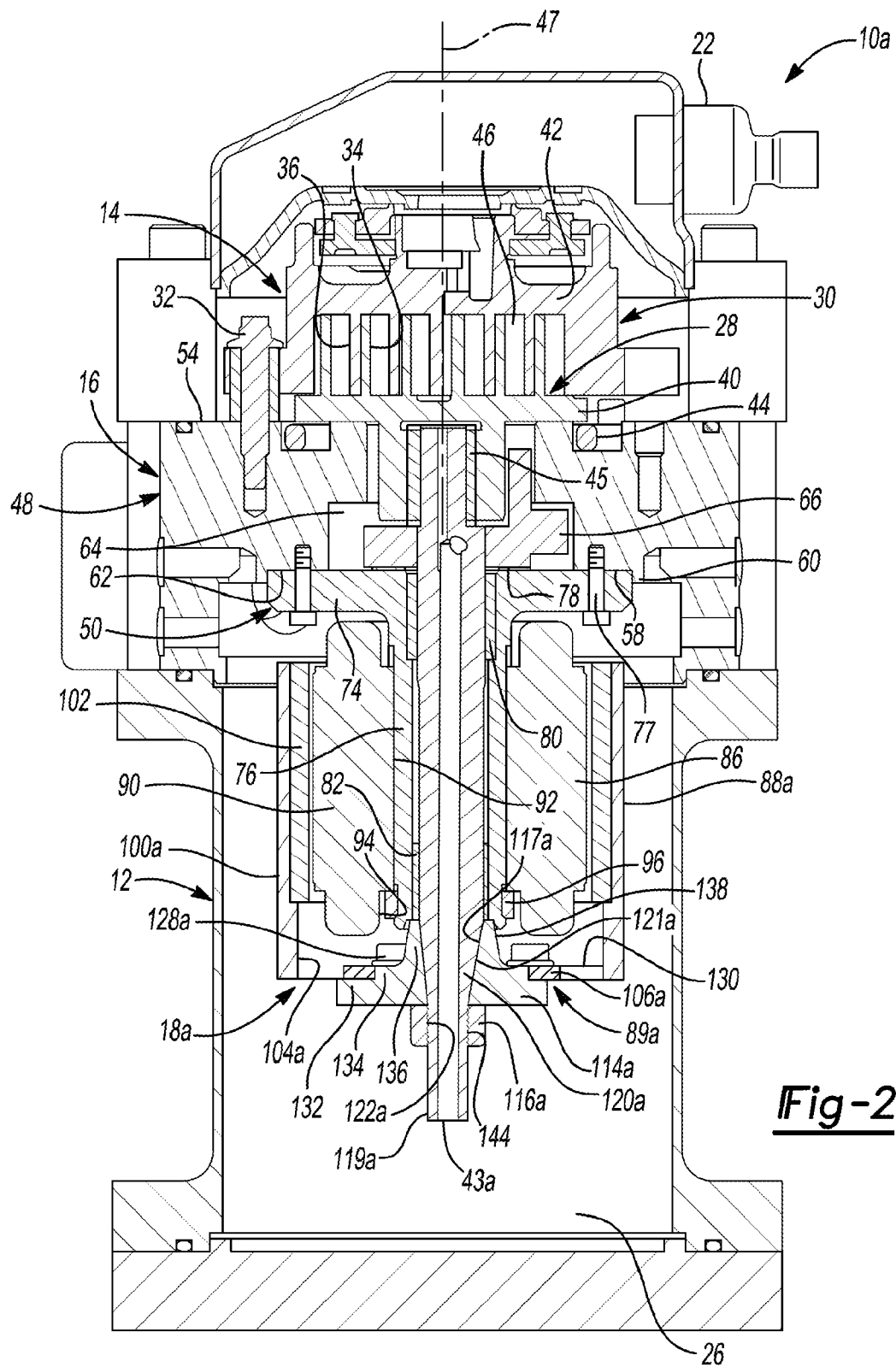
5 20. The compressor of claim 19, wherein said second support member is threadably engaged with said driveshaft.

10 21. The compressor of claim 20, wherein said second outer surface includes a conically shaped outer surface, and said first support member includes an aperture having a conically shaped inner surface engaged with said conically shaped outer surface.

