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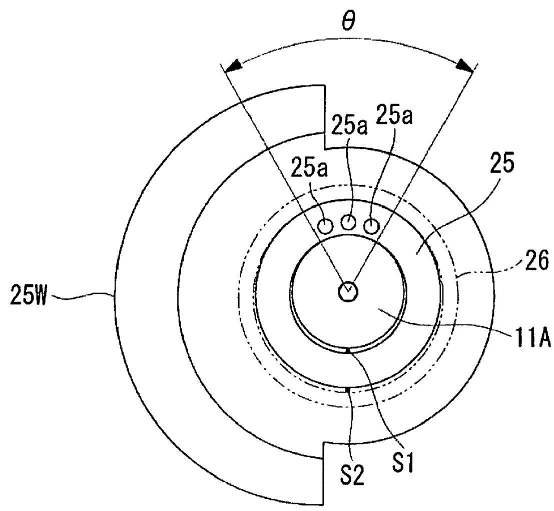
(54) SCROLL COMPRESSOR

(57) Scroll compressor including: a hermetic housing; a scroll compression mechanism; an electric motor; a crankshaft that is rotationally driven by the electric motor; a crankpin (11A) that is provided at an upper end of the crankshaft and that is inserted into an orbit boss part of an orbiting scroll through a drive bush (25) and a drive bearing (26) in a relatively rotatable manner; an oil supply passage (11a) that is formed along a shaft center line of the crankshaft; and an oil through hole (25a) that has a through-hole shape and that is formed in an interior of a cylindrical wall of the drive bush (25) along an axial direction, and the oil through hole (25a) is formed in a predetermined load angle region (θ) in which an outer circumferential surface of the drive bush (25) presses on an inner circumferential surface of the drive bearing (26) at the time of a load operation of the scroll compressor.

FIG. 3



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Description

{Technical Field}

[0001] The present invention relates to a scroll compressor that improves the cooling capability of a drive bearing interposed together with a drive bush between a crankpin of a crankshaft for driving an Orbit Scroll and an Orbit boss part formed on a back surface of the Orbit Scroll.

{Background Art}

[0002] As disclosed in PTL 1, there is a scroll compressor in which a drive bush is rotatably put in an Orbit boss part formed on a back surface of an end plate of an Orbit Scroll, a crankpin of a crankshaft is slidably fitted in a slide groove drilled on the drive bush, at least one or more through-holes along the axial direction are drilled on the above drive bush and further a radial-directional groove communicated with the through-holes is formed.

[0003] In the above configuration, the lubricant oil enclosed in the scroll compressor or the gas containing the mist of the lubricant oil flows through the through-holes and the groove, and thereby, it is possible to cool the drive bush and therewith to lubricate an end surface of the drive bush and an end surface of a rotating shaft suitably in no small way. {Citation List}

{Patent Literature}

[0004] {PTL 1}
Japanese Unexamined Utility Model Application, Publication No. Hei 4-49684

{Summary of Invention}

{Technical Problem}

[0005] However, in the above configuration, the position of the through-hole drilled on the drive bush is not necessarily optimized. That is, in the scroll compressor in which the crankshaft is disposed in the longitudinal direction, the lubricant oil is supplied through an oil supply passage formed along the shaft center line of the crankshaft, by an oil pump at a lower end of the crankshaft, and the lubricant oil is discharged from an upper end of the crankshaft and is refluxed to the oil pump side through interspaces of the drive bearing. Most of the lubricant oil is refluxed from an interspace between the drive bearing and the drive bush and an interspace between the drive bush and the crankpin in the non-load side on which the interspace is large, and a small amount of the lubricant oil passes through the load side on which the interspace is small.

[0006] Since the amount of the lubricant oil to pass through the part of the drive bearing on which the load from the crankpin strongly acts is small in this way, it is hard to promote the thermal exhaust of the drive bearing, and the drive bearing sometimes causes the damage of the drive bearing such as early abrasion. Particularly, at the time of a low-speed operation, the suction amount of the lubricant oil by way of the crankshaft decreases. Therefore, an oil film is hard to form, and the problem becomes conspicuous.

