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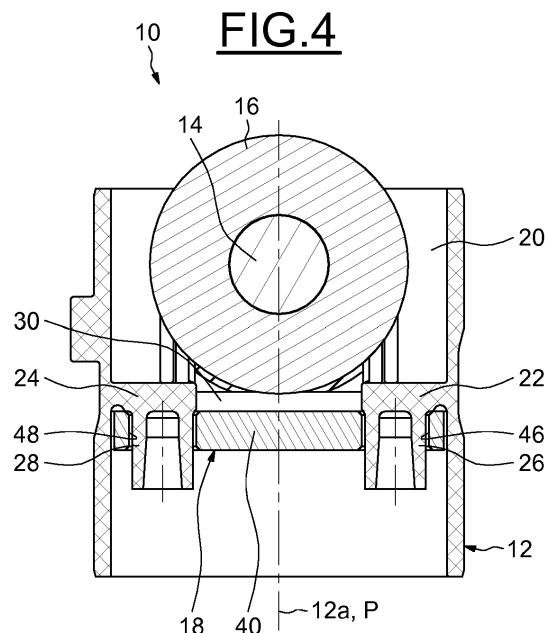
(54) **CAM FOLLOWER ROLLER DEVICE AND ASSOCIATED MANUFACTURING METHOD**

(57) The cam follower roller device comprises a tappet body 12 extending along an axis, an insert 18 mounted in said body, a pin 14 mounted at least on said insert, and a roller 16 mounted on said pin.

The tappet body 12 comprises abutting means 22 extending from an inner surface 12c of said body and at least one centring part 26 protruding axially from said

abutting means.

The insert 18 is mounted axially against said abutting means 22, 24 and comprises at least one hole 46 inside which said centring part 26 extends. Retaining means 60 are provided on said centring part to axially retain the insert 18 against said abutting means.



## Description

**[0001]** The present invention relates to the field of cam follower roller devices used in automotive or industrial applications.

**[0002]** One advantageous application of the invention is the use of the cam follower roller device in a fuel injection pump intended for an internal combustion engine, in particular of a motor vehicle. Another advantageous application of the invention is the use of the device in a rocker system intended for controlling valves of an internal combustion piston engine.

**[0003]** Such a cam follower roller device generally comprises an outer tappet housing, a pin fixed to the tappet housing and a roller movable in rotation relative to the pin around its axis. When the cam follower roller device is in service in a fuel injection pump, the roller collaborates with a cam synchronized with the internal combustion engine camshaft. The rotation of the camshaft leads to a periodic displacement of a piston of the pump that rests against the tappet housing, to allow fuel to be delivered.

**[0004]** It is known to provide the cam follower roller device with an insert as a stroke-transmission part mounted in the tappet housing. EP-A1-2 853 738 describes a device comprising such an insert supporting the pin while the tappet housing supports said insert. For fixing the insert to the tappet housing, first and second local deformations are formed on said housing. The first and second deformations are respectively made by punching the tappet housing along a radial direction, and then along an axial direction.

**[0005]** One aim of the present invention is to provide an improved cam follower roller device having a simplified assembly.

**[0006]** In one embodiment, the cam follower roller device comprises a tappet body extending along an axis, an insert mounted in said body, a pin mounted at least on said insert, and a roller mounted on said pin.

**[0007]** The tappet body comprises abutting means extending from an inner surface of said body and at least one centring part protruding axially from said abutting means. The insert is mounted axially against said abutting means and comprises at least one hole inside which said centring part extends. Retaining means are provided on said centring part to axially retain the insert relative to the tappet housing.

**[0008]** The assembly of the cam follower roller device is simplified. The abutting means of the tappet body axially support the insert. The centring part extending into the hole of the insert enables to radially centre said insert with respect to said body.

**[0009]** Preferably, the insert comprises a central core provided with said hole and at least two side tabs each comprising a receiving housing for an end of the pin. Advantageously, the central core is mounted into axial contact with the abutting means of the tappet body. In one embodiment, the tappet body may further comprise axial

blocking means for maintaining the pin into the receiving housings.

**[0010]** Advantageously, the retaining means comprise at least one local plastic deformation formed on said centring part.

**[0011]** Said retaining means may axially bear against the insert, for example against the central core. In this case, the retaining means may be adapted to axially retain the insert against said abutting means.

