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(54) **CAM ACTUATED FUEL PUMP**

NOCKENBETÄTIGTE KRAFTSTOFFPUMPE

POMPE À CARBURANT ACTIONNÉE PAR CAME

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EP 3 555 453 B1

Description

TECHNICAL FIELD

[0001] The present invention relates to a fuel pump having a cambox in which a camshaft cooperates with a piston, said camshaft having a cam arrangement minimising the mechanical stresses in the cam or/and in the housing of the cambox.

BACKGROUND OF THE INVENTION

[0002] A fuel injection equipment of an internal combustion engine comprises a pump receiving low pressure fuel and delivering high pressure fuel to fuel injectors. Constant efforts are made to increase the outlet fuel pressure toward 3000 bar and above in order to improve combustion and fuel efficiency of the engine and also to decrease the overall size of the pump for enabling easier packaging in the engine compartment of a vehicle. Both trends are detrimental to the pump durability as tending to increase the mechanical stresses internal to the pump.

[0003] An example of such a pump is shown in DE 10 2014 220384 A1.

SUMMARY OF THE INVENTION

[0004] Accordingly, it is an object of the present invention to resolve at least partially the above mentioned problems in providing a fuel pump of a fuel injection equipment of an internal combustion engine, as defined in claim 1.

[0005] In another aspect of the invention, the outer sleeve may be integral to the core.

[0006] In another aspect of the invention, the cam may be integral to the shaft.

[0007] In another aspect of the invention, the core may be integral to the shaft.

[0008] In another aspect of the invention, the outer sleeve may be inserted over the core.

[0009] In another aspect of the invention, the cambox may be further provided with a front annular member surrounding the bore wherein is arranged the front bearing, said front annular member being integral to the front plate and protruding in the inner space S.

[0010] In another aspect of the invention, the front annular member may be engaged in the front recess of the cam.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The present invention is now described by way of example with reference to the accompanying drawings in which:

Figure 1 is a section view of a cam actuated pump as per the invention, a camshaft being in a BDC position.

Figure 2 is similar to figure 1, the camshaft being in TDC position.

Figure 3 is a 3D exploded view of an embodiment of the camshaft.

Figure 4 is a 3D view of the camshaft of figure 3 when assembled.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0012] A diesel internal combustion engine fueled with direct injection has an injection equipment 10 wherein fuel pressurised by a pump 12 is delivered to injectors. The pump 12 comprises a pumping head fixed onto a cambox 14, a cam 16 of a camshaft 18 rotating about a cam axis X between a front bearing 20 and a rear bearing 22 urges a piston to reciprocally slide in a bore and for varying the volume of a compression chamber defined in the pumping head. The cambox 14 has a housing 24 closed by a front plate 26 which defines an inner space S wherein the cam 16 and a cam follower, provided at an end of the piston, cooperate. The rear bearing 22 is a sleeve registered in a recess 28 arranged in the housing 24 and, the front bearing 20 is another sleeve registered in a through bore 30 arranged in the front plate 26 and, between said bearings, the cam 16 defines a peripheral outer face 32 that is in contact with the cam follower, a transverse front side 34 next to the front bearing 20 and, an opposed transverse rear side 36 next to the rear bearing 22.

[0013] The embodiment presented on the figures shows a composite camshaft 18 wherein the cam 16 is an independent member inserted with press-fit over a shaft 38 between a cylindrical front bearing face 40 and a cylindrical rear bearing face 42. The cam 16 comprises a central core 44 having an axial X hole 46 complementary engaged over the shaft 38 and, an integral outer sleeve 48 defining said peripheral outer face 32 that is in contact with the cam follower.

[0014] In alternative constructional combinations not shown, the cam 16 can be entirely integral to the shaft 38 or, the core 44 only could be integral to the shaft 32, the outer sleeve 48 being an independent member inserted over the core 44 or also, the shaft 38, the core 44 and the outer sleeve 48 can be three distinct members assembled afterward. The design choice depends upon compromised made between, for instance, manufacturing process and material selections.

[0015] Whatever the embodiment, the outer sleeve 48 is larger than the core member 44 and is centred over it thus defining a front recess 50, or front undercut, arranged on the front side 34 of the cam and, an opposed rear recess 52, or rear undercut, arranged on the rear side 36 of the cam, said recesses 50, 52 surrounding the opposed openings of the axial hole 46, the front edge area 54 and the rear edge area 56 of the outer sleeve defining the peripheral wall of the recesses 50, 52.

