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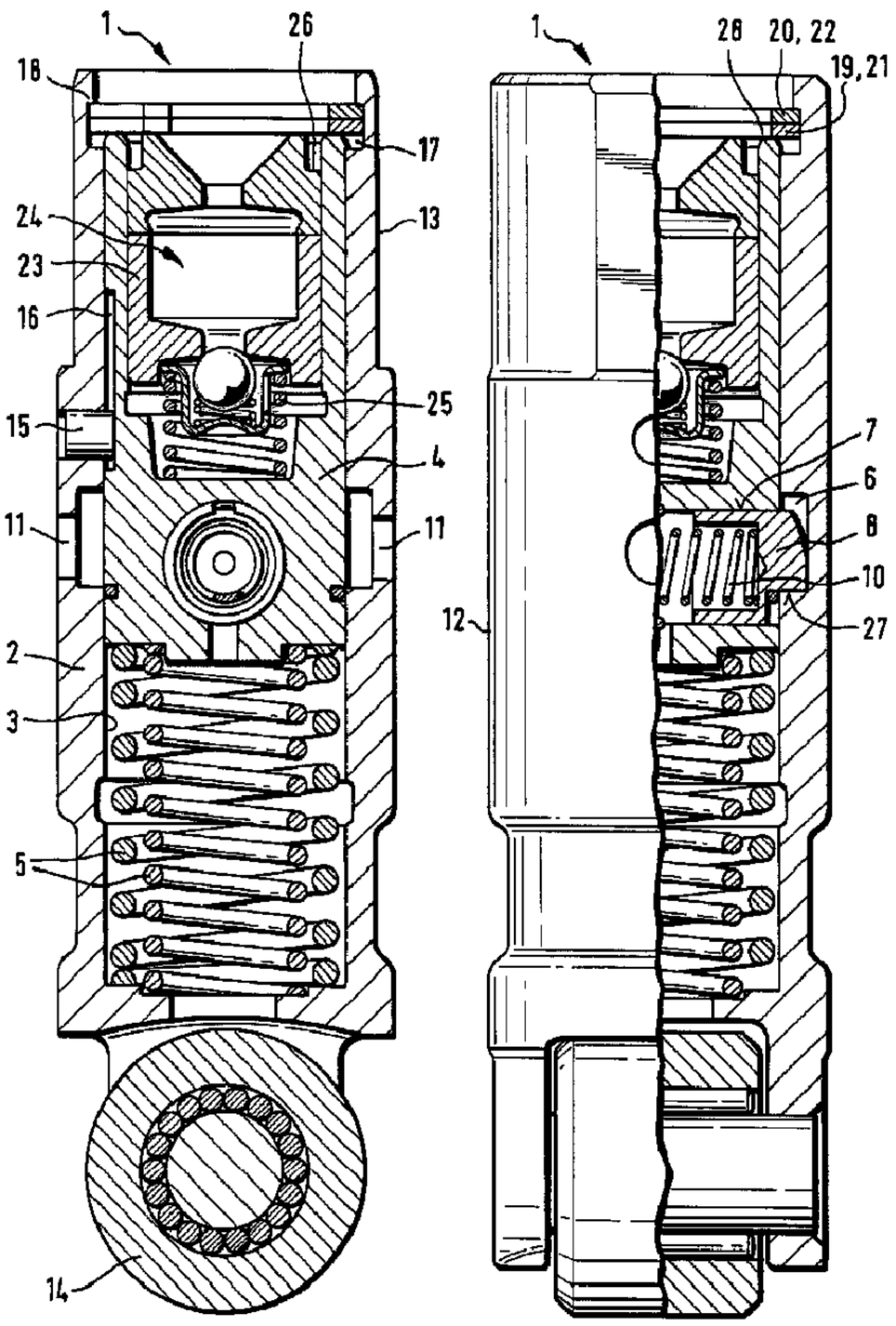
(54) Titre : ELEMENT DE COMMUTATION POUR UN MECANISME DE COMMANDE DE SOUPAPES D'UN MOTEUR A COMBUSTION INTERNE

(54) Title: SWITCH ELEMENT FOR VALVE ACTUATION IN AN INTERNAL COMBUSTION ENGINE



(57) Abrégé/Abstract:
A switch element (1) for valve actuation in an internal combustion engine is disclosed, preferably for valve closure, comprising a simply achieved measure for adjustment of the coupling play, the coupling means (8) for which are retained in a recess by means of two securing rings (19, 20), the thickness of one of which may be varied.