**[0012]** In one embodiment, said retaining means are axially disposed on the side opposite to the abutting means of the tappet body with respect to the insert. The insert may be mounted axially against the abutting means of the tappet body on the side opposite to the pin and the roller. The centring part of the tappet body may protrude axially on the side opposite to the pin and the roller.

**[0013]** In one embodiment, the abutting means of the tappet body comprise at least two lugs each supporting a centring part. The roller may extend into a space delimited between said lugs. Accordingly, the axial distance between a lower face of the insert and the roller is reduced. It is also possible to dispose said lugs to be symmetrical relative to an axial plane passing through the centre of roller.

**[0014]** In one embodiment, the tappet body is made in one part. The tappet body may be made from plastic material or be made of metal.

**[0015]** The present invention also relates to a method for manufacturing a cam follower roller device comprising a tappet body, an insert mounted in said body, a pin and a roller mounted on said pin. The insert, the pin and the roller are introduced inside the tappet body in order that the insert comes into axial contact against abutting means which extend from an inner surface of said body, and that at least a centring part protrudes axially from said abutting means extending into a hole formed on the insert. Then, retaining means are formed on said centring part by at least one local plastic deformation to axially retain the insert relative to the tappet housing.

**[0016]** The present invention and its advantages will be better understood by studying the detailed description of specific embodiments given by way of non-limiting examples and illustrated by the appended drawings on which:

- Figure 1 is a cross-section of a cam follower roller device according to a first example of the invention,
- Figure 2 is a bottom view of the device of Figure 1,
- Figure 3 is a section on III-III of Figure 1 or Figure 2,
- Figure 4 is a cross-section of the device of Figure 1 before a deformation step,
- Figure 5 is an exploded perspective view of the device of Figure 1,
- Figure 6 is a cross-section of a cam follower roller device according to a second example of the invention,
- Figure 7 is a bottom view of the device of Figure 6, and

- Figure 8 is a cross-section of the device of Figure 6 before a deformation step.

**[0017]** As shown on Figures 1 and 2, a cam follower roller device 10 comprises an outer tappet body 12 extending along an axis 12a, a shaft or pin 14 extending along an axis 14a, a roller 16 mounted on the pin and movable in rotation relative to said pin, and an insert 18 supported by said tappet body. In the disclosed embodiment, the roller 16 is directly mounted on the pin 14. Alternatively, a rolling bearing or a plain bearing may be radially interposed. The axis 12a, 14a are perpendicular.

**[0018]** The tappet body 12 is made in one part. In the disclosed example, the body 12 has a tubular form. The tappet body 12 comprises a cylindrical axial outer surface 12b and a cylindrical axial inner bore or surface 12c. The inner surface 12c delimits a cavity 20 inside which are located the insert 18 and the pin 14. The roller 16 axially protrudes outwards with respect to an upper edge 12d of the tappet body 12. In the disclosed example, the tappet body 12 is deprived of any through-hole extending between the outer surface 12b and the inner surface 12c.

**[0019]** As shown more clearly on Figure 3, the tappet body 12 further comprises two abutting lugs 22, 24 extending from the inner surface 12c and two centring pins 26, 28 each protruding axially from one of said lugs. The lugs 22, 24 and the pins 26, 28 are disposed inside the cavity 20. The lugs 22, 24, the pins 26, 28 and the tappet body 12 are made in one part.

**[0020]** Each abutting lug 22, 24 extends radially inwards from the inner surface 12c. Each lug 22, 24 extends perpendicularly to the axial inner surface 12c. The lugs 22, 24 are identical to one another. The lugs 22, 24 are symmetrical relative to an axial plane P passing through the centre of the roller 16. The pin 14 is axially offset towards the upper edge 12d of the tappet body with respect to the abutting lugs 22, 24. Each lug 22, 24 comprises an upper frontal surface 22a, 24a oriented axially towards the pin 14 and the roller 16, and an opposite lower frontal surface 22b, 24b. Said frontal surfaces delimit axially the associated lug. A space 30 is radially delimited between the abutting lugs 22, 24. In the disclosed example, the roller 16 protrudes inside the space 30.

**[0021]** Each centring pin 26, 28 extends from the associated lug 22, 24. Each centring pin 26, 28 extends axially on the side opposite to the pin 14 and the roller 16. Each centring pin 26, 28 extends from the lower frontal surface 22b, 24b of the associated lug. In the disclosed example, each centring pin 26, 28 has a cylindrical shape. Alternatively, each centring pin may have a different profile, for example a rectangular or a square one.