[0016] Moreover, an annular rear member 58 integral to the housing 24 surrounds the rear bearing recess 52 and protrudes in the inner space S, said annular member

58 engaging the rear recess 52 of the cam without touching any of the faces of the cam maintaining a gap between the faces of the annular member 58 and the faces of the rear recess 52. Symmetrically, an annular front member 60 integral to the front plate 26 surrounds the bore 30 and protrudes in the inner space S, said annular member 60 engaging the front recess 50 of the cam without touching the cam maintaining a gap between the faces of the annular member 60 and the faces of the front recess 50.

[0017] Said arrangement enables several pump embodiment each providing solution to at least one of the known issues. For instance, the size of the pump12 can be decreased by bringing the front plate 26 closer the housing. Also the front 54 and rear 56 edges of the cam outer sleeve are provided with enhanced resilient properties, said areas being able to slightly deflect under the forces applied on the outer face 32 of the sleeve member by the cam follower. Moreover, thanks to the front 60 and rear 58 annular members the axial length of the bearings 20, 22 may be increased.

[0018] In yet another embodiment, the cam 16 can be non-symmetrical, outer sleeve 48 not being centred over the central core 44, this enabling for instance to increase the length of a bearing.

LIST OF REFERENCES

[0019]

X	main axis
S	inner space
10	injection equipment
12	pump
14	cambox
16	cam
18	camshaft
20	front bearing
22	rear bearing
24	cambox housing
26	front plate
28	recess
30	bore
32	peripheral outer face of the cam
34	front side of the cam
36	rear side of the cam
38	shaft
40	front bearing face
42	rear bearing face
44	central core
46	axial hole
48	outer sleeve
50	front recess
52	rear recess
54	front edge area of the outer sleeve
56	rear edge area of the outer sleeve
58	annular rear member
60	annular front member

Claims

1. Fuel pump (12) of a fuel injection equipment (10) of an internal combustion engine, said pump (12) comprising a camshaft (18) rotating about a main axis (X) in a cambox (14) and cooperating with a piston to reciprocally slide in a bore and alternatively vary the volume of a compression chamber defined in a pumping head,
the camshaft (18) comprising a shaft member (38) and a cam member (16) arranged between a rear bearing (42), registered in a recess (28) of the housing (24) of the cambox (14) and, a front bearing (20) registered in a through bore (30) of a front plate (26) fixed on said housing (24); the cam (16) being in an inner space (S) defined between said housing (24) and said front plate (26), said cam (16) having a peripheral outer face (32), a transverse front side (34) next to the front bearing (20) and a transverse rear side (36) next to the rear bearing (22), wherein the cam member (16) comprises a core (44) fixed on the shaft (38) and an outer sleeve (48) arranged over the core (44), the piston cooperating with the outer face (32) of said sleeve, the core (44) being narrower than the sleeve (48) so that an annular recess (50, 52) is defined on at least one side of the cam and,
wherein the core (44) and the outer sleeve (48) define a front annular recess (50) on the front side (34) of the cam and, a rear annular recess (52) on the rear side (42) of the cam,
wherein the cambox (14) is further provided with a rear annular member (58) surrounding the recess (28) wherein is arranged the rear bearing (22), said rear annular member (58) being integral to the housing (24) and protruding in the inner space (S) and,
characterised in that said rear annular member (58) is engaged in the rear recess (52) of the cam.

2. Fuel pump (12) as claimed in the preceding claim wherein the outer sleeve (48) is integral to the core (44).

3. Fuel pump (12) as claimed in claim 2 wherein the cam (16) is integral to the shaft (38).

4. Fuel pump (12) as claimed in any on the claims 1 or 2 wherein the core (44) is integral to the shaft (38).

5. Fuel pump (12) as claimed in claim 4 wherein the outer sleeve (48) is inserted over the core (44).

6. Fuel pump (12) as claimed in any of the preceding claims wherein the cambox (14) is further provided with a front annular member (60) surrounding the bore (30) wherein is arranged the front bearing (20), said front annular member (60) being integral to the front plate (26) and protruding in the inner space (S).

7. Fuel pump (12) as claimed in claim 6 wherein the front annular member (54) is engaged in the front recess (50) of the cam.

