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(54) **GUIDING ARRANGEMENT OF HIGH PRESSURE PUMP**

FÜHRUNGSANORDNUNG EINER HOCHDRUCKPUMPE

SYSTÈME DE GUIDAGE DE POMPE À HAUTE PRESSION

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Description

TECHNICAL FIELD

[0001] The present invention relates to a high pressure pump and more particularly to a guiding arrangement adapted to guide a shoe member and roller cooperating with a cam.

BACKGROUND OF THE INVENTION

[0002] In high pressure fuel pump, a piston reciprocally translates within a bore performing therein a pumping cycle. A rotating cam cooperates with the piston via a cam follower provided at an end of the piston. The cam follower comprises a shoe and a cylindrical roller, the shoe being a parallelepiped rectangle provided, on a lower side with a cylindrical hollow wherein is complementary received the roller and, on the opposite upper side with an abutment face for the lower end of the piston. The displacement of the shoe are guided in a shoe guide fixed in the body of the pump, said shoe guide being provided with a complementary opening having a rectangular section and defining long and short faces against which, in use, the shoe member slides. A shoe guide for a high pressure fuel pump is known e.g. from EP-2657505-A1.

[0003] Despite a flow of lubricant fluid within a thin functional clearance defined between the shoe member and the shoe guide, wear due to cavitation of the fluid is observed on the sliding faces.

SUMMARY OF THE INVENTION

[0004] Accordingly, it is an object of the present invention to resolve the above mentioned problems in providing a shoe guide member of a high pressure fuel pump, the shoe guide member being provided with a guiding bore extending along a pumping axis and opening in a top face and in a bottom face of the shoe guide member, said guiding bore defining two long faces parallel to each other and perpendicular to two short faces, against which, in use, slide faces of a shoe member.

[0005] The shoe guide member is further provided with at least one passage extending from said top to said bottom face and enabling, in use, lubricant fluid to flow between said top and bottom faces and to lubricate the sliding faces of the shoe member and of the guiding member.

[0006] Said passages are conduits in the shoe guide member and angled relative to the pumping axis. Said conduits open at a first end in the bottom face at a distance from the long faces, and, in the vicinity of the top face in the long face, so that the area of said long faces, closer to the bottom face is larger than the area closer to the top face.

[0007] Also in an example not part to the invention, said passages are a plurality of grooves arranged in each of the long guiding face.

[0008] Also, the guiding bore defines a pumping axis, the groove being aligned with said pumping axis.

[0009] Also, in said example not part to the invention, said plurality of grooves are parallel to each other. They are equally distributed across said guiding faces.

[0010] Also, said groove intersects with said guiding face along edge lines which are rounded and smooth so that, stress concentration are avoided.

[0011] Also, two conduits are provided, one close to each of the long faces.

[0012] Also, in an alternative, said conduit is drilled at an angle relative to the long faces, said angular drilling enabling a bottom opening distant from the face and a top opening in the long face.

[0013] In another alternative, said conduit is drilled parallel to and distant the long face, the shoe guide member being further provided with a side opening joining the conduit to said long face, said side opening being limited to a region of said long face in the vicinity to the top face.

[0014] The invention also extends to a shoe member adapted to be slidably guided within a guiding bore provided in a shoe guide member, the shoe member having side faces sliding, in use, against guiding faces of the guiding bore and, the shoe member is further provided with at least one groove arranged in a side face, said groove extending from a top face to a bottom face of the shoe member and enabling, in use, lubricant fluid to flow between said top and bottom faces.

[0015] Also, the shoe member has two lateral faces, parallel to each other and two end faces, parallel to each other, the end faces, being perpendicular to the lateral faces, and wherein, each of the lateral face, is provided with at least one groove.

[0016] Also, the shoe member further comprises a plurality of said grooves in each of the lateral face,.

[0017] Also, in use, the shoe member slides along a pumping axis, the groove being aligned with said pumping axis.

[0018] Also, said plurality of grooves are parallel to each other.

[0019] Also, said plurality of grooves are equally distributed across said side faces.

[0020] Also, said groove intersects with said lateral face along edge lines which are rounded and smooth so that, stress concentration are avoided.

[0021] The invention further extends to a guiding arrangement of a shoe member slidably arranged in a shoe guide member as previously described.

[0022] The invention further extends to high pressure fuel pump comprising a shoe member sliding in a shoe guide member or a guiding arrangement as previously described.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] The present invention is now described by way of example with reference to the accompanying drawings in which:

Figure 1 is a section of a high pressure pump provided with a shoe guide member.
Figure 2 is a magnified area of the pump of figure 1.
Figure 3 is a 3D view of a shoe guide member not part to the invention.
Figure 4 is a top view of the shoe guide member of figure 3.
Figures 5-8 present a shoe guide member as per the invention.
Figures 9-12 is an alternative not part to the invention.
Figures 13-16 is another alternative not part to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0024] In reference to the figures is now described a high pressure diesel pump 10 adapted to be arranged in a diesel fuel injection equipment between an upstream low pressure delivery unit and a high pressure injection unit. The pump 10 comprises a pump body 12 on which is fixed a pumping head 14 wherein a piston 16, slidably arranged in a bore 18 extending along a pumping axis X, performs a pumping cycle during which the volume of a control chamber 20 is varied.

[0025] The pump body 12 further defines an inner space S wherein is arranged a camshaft 22 adapted to rotate about a camshaft axis Y1 perpendicular to the pumping axis X.

[0026] While the upper end of the piston remains inside the pumping head 14 and directly contributes to the compression of the fuel in the compression chamber, an opposite lower end 24 of the piston protrudes outside the pumping head 14, and extends inside the inner space S for cooperating via a cam-follower 26 with a cam 28 of the camshaft 22. The cam-follower 26 is fixed to said lower end 24 and is axially guided along the pumping axis X by a guide member 30 fixed to the pump body 12. In use, the cam 28 rotates about the camshaft axis Y1 and it urges the piston 16, via the cam-follower 26, to said reciprocal displacements forming the pumping cycle.

[0027] The use of relative terms such as upper or lower is done in relation to the arbitrary orientation of figure 1. It eases and clarifies the description and must not be interpreted as a limitation to the invention.

[0028] More precisely, the cam-follower 26 comprises a shoe member 32 wherein is received a cylindrical roller 34 adapted to rotate about a roller axis Y2 parallel to the camshaft axis Y1. In use, the outer cylindrical face of the roller rolls on the cam profile and imparts said axial X displacements to the shoe member 32 and to the piston 16.

[0029] In a plan transverse to the pumping axis X, the shoe member 32 has a rectangular cross-section and its shape is substantially circumscribed to a parallelepiped rectangle. The shoe member 32 has a rectangular flat upper face 36 receiving in abutment the lower end 24 of the piston and, an opposed lower face 38 provided with a cylindrical concave hollow 40 adjusted to complementary receive the roller 34. Between said upper 36 and lower 38 faces are defined four side faces comprising two lateral faces 42, 44, parallel to each other, said lateral faces being rectangular, and two end faces 46, 48 parallel to each other and transverse to the roller axis Y2, the hollow 40 opening in a truncated circle in said end faces.

[0030] The cam-follower 26 is axially X guided within the guide member 30, or shoe guide member 30 represented on figures 3 and 4.

[0031] The shoe guide member 30 is a tubular member having a cylindrical outer face 50 extending along the pumping axis X between a transverse top face 52 and an opposed transverse bottom face 54. Alternatively, other profiles such as rectangular are possible for the outer face 50. The shoe guide 30 further defines a guiding bore 56 opening in said top 52 and bottom 54 faces, said guiding bore 56 defining four guiding faces 58, 60, 62, 64, comprising a first 58 and a second 60 long faces that are parallel to each other and, a first 62 and a second 64 short faces that are parallel to each other, the short faces 62, 64, being perpendicular to the long faces.