15 22. The compressor of claim 12, wherein said stator is disposed axially between a first support member and said compression mechanism, and wherein said first support member is coupled to said driveshaft and to said rotor, thereby fixing said rotor to said driveshaft for rotation therewith.



2/3

**Fig-2**

3/3

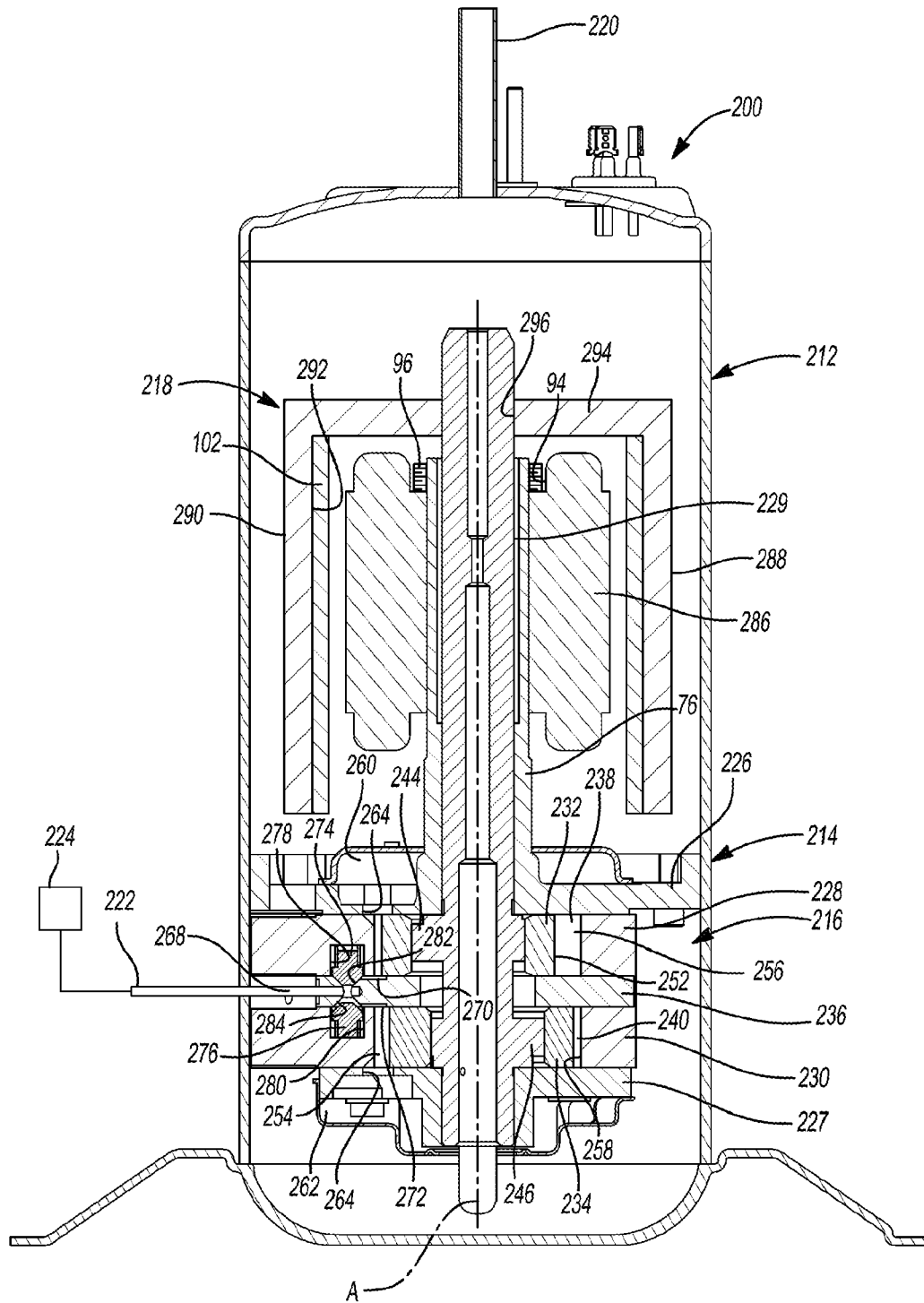


Fig-3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/042479**A. CLASSIFICATION OF SUBJECT MATTER****F04C 29/00(2006.01)i, F04C 23/02(2006.01)i, F04C 18/00(2006.01)i, H02K 5/04(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F04C 29/00; F04B 39/02; F04C 18/02; F04C 29/12; F04B 17/03; F04B 39/06; F04C 23/02; F04C 18/00; H02K 5/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: compressor, driveshaft, bearing, motor, stator, rotor, and counterweight