[0007] The present invention has been made for solving the above problem, and has object to provide a scroll compressor that can improve the cooling capability of a drive bearing interposed together with a drive bush between a crankpin of a crankshaft for driving an Orbit Scroll and an Orbit boss part formed on a back surface of the Orbit Scroll.

{Solution to Problem}

[0008] For solving the above problem, the present invention employs the following solution.

[0009] A scroll compressor according to the present invention includes: a hermetic housing; a scroll compression mechanism in which a fixed scroll and an Orbit Scroll are combined, the scroll compression mechanism being installed at an upper site in the hermetic housing; an electric motor that is installed at a lower site of the scroll compression mechanism; a crankshaft that is rotationally driven by the electric motor; a crankpin that is provided at an upper end of the crankshaft and that is inserted into an Orbit boss part through a cylindrical drive bush and a drive bearing in a relatively rotatable manner, the Orbit boss part being formed on a back surface of the Orbit Scroll; an oil supply passage that is formed along a shaft center line of the crankshaft and through which lubricant oil is supplied to a vicinity of the drive bearing; and an oil through hole that has a through-hole shape and that is formed in an interior of a cylindrical wall of the drive bush along an axial direction, the oil through hole being formed in a predetermined load angle region in which an outer circumferential surface of the drive bush presses on an inner circumferential surface of the drive bearing at the time of a load operation.

[0010] At the time of the load operation of the scroll compressor having the above configuration, by the pressure from the crankpin, the outer circumferential surface of the drive bush presses on the inner circumferential surface of the drive bearing, resulting in the generation of the predetermined load angle region in which the interspace between the outer circumferential surface of the crankpin and the inner circumferential surface of the drive bush and the interspace between the outer circumferential surface of the drive bush and the inner circumferential surface of the drive bearing decrease. Accordingly, the lubricant oil supplied to the vicinity of the drive bearing through the oil supply passage formed along the shaft center line of the crankshaft is difficult to reflux while passing through ranges of the interspaces that correspond to the load angle region, and the reflux amount of the lubricant oil in this region decreases.

[0011] However, the lubricant oil can be refluxed downward through the oil through hole that has a through-hole shape and that is formed in the drive bush so as to be adjacent to the load angle region. Therefore, the drive bush is cooled by the lubricant oil that passes through the oil through hole, and the thermal exhaust of the drive bearing adjacent to the drive bush is promoted. Accordingly, it is possible to prevent damage such as early abrasion at a part of the drive bearing that corresponds to the load angle region.

[0012] In the above configuration, it is preferable that a plurality of the oil through holes be formed so as to be arrayed in a circumferential direction of the drive bush. By providing the plurality of the oil through holes in this way, it is possible to make the oil through holes exist over the whole range of the load angle region extending in the circumferential direction of the drive bush, and to enhance the cooling effect of the drive bush.

[0013] Furthermore, it is possible to reduce the inner diameter of each oil through hole, and therefore, it is possible to avoid the decrease in the strength of the drive bush due to the drilling of the oil through holes.

{Advantageous Effects of Invention}

[0014] As described above, in the scroll compressor according to the present invention, it is possible to improve the cooling capability of the drive bearing interposed together with the drive bush between the crankpin of the crankshaft for driving the Orbit Scroll and the Orbit boss part formed on the back surface of the Orbit Scroll.

{Brief Description of Drawings}

[0015]

{Fig. 1} Fig. 1 is a vertical cross-sectional view showing an example of a scroll compressor to which the present invention can be applied.

{Fig. 2} Fig. 2 is an enlarged vertical cross-sectional view of a drive bush shown in Fig. 1.

