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(71) Applicant: **DANFOSS COMMERCIAL COMPRESSORS** [FR/FR]; Route Départementale 28 ZI, Lieu dit Les Communaux Reyrieux, F-01600 Trevoux (FR).

(72) Inventors: **ROSSON, Yves**; 71 rue des Autieres, F-01330 Villars Les Dombes (FR). **BONNEFOI, Patrice**; 14 rue du Commandant Israel, F-69370 Saint Didier au Mont D'or (FR). **CLAUDIN, Ingrid**; 47 rue Gilbert Boullier, F-01330 Villars les Dombes (FR).

(74) Agent: **STEVENS, Brian**; Danfoss A/S, L25 - Intellectual Property, Nordborgvej 81, DK-6430 Nordborg (DK).

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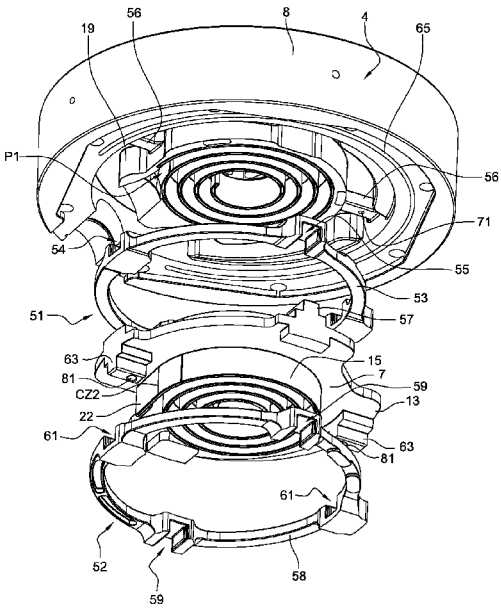

Fig. 9

(57) Abstract: A scroll compressor including an Oldham coupling lubrication system The scroll compressor (1) includes a first fixed scroll (4), an orbiting scroll arrangement (7), a first Oldham coupling (51) configured to prevent rotation of the orbiting scroll arrangement (7) with respect to the first fixed scroll (4) and including at least a pair of first engaging elements (54) respectively slidably engaged with a pair of complementary engaging elements (56) provided on the first fixed scroll (4), an oil sump, and a lubrication system configured to lubricate at least partially the first engaging elements (54) of the first Oldham coupling (51) with oil supplied from the oil sump.

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A SCROLL COMPRESSOR INCLUDING AN OLDHAM COUPLING LUBRIFICATION SYSTEM

Field of the invention

The present invention relates to a scroll compressor, and in particular to a scroll refrigeration compressor.

Background of the invention

As known, a scroll refrigeration compressor includes:

- a closed container,
- a scroll compression unit disposed in the closed container and including at least:
  - at least a first fixed scroll including a first fixed base plate and a first fixed spiral wrap,
  - an orbiting scroll arrangement including a first orbiting spiral wrap, the first fixed spiral wrap and the first orbiting spiral wrap forming a plurality of compression chambers,
  - at least a first Oldham coupling configured to prevent rotation of the orbiting scroll arrangement with respect to the first fixed scroll, the first Oldham coupling including at least a pair of first engaging elements respectively slidably engaged with a pair of complementary engaging elements provided on the first fixed scroll,
  - a drive shaft adapted for driving the orbiting scroll arrangement in an orbital movement,
  - a driving motor coupled to the drive shaft and arranged for driving in rotation the drive shaft about a rotation axis,
  - a refrigerant suction part suitable for supplying the scroll compression unit with refrigerant to be compressed, and
  - an oil sump.

Typically, the first Oldham coupling is disposed inside the refrigerant flow path. Thus, the engaging elements of the Oldham coupling can be lubricated by the oil droplets contained in the refrigerant.

However, such a lubrication of the engaging elements of the Oldham coupling by means of the refrigerant may be insufficient, notably when the refrigerant has a low oil content or when the first Oldham coupling is disposed outside the

refrigerant flow path, which may harm the efficiency and the reliability of the scroll compression unit, and thus of the scroll compressor.

Summary of the invention

It is an object of the present invention to provide an improved scroll compressor which can overcome the drawbacks encountered in conventional scroll compressors.

Another object of the present invention is to provide a scroll compressor which has an improved reliability and efficiency compared to the conventional scroll compressors.

According to the invention such a scroll compressor includes:

- a scroll compression unit including:
  - a first fixed scroll comprising a first fixed base plate and a first fixed spiral wrap,
  - an orbiting scroll arrangement including a first orbiting spiral wrap, the first fixed spiral wrap and the first orbiting spiral wrap forming a plurality of compression chambers,
  - a refrigerant suction part suitable for supplying the scroll compression unit with refrigerant to be compressed,
  - at least a first Oldham coupling configured to prevent rotation of the orbiting scroll arrangement with respect to the first fixed scroll, the first Oldham coupling including at least a pair of first engaging elements respectively slidably engaged with a pair of complementary engaging elements provided on the first fixed scroll,
  - an oil sump, and
  - a lubrication system configured to lubricate at least partially the first engaging elements of the first Oldham coupling with oil supplied from the oil sump, the lubrication system including:
    - an oil supplying passage delimited at least partially by the first fixed base plate,
    - an oil supplying duct fluidly connected to the oil sump and configured to supply the oil supplying passage with oil from the oil sump, and
    - at least one first lubrication passage provided on the first fixed base plate and fluidly connected to the oil supplying passage, the at least one first

lubrication passage being configured to supply with oil at least one of the first engaging elements of the first Oldham coupling.

Such a configuration of the lubrication system allows to lubricate the first Oldham coupling, and particularly the first engaging elements of the latter, directly with oil supplied from the oil sump, which enables an optimized lubrication of the first Oldham coupling, and thus improves the reliability and efficiency of the first Oldham coupling and of the scroll compression unit.

Further, due to the configuration of the lubrication system, the lubrication of the first Oldham coupling is independent from the rotational speed of the drive shaft.

According to an embodiment of the invention, the first Oldham coupling is disposed outside the refrigerant flow path.

According to an embodiment of the invention, the lubrication system includes a plurality of first lubrication passages provided on the first fixed base plate and fluidly connected to the oil supplying passage, each of the first lubrication passages being configured to supply with oil a respective one of the first engaging elements of the first Oldham coupling.

According to an embodiment of the invention, each first lubrication passage includes an oil outlet aperture emerging in an outer surface of a respective one of the complementary engaging elements provided on the first fixed scroll.

According to an embodiment of the invention, the oil outlet aperture of each first lubrication passage emerges in an outer engaging surface of the respective one of the complementary engaging elements provided on the first fixed scroll, said outer engaging surface being configured to slidably cooperate with the respective one of the first engaging elements of the first Oldham coupling.

According to an embodiment of the invention, each first lubrication passage includes an oil inlet aperture emerging in the oil supplying passage.

According to an embodiment of the invention, the oil supplying passage extends around at least a part of a perimeter edge of the orbiting scroll arrangement. Advantageously, the oil supplying passage is offset relative to the perimeter edge of the orbiting scroll arrangement.

According to an embodiment of the invention, the oil supplying passage extends substantially in an arc of a circle.

According to an embodiment of the invention, the oil supplying passage extends over an angular sector of at least 180°, and advantageously of at least 270°, and for example of about 270°.

According to an embodiment of the invention, the scroll compression unit further includes a second fixed scroll including a second fixed base plate and a second fixed spiral wrap, the first and second fixed scrolls defining an inner volume, the orbiting scroll arrangement being disposed in the inner volume and further including a second orbiting spiral wrap, the second fixed spiral wrap and the second orbiting spiral wrap forming a plurality of compression chambers.

According to an embodiment of the invention, the oil supplying passage is delimited by the first and second fixed base plates.

According to an embodiment of the invention, the first fixed base plate includes a first face from which projects the first fixed spiral wrap and the second fixed base plate includes a first face from which projects the second fixed spiral wrap, the oil supplying passage being delimited by the first faces of the first and second fixed base plates.

According to an embodiment of the invention, the first fixed base plate and/or the second fixed base plate includes an oil supplying groove forming partially the oil supplying passage.

According to an embodiment of the invention, the first Oldham coupling is disposed in the inner volume.

According to an embodiment of the invention, the first Oldham coupling is disposed between the first fixed scroll and the orbiting scroll arrangement, and advantageously between the first fixed base plate and an orbiting base plate of the orbiting scroll arrangement.

According to an embodiment of the invention, the first Oldham includes an annular body disposed around the first fixed spiral wrap.

According to an embodiment of the invention, the scroll compressor further includes a second Oldham coupling configured to prevent rotation of the orbiting scroll arrangement with respect to the second fixed scroll, the second Oldham coupling including at least a pair of first engaging respectively slidably engaged with a pair of complementary engaging elements provided on the second fixed scroll.

According to an embodiment of the invention, the second Oldham coupling is disposed outside the refrigerant flow path.

According to an embodiment of the invention, the second Oldham coupling is disposed in the inner volume.

According to an embodiment of the invention, the second Oldham coupling is disposed between the second fixed scroll and the orbiting scroll

arrangement, and advantageously between the second fixed base plate and the orbiting base plate of the orbiting scroll arrangement.

According to an embodiment of the invention, the second Oldham coupling includes an annular body disposed around the second fixed spiral wrap.

According to an embodiment of the invention, the first and second Oldham couplings extend respectively above and below the refrigerant suction part.