[0032] The guiding bore 56 is adapted to complementary receive the shoe member 32, the lateral faces 42, 44, of the shoe member sliding against the long faces 58, 60 of the bore 56 and, the end faces 46, 48, of the shoe member sliding against the short faces 62, 64, of the bore. To enable the relative sliding movements, a functional clearance C is defined between each pair of sliding faces.

[0033] In a first example not part to the invention, as represented on figure 3, the long faces 58, 60 of the bore 56 are provided with lubricant passages 65 which, in this first embodiment of the invention are vertical grooves 66 extending along the pumping axis X between the top 52 and bottom face 54 of the shoe guide member. In the figure, five grooves 66 are represented but any other number is possible. Also, only one of the long face is visible but the grooves 66 are provided on both long faces 58 and 60.

[0034] The grooves 66 represented have a triangular profile but other profiles, semi-circular, square, trapezoidal... are adequate as well. The grooves 66 intersect with the long faces 58, 60 along edge lines 68 and, to avoid stress concentration, said edge lines 68 are rounded to provide a smooth transition between the face and the groove.

[0035] More small grooves well spread and arranged regularly across the faces 58, 60 is preferable to a smaller number of larger grooves, or a unique groove. Indeed the objective being to improve lubrication of the sliding faces and wear of said faces due to cavitation, grooves regularly arranged across the face enable lubricant to lubricate the entire sliding area. Moreover, grooves of rather small width preserve an important guiding area. More small grooves optimise the complete lubrication of the sliding faces and still manage a large guiding area.

Conclusive tests have been performed demonstrating that said grooves 66 ease the lubricant flow and avoid wear due to cavitation of said lubricant fluid.

[0036] In a non-represented alternative, the first and second short faces 62, 64, of the shoe guide member 30 are also provided with grooves 66.

[0037] In a non-represented alternative embodiment, the faces of the guiding bore 56 are planar and the side faces 42, 44, of the shoe member are provided with grooves 66 having rounded edge lines 68.

[0038] In another alternative, the end faces 46, 48, of the shoe member are also provided with grooves 66.

[0039] In a further alternative embodiment, faces of both the shoe member 32 and of the shoe guide member 30 are provided with grooves 66.

[0040] An embodiment of the shoe guide member 30 as per the invention is now described on figures 5-8 by way of differences to the first example.

[0041] The lubricant passages 65 are conduits 67, or drillings, arranged in the body of the shoe guide member 30 where they extend from a lower opening 70 in the bottom face 54 of the shoe guide member to an upper, or side, opening 72 in said long faces 58, 60.

[0042] In the embodiment of figures 5-8, the conduits 67 makes an angle A with the pumping axis X, said angle A being quite small of few degrees, the conduit 67 is not exactly perpendicular to said bottom face 54 of the shoe guide member. Therefore, the lower opening 70 of the conduit is slightly elliptical and is provided in the largest part of said bottom face 54, where the guiding face is the most distant from the cylindrical outer face 50 of the shoe guide member. More precisely, as visible on figure 5 the lower opening 70 is arranged on the median plane of the guiding faces 58, 60, equidistant between said outer face 50 and said guiding face 58, 60. From said almost circular lower opening 70, the conduit 67 extends in said median plane to the upper opening 72 that defines in the upper portion of the guiding face 58, 60 a long elliptical notch.

[0043] To the contrary of the first example where a large number of small grooves 66 is preferred to reach the same objective of improved lubrication of the guiding faces, this embodiment prefers a unique conduit 67 which long notch defined by the upper opening 72 extends on substantially the upper half height of said face.

[0044] In the alternative of figures 9-12 not part to the invention the conduit 67 is drilled aligned to the pumping axis X, therefore parallel to the guiding face 58, 60. the conduit 67 extending from the lower opening 70, which now forms an exact circle in the bottom face 54, to the top face 56 of the shoe guide member. A rectangular aperture 74 is formed joining the upper half of the guiding face to the conduit 67 and enabling, in use, lubricant fluid to flow along said guiding face.

[0045] In an alternative not part to the invention presented on figures 13-16, the conduit 67 is drilled aligned to the pumping axis X, similarly to the previous alternative but, instead of having a circular section the conduit's section is oblong, with long axis parallel to the guiding face.

LIST OF REFERENCES

[0046]

X	pumping axis
Y1	camshaft axis
Y2	roller axis
S	inner space
C	clearance
10	pump
12	pump body
14	pumping head
16	piston
18	bore
20	control chamber
22	camshaft
24	lower end of the piston
26	cam-follower
28	cam
30	shoe guide member
32	shoe member
34	roller
36	upper face of the shoe member
38	lower face of the shoe member
40	concave hollow
42	side face of the shoe member - lateral face
44	side face of the shoe member - lateral face
46	side face of the shoe member - end face
48	side face of the shoe member - end face
50	outer face of the shoe guide member
52	top face of the shoe guide member
54	bottom face of the shoe guide member
56	guiding bore
58	guiding face of the guiding bore - first long face
60	guiding face of the guiding bore - second long face
62	guiding face of the guiding bore - first short face
64	guiding face of the guiding bore - second short face
65	lubricant passage
66	groove
67	conduit
68	edge lines of the groove
70	side opening
72	upper opening of the conduit in the guiding face - long notch
74	rectangular opening

Claims

1. Shoe guide member (30) of a high pressure fuel pump (10), the shoe guide member (30) being provided with a guiding bore (56) extending along a pumping axis (X) and opening in a top face (52) and in a bottom face (54) of the shoe guide member, said guiding bore (56) defining two long faces (58, 60) parallel to each other and perpendicular to two short faces (62, 64) against which, in use, slide faces (42, 44, 46, 48) of a shoe member and,

wherein the shoe guide member (30) is further provided with at least one passage (65, 66) extending from said top (52) to said bottom (54) face and enabling, in use, lubricant fluid to flow between said top and bottom faces,
characterized in that
said passages (65) are conduits (67) arranged in the shoe guide member and angled relative to the pumping axis (X), said conduits (67) opening at a first end in the bottom face (54) at a distance from the long faces (58, 60) and, at a second end in the vicinity of the top face (52) in the long face (58, 60) so that the area of said long faces (58, 60) closer to the bottom face (54) is larger than the area closer to the top face (52).

2. Shoe guide member (30) as claimed in the preceding claim wherein said passages (65) are a plurality of grooves (66) arranged in each of the long face (58, 60).

3. Shoe guide member (30) as claimed in claim 2 further comprising a plurality of said grooves (66) in each of the lateral guiding face.

4. Shoe guide member (30) as claimed in any one of the claims 2 or 3 wherein the guiding bore (56) defines a pumping axis (X), the groove (66) being aligned with said pumping axis (X).

5. Shoe guide member (30) as claimed in claim 4 when depending upon claim 3 wherein said plurality of grooves (66) are parallel to each other.

6. Shoe guide member (30) as claimed in claim 5 wherein said plurality of grooves (66) are distributed across said guiding faces.

7. Shoe guide member (30) as claimed in any one of the preceding claims wherein said groove (66) intersects with said guiding face along edge lines (68) which are rounded and smooth so that, stress concentration is avoided.

8. Shoe guide member (30) as claimed in claim 1 wherein two conduits (67) are provided, one close to each of the long faces (58, 60).

9. Shoe guide member (30) as claimed in any one of the claims 1 or 8 wherein said conduit (67) is drilled at an angle (A) relative to the long faces (58, 60), said angular drilling enabling a lower opening (70) distant from the face and an upper opening (72) in the long face.

10. Shoe guide member (30) as claimed in any one of the claims 1 or 8 wherein said conduit (67) is drilled parallel to and from distant the long face, the shoe guide member being further provided with a side opening (74) joining the conduit (67) to said long face (58, 60), said side opening (74) being limited to a region of said long face in the vicinity to the top face (52).

11. Shoe member (32) of a high pressure fuel pump (10), the shoe member (32) being adapted to be slidably guided within the guiding bore (56) provided in a shoe guide member (30) as claimed in any of the preceding claims.