{Fig. 3} Fig. 3 is a plan view of the drive bush in an embodiment of the present invention, viewed along arrow III in Fig. 2.

{Description of Embodiments}

[0016] Hereinafter, an embodiment of the present invention will be described with reference to the drawings.

[0017] Fig. 1 is a vertical cross-sectional view of the whole of a scroll compressor according to an embodiment of the present invention. In the embodiment, a hermetic-type electric scroll compressor will be described as an example. However, the present invention is not limited to this, and can be applied to an open type.

[0018] A scroll compressor 1 includes a cylindrical hermetic housing 2 that is vertically long, that has a bottom, and that is made of a steel plate. A scroll compression mechanism 3 is installed at an upper site in the hermetic housing 2, and an electric motor 4 is installed at lower site therein.

[0019] In the hermetic housing 2, the upper part side relative to the scroll compression mechanism 3 is a discharge chamber 5 that discharges the high-pressure gas compressed by the scroll compression mechanism 3, and is connected with a discharge pipe 6. The lower part side relative to the scroll compression mechanism 3 is a suction chamber 7 that sucks low-pressure suction gas, and is connected with a suction pipe 8. On the suction chamber 7 side, an electric motor 4 constituted by a stator 9 and a rotor 10 is installed in the hermetic housing 2 by press fitting or the like, and a crankshaft 11 that is linked with the rotor 10 of the electric motor 4 and that is rotationally driven by the electric motor 4 extends in the vertical direction.

[0020] A lower end part of the crankshaft 11 is supported by a lower part bearing 12 provided in the hermetic housing 2, and has a configuration in which a lubricant oil 14 stored in a bottom part of the hermetic housing 2 is supplied to main lubrication sites such as the scroll compression mechanism 3, an upper part bearing member 15 and a later-described drive bearing 26, through an oil supply passage 11a formed along the axial direction in the crankshaft 11, by a known oil supply pump 13 provided between the lower end part and the lower part bearing 12, and can lubricate those sites. The oil supply passage 11a is opened at an upper part of the crankshaft 11.

[0021] The scroll compression mechanism 3 is installed in the hermetic housing 2 through the upper part bearing member 15. The scroll compression mechanism 3 is constituted by a fixed scroll 16 that is fixedly installed on the upper part bearing member 15, and an Orbit Scroll 20 that is supported on the upper part bearing member 15 so as to be able to revolve and circulate around the fixed scroll 16. The fixed scroll 16 includes a fixed end plate 17 and a fixed spiral lap 18 that stands on one surface of the fixed end plate 17, and has a configuration in which a discharge port 19 is provided at a center part of the fixed end plate 17.

[0022] The Orbit Scroll 20 includes a circulating end plate 21 and a circulating spiral lap 22 that stands on one surface of the circulating end plate 21, and has a configuration in which a cylindrical Orbit boss part 23 is integrally formed on the back surface side of the circulating end plate 21. The fixed scroll 16 and the Orbit Scroll 20 are configured such that the fixed spiral lap 18 and the circulating spiral lap 22 are meshed by a known method while having a phase difference of 180 degrees and thereby a single compression space 24 is formed between both scrolls 16, 20. The single compression space 24 is configured to be moved while the volume is decreased from an outer circumferential position to a center part by the revolution and circulation of the Orbit Scroll 20, and to exert a compression action.

[0023] The Orbit Scroll 20 has a configuration in which the back surface of the circulating end plate 21 is supported on a thrust bearing part 15A of the upper part bearing member 15, a crankpin 11A provided at an upper end of the crankshaft 11 is inserted into the Orbit boss part 23 on the back surface side through a drive bush 25 and a drive bearing 26 that constitute a known driven crank mechanism, in a relatively rotatable manner, and thereby, the revolution and circulation drive can be performed around the fixed scroll 16 such that the circulating radius can be changed. Reference character 25W denotes a balancer weight that is provided integrally with the drive bush 25. A rotation prevention means 27 including an Oldham ring and the like and blocking the rotation of the Orbit Scroll 20 is incorporated between the back surface of the circulating end plate 21 of the Orbit Scroll 20 and the thrust bearing part 15A of the upper part bearing member 15.