According to an embodiment of the invention, the lubrication system is further configured to lubricate at least partially the first engaging elements of the second Oldham coupling with oil supplied from the oil sump.

According to an embodiment of the invention, the lubrication system further includes at least one second lubrication passage provided on the second fixed base plate and fluidly connected to the oil supplying passage, the at least one second lubrication passage being configured to supply with oil at least one of the first engaging elements of the second Oldham coupling.

According to an embodiment of the invention, the lubrication system includes a plurality of second lubrication passages provided on the second fixed base plate and fluidly connected to the oil supplying passage, each of the second lubrication passages being configured to supply with oil a respective one of the first engaging elements of the second Oldham coupling.

According to an embodiment of the invention, each second lubrication passage includes an oil outlet aperture emerging in an outer surface of a respective one of the complementary engaging elements provided on the second fixed scroll.

According to an embodiment of the invention, the oil outlet aperture of each second lubrication passage emerges in an outer engaging surface of the respective one of the complementary engaging elements provided on the second fixed scroll, said outer engaging surface being configured to slidably cooperate with the respective one of the first engaging elements of the second Oldham coupling.

According to an embodiment of the invention, each second lubrication passage includes an oil inlet aperture emerging in the oil supplying passage.

According to an embodiment of the invention, the first Oldham coupling further includes a pair of second engaging elements respectively slidably engaged with a pair of first complementary engaging elements provided on the orbiting scroll arrangement, the lubrication system being further configured to lubricate at least partially the second engaging elements of the first Oldham coupling with oil supplied from the oil sump.

According to an embodiment of the invention, the first fixed scroll is disposed above the second fixed scroll, and the lubrication system further includes at least one third lubrication passage provided on the first fixed base plate and fluidly connected to the oil supplying passage, the at least one third lubrication passage being configured to supply with oil at least one of the second engaging elements of the first Oldham coupling.

According to an embodiment of the invention, the lubrication system includes a plurality of third lubrication passages provided on the first fixed base plate and fluidly connected to the oil supplying passage, each of the third lubrication passages being configured to supply with oil a respective one of the second engaging elements of the first Oldham coupling.

According to an embodiment of the invention, each third lubrication passage includes an oil outlet aperture configured to be located vertically above a respective one of the first complementary engaging elements provided on the orbiting scroll arrangement during at least a part of the orbital movement of the orbiting scroll arrangement.

According to an embodiment of the invention, the oil outlet aperture of each third lubrication passage emerges vertically above a respective one of the second engaging elements of the first Oldham coupling and/or a respective one of the first complementary engaging elements provided on the orbiting scroll arrangement.

According to an embodiment of the invention, each third lubrication passage includes an oil inlet aperture emerging in the oil supplying passage.

According to an embodiment of the invention, the second Oldham coupling further includes a pair of second engaging elements respectively slidably engaged with a pair of second complementary engaging elements provided on the orbiting scroll arrangement, each of the second complementary engaging elements provided on the orbiting scroll arrangement including an oil passage provided with an oil outlet aperture emerging vertically above a respective one of the second engaging elements of the second Oldham coupling.

According to an embodiment of the invention, the first Oldham coupling is slidable with respect to the first and second fixed scrolls along a first displacement direction, and the second Oldham coupling is slidable with respect to the first and second fixed scrolls along a second displacement direction, the first and second displacement directions being transverse with respect to each other, and for example substantially orthogonal with respect to each other.

According to an embodiment of the invention, the oil supplying duct is at least partly formed by an oil supplying pipe, and the first fixed scroll or the second fixed scroll includes a mounting part fluidly connected to the oil supplying passage, an end portion of the oil supplying pipe being mounted in the mounting part.

According to an embodiment of the invention, the refrigerant suction part emerges in the inner volume.

According to an embodiment of the invention, the refrigerant suction part is formed by a refrigerant suction element sealingly connected to the scroll compression unit. Therefore, the refrigerant enters the scroll compression unit without cooling down beforehand the driving motor and thus without being heated by the driving motor, which improves the scroll compression unit efficiency.

According to an embodiment of the invention, the scroll compressor further includes a closed container delimiting the oil sump and defining a high pressure discharge volume, the oil sump being fluidly connected to the high pressure discharge volume.

According to an embodiment of the invention, the refrigerant suction part is fluidly isolated from the high pressure discharge volume.

According to an embodiment of the invention, the first fixed scroll further includes a first fixed guiding portion extending from an outer end portion of the first fixed spiral wrap, the first fixed guiding portion partially delimiting a first refrigerant inlet passage.

According to an embodiment of the invention, the refrigerant suction part is oriented towards the first refrigerant inlet passage and is configured to conduct, in use, at least a part of the refrigerant suctioned in the refrigerant suction part towards the first refrigerant inlet passage.

According to an embodiment of the invention, the second fixed scroll further includes a second fixed guiding portion extending from an outer end portion of the second fixed spiral wrap, the second fixed guiding portion partially delimiting a second refrigerant inlet passage.

According to an embodiment of the invention, the refrigerant suction part is oriented towards the second refrigerant inlet passage and is configured to conduct, in use, at least a part of the refrigerant suctioned in the refrigerant suction part towards the second refrigerant inlet passage.

According to an embodiment of the invention, the refrigerant suction part emerges nearby or in the first refrigerant inlet passage.

According to an embodiment of the invention, the refrigerant suction part emerges nearby or in the second refrigerant inlet passage.

According to an embodiment of the invention, the scroll compressor further includes a drive shaft adapted for driving the orbiting scroll arrangement in an orbital movement, and a driving motor coupled to the drive shaft and arranged for driving in rotation the drive shaft about a rotation axis.

According to an embodiment of the invention, the driving motor is contained in the high pressure discharge volume.

According to an embodiment of the invention, the drive shaft extends across the orbiting scroll arrangement and further includes a first guided portion and second guided portion located on either side of a driving portion adapted for driving the orbiting scroll arrangement in an orbital movement, the scroll compressor further including guide elements for guiding in rotation the drive shaft, the guide elements comprising at least one first guide bearing and at least one second guide bearing located on either side of the orbiting scroll arrangement and arranged to respectively guide the first and second guided portions of the drive shaft.

According to an embodiment of the invention, the scroll compressor is a vertical scroll compressor and the drive shaft extends substantially vertically. The driving motor may be located above the scroll compression unit.

According to an embodiment of the invention, the first and second orbiting spiral wraps are respectively provided on first and second faces of a common base plate, the second face being opposite to the first face.

According to an embodiment of the invention, each of the first and second engaging elements of the first Oldham coupling can be an engaging groove or an engaging projection.

According to an embodiment of the invention, each of the first and second engaging elements of the second Oldham coupling can be an engaging groove or an engaging projection.

According to an embodiment of the invention, each of the first and second complementary engaging elements of the orbiting scroll arrangement can be an engaging groove or an engaging projection.

According to an embodiment of the invention, each of the complementary engaging elements of the first and second fixed scrolls can be an engaging groove or an engaging projection.

These and other advantages will become apparent upon reading the following description in view of the drawing attached hereto representing, as non-limiting example, an embodiment of a scroll compressor according to the invention.

Brief description of the drawings

The following detailed description of one embodiment of the invention is better understood when read in conjunction with the appended drawings being understood, however, that the invention is not limited to the specific embodiment disclosed.

Figure 1 is a longitudinal section view of a scroll compressor according to the invention.

Figures 2 to 5 are partial longitudinal section views of the scroll compressor of figure 1.

Figure 6 is a partial transversal section view showing an orbiting guiding portion provided on the orbiting scroll arrangement.

Figures 7 is an exploded perspective view of one fixed scroll and of a refrigerant suction element of the scroll compressor of figure 1.

Figures 8 and 9 are exploded perspective views of two Oldham couplings and of an orbiting scroll arrangement of the scroll compressor of figure 1.

Detailed description of the invention

Figure 1 shows a vertical scroll compressor 1 including a closed container 2 defining a high pressure discharge volume, and a scroll compression unit 3 disposed inside the closed container 2.

The scroll compression unit 3 includes upper and lower fixed scrolls 4, 5 defining an annular inner volume 6. In particular the upper and lower fixed scrolls 4, 5 are fixed in relation to the closed container 2. The scroll compression unit 3 further includes an orbiting scroll arrangement 7 disposed in the inner volume 6.

The upper fixed scroll 4 includes a base plate 8 and a spiral wrap 9 projecting from the base plate 8 towards the lower fixed scroll 5, and the lower fixed scroll 5 includes a base plate 11 and a spiral wrap 12 projecting from the base plate 11 towards the upper fixed scroll 4.

The orbiting scroll arrangement 7 includes a base plate 13, a first spiral wrap 14 projecting from a first face of the base plate 13 towards the upper fixed scroll 4, and a second spiral wrap 15 projecting from a second face of the base plate 13 towards the lower fixed scroll 5, the second face being opposite to the first face such that the first and second spiral wraps 14, 15 project in opposite directions. The upper

and lower fixed scrolls 4, 5 are respectively located above and below the orbiting scroll arrangement 7.

The first spiral wrap 14 of the orbiting scroll arrangement 7 meshes with the spiral wrap 9 of the upper fixed scroll 4 to form a plurality of compression chambers 16 between them, and the second spiral wrap 15 of the orbiting scroll arrangement 7 meshes with the spiral wrap 12 of the lower fixed scroll 5 to form a plurality of compression chambers 17 between them. Each of the compression chambers 16, 17 has a variable volume which decreases from the outside towards the inside, when the orbiting scroll arrangement 7 is driven to orbit relative to the upper and lower fixed scrolls 4, 5.