12. High pressure fuel pump (10) comprising a shoe guide member (30) as claimed in any one of the claims 1 to 10.

Patentansprüche

1. Schuhführungselement (30) einer Hochdruckkraftstoffpumpe (10), wobei das Schuhführungselement (30) mit einer Führungsbohrung (56) vorgesehen ist, die sich entlang einer Pumpachse (X) erstreckt und in einer Oberseite (52) und in einer Unterseite (54) des Schuhführungselements mündet, wobei die Führungsbohrung (56) zwei lange Flächen (58, 60) parallel zueinander und senkrecht zu zwei kurzen Flächen (62, 64) definiert, gegen die, in Betrieb, Flächen (42, 44, 46, 48) eines Schuhelements gleiten, und
wobei das Schuhführungselement (30) weiter mit zumindest einem Durchlass (65, 66) vorgesehen ist, der sich von der Oberseite (52) zu der Unterseite (54) erstreckt und in Betrieb ermöglicht, dass Schmiermittelfluid zwischen der Oberseite und der Unterseite fließt,
dadurch gekennzeichnet, dass
die Durchlässe (65) Kanäle (67) sind, die in dem Schuhführungselement angeordnet sind und relativ zu der Pumpachse (X) abgewinkelt sind, wobei die Kanäle (67) an einem ersten Ende in der Unterseite (54) in einem Abstand von den langen Flächen (58, 60) münden und an einem zweiten Ende in der Nähe der Oberseite (52) in der langen Fläche (58, 60) münden, so dass der Bereich der langen Flächen (58, 60) näher an der Unterseite (54) größer ist als der Bereich näher an der Oberseite (52).

2. Schuhführungselement (30) gemäß dem vorhergehenden Anspruch, wobei die Durchlässe (65) eine Vielzahl von Rillen (66) sind, die in jeder der langen Flächen (58, 60) angeordnet sind.

3. Schuhführungselement (30) gemäß Anspruch 2, das weiter eine Vielzahl der Rillen (66) in jeder der seitlichen Führungsflächen aufweist.

4. Schuhführungselement (30) gemäß einem der An-

sprüche 2 oder 3, wobei die Führungsbohrung (56) eine Pumpachse (X) definiert, wobei die Rille (66) mit der Pumpachse (X) ausgerichtet ist.

5. Schuhführungselement (30) gemäß Anspruch 4, wenn von Anspruch 3 abhängig, wobei die Vielzahl von Rillen (66) parallel zueinander sind.

6. Schuhführungselement (30) gemäß Anspruch 5, wobei die Vielzahl von Rillen (66) über die Führungsflächen verteilt sind.

7. Schuhführungselement (30) gemäß einem der vorhergehenden Ansprüche, wobei sich die Rille (66) mit der Führungsfläche entlang von Kantenlinien (68) schneidet, die abgerundet und glatt sind, so dass eine Belastungskonzentration vermieden wird.

8. Schuhführungselement (30) gemäß Anspruch 1, wobei zwei Kanäle (67) vorgesehen sind, eine nahe jeder der langen Flächen (58, 60).

9. Schuhführungselement (30) gemäß einem der Ansprüche 1 oder 8, wobei der Kanal (67) in einem Winkel (A) relativ zu den langen Flächen (58, 60) gebohrt ist, wobei die Bohrung in einem Winkel eine untere Öffnung (70) entfernt von der Fläche und eine obere Öffnung (72) in der langen Fläche ermöglicht.

10. Schuhführungselement (30) gemäß einem der Ansprüche 1 oder 8, wobei der Kanal (67) parallel zu der langen Fläche und von dieser entfernt gebohrt ist, wobei das Schuhführungselement weiter mit einer Seitenöffnung (74) vorgesehen ist, die sich mit dem Kanal (67) zu der langen Fläche (58, 60) verbindet, wobei die Seitenöffnung (74) auf einen Bereich der langen Fläche in der Nähe der Oberseite (52) beschränkt ist.

11. Schuhelement (32) einer Hochdruckkraftstoffpumpe (10), wobei das Schuhelement (32) ausgebildet ist, um in der Führungsbohrung (56), die in einem Schuhführungselement (30) gemäß einem der vorhergehenden Ansprüche vorgesehen ist, verschiebbar geführt zu werden.

12. Hochdruckkraftstoffpumpe (10) mit einem Schuhführungselement (30) gemäß einem der Ansprüche 1 bis 10.

Revendications

1. Organe de guidage de sabot (30) d'une pompe à carburant haute pression (10), l'organe de guidage de sabot (30) étant pourvu d'un alésage de guidage (56) s'étendant le long d'un axe de pompage (X) et ouvrant sur une face supérieure (52) et sur une face inférieure (54) de l'organe de guidage de sabot, ledit alésage de guidage (56) définissant deux faces longues (58, 60) parallèles l'une à l'autre et perpendiculaires à deux faces courtes (62, 64) contre lesquelles, pendant l'utilisation, glissent les faces (42, 44, 46, 48) d'un organe de sabot, et
l'organe de guidage de sabot (30) étant en outre pourvu d'au moins un passage (65, 66) s'étendant depuis ladite face supérieure (52) jusqu'à ladite face inférieure (54) et permettant, pendant l'utilisation, à du fluide de lubrification de s'écouler entre lesdites faces supérieure et inférieure,
caractérisé en ce que
lesdits passages (65) sont des conduits (67) agencé dans l'organe de guidage de sabot et inclinés par rapport à l'axe de pompage (X), lesdits conduits (67) ouvrant, au niveau d'une première extrémité, sur la face inférieure (54) à une certaine distance des faces longues (58, 60), et à une deuxième extrémité, à proximité de la face supérieure (52), sur la face longue (58, 60) de telle sorte que la surface desdites faces longues (58, 60) plus proche de la face inférieure (54) soit plus grande que la surface plus proche de la face supérieure (52).

2. Organe de guidage de sabot (30) selon la revendication précédente, dans lequel lesdits passages (65) sont une pluralité de gorges (66) agencées dans chacune des faces longues (58, 60).

3. Organe de guidage de sabot (30) selon la revendication 2, comprenant en outre une pluralité desdites gorges (66) dans chacune des faces de guidage latérales.

4. Organe de guidage de sabot (30) selon l'une quelconque des revendications 2 et 3, dans lequel l'alésage de guidage (56) définit un axe de pompage (X), la gorge (66) étant alignée avec ledit axe de pompage (X).

5. Organe de guidage de sabot (30) selon la revendication 4 lorsqu'elle dépend de la revendication 3, dans lequel ladite pluralité de gorges (66) sont parallèles les unes aux autres.

6. Organe de guidage de sabot (30) selon la revendication 5, dans laquelle ladite pluralité de gorges (66) sont réparties sur lesdites faces de guidage.

7. Organe de guidage de sabot (30) selon l'une quelconque des revendications précédentes, dans lequel ladite gorge (66) intersecte ladite face de guidage le long de lignes de bord (68) qui sont arrondies et lisses de manière à éviter une concentration des contraintes.

8. Organe de guidage de sabot (30) selon la revendi-

cation 1, dans lequel deux conduits (67) sont prévus, l'un étant proche de chacune des faces longues (58, 60).

9. Organe de guidage de sabot (30) selon l'une quelconque des revendications 1 et 8, dans lequel ledit conduit (67) est percé suivant un angle (A) par rapport aux faces longues (58, 60), ledit perçage angulaire permettant une ouverture inférieure (70) distante de la face et une ouverture supérieure (72) dans la face longue.

10. Organe de guidage de sabot (30) selon l'une quelconque des revendications 1 et 8, dans lequel ledit conduit (67) est percé parallèlement à, et à distance de, la face longue, l'organe de guidage de sabot étant en outre pourvu d'une ouverture latérale (74) reliant le conduit (67) à ladite face longue (58, 60), ladite ouverture latérale (74) étant limitée à une région de ladite face longue à proximité de la face supérieure (52).