[0024] The upper part of the crankshaft 11 is rotatably supported by a journal bearing part 15B of the upper part bearing member 15. On the fixed end plate 17 of the fixed scroll 16, a discharge cover 28 is provided on the back surface side, and a reed-valve-type discharge valve 29 for opening and closing the discharge port 19 is provided. Furthermore, on the fixed end plate 17 of the fixed scroll 16, a plurality of relief ports 30 having a plurality of holes for communicating between the compression space 24 and the discharge chamber 5, and a relief valve 31 for opening and closing the port 30 are provided at a plurality of positions with different circulating angles along the spiral direction of the fixed spiral lap 18 on the outer circumference side of the discharge port 19 provided at the center part.

[0025] As described above, the lubricant oil 14 to be supplied to the scroll compression mechanism 3 and the like through the oil supply passage 11a formed in the crankshaft 11 is supplied to the drive bush 25, the drive bearing 26, the thrust bearing part 15A and the like. As the drive bearing 26, not a rolling bearing but a sliding bearing is selected because of the supply capability of the lubricant oil 14 and the space relation.

[0026] Fig. 2 is an enlarged vertical cross-sectional view of the drive bush 25, and Fig. 3 is a plan view of the drive bush 25, viewed along arrow III in Fig. 2. As shown here, a plurality of oil through holes 25a having a through-hole shape along the axial direction are formed in the interior of the cylindrical wall of the cylindrically formed drive bush 25. As the oil through holes 25a, for example, three round holes are formed. However, the hole shape and the number are not limited to this, and it is possible that the hole shape is another shape or the number is one or four or more. The oil through hole 25a may be a curved elongate hole that extends in the circumferential direction of the drive bush 25, if the strength of the drive bush 25 is satisfied.

[0027] As shown in Fig. 3, the oil through holes 25a are formed in accordance with a predetermined load angle region θ in which the outer circumferential surface of the drive bush 25 to be pushed outward in the radial direction by the pressure from the crankpin 11A of the crankshaft 11 presses on the inner circumferential surface of the drive bearing 26 at the time of the load operation of the scroll compressor 1. The angle of the load angle region θ is about 60 degrees to 80 degrees. The oil through holes 25a may be formed over a somewhat wider range.

[0028] At the time of the load operation of the scroll compressor 1, the crankpin 11A is slightly decentered with respect to the inner circumferential surface of the drive bush 25, and an interspace S1 between the outer circumferential surface of the crankpin 11A and the inner circumferential surface of the drive bush 25 increases in a region opposite to the load angle region θ. Similarly, an interspace S2 between the outer circumferential surface of the drive bush 25 and the inner circumferential surface of the drive bearing 26 increases. It is desirable that the oil through holes 25a be at an about 180-degree opposite side to positions of the interspaces S1, S2 where the widths are maximized.

[0029] At the time of the load operation of the scroll compressor 1 configured as described above, the outer circumferential surface of the crankpin 11A presses on the inner circumferential surface of the drive bush 25, and the outer circumferential surface of the drive bush 25 presses on the inner circumferential surface of the drive bearing 26, resulting in the generation of the predetermined load angle region θ in which the interspace S1 between the outer circumferential surface of the crankpin 11A and the inner circumferential surface of the drive bush 25 and the interspace S2 between the outer circumferential surface of the drive bush 25 and the inner circumferential surface of the drive bearing 26 decrease. Accordingly, the lubricant oil 14 supplied to the vicinity of the drive bearing 26 through the oil supply passage 11a formed along the shaft center line of the crankshaft 11 is difficult to reflux while passing through ranges of the interspaces S1, S2 that correspond to the load angle region θ, and the reflux amount of the lubricant oil 14 in this region decreases.