Patentansprüche

1. Kraftstoffpumpe (12) einer Kraftstoffeinspritzvorrichtung (10) eines Verbrennungsmotors, wobei die Pumpe (12) eine Nockenwelle (18) aufweist, die um eine Hauptachse (X) in einer Nockenbox (14) rotiert und mit einem Kolben zusammenwirkt, um in einer Bohrung hin und her zu gleiten und das Volumen einer in einem Pumpenkopf definierten Kompressionskammer alternativ zu variieren,
wobei die Nockenwelle (18) ein Wellenelement (38) und ein Nockenelement (16) aufweist, angeordnet zwischen einem hinteren Lager (42), das in einer Aussparung (28) des Gehäuses (24) der Nockenbox (14) registriert ist, und einem vorderen Lager (20), das in einer Durchgangsbohrung (30) einer an dem Gehäuse (24) befestigten Frontplatte (26) registriert ist; wobei sich der Nocken (16) in einem Innenraum (S) befindet, der zwischen dem Gehäuse (24) und der Frontplatte (26) definiert ist, wobei der Nocken (16) eine periphere Außenfläche (32), eine quer verlaufende Vorderseite (34) neben dem vorderen Lager (20) und eine quer verlaufenden Rückseite (36) neben dem hinteren Lager (22) hat,
wobei das Nockenelement (16) einen Kern (44), der an der Welle (38) befestigt ist, und eine Außenhülle (48) aufweist, die über dem Kern (44) angeordnet ist, wobei der Kolben mit der Außenfläche (32) der Hülle zusammenwirkt, wobei der Kern (44) schmaler ist als die Hülle (48), so dass eine ringförmige Aussparung (50, 52) auf zumindest einer Seite des Nockens definiert ist, und
wobei der Kern (44) und die äußere Hülle (48) eine vordere ringförmige Aussparung (50) an der Vorderseite (34) des Nockens und eine hintere ringförmige Aussparung (52) an der Rückseite (42) des Nockens definieren,
wobei die Nockenbox (14) weiter mit einem hinteren ringförmigen Element (58) versehen ist, das die Aussparung (28) umgibt, in der das hintere Lager (22) angeordnet ist, wobei das hintere ringförmige Element (58) in das Gehäuse (24) integriert ist und in den Innenraum (S) hineinragt, und
dadurch gekennzeichnet, dass
das hintere ringförmige Element (58) in die hintere Aussparung (52) des Nockens eingreift.

2. Kraftstoffpumpe (12) gemäß dem vorhergehenden Anspruch, wobei die äußere Hülle (48) in den Kern (44) integriert ist.

3. Kraftstoffpumpe (12) gemäß Anspruch 2, wobei der Nocken (16) in die Welle (38) integriert ist.

4. Kraftstoffpumpe (12) gemäß einem der Ansprüche 1 oder 2, wobei der Kern (44) in die Welle (38) integriert ist.

5. Kraftstoffpumpe (12) gemäß Anspruch 4, wobei die äußere Hülle (48) über dem Kern (44) eingefügt ist.

6. Kraftstoffpumpe (12) gemäß einem der vorhergehenden Ansprüche, wobei die Nockenbox (14) weiter mit einem vorderen ringförmigen Element (60) versehen ist, das die Bohrung (30) umgibt, in der das vordere Lager (20) angeordnet ist, wobei das vordere ringförmige Element (60) in die Frontplatte (26) integriert ist und in den Innenraum (S) hineinragt.

7. Kraftstoffpumpe (12) gemäß Anspruch 6, wobei das vordere ringförmige Element (54) in die vordere Aussparung (50) des Nockens eingreift.

Revendications

1. Pompe à carburant (12) d'un équipement d'injection de carburant (10) d'un moteur à combustion interne, ladite pompe (12) comprenant un arbre à cames (18) en rotation autour d'un axe principal (X) dans une boîte à came (14) et coopérant avec un piston pour coulisser en va-et-vient dans un perçage et faire varier alternativement le volume d'une chambre de compression définie dans une tête de pompage,
l'arbre à cames (18) comprenant un élément formant arbre (38) et un élément formant came (16) agencé entre un palier arrière (42), emboîté dans un évidement (28) du boîtier (24) de la boîte à came (14), et un palier avant (20) emboîté dans un trou traversant (30) d'une plaque avant (26) fixé sur ledit boîtier (24), la came (16) étant dans un espace intérieur (S) défini entre ledit boîtier (24) et ladite plaque avant (26), ladite came (16) ayant une face extérieure périphérique (32), un côté avant transversale (34) voisin du palier avant (20) et un côté arrière transversal (36) voisin du palier arrière (22),
dans laquelle l'élément formant came (16) comprend un cœur (44) fixé sur l'arbre (38) et un manchon extérieur (48) agencé par-dessus le cœur (44), le piston coopérant avec la face extérieure (32) dudit manchon, le cœur (44) étant plus étroit que le manchon (48) de sorte qu'un évidement annulaire (50, 52) est défini sur au moins un côté de la came, et
dans laquelle le cœur (44) et le manchon extérieur (48) définissent un évidement annulaire avant (50) sur le côté avant (34) de la came, et un évidement annulaire arrière (52) sur le côté arrière (42) de la came,
dans laquelle la boîte à came (14) est en outre dotée d'un élément annulaire arrière (58) qui entoure l'évidement (28) dans lequel est agencé le palier arrière