The orbiting scroll arrangement 7 includes at least one communicating hole 18 arranged to fluidly connect the central compression chamber 16 and the central compression chamber 17.

As better shown on figures 5 to 9, the upper fixed scroll 4 further includes a fixed guiding portion 19 extending from the outer end portion of the spiral wrap 9, and the lower fixed scroll 5 further includes a fixed guiding portion 20 extending from the outer end portion of the spiral wrap 12.

The base plate 8, the spiral wrap 9, the fixed guiding portion 19 and the base plate 13 delimit a refrigerant inlet passage P1, while the base plate 11, the spiral wrap 12, the fixed guiding portion 20 and the base plate 13 delimit a refrigerant inlet passage P2.

The orbiting scroll arrangement 7 further includes a first orbiting guiding portion 21 projecting from the first face of the base plate 13 and extending tangentially from the outer end portion of the first spiral wrap 14, and a second orbiting guiding portion 22 projecting from the second face of the base plate 13 and extending tangentially from the outer end portion of the second spiral wrap 15.

According to the embodiment shown on the figures, each of the first and second orbiting guiding portions 21, 22 is substantially straight, and extends in the continuity of the respective one of the first and second spiral wraps 14, 15.

The first spiral wrap 14 includes a plurality of sealing contact zones configured to cooperate with the spiral wrap 9 during the orbital movement of the orbiting scroll arrangement 7, and the second spiral wrap 15 includes a plurality of sealing contact zones configured to cooperate with the spiral wrap 12 during the orbital movement of the orbiting scroll arrangement 7. According to the embodiment shown on the figures, the first orbiting guiding portion 21 extends upstream and from the outermost sealing contact zone CZ1 provided on the first spiral wrap 14, while the

second orbiting guiding portion 22 extends upstream and from the outermost sealing contact zone CZ2 provided on the second spiral wrap 15.

The first orbiting guiding portion 21 extends in the refrigerant inlet passage P1 and is configured to guide, in use, the refrigerant supplied to the refrigerant inlet passage P1 towards the compression chambers 16, and more particularly towards the two outermost compression chambers 16, while the second orbiting guiding portion 22 extends in the refrigerant inlet passage P2 and is configured to guide, in use, the refrigerant supplied to the refrigerant inlet passage P2 towards the compression chambers 17, and more particularly towards the two outermost compression chambers 17.

Advantageously, the first orbiting guiding portion 21 and the first spiral wrap 14 have substantially a same height, and the second orbiting guiding portion 22 and the second spiral wrap 15 have substantially a same height. Each of the first and second orbiting guiding portions 21, 22 includes a nose portion which may be rounded, tapered or sharp.

The scroll compressor 1 also includes a refrigerant suction pipe 23 for supplying the scroll compression unit 3 with refrigerant, and a refrigerant discharge pipe 24 for discharging the compressed refrigerant outside the scroll compressor 1. The refrigerant suction pipe 23 extends along a longitudinal axis A, and includes an outer end portion 23a, an intermediate portion 23b and a refrigerant supplying portion 23c.

The refrigerant suction pipe 23 is sealingly connected to the scroll compression unit 3. The scroll compression unit 3 may for example include a first mounting portion 24 into which the intermediate portion 23b of the refrigerant suction pipe 23 is sealingly mounted, and a second mounting portion 25 into which the refrigerant supplying portion 23c of the refrigerant suction pipe 23 is mounted.

The refrigerant suction pipe 23 is oriented towards the refrigerant inlet passages P1, P2 and is configured to conduct, and more particularly to canalize, in use, at least a first part of the refrigerant suctioned in the refrigerant suction pipe 23 towards the refrigerant inlet passage P1 and at least a second part of the refrigerant suctioned in the refrigerant suction pipe 23 towards the refrigerant inlet passage P2.

According to the embodiment shown on the figures, the refrigerant supplying portion 23c is provided with a deflector 231 mounted inside the refrigerant supplying portion 23c and configured to deflect the first part of the refrigerant suctioned in the refrigerant suction pipe 23 towards the refrigerant inlet passage P1 and the second part of the refrigerant suctioned in the refrigerant suction pipe 23

towards the refrigerant inlet passage P2. The deflector 231 may for example have a triangular cross section.

According to the embodiment shown on the figures, the refrigerant supplying portion 23c includes a refrigerant supplying aperture 232 having an upper section facing and emerging in the refrigerant inlet passage P1 and a lower section facing and emerging in the refrigerant inlet passage P2.

As shown on figures 6 to 9, the width of the refrigerant inlet passages P1, P2 decreases in the refrigerant flow direction, and the height of the refrigerant inlet passages P1, P2 increases in the refrigerant flow direction. Advantageously, the width of the refrigerant inlet passage P1 decreases as far as the outermost sealing contact zone provided on the spiral wrap 9, while the width of the refrigerant inlet passage P2 decreases as far as the outermost sealing contact zone CZ3 provided on the spiral wrap 12.

According to the embodiment shown on the figures, the refrigerant supplying portion 23c includes a notch 233 suitable for receiving a portion of the base plate 13 of the orbiting scroll arrangement 7 during at least a part of the orbital movement of the orbiting scroll arrangement 7. The notch 233 is advantageously located downstream the deflector 231.

According to the embodiment shown on the figures, the nose portions of the first and second orbiting guiding portions 21, 22 are oriented towards the refrigerant suction pipe 23 and are configured to be located nearby the refrigerant suction pipe 23 during at least a part of the orbital movement of the orbiting scroll arrangement 7.

The upper fixed scroll 4 includes a plurality of discharge passages 26 fluidly connected to the high pressure discharge volume and arranged to conduct the refrigerant compressed in the compression chambers 16 outside the inner volume 6.

The lower fixed scroll 5 also includes a plurality of discharge passage 27 fluidly connected to the high pressure discharge volume and arranged to conduct the refrigerant compressed in the compression chambers 17 outside the inner volume 6.

Furthermore the scroll compressor 1 includes a stepped drive shaft 28 adapted for driving the orbiting scroll arrangement 7 in orbital movements, an electric driving motor 29 coupled to the drive shaft 28 and arranged for driving in rotation the drive shaft 28 about a rotation axis, and an intermediate casing 30 fixed on the upper fixed scroll 4 and in which the driving motor 29 is entirely mounted.

Each discharge passage 26 is provided in the base plate 8 of the upper fixed scroll 4, and includes a first end portion emerging in an annular chamber C1

defined by the upper fixed scroll 4 and the drive shaft 28 and fluidly connected to the central compression chamber 16, and a second end portion emerging outside the inner volume 6. Each discharge passage 27 is provided in the base plate 11 of the lower fixed scroll 5, and includes a first end portion emerging in an annular chamber C2 defined by the lower fixed scroll 5 and the drive shaft 28 and fluidly connected to the central compression chamber 17, and a second end portion emerging outside the inner volume 6 towards an oil sump S defined by the closed container 2.

The driving motor 29, which may be a variable-speed electric motor, is located above the upper fixed scroll 4. The driving motor 29 has a rotor 31 fitted on the drive shaft 28, and a stator 32 disposed around the rotor 31. The stator 32 includes a stator stack or stator core 33, and stator windings wound on the stator core 33. The stator windings define a first winding head 34a which is formed by the portions of the stator windings extending towards outside from the end face 33a of the stator core 33 oriented towards the scroll compression unit 3, and a second winding head 34b which is formed by the portions of the stator windings extending towards outside from the end face 33b of the stator core 33 opposite to the scroll compression unit 3.

As shown in figure 1, the intermediate casing 30 and the closed container 2 define an annular outer volume 36 fluidly connected to the discharge pipe 24. Further the intermediate casing 30 and the driving motor 29 define a proximal chamber 37 containing the first winding head 34a of the stator 32, and a distal chamber 38 containing the second winding head 34b of the stator 32.

The intermediate casing 30 is provided with a plurality of refrigerant discharge apertures 39 emerging in the distal chamber 38 and arranged to fluidly connect the distal chamber 38 and the annular outer volume 36. According to the embodiment shown on the figures, the intermediate casing 30 includes a side part 30a surrounding the stator 32 and a closing part 30b closing an end portion of the side part 30a opposite to the upper fixed scroll 4.

According to the embodiment shown on the figures, the second end portion of each discharge passages 26 emerges in the proximal chamber 37 nearby the driving motor 29, and particularly nearby the first winding head 34a of the stator 32. Advantageously, each of the discharge passages 26, 27 is inclined relative to the rotation axis of the drive shaft 28.

The drive shaft 28 extends vertically across the base plate 13 of the orbiting scroll arrangement 7. The drive shaft 28 comprises a first end portion 40 located above the upper fixed scroll 4 and on which is fitted the rotor 31, and a

second end portion 41 opposite to the first end portion 40 and located below the lower fixed scroll 5. The first end portion 40 has an external diameter larger than the external diameter of the second end portion 41. The first end portion 40 includes a central recess 42 emerging in the end face of the drive shaft 28 opposite to the second end portion 41.