11. Organe de sabot (32) d'une pompe à carburant haute pression (10), l'organe de sabot (32) étant prévu pour être guidé de manière coulissante à l'intérieur de l'alésage de guidage (56) prévu dans un organe de guidage de sabot (30) selon l'une quelconque des revendications précédentes.

12. Pompe à carburant haute pression (10) comprenant un organe de guidage de sabot (30) selon l'une quelconque des revendications 1 à 10.

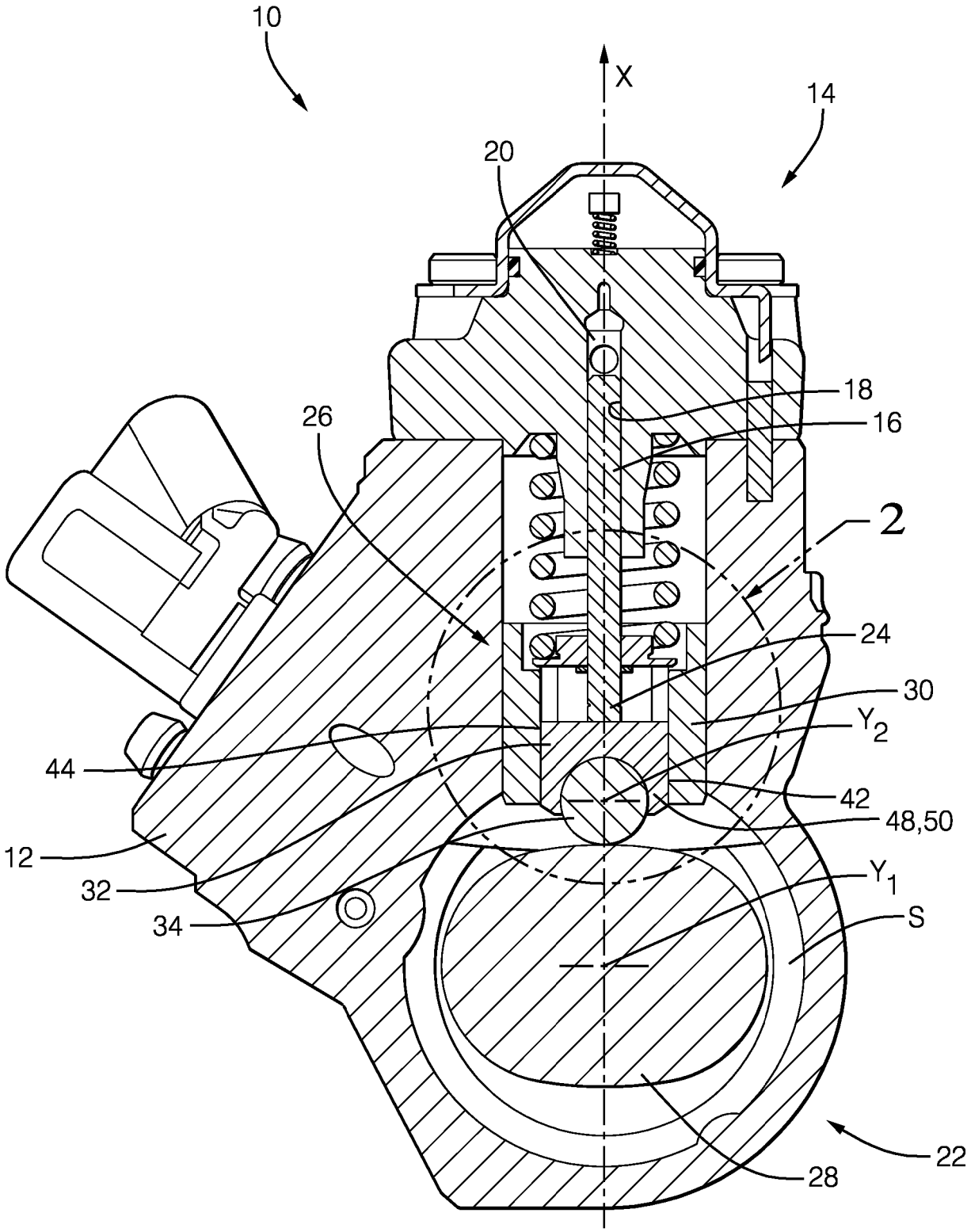

FIG. 1

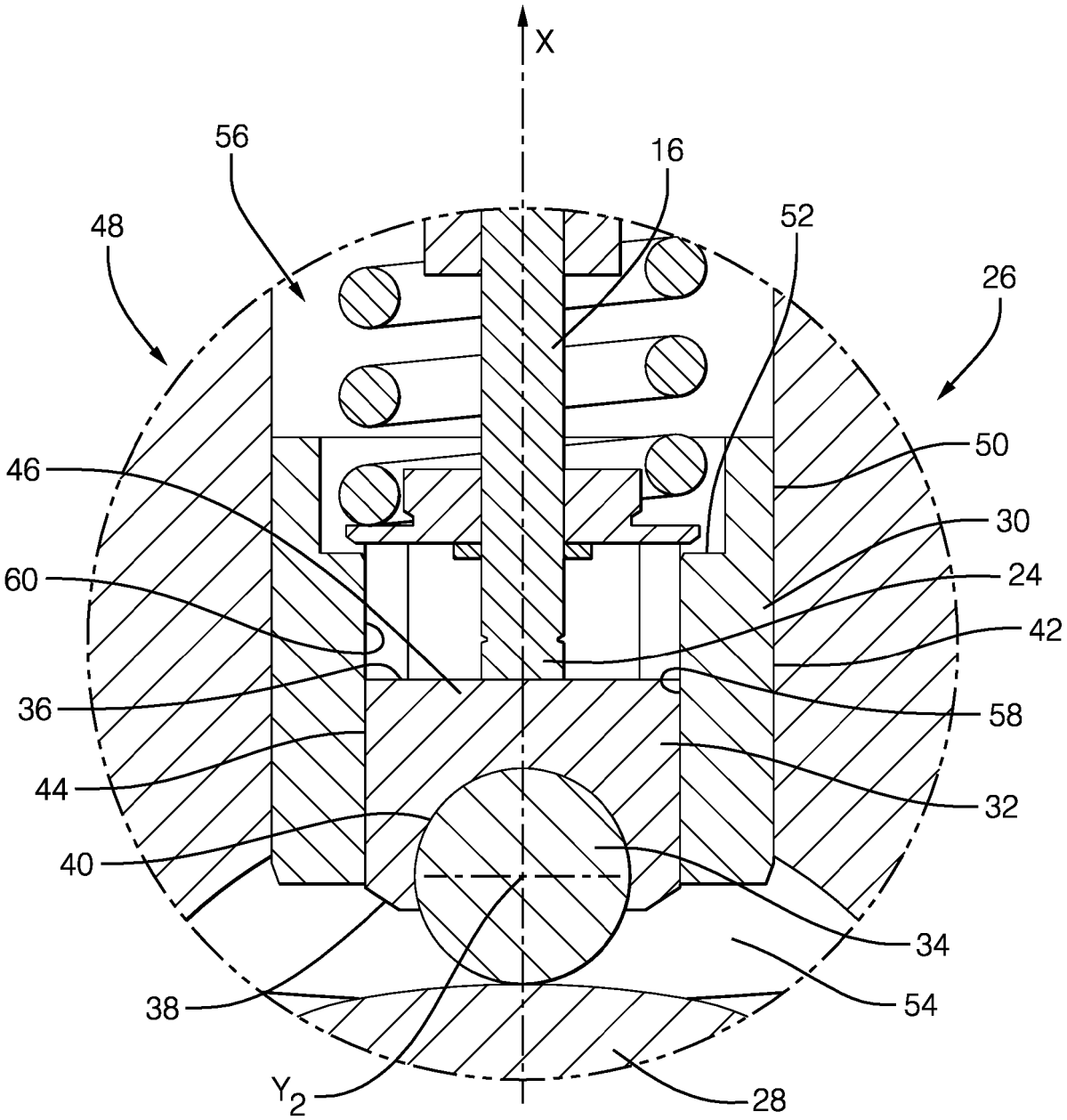

FIG. 2