**[0022]** The insert 18 is made in one part. The insert 18 may preferably be made of metal, by example steel. The insert 18 is distinct from the tappet housing 12. The insert 18 is entirely housed inside the cavity 20 delimited by the tappet housing 12. The insert 18 is mounted into axial contact with the abutting lugs 22, 24. The insert 18 comprises a central core 40 and two lateral tabs 42, 44 (Figure

5) extending from said core and facing each other. The core 40 axially abuts against the lugs 22, 24 axially on the side opposite to the roller 14 and the pin 16. The core 40 axially abuts against the lower frontal surfaces 22b, 24b of the lugs.

**[0023]** The insert 18 is provided with two axial through-holes 46, 48. The through-holes 46, 48 are made into the thickness of the insert 18. The through-holes 46, 48 are provided on the core 40. Each centring pin 26, 28 of the tappet body extends into the associated through-hole 46, 48 of the insert and axially protrudes outwards. Each centring pin 26, 28 axially protrudes with respect to the core 40 towards a lower edge 12e of the tappet body. The shape of the through-holes 46, 48 is complementary to that of the centring pins 26, 28.

**[0024]** Referring once again to Figure 1, the lateral tabs 42, 44 of the insert extend from the core 40 towards the upper edge 12d of the tappet body. The roller 16 is disposed between the tabs 42, 44. A concave recess 50, 52 is provided at the free end of each tab to receive the pin 14 as shown more clearly on Figure 5. Both recesses 50, 52 extend through the tabs 42, 44 along the axis 14a and have the same diameter. Recesses 50, 52 form receiving housings adapted to receive the ends of the pin 14. Each end of said pin 14 is supported by one of the two tabs 42, 44. The pin 14 is supported by the insert 18.

**[0025]** The tappet body 12 further comprises means 54, 56 for axially blocking the pin 14 and the roller 16 relative to said body. The axial blocking means 54, 56 are integrally formed with the tappet body 12. These means 54, 56 are provided on the inner surface 12c of the tappet body. In the illustrated example, the axial blocking means 54, 56 delimit receiving housings each facing one of the receiving housings 50, 52 of the insert to delimit cylindrical bores for the ends of the pin 14. Alternatively, the tappet body 12 may comprise through-holes made into its thickness, facing one another and into which the ends of the pin 14 are fixed.

**[0026]** Referring once again to Figure 3, each centring pin 26, 28 comprises a lateral rib 60, 62 forming axial retaining means of the insert 18 into the tappet body 12. Each rib 60, 62 extends radially the associated pin 26, 28. Each rib 60, 62 is provided at the free end of the associated pin 26, 28. In the disclosed example, each rib 60, 62 is axially disposed on the side opposite to the lugs 22, 24 with respect to the insert. Each rib 60, 62 axially bears against the insert 18. Each rib 60, 62 axially bears against a lower face of the insert 18. Each rib 60, 62 axially bears against the central core 40 of the insert. In the illustrated example, each rib 60, 62 forms an annular flange extending circumferentially along the associated pin 26, 28. Alternatively, each rib 60, 62 may be discontinuous in the circumferential direction.

**[0027]** In the illustrated example, the tappet body 12 is made from synthetic material such as polyamide for example. The tappet body 12 is advantageously formed by moulding. Each rib 60, 62 is obtained by local plastic deformation of the associated centring pin 26, 28. Each

rib 60, 62 and the associated centring pin 26, 28 are formed in one part.

[0028] The device 10 is assembled as follows. In a first step, the insert 18, the pin 14 and the roller 16 are introduced inside the tappet body 12. The insert is introduced from the lower edge 12e until it axially bears against the lugs 22, 24. At this step, the tapped body 12 is deprived of ribs as shown on Figure 4.

[0029] In a second step, each centring pin 22, 24 is heated. Then, in a third step, each rib 60, 62 is formed by plastic deformation of the free end of the associated pin 22, 24. The deformation is achieved by upsetting some of the material of each pin 22, 24 in order to cause the material to creep axially against the insert 18 and radially outwards. Thus causes an interference in shape preventing the insert 18 from moving axially with respect to the tappet body 12. The deformation is obtained by axial pushing. Each rib 60, 62 may be formed by hot-riveting or by ultrasonic bonding. In the illustrated example, each centring pin 22, 24 has a recess, which is formed from its free end, in order to reduce the amount of material to be plastically deformed.