[0030] However, the lubricant oil 14 can be refluxed downward through the three oil through holes 25a that have a through-hole shape and that are formed in the drive bush 25 so as to be adjacent to the load angle region θ. Therefore, the drive bush 25 is cooled by the lubricant oil 14 that passes through the oil through holes 25a, and the thermal exhaust of the drive bearing 26 adjacent to the drive bush 25 is promoted. Accordingly, it is possible to prevent damage such as early abrasion at a part of the drive bearing 26 that corresponds to the load angle region θ. This is particularly effective in the case where the drive bearing 26 is a sliding bearing as shown in the embodiment. Meanwhile, on the non-load side, the interspaces S1, S2 are enlarged, and therefore, also from these, a lot of the lubricant oil 14 is refluxed. Therefore, the whole circumference of the drive bush 25 is cooled.

[0031] The plurality of the oil through holes 25a are formed so as to be arrayed in the circumferential direction of the drive bush 25, and therefore, it is possible to make the oil through holes 25a exist over the whole range of the load angle region θ extending in the circumferential direction of the drive bush 25, and to enhance the cooling effect of the drive bush 25. Furthermore, it is possible to reduce the inner diameter of each oil through hole 25a, and therefore, it is possible to avoid the decrease in the strength of the drive bush 25 due to the drilling of the oil through holes 25a.

[0032] As described above, in the scroll compressor 1 according to the above embodiment, it is possible to improve the cooling capability of the drive bearing 26 interposed together with the drive bush 25 between the crankpin 11A of the crankshaft 11 for driving the Orbit Scroll 20 and the Orbit boss part 23 formed on the back surface of the Orbit Scroll 20, and it is possible to avoid the damage of the drive bearing 26.

[0033] The present invention is not limited to the configuration of the above embodiment, and changes and modifications may be optionally made without departing from the scope of the present invention. The changed or modified embodiments are also included in the right scope of the present invention.

{Reference Signs List}

[0034]

1	scroll compressor
2	hermetic housing
3	scroll compression mechanism
4	electric motor
10	rotor
11	crankshaft
11A	crankpin
11a	oil supply passage
14	lubricant oil
16	fixed scroll
20	Orbit Scroll
23	Orbit boss part
25	drive bush
25a	oil through hole
26	drive bearing
θ	load angle region
S1	interspace between crankpin and drive bush
S2	interspace between drive bush and drive bearing