The drive shaft 28 further comprises a first guided portion 43 and a second guided portion 44 located between the first and second end portion 40, 41, and an eccentric driving portion 45 located between the first and second guided portions 43, 44 and being off-centered from the center axis of the drive shaft 28. The eccentric driving portion 45 is arranged to cooperate with the orbiting scroll arrangement 7 so as to cause the latter to be driven in an orbital movement relative to the upper and lower fixed scrolls 4, 5 when the driving motor 29 is operated.

The scroll compressor 1 further comprises guide bearings 46, 47 provided on the upper and lower fixed scrolls 4, 5 and arranged for guiding in rotation the first and second guided portions 43, 44 of the drive shaft 28. The scroll compressor 1 further comprises one or two bearings 48 provided on the orbiting scroll arrangement 7 and arranged for cooperating with the eccentric driving portion 45 of the drive shaft 28.

The scroll compressor 1 also comprises an Oldham coupling 51 which is slidably mounted with respect to the upper fixed scroll 4 along a displacement direction D1, and an Oldham coupling 52 which is slidably mounted with respect to the lower fixed scroll 5 along a displacement direction D2 which is substantially orthogonal to the displacement direction D1. The displacement directions D1, D2 are substantially perpendicular to the rotation axis of the drive shaft 28. The Oldham couplings 51, 52 are configured to prevent rotation of the orbiting scroll arrangement 7 with respect to the upper and lower fixed scrolls 4, 5. Each of the Oldham couplings 51, 52 undergoes a reciprocating motion respectively along the displacement directions D1, D2.

The Oldham couplings 51, 52 are located in the inner volume 6 and extend respectively above and below the refrigerant suction pipe 23.

The Oldham coupling 51 includes an annular body 53 disposed between the base plate 8 of the upper fixed scroll 4 and the base plate 13 of the orbiting scroll arrangement 7, and around the spiral wraps 9, 14.

The Oldham coupling 51 further includes a pair of first engaging grooves 54 diametrically opposed and provided on a first side of the annular body 53, and a pair of second engaging grooves 55 diametrically opposed and provided on a second

side of the annular body 53. The first engaging grooves 54 of the Oldham coupling 51 are respectively slidably engaged with a pair of complementary engaging projections 56 provided on the base plate 8 of the upper fixed scroll 4, the complementary engaging projections 56 being offset and extending parallel to the displacement direction D1. The second engaging grooves 55 of the Oldham coupling 51 are respectively slidably engaged with a pair of complementary engaging projections 57 provided on the base plate 13 of the orbiting scroll arrangement 7, the complementary engaging projections 57 being offset and extending parallel to the displacement direction D2, i.e. perpendicularly to the displacement direction D1.

The Oldham coupling 52 includes an annular body 58 disposed between the base plate 11 of the lower fixed scroll 5 and the base plate 13 of the orbiting scroll arrangement 7, and around the spiral wraps 12, 15.

The Oldham coupling 52 further includes a pair of first engaging grooves 59 diametrically opposed and provided on a first side of the annular body 58, and a pair of second engaging grooves 61 diametrically opposed and provided on a second side of the annular body 58. The first engaging grooves 59 of the Oldham coupling 52 are respectively slidably engaged with a pair of complementary engaging projections 62 provided on the base plate 11 of the lower fixed scroll 5, the complementary engaging projections 62 being offset and extending parallel to the displacement direction D2. The second engaging grooves 61 of the Oldham coupling 52 are respectively slidably engaged with a pair of complementary engaging projections 63 provided on the base plate 13 of the orbiting scroll arrangement 7, the complementary engaging projections 63 being offset and extending parallel to the displacement direction D1, i.e. perpendicularly to the displacement direction D2.

The scroll compressor 1 further comprises a lubrication system configured to lubricate at least partially the first and second engaging grooves 54, 55, 59, 61 of the Oldham couplings 51, 52 with oil supplied from the oil sump S.

The lubrication system includes an oil supplying passage 64 delimited by the base plates 8, 11 of the upper and lower fixed scrolls 4, 5. The oil supplying passage 64 extends substantially in an arc of a circle around a part of a perimeter edge of the orbiting scroll arrangement 7. According to the embodiment shown on the figures, the oil supplying passage 64 extends over an angular sector of about 270°. According to the embodiment shown on the figures, the base plate 8 of the upper fixed scroll 4 includes an oil supplying groove 65 forming partially the oil supplying passage 64. The oil supplying groove 65 is advantageously provided on a face of the base plate 8 oriented towards the base plate 11 of the lower fixed scroll 5.

The lubrication system further includes an oil supplying duct 66 fluidly connected to the oil sump S and configured to supply the oil supplying passage 64 with oil from the oil sump S.

According to the embodiment shown on the figures, the base plate 11 of the lower fixed scroll 5 includes a mounting recess 67 emerging in a face of the base plate 8 oriented towards the oil sump S, and an oil supplying channel 71 fluidly connected to the mounting recess 67 and emerging in the oil supplying passage 64. The oil supplying duct 66 is partly formed by the oil supplying channel 71 and an oil supplying pipe 66a having an end portion mounted in the mounting recess 67.

The lubrication system also includes two lubrication passages 68 provided on the base plate 8 of the upper fixed scroll 4 and fluidly connected to the oil supplying passage 64. Each lubrication passage 68 is configured to supply with oil a respective one of the first engaging grooves 54 of the Oldham coupling 51. According to the embodiment shown on the figures, each lubrication passage 68 includes an oil inlet aperture 69 emerging in the oil supplying passage 64 and an oil outlet aperture 71 emerging in an outer engaging surface of a respective one of the complementary engaging projections 56 provided on the upper fixed scroll 4. Advantageously, each oil outlet aperture 71 emerges vertically above the respective one of the first engaging grooves 54 of the Oldham coupling 51.

The lubrication system also includes two lubrication passages 72 (see figure 1) provided on the base plate 11 of the lower fixed scroll 5 and fluidly connected to the oil supplying passage 64. Each lubrication passage 72 is configured to supply with oil a respective one of the first engaging grooves 59 of the Oldham coupling 52. According to the embodiment shown on the figures, each lubrication passage 72 includes an oil inlet aperture 73 emerging in the oil supplying passage 64 and an oil outlet aperture 74 emerging in an outer engaging surface of a respective one of the complementary engaging projections 62 provided on the lower fixed scroll 5. Advantageously, each oil outlet aperture 72 emerges vertically below the respective one of the first engaging grooves 59 of the Oldham coupling 52.

The lubrication system further includes a two lubrication passages 75 (see figure 1) provided on the base plate 8 of the upper fixed scroll 4 and fluidly connected to the oil supplying passage 64. Each lubrication passage 75 is configured to supply with oil, by gravity, a respective one of the second engaging grooves 55 of the Oldham coupling 51. Each lubrication passage 75 includes an oil inlet aperture 76 emerging in the oil supplying passage 64 and an oil outlet aperture 77 emerging

vertically substantially above a respective one of the complementary engaging projections 57 provided on the orbiting scroll arrangement 7.

According to the embodiment shown on the figures, each of the complementary engaging projections 63 provided on the orbiting scroll arrangement 7 includes an oil passage 78 (see figures 2 and 9) having an oil inlet aperture 79 emerging in the first face of the base plate 13 of the orbiting scroll arrangement 7 and an oil outlet aperture 81 emerging vertically above a respective one of the second engaging grooves 61 of the Oldham coupling 52.

In operation, a first part of the refrigerant supplied by the refrigerant suction pipe 23 enters the refrigerant inlet passage P1 and is guided towards the outermost compression chambers 16 by the first orbiting guiding portion 21, then is compressed into the compression chambers 16 and escapes from the centre of the upper fixed scroll 4 and of the orbiting scroll arrangement 7 through the discharge passages 26 leading to the proximal chamber 37. The compressed refrigerant entering in the proximal chamber 37 then flows upwardly towards the distal chamber 38 by passing through refrigerant flow passages delimited by the stator 32 and the intermediate casing 30 and through gaps delimited between the stator 32 and the rotor 31. Next, the compressed refrigerant travels through the refrigerant discharge apertures 39 leading to the annular outer volume 36, from which the compressed refrigerant is discharged by the discharge pipe 24.

Thus the compressed refrigerant coming out of the discharge passages 26 cools down the first winding head 34a, the compressed refrigerant passing through the refrigerant flow passages cools down the stator core 33, the refrigerant passing through the gaps cools down the stator core 33, the stator windings and the rotor 31, while the compressed refrigerant coming out of the refrigerant flow passages and of the gaps cools down the second winding head 34b. Such a cooling down of the driving motor 29 protects the stator 32 and the rotor 31 against damage (by limiting the temperature by forced convection) and improves the efficiency of the scroll compressor 1.

In operation, a second part of the refrigerant supplied by the refrigerant suction pipe 23 enters the refrigerant inlet passage P2 and is guided towards the outermost compression chambers 17 by the second orbiting guiding portion 22, then is compressed into the compression chambers 17 and escapes from the centre of the lower fixed scroll 5 and of the orbiting scroll arrangement 7 partially through the communicating hole 18 and the discharge passages 26, and partially through the discharge passages 27 leading to the high pressure discharge volume. Therefore, a

first part of the refrigerant compressed in the compression chambers 17 is discharged by the refrigerant discharge pipe 24 without cooling down the driving motor 29, and a second part of the refrigerant compressed in the compression chambers 17 is discharged by the refrigerant discharge pipe 24 after having cooling down the driving motor 29.

The configuration of the discharge passages 26, 27 allows to balance the pressure in the oil sump on the one hand, and the pressure in the space in which emerges the refrigerant discharge pipe 24 on the other hand. Such a pressure balance avoids the "oil cleaning" of the several bearings by the refrigerant.