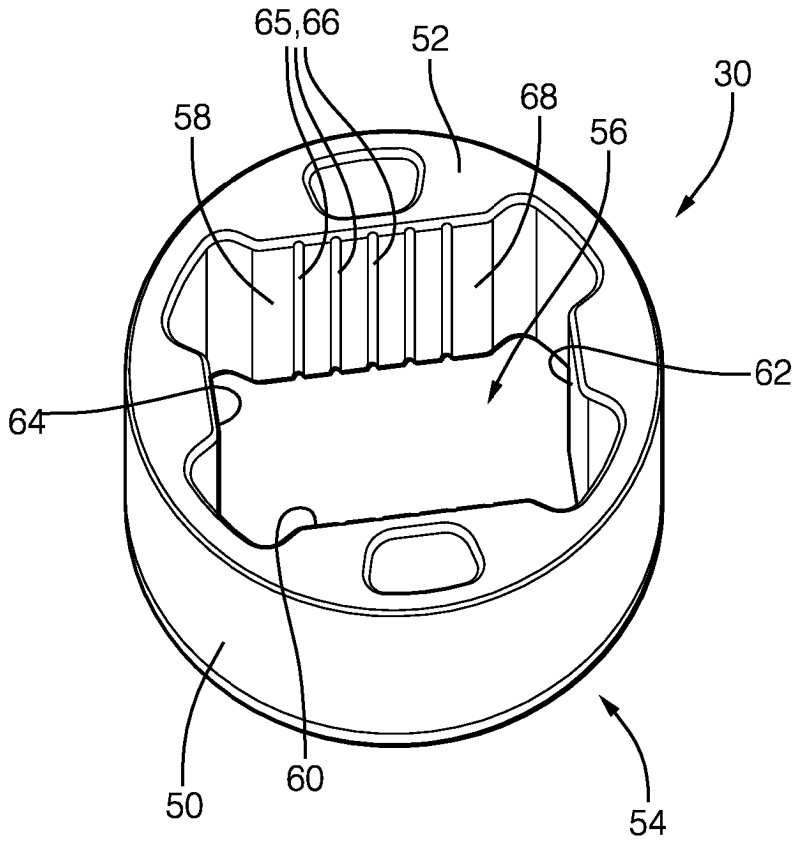

FIG. 3

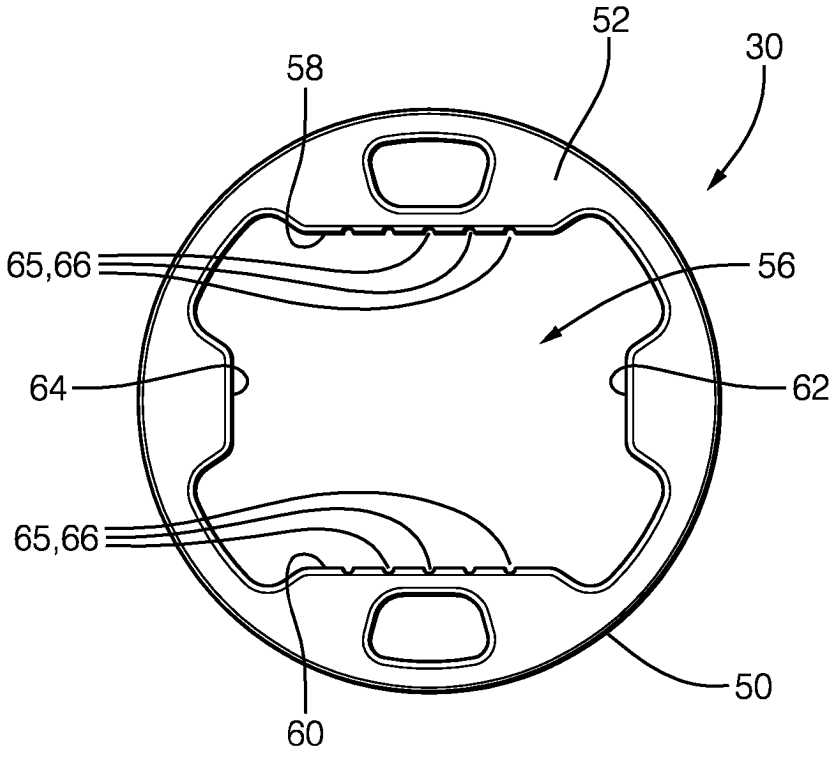

FIG. 4

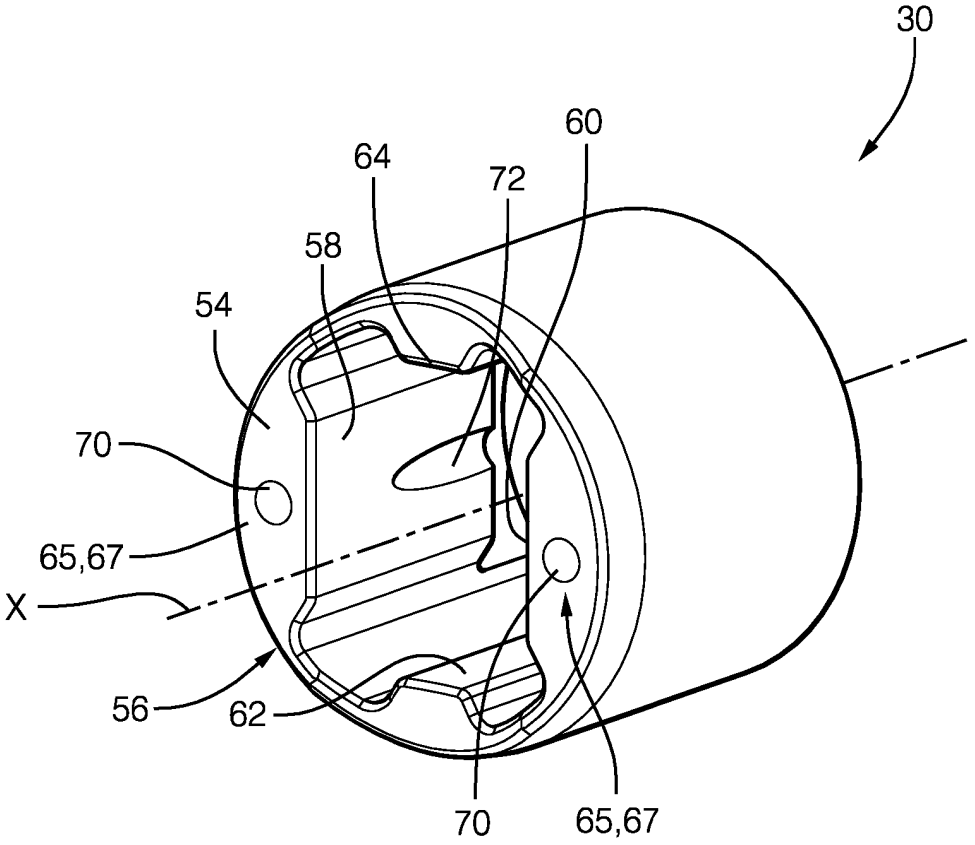

FIG. 5

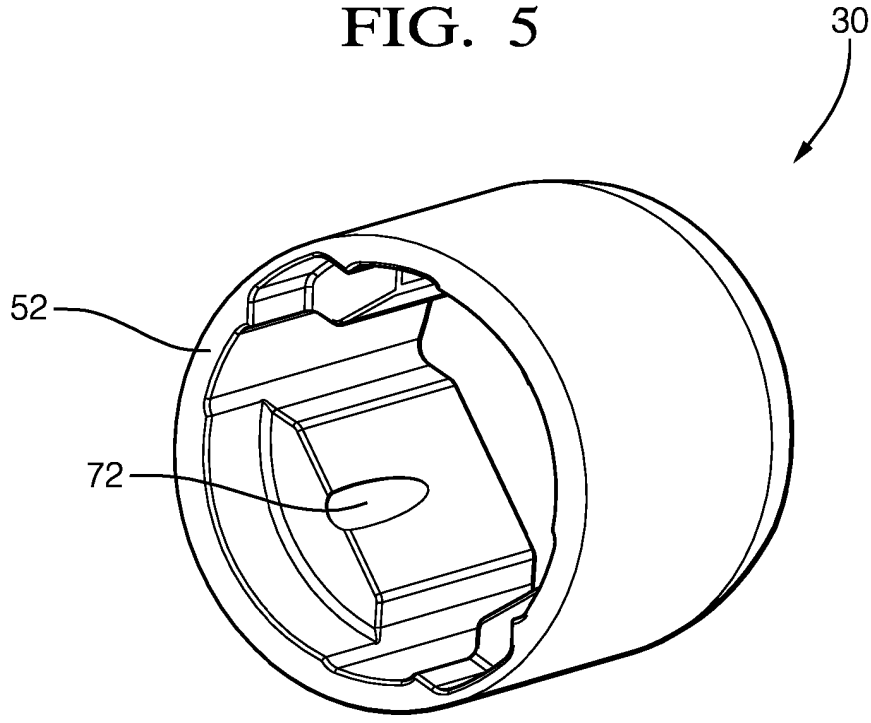

FIG. 6

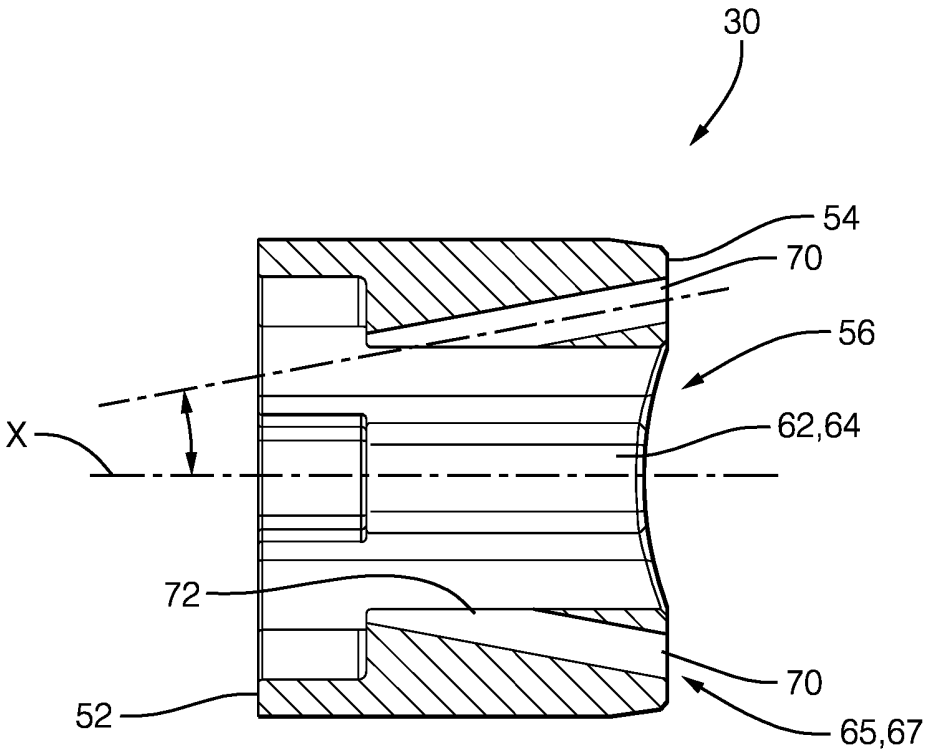

FIG. 7

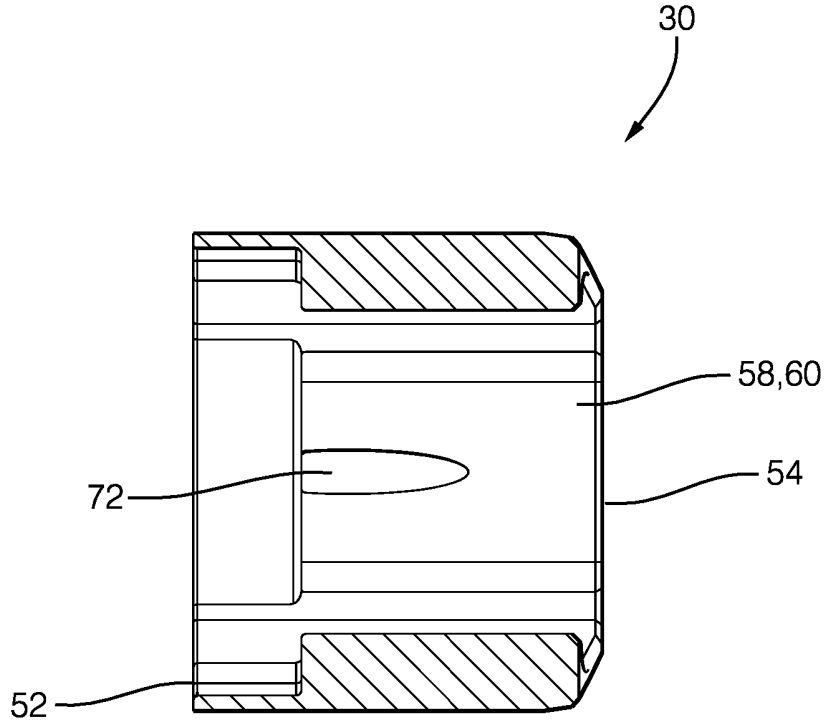