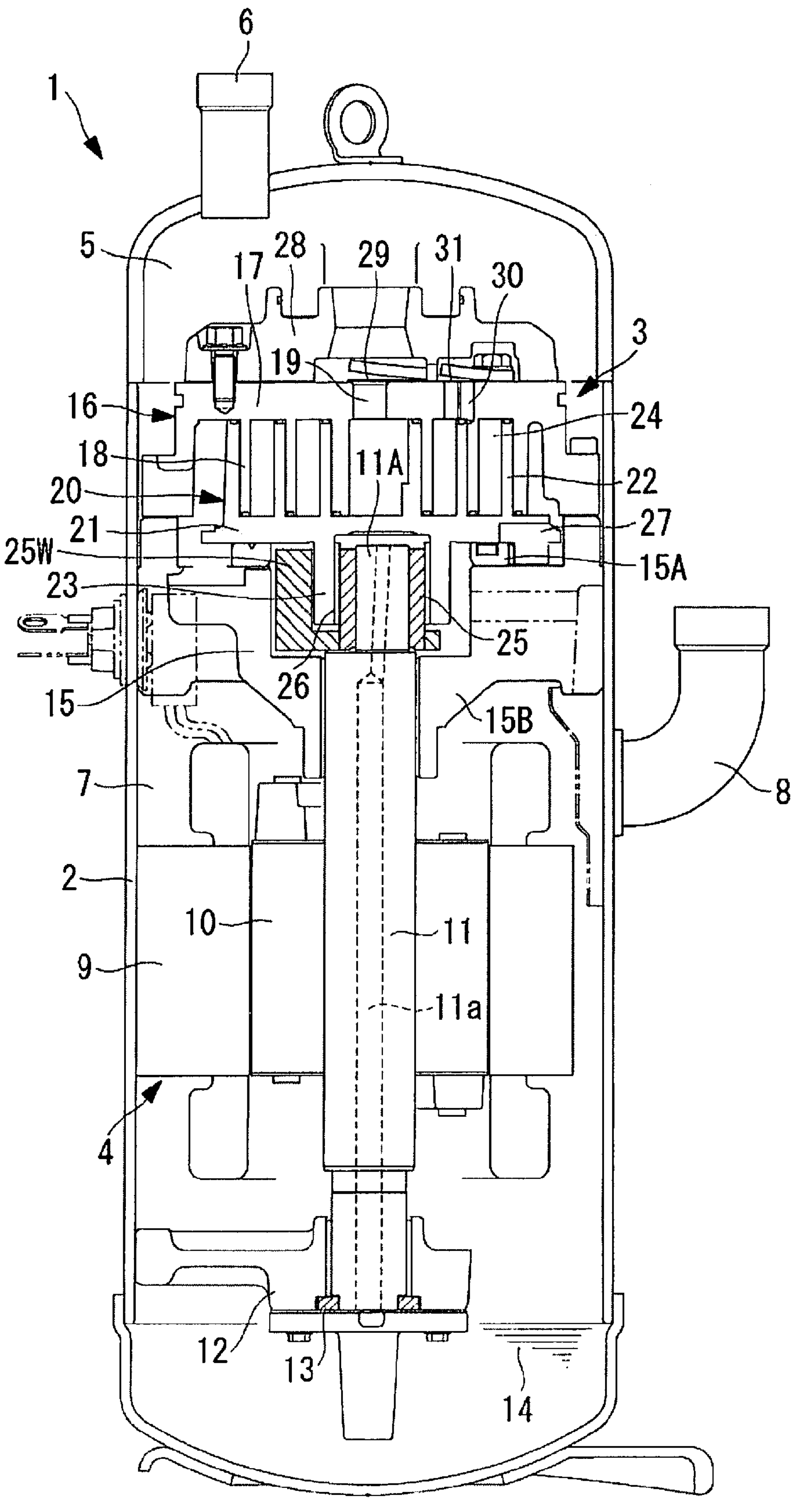
Claims

1. A scroll compressor (1) comprising:

a hermetic housing (2);
a scroll compression mechanism (3) in which a fixed scroll (16) and an Orbit Scroll (20) are combined, the scroll compression mechanism (3) being installed at an upper site in the hermetic housing (2);
an electric motor (4) that is installed at a lower site of the scroll compression mechanism (3);
a crankshaft (11) that is rotationally driven by the electric motor (4);
a crankpin (11A) that is provided at an upper end of the crankshaft (11) and that is inserted into an Orbit boss part (23) through a cylindrical drive bush (25) and a drive bearing (26) in a relatively rotatable manner, the Orbit boss part (23) being formed on a back surface of the Orbit Scroll (20);
an oil supply passage (11a) that is formed along a shaft center line of the crankshaft (11) and through which lubricant oil (14) is supplied to a vicinity of the drive bearing (26); and
an oil through hole (25a) that has a through-hole shape and that is formed in an interior of a cylindrical wall of the drive bush (25) along an axial direction,
the oil through hole (25a) being formed in a predetermined load angle region (θ) in which an outer circumferential surface of the drive bush (25) presses on an inner circumferential surface of the drive bearing (26) at the time of a load operation.

2. The scroll compressor (1) according to claim 1, wherein a plurality of the oil through holes (25a) are formed so as to be arrayed in a circumferential direction of the drive bush (25).