[0030] In the illustrated example, the axial retaining means on the centring pins 26, 28 are formed by plastic deformations which axially interfere with the insert 18. Alternatively, the centring pins 26, 28 may be radially deformed to obtain plastic deformations which radially interfere with the insert 18, for example with the through-holes 46, 48 of said insert.

[0031] In the disclosed examples, the axial retaining means of the insert are formed by plastic deformations of the centring pins. Alternatively, it could however be possible to foresee another type of axial retaining means, for example clipping means. In this case, the centring pins are elastically deformable in radial direction to enable the mounting of the insert 18 on the tappet body 12.

[0032] In the second example illustrated on Figures 6 to 8, in which identical parts are given identical references, the device 10 differs in that the tappet body 18 is made of metal. The tappet body 18 is made in one part and may be advantageously manufactured in an economic way by cutting, stamping and folding.

[0033] In this example, the tappet body 18 comprises two centring fingers or tabs 66, 68 each protruding axially from one of the abutting lugs 22, 24 instead of the centring pins. The disposition of the tabs 66, 68 is identical to that of the pins described in the first example.

[0034] Each centring tab 66, 68 comprises a bended hook 70, 72 forming axial retaining means of the insert 18 relative to the tappet body 12. Each hook 70, 72 extends radially the associated tabs 66, 68. Each hook 70, 72 extends radially the lower end of associated tabs 66, 68. Each hook 70, 72 axially bears against the insert 18. Each hook 70, 72 axially bears against a lower face of the insert 18. Each hook 70, 72 axially bears against the central core 40 of the insert. Each hook 70, 72 is axially disposed on the side opposite to the lugs 22, 24 with respect to the insert. Each rib 70, 72 extends radially.

Each hook 70, 72 is obtained by folding the free end of the associated tab 66, 68 against the insert 18. The through-holes 46, 48 of the insert each have here an elongated shape. In this example, the tappet body 12 comprises through-holes (not shown) made into its thickness and facing one another. The ends of the pin 14 are fixed for example by caulking in said through-holes.

[0035] In the disclosed examples, the axial retaining means axially bear against the insert. Alternatively, the axial retaining means may be provided to axially face the insert and to leave therebetween an axial gap. In the illustrated examples, the centring pins or lugs protrude axially on the side opposite to the pin and the roller. Alternatively, it could be possible to foresee a tappet body having centring parts protruding axially on side of said pin and roller. In this case, the subassembly comprising the insert, the pin and the roller is introduced inside the tappet body from the upper edge of said body.

[0036] In the illustrated examples, the tappet body comprises inner abutting lugs against which is mounted the insert 18. Alternatively, the tappet body may comprise an abutting plate extending radially from the inner surface of said body. The abutting plate may be integrally formed with the tappet body or secured to said body by any appropriate means. With such a tappet body having an abutting plate, one or a plurality of centring parts extending from said plate may be provided to cooperate with the insert.

## Claims

1. Cam follower roller device comprising a tappet body (12) extending along an axis, an insert (18) mounted in said body, a pin (14) mounted at least on said insert and a roller (16) mounted on said pin, **characterized in that** the tappet body (12) comprises abutting means (22) extending from an inner surface (12c) of said body and at least one centring part (26; 66) protruding axially from said abutting means, the insert (18) being mounted axially against said abutting means (22) and comprises at least one hole (46) inside which said centring part (26; 66) extends, retaining means (60; 70) being provided on said centring part to axially retain the insert (18) relative to the tappet housing (12).
2. Device according to claim 1, wherein the insert (18) comprises a central core (40) provided with said hole (46) and at least two side tabs (42, 44) each comprising a receiving housing (50, 52) for an end of the pin (14).
3. Device according to claim 2, wherein the central core (40) of the insert is mounted into axial contact with the abutting means (22) of the tappet body.
4. Device according to claim 2 or 3, wherein the tappet

body (12) comprises axial blocking means (54, 56) for maintaining the pin (14) into the receiving housings (50, 52).

on said centring part by at least one local plastic deformation to axially retain the insert relative to the tappet housing.