(22), ledit élément annulaire arrière (58) étant intégré avec le boîtier (24) et se projetant dans l'espace intérieur (S), et
caractérisé en ce que
ledit élément annulaire arrière (58) est engagé dans l'évidement arrière (52) de la came.

2. Pompe à carburant (12) selon la revendication précédente, dans laquelle le manchon extérieur (48) est intégré avec le cœur (44).

3. Pompe à carburant (12) selon la revendication 2, dans laquelle la came (16) est intégrée avec l'arbre (38).

4. Pompe à carburant (12) selon l'une quelconque des revendications 1 ou 2, dans laquelle le cœur (44) est intégré avec l'arbre (38).

5. Pompe à carburant (12) selon la revendication 4, dans laquelle le manchon extérieur (48) est inséré par-dessus le cœur (44).

6. Pompe à carburant (12) selon l'une quelconque des revendications précédentes, dans laquelle la boîte à came (14) est en outre dotée d'un élément annulaire avant (60) qui entoure le perçage (30) dans lequel est agencé le palier avant (20), ledit élément annulaire avant (60) étant intégré avec la plaque avant (26) et se projetant dans l'espace intérieur (S).

7. Pompe à carburant (12) selon la revendication 6, dans lequel l'élément annulaire avant (54) est engagé dans l'évidement avant (50) de la came.

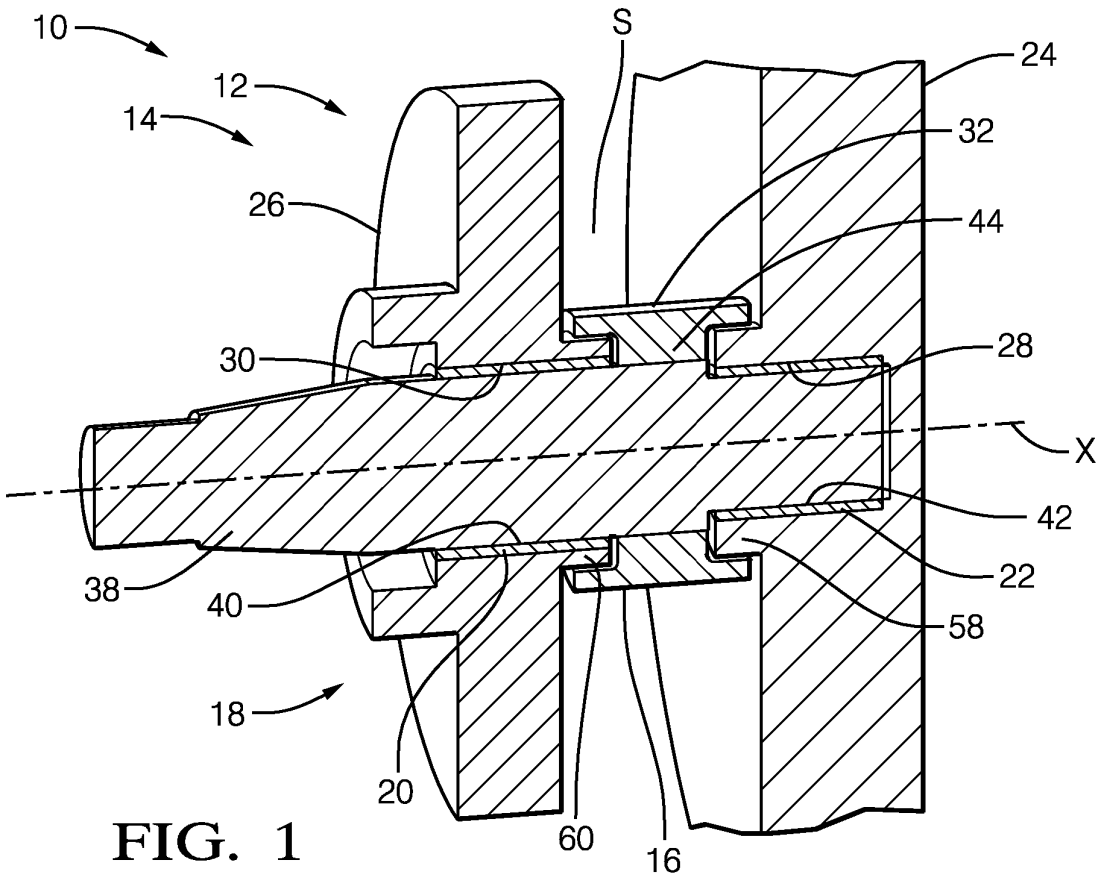
10
12
14
S
24
32
26
44
30
28
X
42
22
38
40
58
18
20
60
16