Further, the configuration of the refrigerant suction pipe 23, of the first and second orbiting guiding portion 21, 22 and of the fixed guiding portions 19, 20 induces a reduction of the pressure drops upstream the outermost compression chambers, and an improvement of the filling of the outermost compression chambers, which lead to an increase of efficiency of the scroll compression unit, and thus of the scroll compressor.

In operation, the inner volume 6 is at low pressure compared to the oil sump S which is fluidly connected to the high pressure discharge volume receiving the compressed refrigerant. Due to this differential of pressure, oil is sucked from the oil sump S through the oil supplying duct 66 and is supplied to the oil supplying passage 64. The oil supplied to the oil supplying passage 64 is then supplied to the first and second engaging grooves 54, 55, 59, 61 of the Oldham couplings 51, 52 via the lubrication passages 68, 72, 75 and the oil passages 78.

Of course, the invention is not restricted to the embodiment described above by way of non-limiting example, but on the contrary it encompasses all embodiments thereof. For example, the Oldham couplings 51, 52 may include first and second engaging projections instead of the first and second engaging projections 54, 55, 59, 61. Further, the orbiting scroll arrangement 7 may include complementary engaging grooves instead of the complementary engaging projections 57, 63. Furthermore, the upper and lower fixed scrolls 4, 5 may include complementary engaging grooves instead of the complementary engaging projections 56, 62.

CLAIMS

1. A scroll compressor (1) including:

- a scroll compression unit (3) including:

- a first fixed scroll (4) comprising a first fixed base plate (8) and a first fixed spiral wrap (9),

- an orbiting scroll arrangement (7) including a first orbiting spiral wrap (14), the first fixed spiral wrap (9) and the first orbiting spiral wrap (14) forming a plurality of compression chambers (16),

- a refrigerant suction part (23) suitable for supplying the scroll compression unit (3) with refrigerant to be compressed,

- at least a first Oldham coupling (51) configured to prevent rotation of the orbiting scroll arrangement (7) with respect to the first fixed scroll (4), the first Oldham coupling (51) including at least a pair of first engaging elements (54) respectively slidably engaged with a pair of complementary engaging elements (56) provided on the first fixed scroll (4),

- an oil sump (S), and

- a lubrication system configured to lubricate at least partially the first engaging elements (54) of the first Oldham coupling (51) with oil supplied from the oil sump (S), the lubrication system including:

- an oil supplying passage (64) delimited at least partially by the first fixed base plate (8),

- an oil supplying duct (66) fluidly connected to the oil sump (S) and configured to supply the oil supplying passage (64) with oil from the oil sump, and

- at least one first lubrication passage (68) provided on the first fixed base plate (8) and fluidly connected to the oil supplying passage (64), the at least one first lubrication passage (68) being configured to supply with oil at least one of the first engaging elements (54) of the first Oldham coupling (51).

2. The scroll compressor (1) according to claim 1, wherein each first lubrication passage (68) includes an oil outlet aperture (71) emerging in an outer surface of a respective one of the complementary engaging elements (56) provided on the first fixed scroll (4).

3. The scroll compressor (1) according to claim 1 or 2, wherein the oil supplying passage (64) extends around at least a part of a perimeter edge of the orbiting scroll arrangement (7).

4. The scroll compressor (1) according to any one of claims 1 to 3, wherein the oil supplying passage (64) extends substantially in an arc of a circle.

5. The scroll compressor (1) according to any one of claims 1 to 4, wherein the scroll compression unit (3) further includes a second fixed scroll (5) including a second fixed base plate (11) and a second fixed spiral wrap (12), the first and second fixed scrolls (4, 5) defining an inner volume (6), the orbiting scroll arrangement (7) being disposed in the inner volume (6) and further including a second orbiting spiral wrap (15), the second fixed spiral wrap (12) and the second orbiting spiral wrap (15) forming a plurality of compression chambers (17).

6. The scroll compressor (1) according to claim 5, wherein the oil supplying passage (64) is delimited by the first and second fixed base plates (8, 11).

7. The scroll compressor according to claim 5 or 6, further including a second Oldham coupling (52) configured to prevent rotation of the orbiting scroll arrangement (7) with respect to the second fixed scroll (5), the second Oldham coupling (52) including at least a pair of first engaging elements (59) respectively slidably engaged with a pair of complementary engaging elements (62) provided on the second fixed scroll (5).

8. The scroll compressor according to claim 7, wherein the lubrication system is further configured to lubricate at least partially the first engaging elements (59) of the second Oldham coupling (52) with oil supplied from the oil sump (S).

9. The scroll compressor according to claim 8, wherein the lubrication system further includes at least one second lubrication passage (72) provided on the second fixed base plate (11) and fluidly connected to the oil supplying passage (64), the at least one second lubrication passage (72) being configured to supply with oil at least one of the first engaging elements (59) of the second Oldham coupling (52).

10. The scroll compressor (1) according to claim 9, wherein each second lubrication passage (72) includes an oil outlet aperture (74) emerging in an outer surface of a respective one of the complementary engaging elements (62) provided on the second fixed scroll (5).

11. The scroll compressor (1) according to any one of claims 1 to 10, wherein the first Oldham coupling (51) further includes a pair of second engaging elements (55) respectively slidably engaged with a pair of first complementary engaging elements (57) provided on the orbiting scroll arrangement (7), the lubrication system being further configured to lubricate at least partially the second engaging elements (55) of the first Oldham coupling (51) with oil supplied from the oil sump (S).

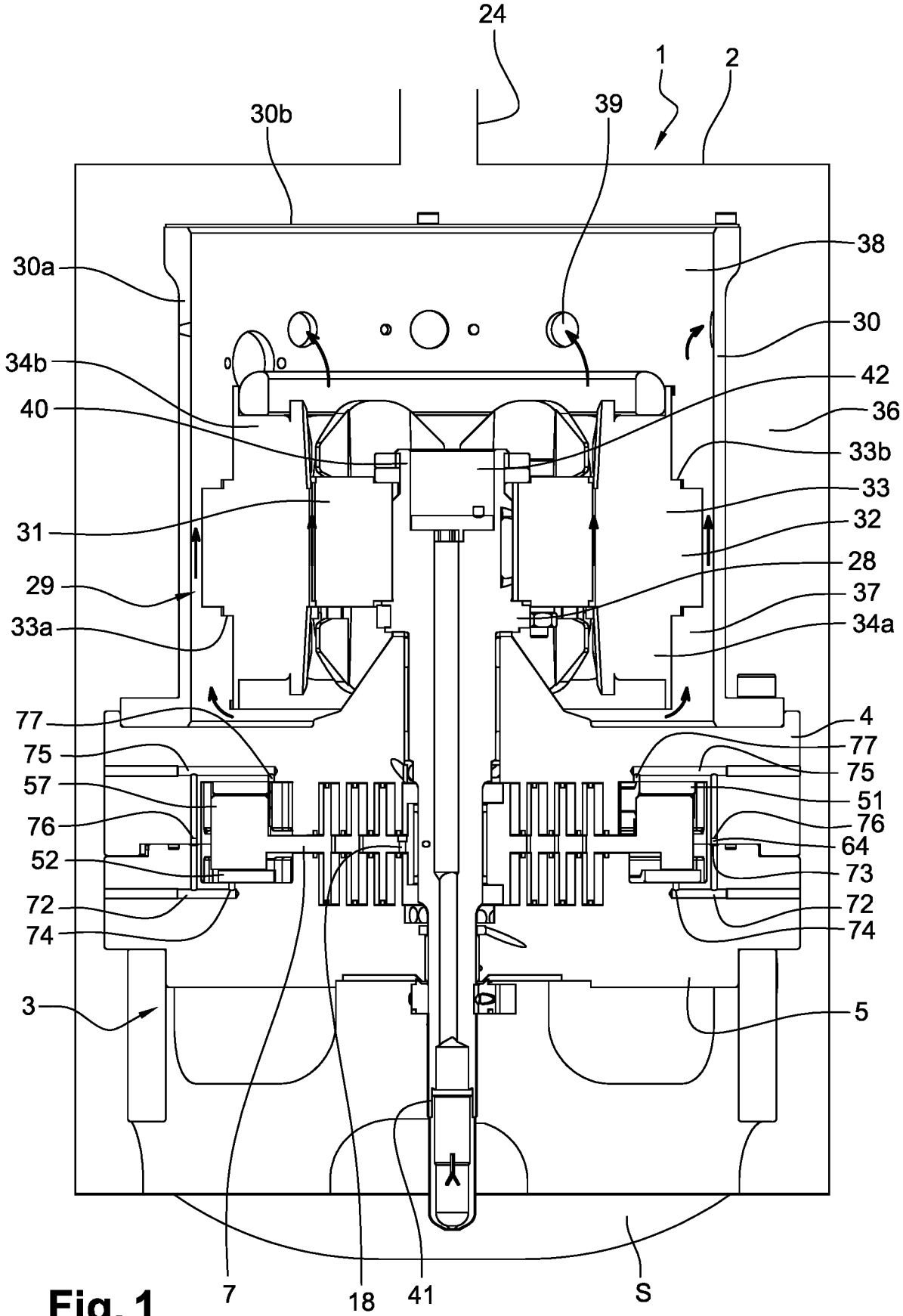
12. The scroll compressor according to claim 11, wherein the first fixed scroll (4) is disposed above the second fixed scroll (5), and the lubrication system further includes at least one third lubrication passage (75) provided on the first fixed base plate (8) and fluidly connected to the oil supplying passage (64), the at least one third lubrication passage (75) being configured to supply with oil at least one of the second engaging elements (55) of the first Oldham coupling (51).