FIG. 8

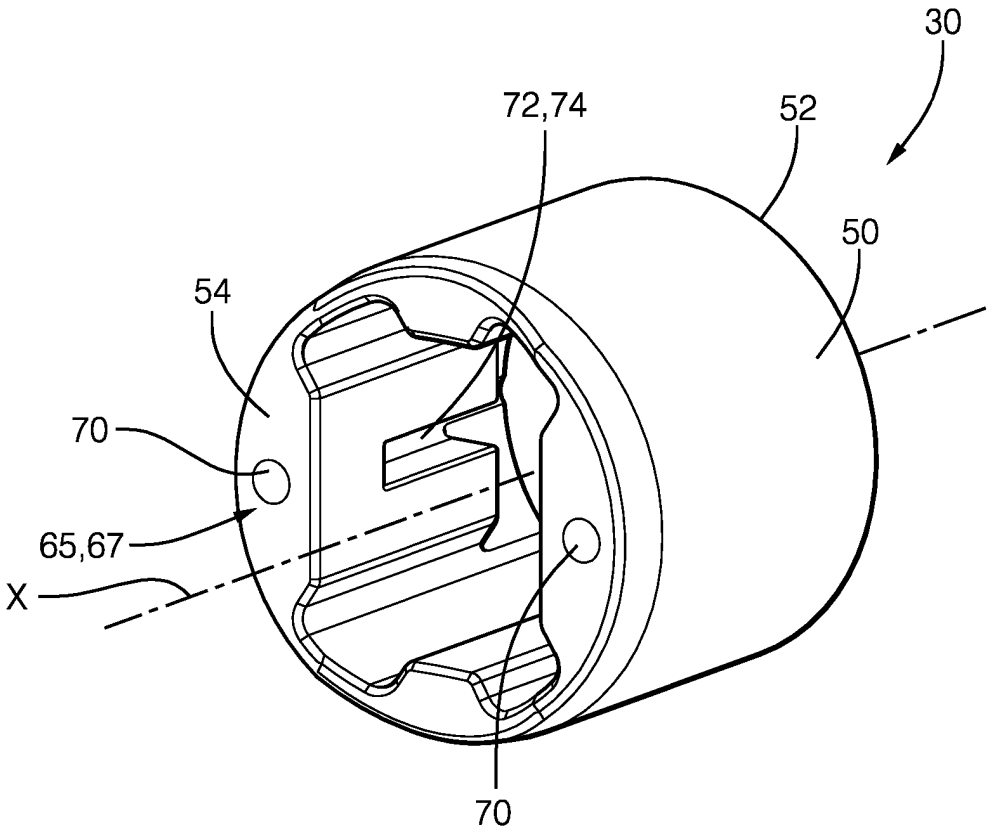

FIG. 9

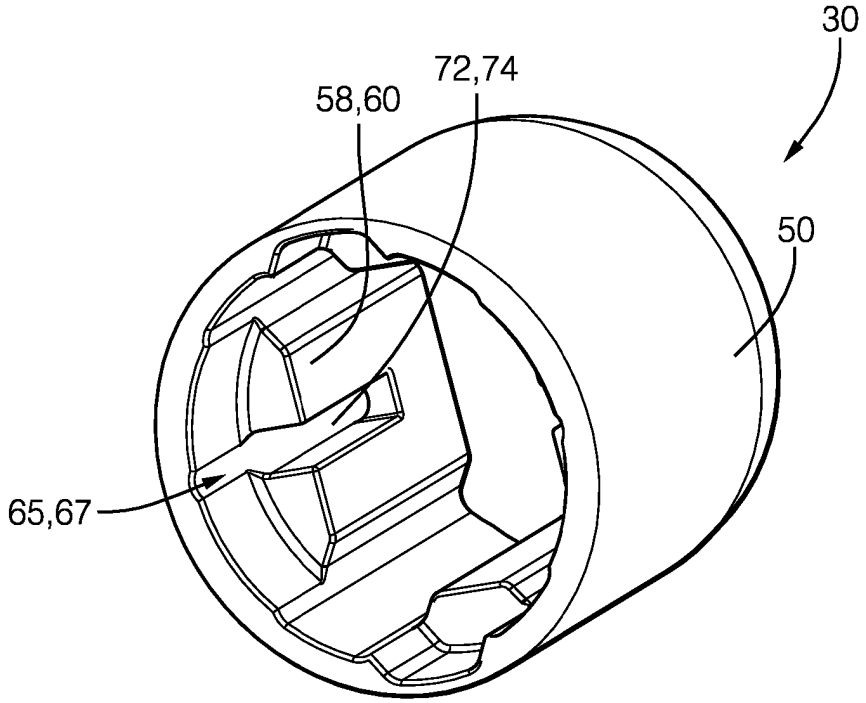

FIG. 10

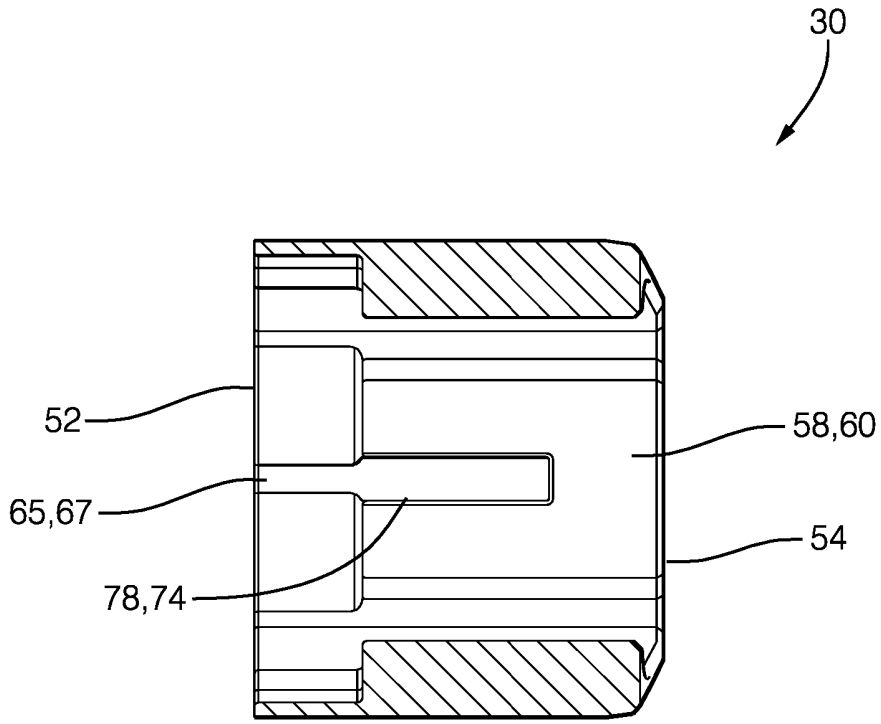

FIG. 11

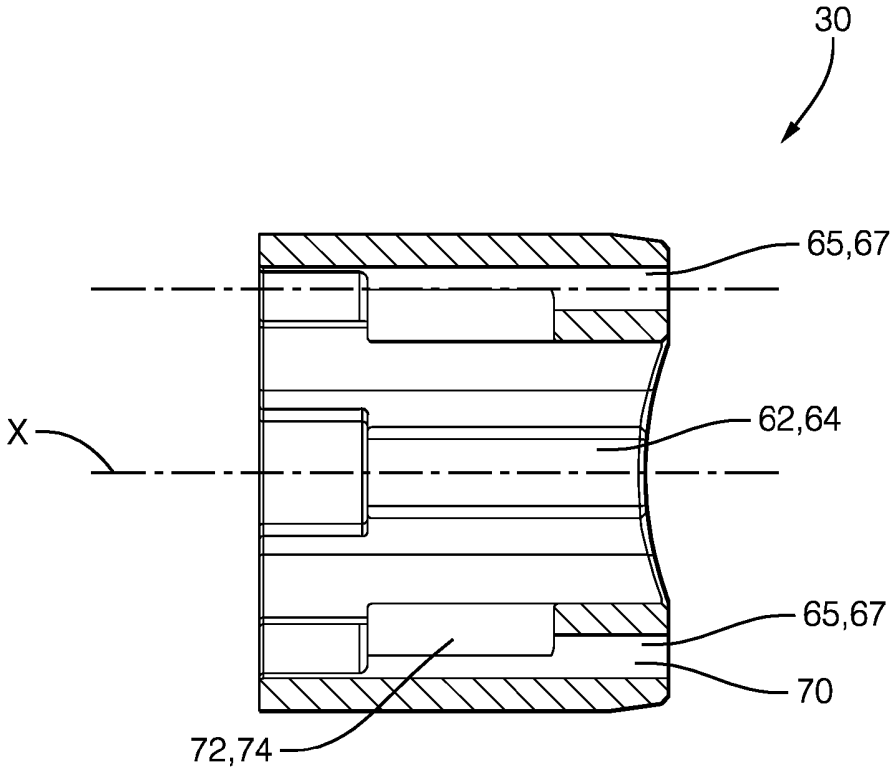

FIG. 12

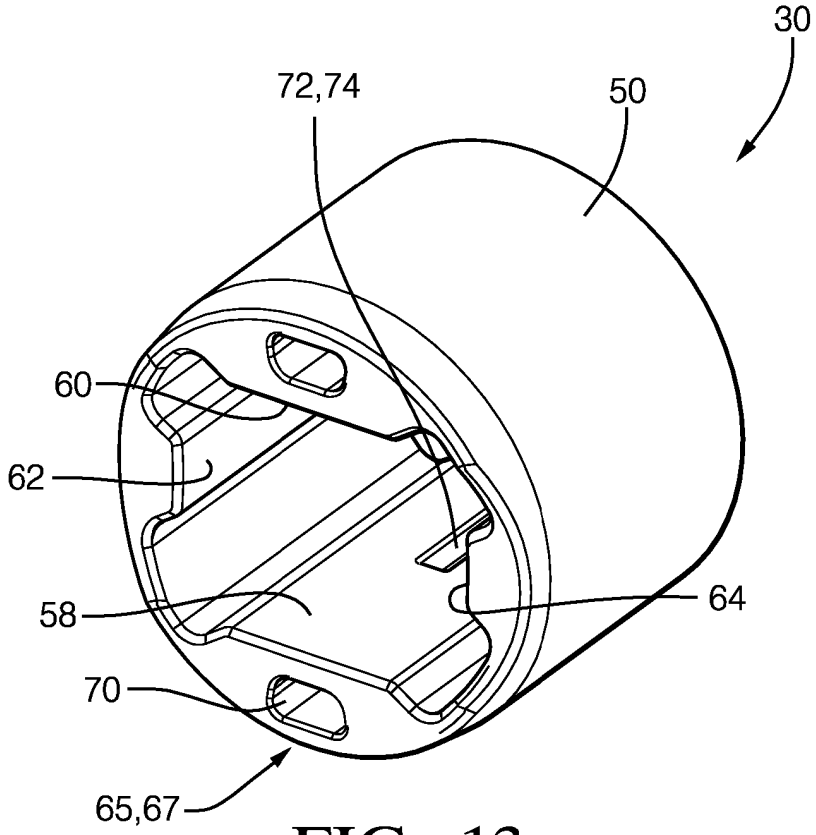