5. Device according to any of the preceding claims, wherein the retaining means (60; 70) comprise at least one local plastic deformation formed on said centring part (26; 66). 5
6. Device according to any of the preceding claims, wherein the retaining means (60; 70) axially bear against the insert (18). 10
7. Device according to any of the preceding claims, wherein the retaining means (60; 70) are axially disposed on the side opposite to the abutting means (22) of the tappet body with respect to the insert (18). 15
8. Device according to any of the preceding claims, wherein the insert (18) is mounted axially against the abutting means (22) of the tappet body on the side opposite to the pin (14) and the roller (16). 20
9. Device according to any of the preceding claims, wherein the centring part (26; 66) of the tappet body protrudes axially on the side opposite to the pin (14) and the roller (16). 25
10. Device according to any of the preceding claims, wherein the abutting means of the tappet body comprise at least two lugs (22, 24) each supporting a centring part (26, 28; 66, 68). 30
11. Device according to claim 10, wherein the roller (14) extends into a space (30) delimited between said lugs (22, 24). 35
12. Device according to claim 10 or 11, wherein said lugs are symmetrical relative to an axial plane passing through the centre of roller (16). 40
13. Device according to any of the preceding claims, wherein the tappet body (12) is made in one part.
14. Device according to any of the preceding claims, wherein the tappet body (12) is made from plastic material or is made of metal. 45
15. Method for manufacturing a cam follower roller device comprising a tappet body, an insert mounted in said body, a pin and a roller mounted on said pin, **characterized in that** the insert, the pin and the roller are introduced inside the tappet body in order that the insert comes into axial contact against abutting means which extend from an inner surface of said body, at least a centring part protruding axially from said abutting means extending into a hole formed on the insert, and **in that** retaining means are formed 50  
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FIG.1