13. The scroll compressor (1) according to claim 12, wherein each third lubrication passage (75) includes an oil outlet aperture (77) configured to be located vertically above a respective one of the first complementary engaging elements (57) provided on the orbiting scroll arrangement (7) during at least a part of the orbital movement of the orbiting scroll arrangement (7).

14. The scroll compressor (1) according to any one of claims 1 to 13, wherein the second Oldham coupling (52) further includes a pair of second engaging elements (61) respectively slidably engaged with a pair of second complementary engaging elements (63) provided on the orbiting scroll arrangement (7), each of the second complementary engaging elements (63) provided on the orbiting scroll arrangement (7) including an oil passage (78) provided with an oil outlet aperture (81) emerging vertically above a respective one of the second engaging elements (61) of the second Oldham coupling (52).

15. The scroll compressor (1) according any one of claims 1 to 14, wherein the oil supplying duct (66) is at least partly formed by an oil supplying pipe (66a), and the first fixed scroll (4) or the second fixed scroll (5) includes a mounting part (67) fluidly connected to the oil supplying passage (64), an end portion of the oil supplying pipe (66) being mounted in the mounting part (67).

16. The scroll compressor (1) according to any one of claims 1 to 15, further including a closed container (2) delimiting the oil sump (S) and defining a high pressure discharge volume, the oil sump (S) being fluidly connected to the high pressure discharge volume.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34a
77
4
75
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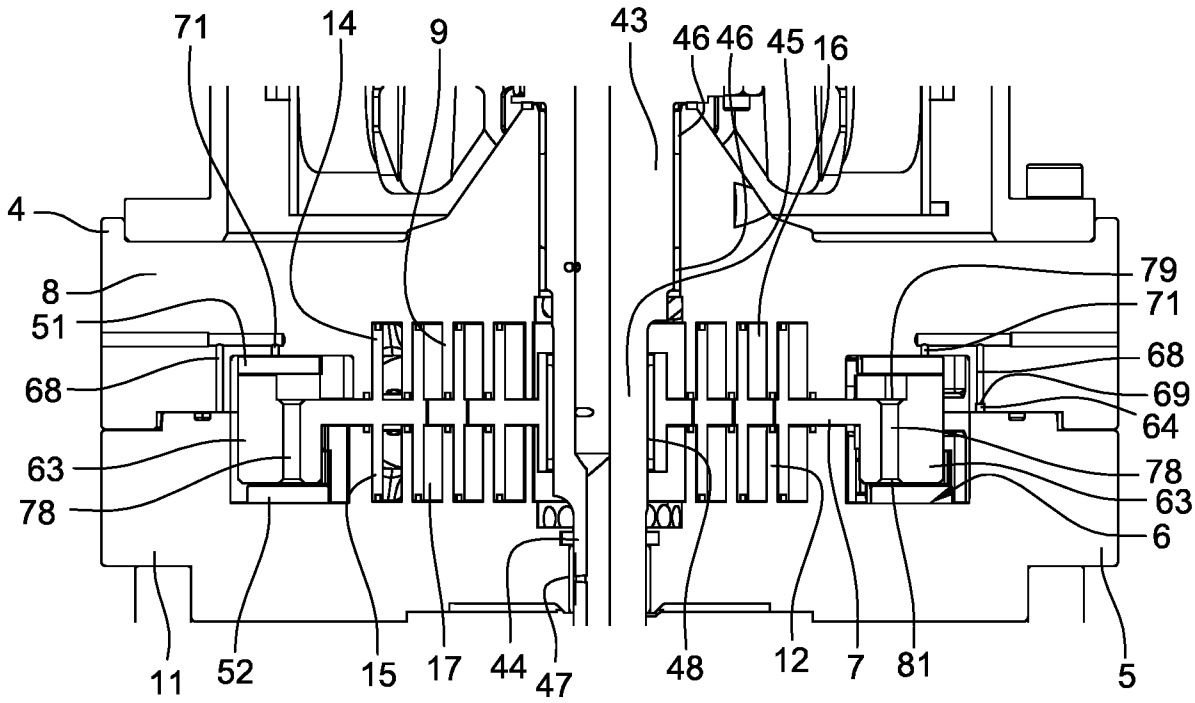
18
41
S

Fig. 1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5

Fig. 2

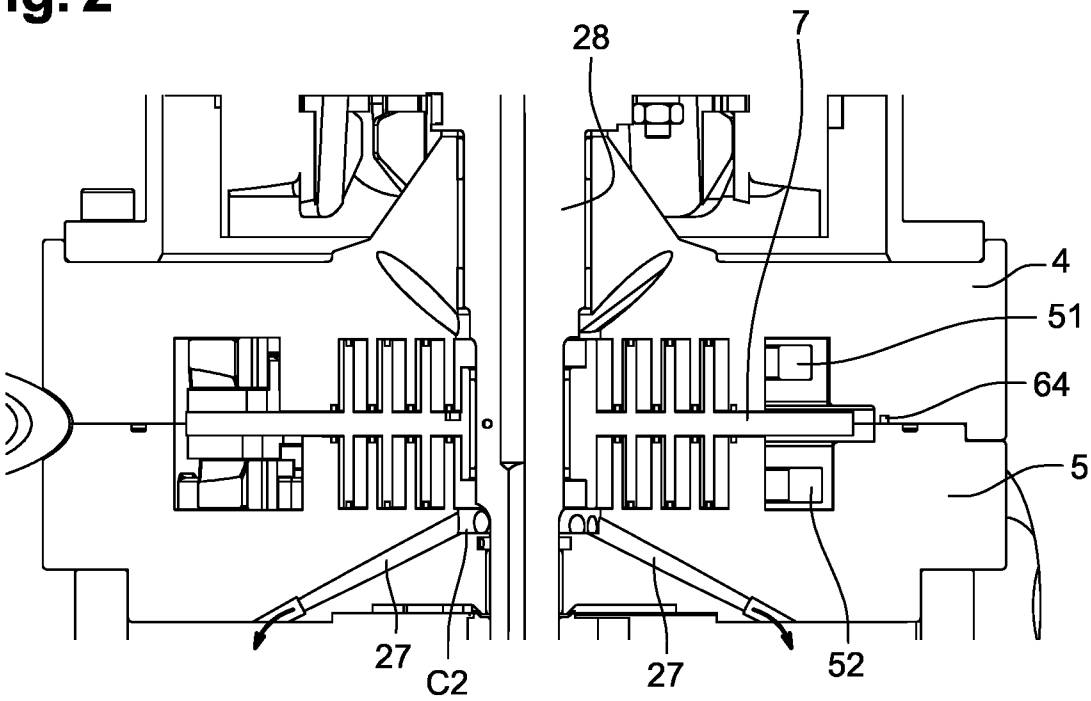
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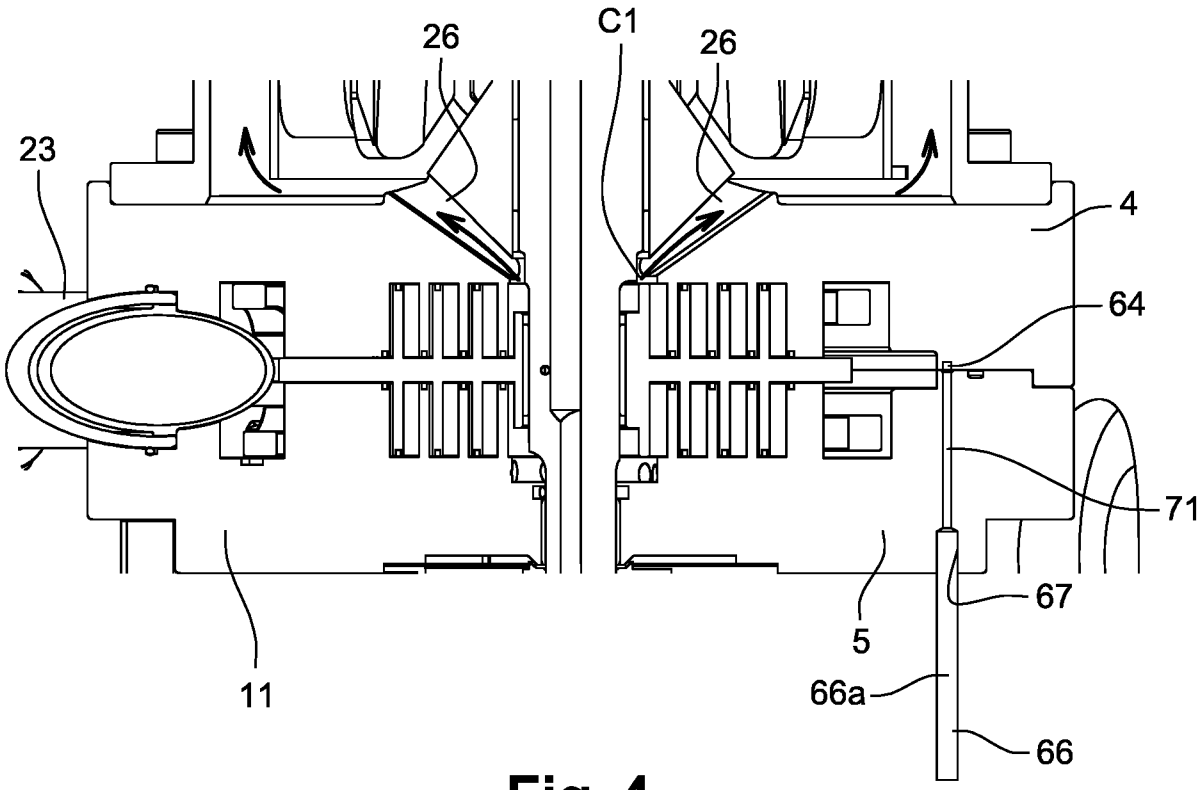
Fig. 3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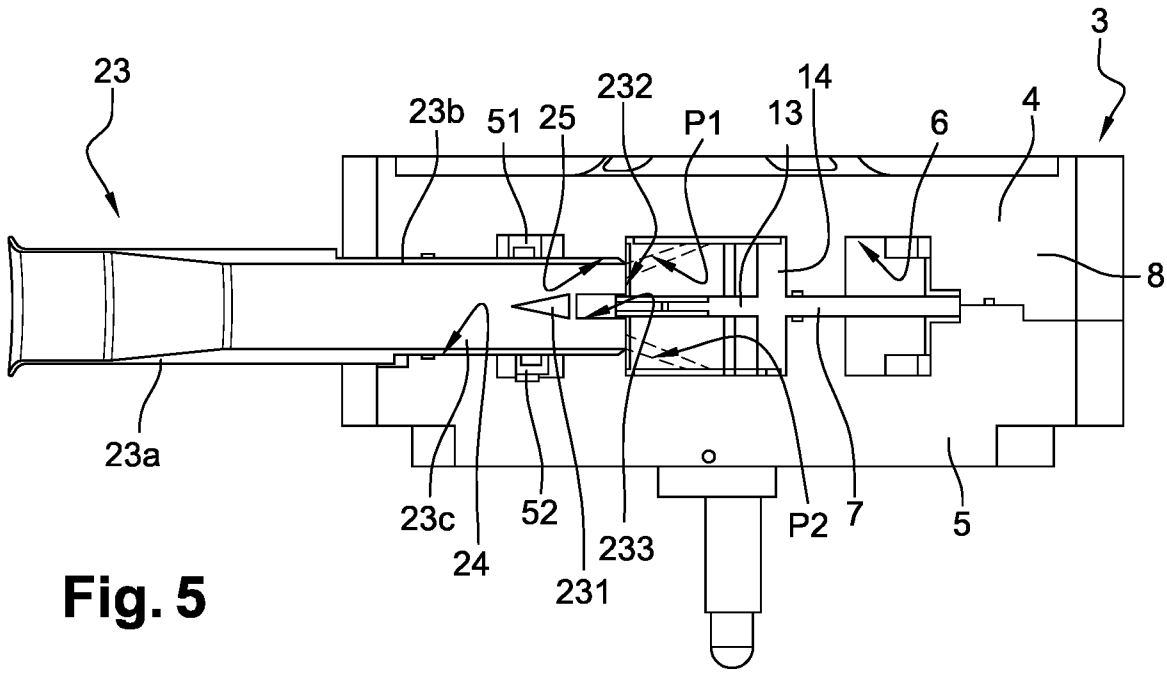
11
66a
66