FIG. 1

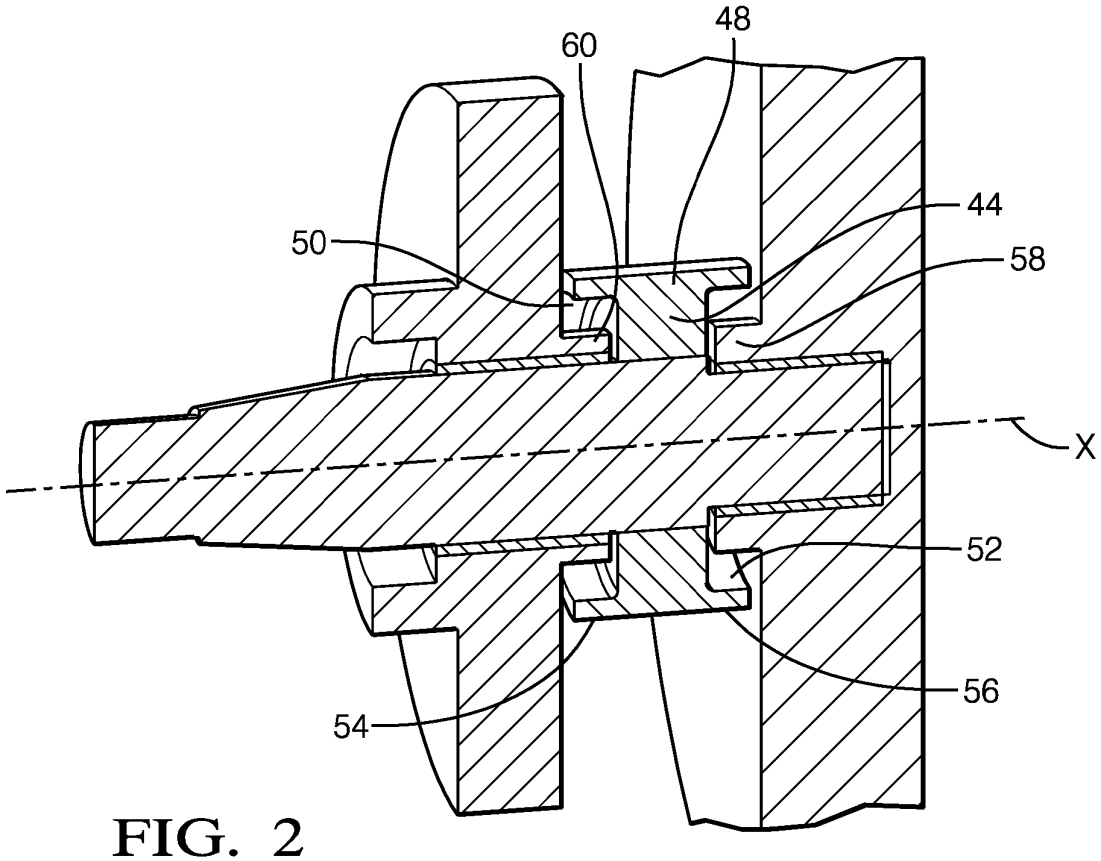
60
48
44
50
58
X
52
56
54

FIG. 2

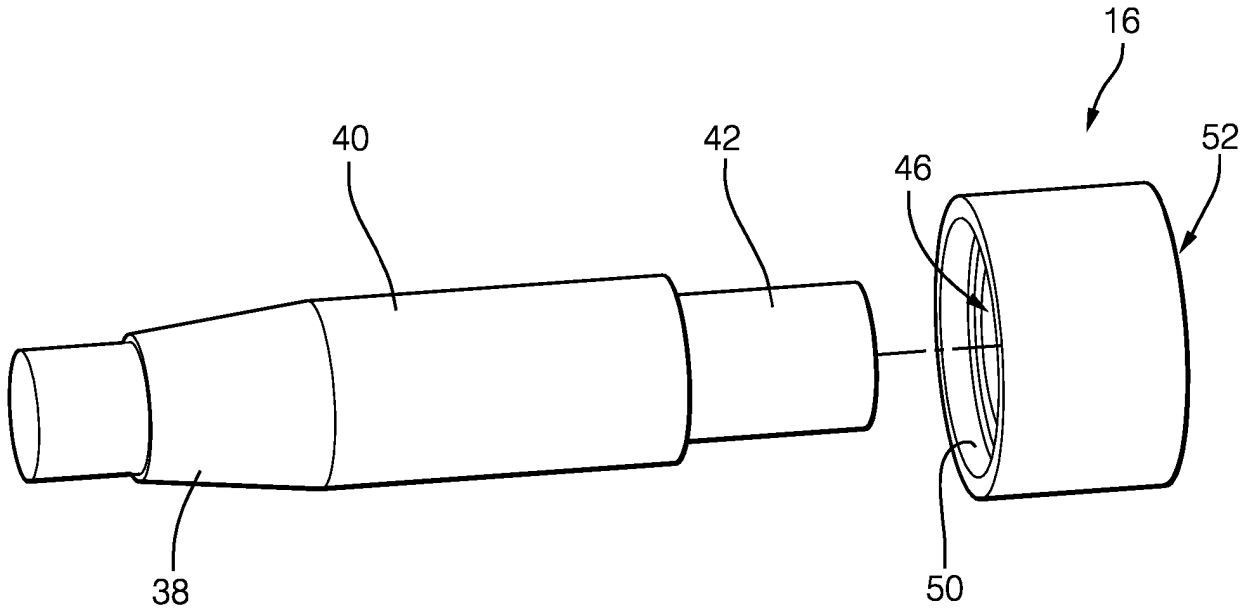

FIG. 3