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6896493 B2 (CHANG et al.) 24 May 2005 See column 5, line 54 - column 7, line 29 and figure 2A.	12-14, 22
Y		1-11, 15-21
Y	JP 07-026618 B2 (MITSUI SEIKI KOGYO CO., LTD.) 29 March 1995 See column 4, lines 3-32 and figure 1.	1-11, 15-21
A	US 4564339 A (NAKAMURA et al.) 14 January 1986 See column 3, lines 6-36 and figure 3.	1-22
A	US 6280154 B1 (CLENDEIN et al.) 28 August 2001 See column 2, lines 17-58 and figure 1.	1-22
A	US 2009-0191080 A1 (IGNATIEV et al.) 30 July 2009 See paragraphs [0048]-[0050] and figure 1.	1-22

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

22 October 2015 (22.10.2015)

Date of mailing of the international search report

23 October 2015 (23.10.2015)

Name and mailing address of the ISA/KR

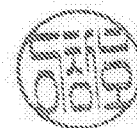
International Application Division
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City, 35208,
Republic of Korea

Facsimile No. +82-42-472-7140

Authorized officer

LEE, Chang Ho

Telephone No. +82-42-481-8398



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2015/042479

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6896493 B2	24/05/2005	CN 1281868 C	25/10/2006
		CN 1479013 A	03/03/2004
		CN 1479013 C	25/10/2006
		JP 04184815 B2	19/11/2008
		JP 2004-084653 A	18/03/2004
		KR 10-0447205 B1	04/09/2004
		KR 10-0447206 B1	04/09/2004
		KR 10-0447207 B1	04/09/2004
		KR 10-0469271 B1	02/02/2005
		US 2004-0042917 A1	04/03/2004
JP 07-026618 B2	29/03/1995	None	
US 4564339 A	14/01/1986	JP 04-024557 B	27/04/1992
		JP 59-224493 A	17/12/1984
US 6280154 B1	28/08/2001	AU 1671601 A	09/08/2001
		AU 2001-16716 A1	09/08/2001
		AU 2001-16716 B2	01/04/2004
		AU 771839 B2	01/04/2004
		BR 0100245 A	02/10/2001
		BR 0100245 B1	24/08/2010
		CN 1164874 C	01/09/2004
		CN 1317645 A	17/10/2001
		DE 60105860 D1	04/11/2004
		DE 60105860 T2	09/03/2006
		EP 1122437 A2	08/08/2001
		EP 1122437 A3	12/06/2002
		EP 1122437 B1	29/09/2004
		ES 2227066 T3	01/04/2005
		JP 2001-221171 A	17/08/2001
		KR 10-0749040 B1	13/08/2007
		KR 10-2001-0078226 A	20/08/2001
		MX PA01001177A	09/07/2002
		TW 576896 A	21/02/2004
US 2009-0191080 A1	30/07/2009	CN 101297117 A	29/10/2008
		CN 101297117 B	18/07/2012
		CN 102705234 A	03/10/2012
		CN 102705235 A	03/10/2012
		CN 102705235 B	24/06/2015
		EP 1941162 A1	09/07/2008
		EP 1941162 A4	04/12/2013
		US 2007-0092390 A1	26/04/2007
		US 2011-0044834 A1	24/02/2011
		US 2012-0258004 A1	11/10/2012
		US 2014-0348679 A1	27/11/2014
		US 7837452 B2	23/11/2010
		US 8226387 B2	24/07/2012

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2015/042479

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		US 8764423 B2	01/07/2014
		WO 2007-050292 A1	03/05/2007