Fig. 4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P2
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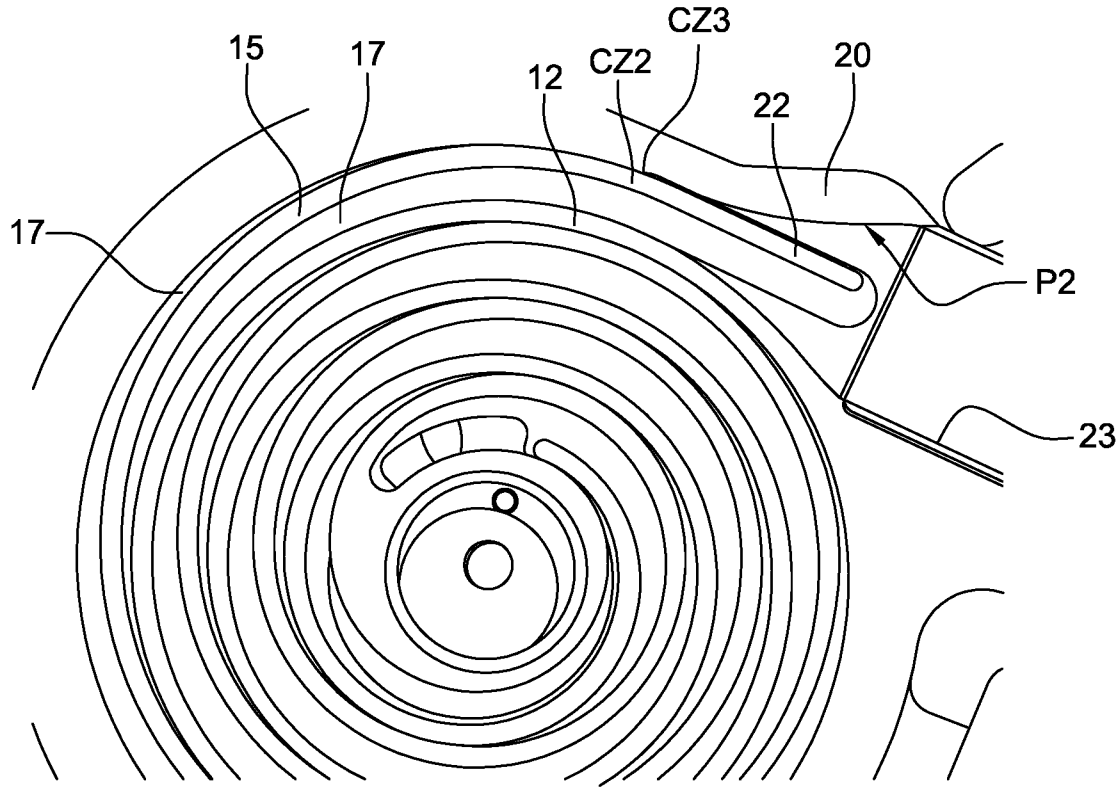
Fig. 5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P2
23

Fig. 6

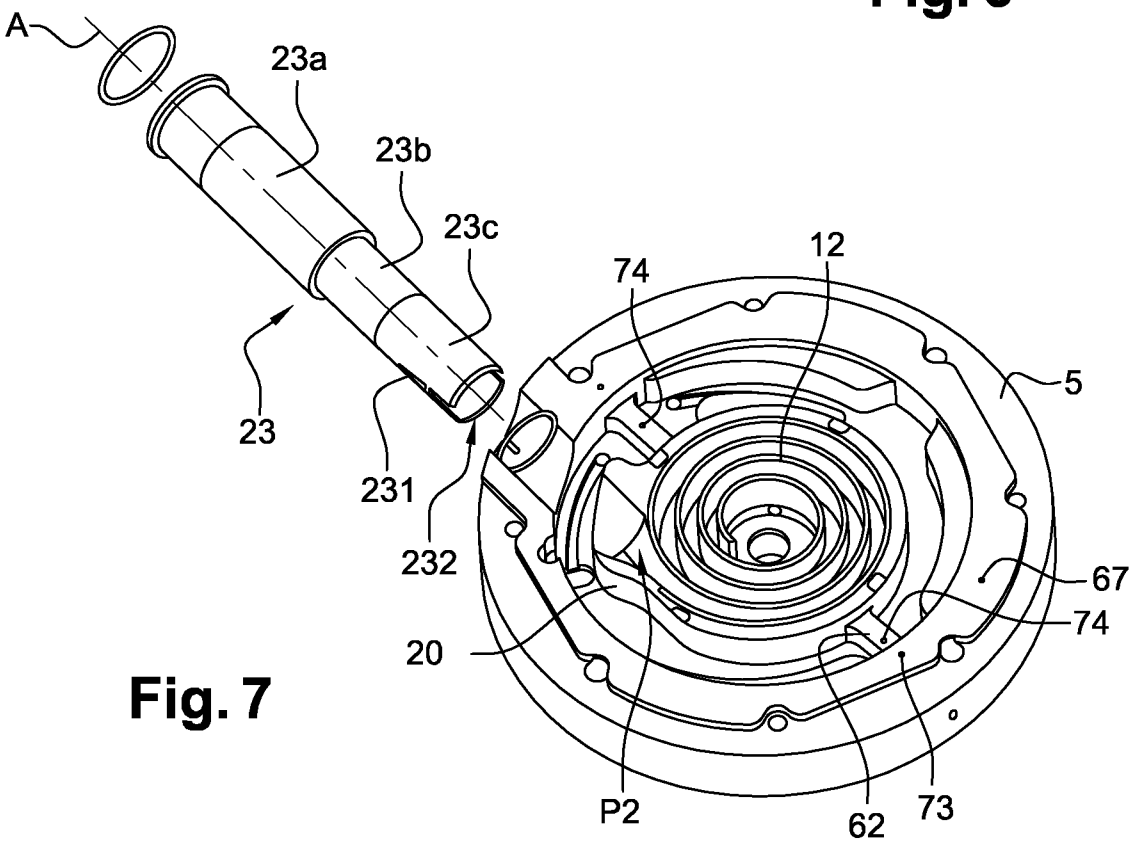
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Fig. 7