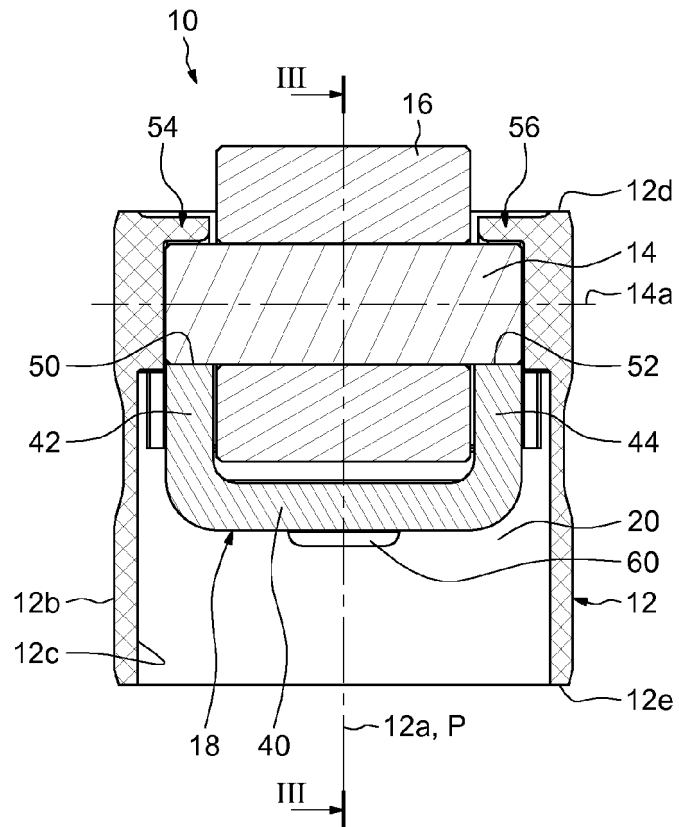


FIG.2

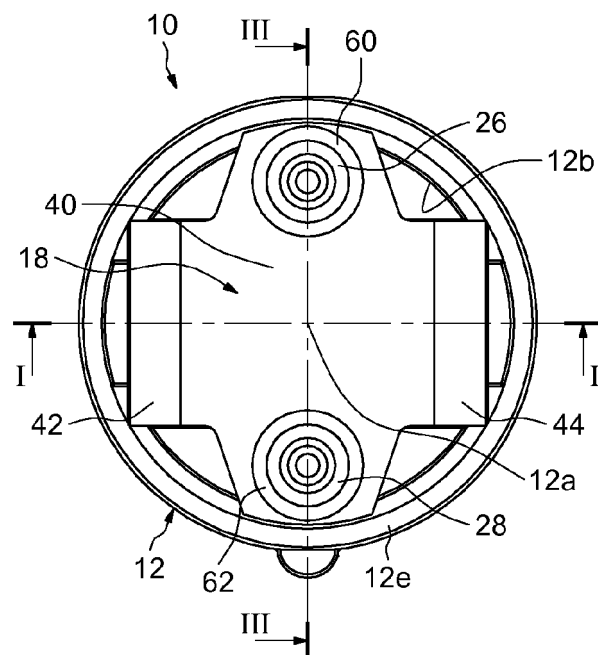


**FIG.3**

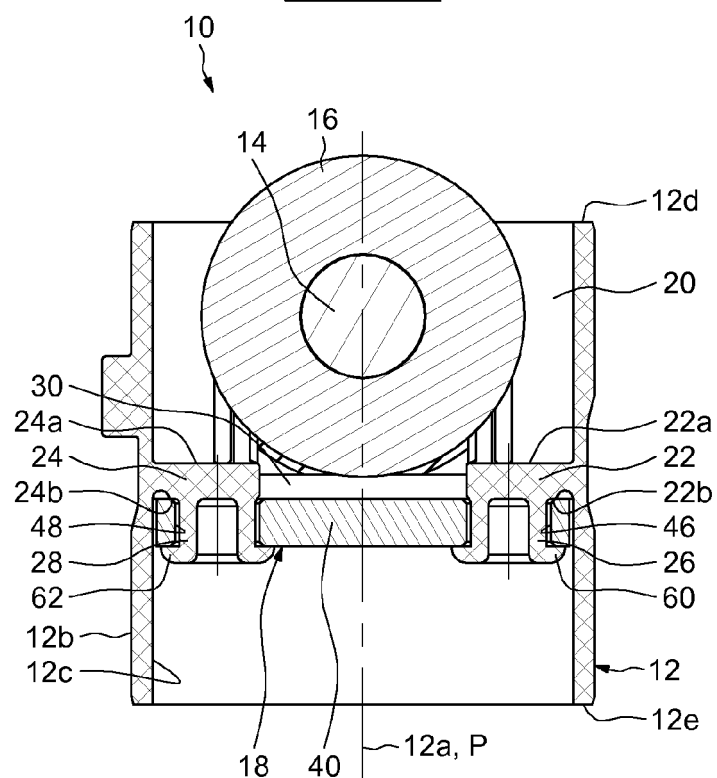


FIG.4

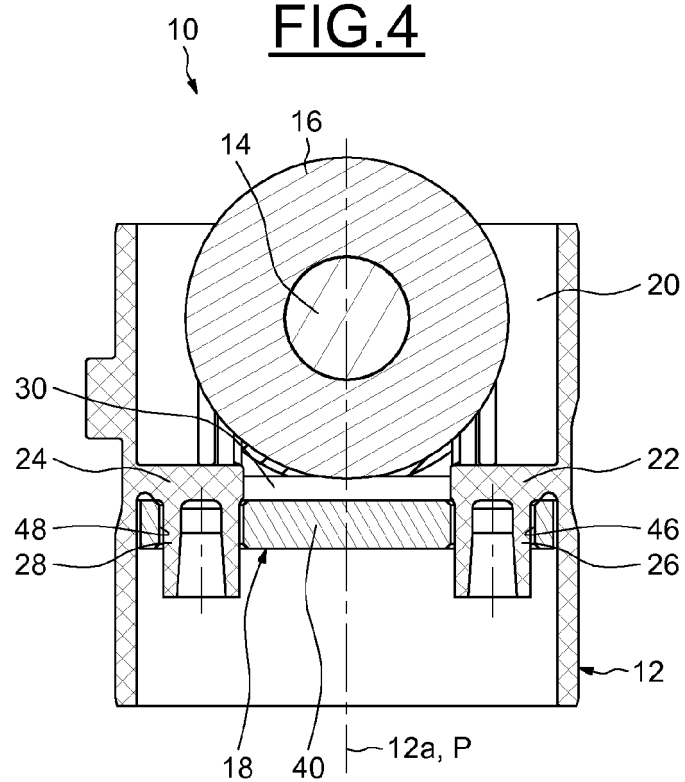


**FIG.5**

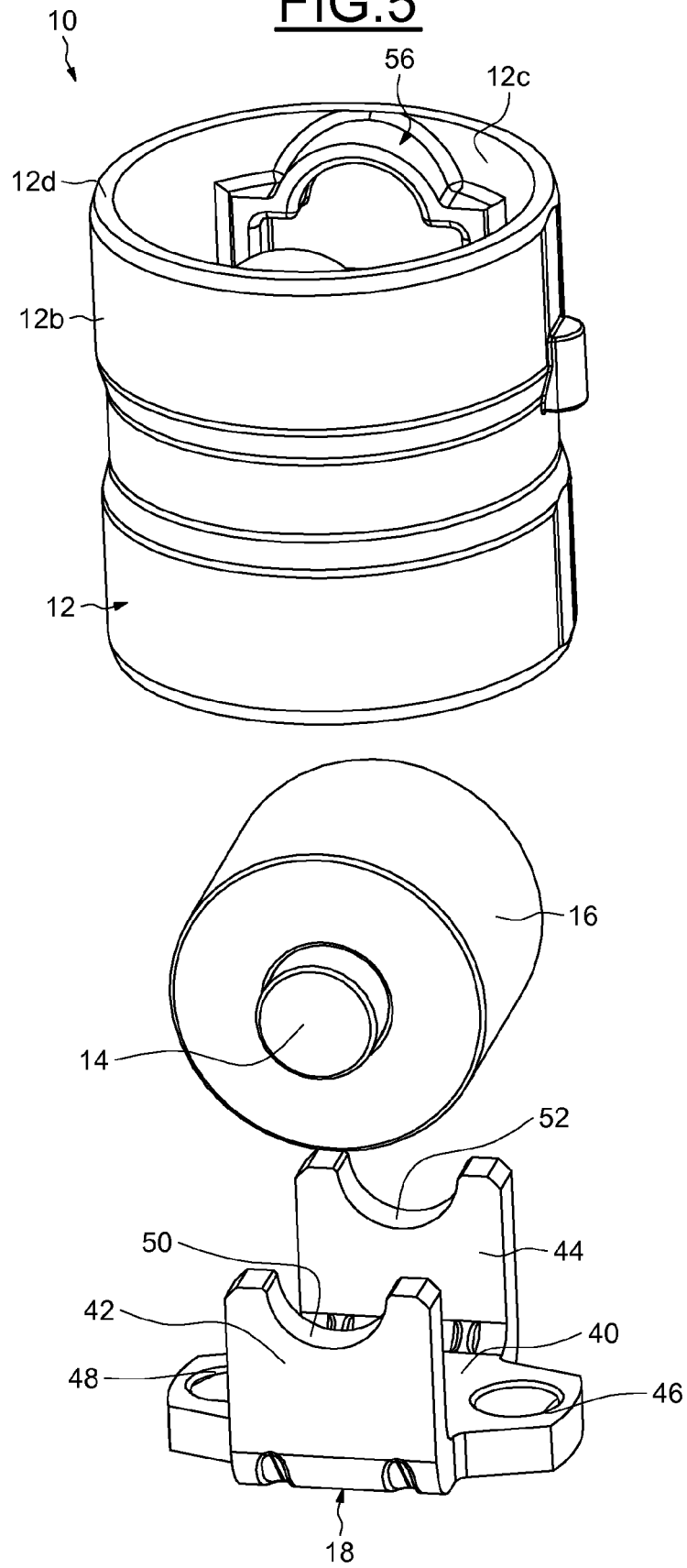


**FIG.6**

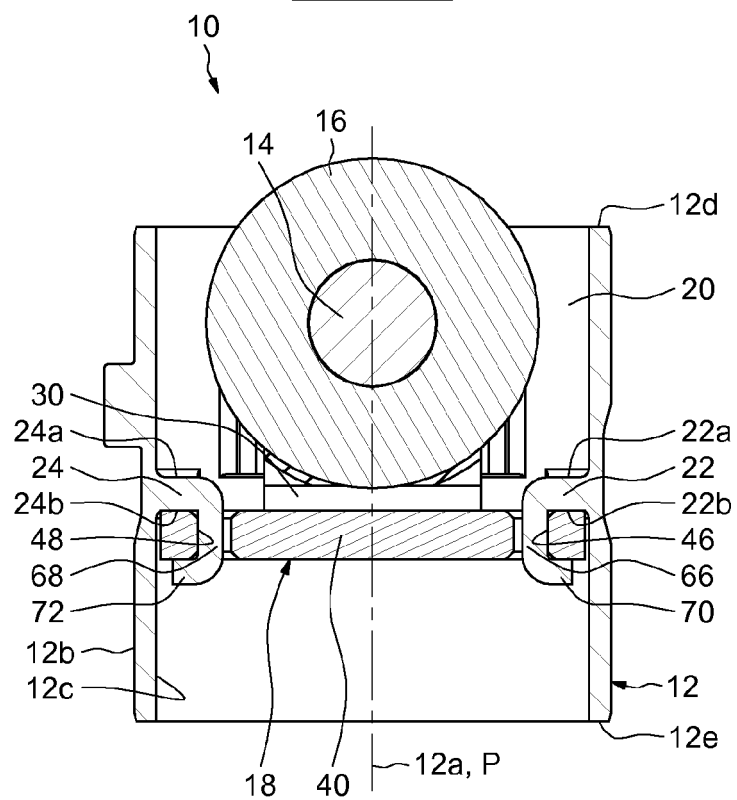


FIG.7

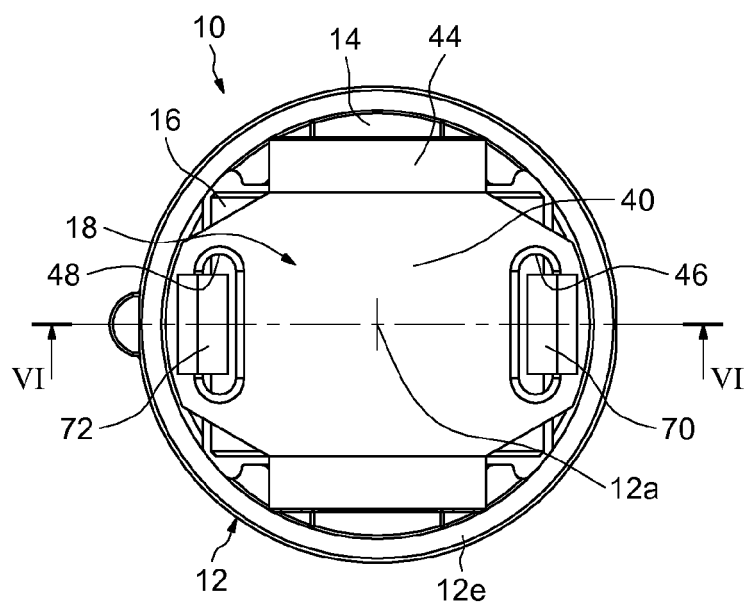
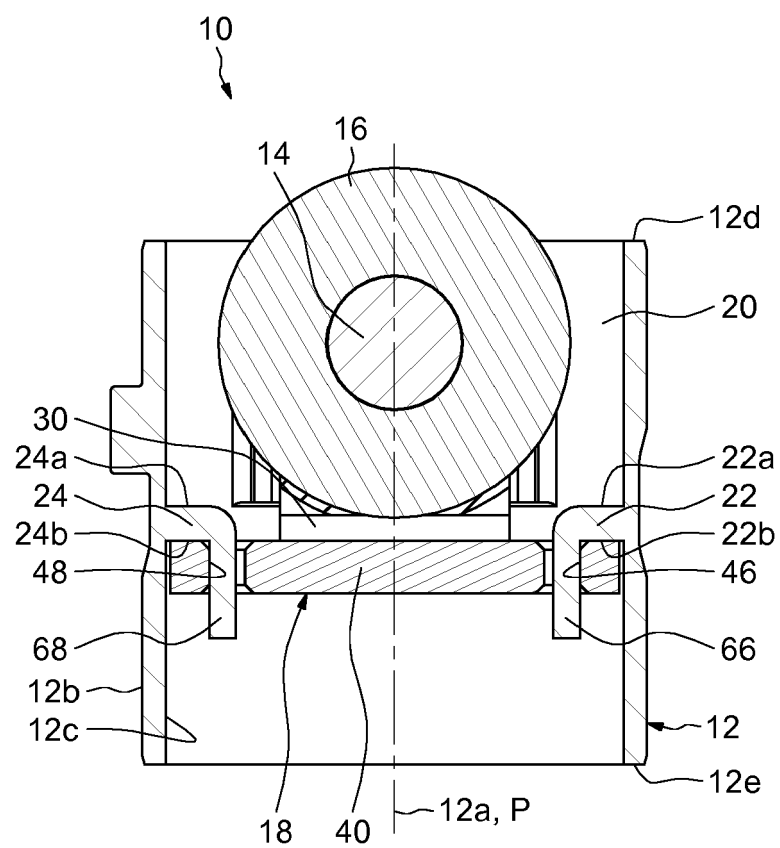


FIG.8





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Application Number  
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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                        |                                                            |                                         |
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| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                        |                                                            |                                         |
| Place of search<br><b>The Hague</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                        | Date of completion of the search<br><b>13 January 2016</b> | Examiner<br><b>Klinger, Thierry</b>     |
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**REFERENCES CITED IN THE DESCRIPTION**

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