FIG. 1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11A
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25W
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11a
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FIG. 2

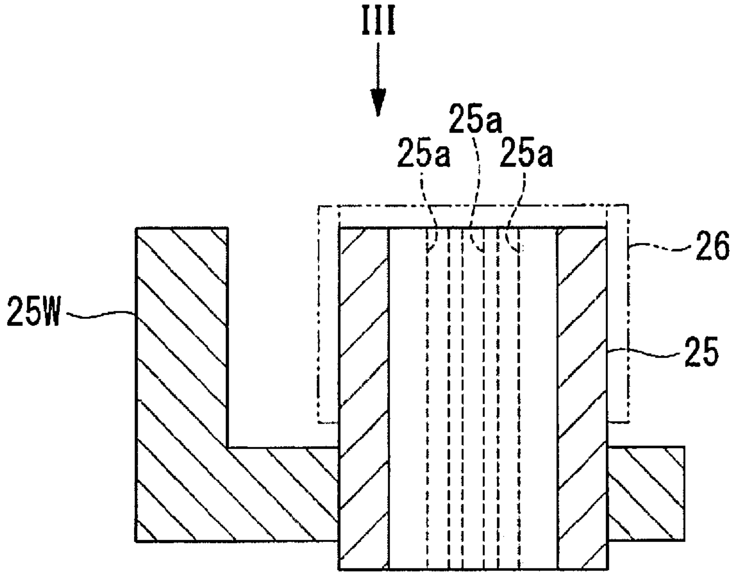
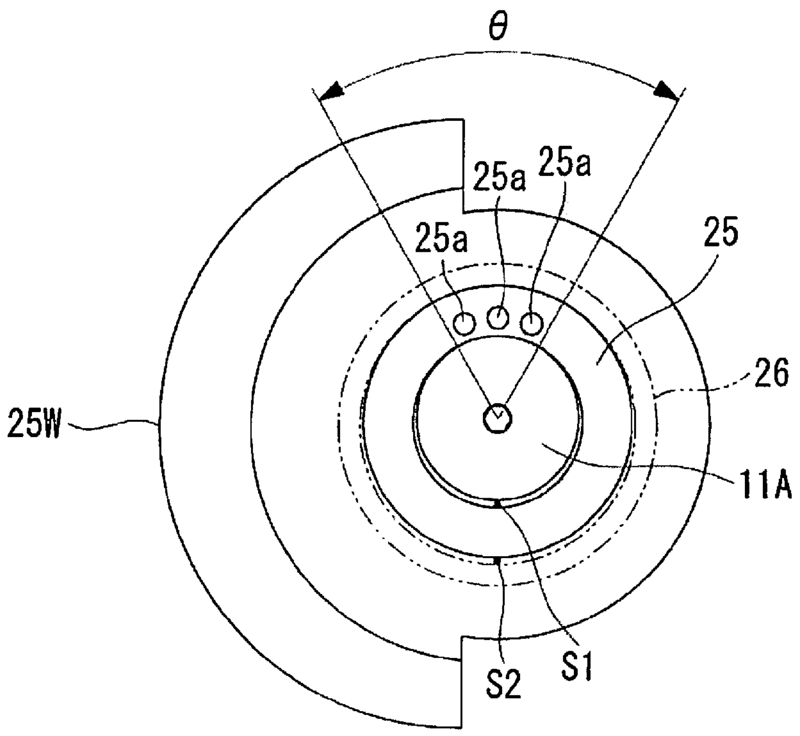


FIG. 3



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EUROPEAN SEARCH REPORT

Application Number
EP 17 16 3269

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A,D	JP H04 49684 U (MITSUBISHI HEAVY INDUSTRIES) 27 April 1992 (1992-04-27) * the whole document * -----	1,2	
			TECHNICAL FIELDS SEARCHED (IPC)
			F04C

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	2 August 2017	Descoubes, Pierre

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02-08-2017

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REFERENCES CITED IN THE DESCRIPTION

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