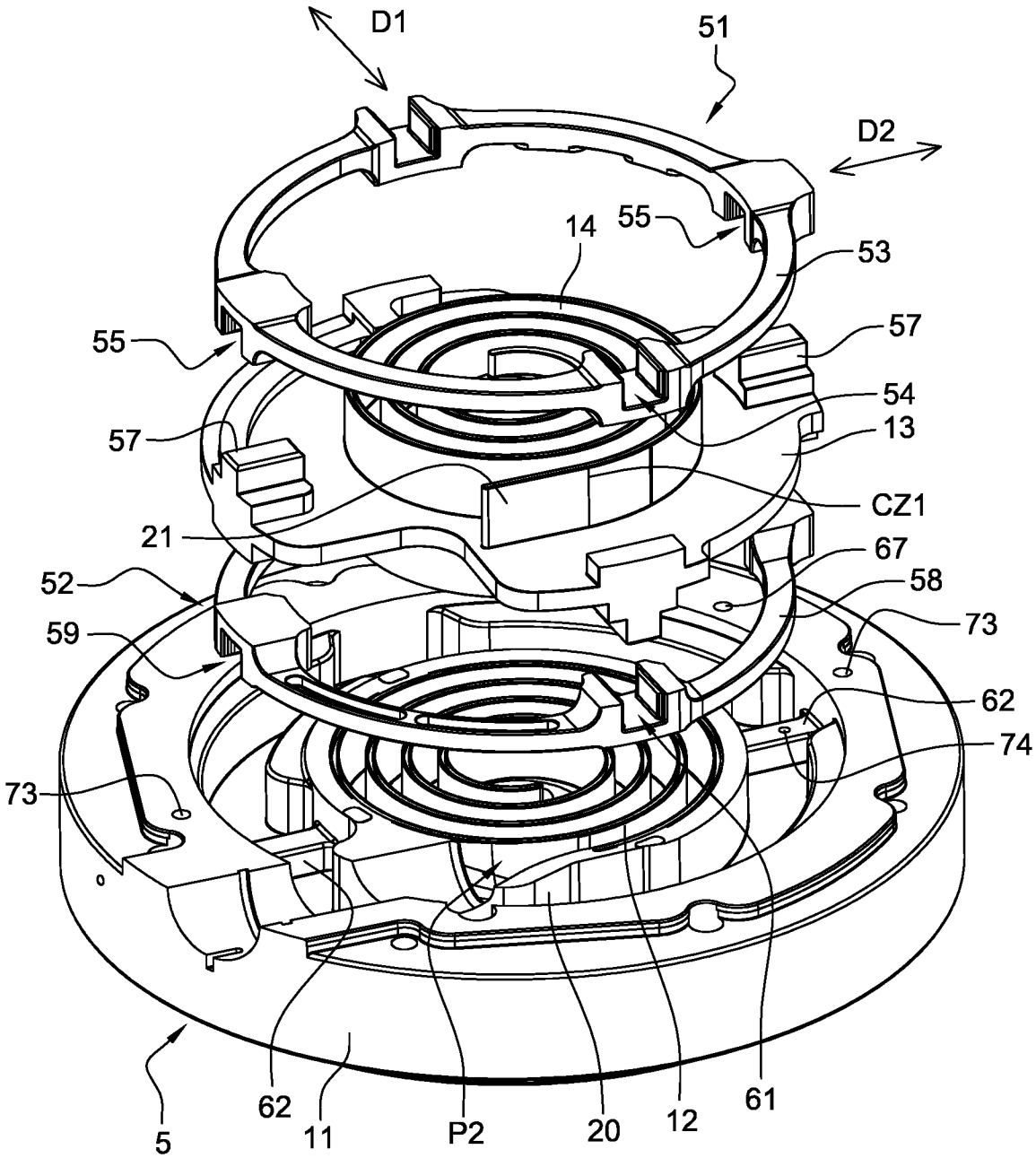
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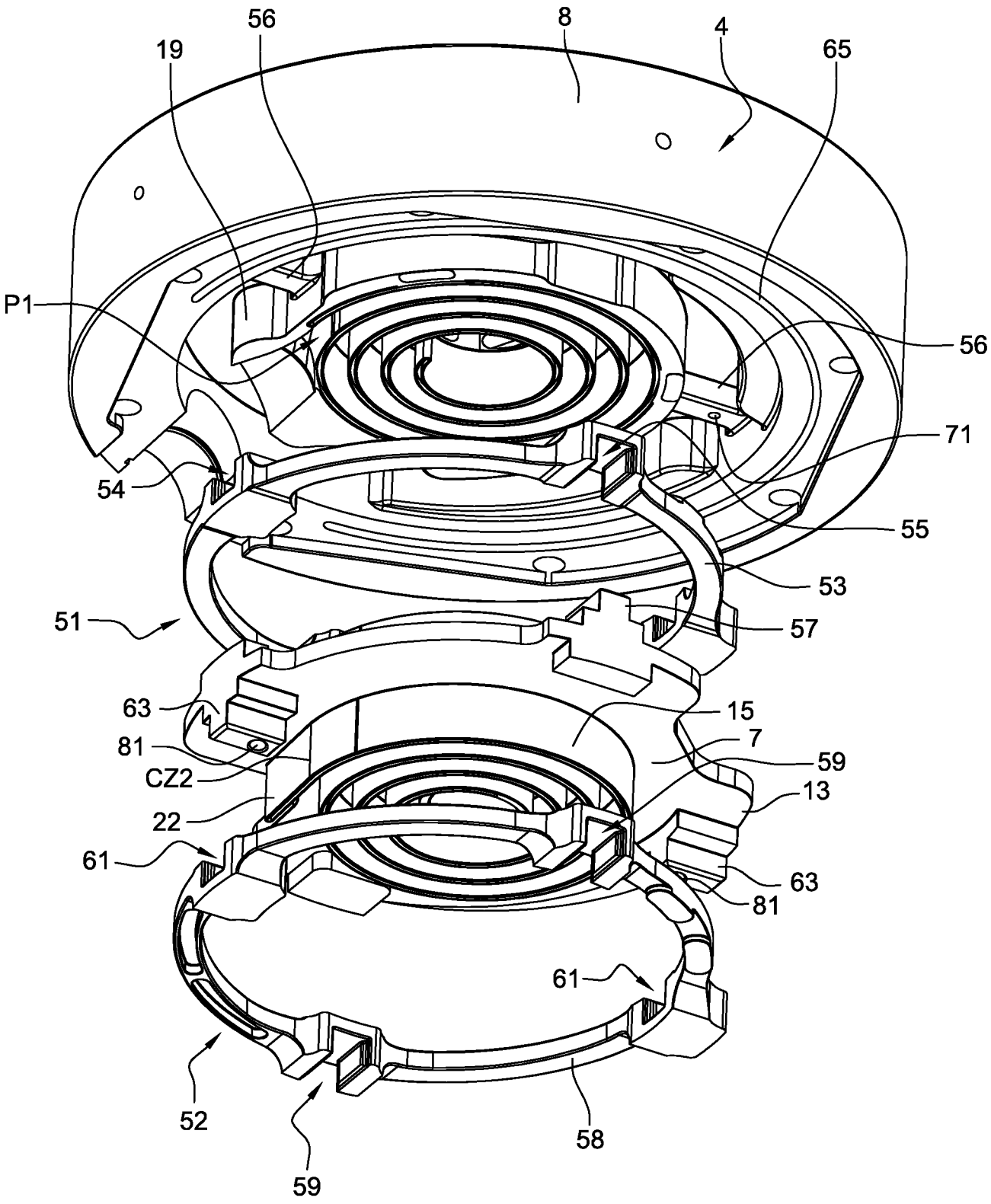
Fig. 8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63
81
61
52
58
59

Fig. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2015/070468

A. CLASSIFICATION OF SUBJECT MATTER
INV. F04C29/02 F04C18/02
ADD.

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 F04B

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 529 660 A1 (DAIKIN IND LTD [JP]) 3 March 1993 (1993-03-03) column 9, line 41 - column 10, line 14 figure 1	1
A	EP 0 322 894 A2 (MATSUSHITA ELECTRIC IND CO LTD [JP]) 5 July 1989 (1989-07-05) column 14, line 27 - column 15, line 5 column 26, line 25 - column 27, line 20 figures 1,15	1
A	DE 33 41 637 A1 (HITACHI LTD [JP]) 14 June 1984 (1984-06-14) page 26, line 19 - page 28, line 21 figure 9	1

☐ 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	Date of mailing of the international search report
12 November 2015	25/11/2015

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Lange, Christian

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2015/070468

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0529660 A1	03-03-1993	DE 69207305 D1	15-02-1996
		DE 69207305 T2	27-06-1996
		EP 0529660 A1	03-03-1993
		JP 2718295 B2	25-02-1998
		JP H0560078 A	09-03-1993
		US 5304047 A	19-04-1994
EP 0322894 A2	05-07-1989	CA 1329183 C	03-05-1994
		DE 3888147 D1	07-04-1994
		DE 3888147 T2	22-09-1994
		EP 0322894 A2	05-07-1989
		US 4958993 A	25-09-1990
DE 3341637 A1	14-06-1984	DE 3341637 A1	14-06-1984
		JP S5993987 A	30-05-1984