FIG. 13

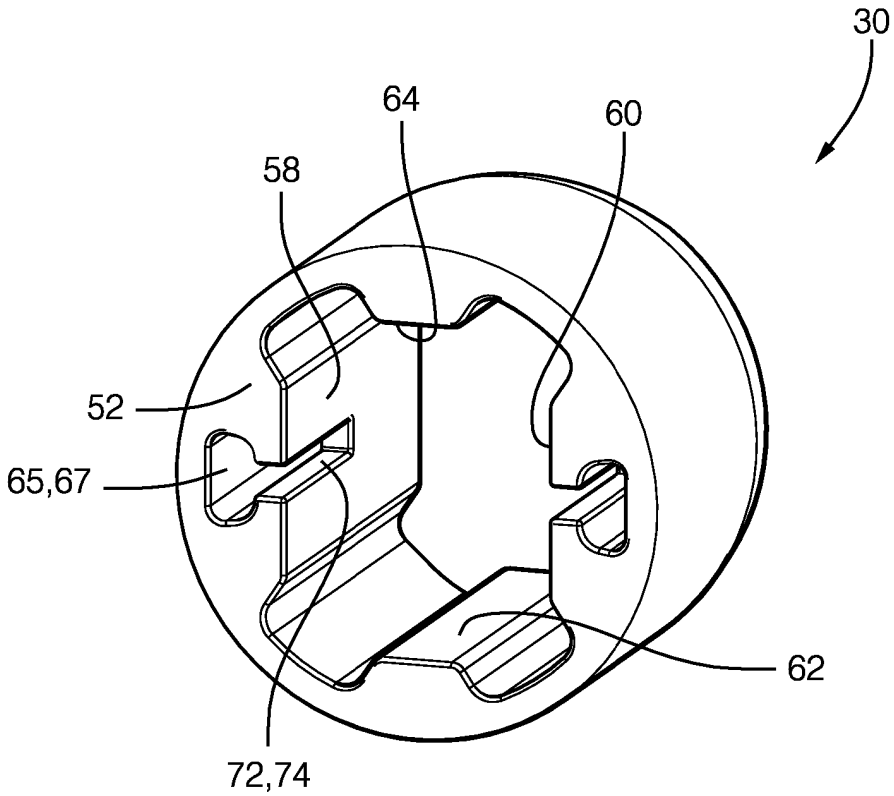

FIG. 14

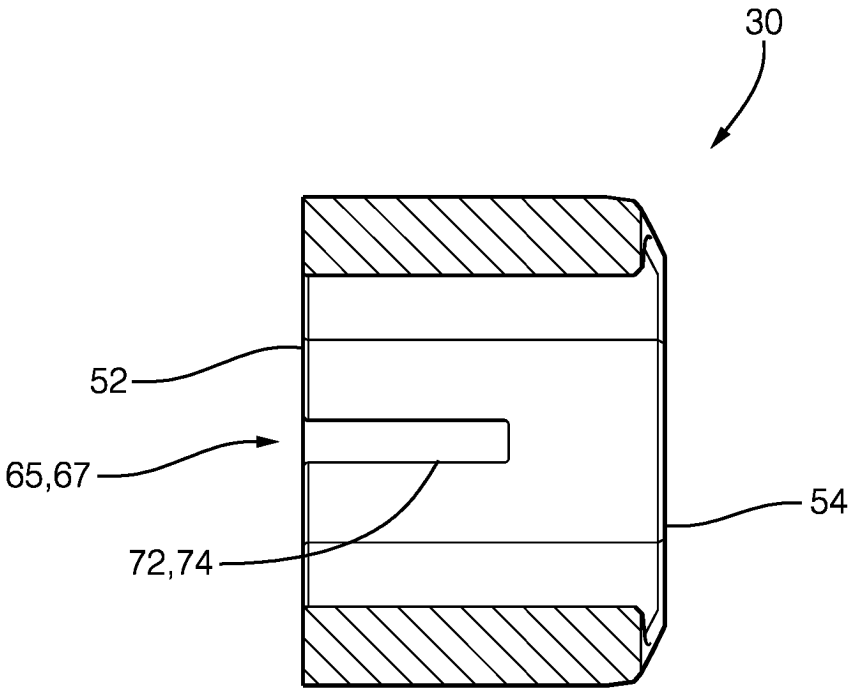

FIG. 15

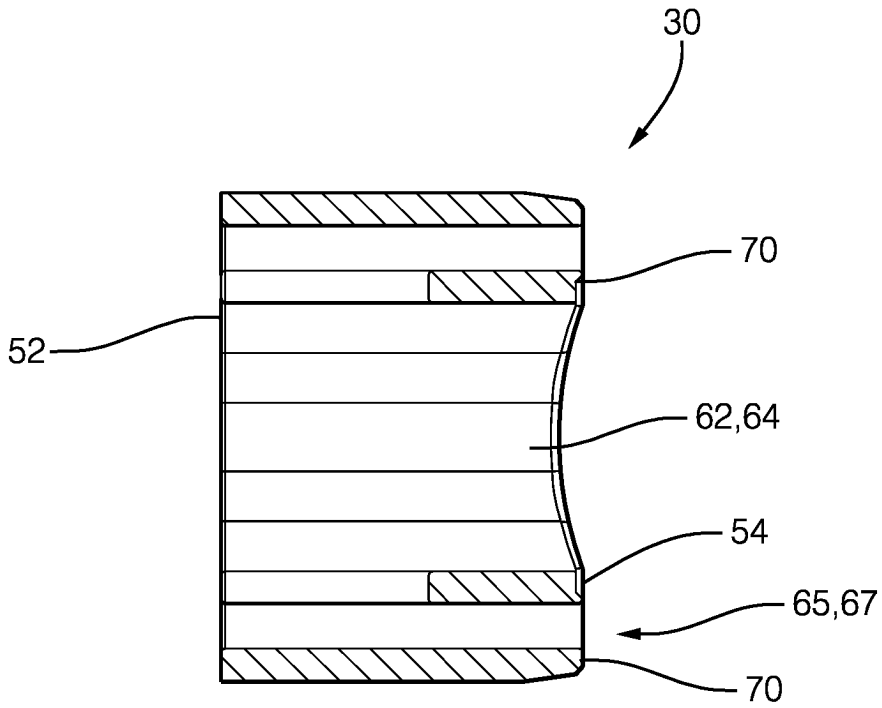

FIG. 16

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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