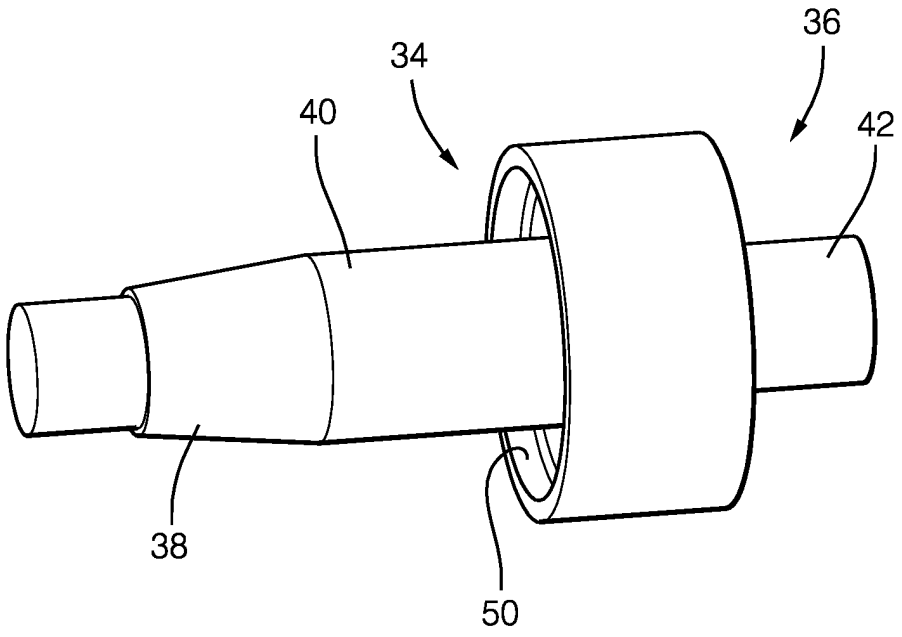

FIG. 4

REFERENCES CITED IN THE DESCRIPTION

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