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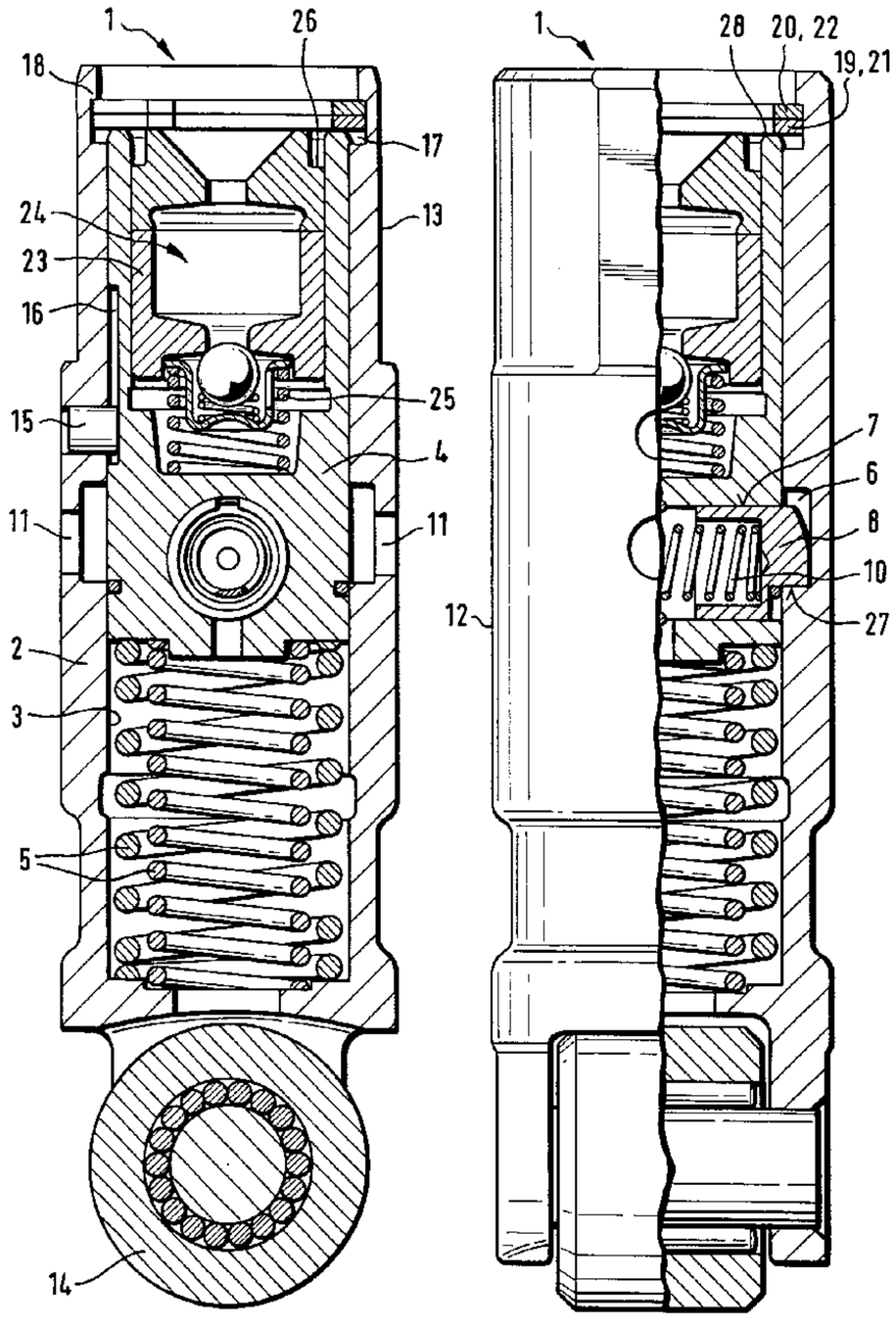
(54) Title: SWITCH ELEMENT FOR VALVE ACTUATION IN AN INTERNAL COMBUSTION ENGINE

(54) Bezeichnung: SCHALTELEMENT FÜR EINEN VENTILTRIEB EINER BRENNKRAFTMASCHINE



(57) Abstract: A switch element (1) for valve actuation in an internal combustion engine is disclosed, preferably for valve closure, comprising a simply achieved measure for adjustment of the coupling play, the coupling means (8) for which are retained in a recess by means of two securing rings (19, 20), the thickness of one of which may be varied.

(57) Zusammenfassung: Vorgeschlagen ist ein Schaltelement (1) für einen Ventiltrieb einer Brennkraftmaschine, vorzugsweise zur Ventilabschaltung, mit einer einfach zu realisierenden Maßnahme einer Einstellung des Koppelspiels dessen Koppelmittel (8) in einer Aufnahme (6) über zwei Sicherungsringe (19, 20), von denen einer dickenvariabel bereitgehalten wird.

WO 03/067038 A1

WO 03/067038 A1

SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

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— *mit internationalem Recherchenbericht*

Zur Erklärung der Zweibuchstaben-Codes und der anderen Abkürzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT-Gazette verwiesen.

SWITCH ELEMENT FOR VALVE ACTUATION IN AN INTERNAL COMBUSTION ENGINE

Description

Field of the invention

The invention concerns a switching element for a valve train of an internal combustion engine, preferably for valve deactivation, comprising an outer part and an inner element that is axially displaceable in a bore of the outer part, said outer part and said inner element comprising at least one reception each, which receptions are aligned to each other in an axially spaced-apart relative position effected by a lost motion spring, one of said receptions comprising at least one coupling means that can be displaced toward the other of said receptions for coupling the inner element to the outer part in said relative position, a first top stop being arranged between the inner element and the outer part for defining said relative position, and a hydraulic lash adjuster comprising a pressure piston being installed in the inner element, which pressure piston is fixed against moving axially out of the inner element by a second top stop.

Background of the invention

A switching element of the pre-cited type is disclosed in DE 199 15 531 that is considered to be generic. The switching element is shown as a switchable cam follower for a tappet push rod drive. A top stop for defining the relative position is realized through a piston-like element arranged in the inner element. This piston-like element projects radially outward into a longitudinal groove of the outer part. In the axially extended state of the inner element relative to the outer part, the piston-like element abuts against an end of the longitudinal groove. The aim of this is to

achieve an aligned positioning of a coupling bore provided in the outer part and a piston arranged in the inner element for enabling coupling.

A drawback of this prior art is that an adjustment of lash in the coupling is relatively complicated and expensive. It is clear that the reception in the outer part (coupling bore) for receiving the piston must have a slight lash relative to the outer peripheral surface of the piston. This lash and a top position vary from one switching element to the other depending on the manufacturing conditions. The relatively broad range of variation of this mechanical idling path in the switching elements is, however, not desirable.

Therefore, to adjust the coupling lash or keep its variance within an acceptable range, the pistons are classified for locking purposes in groups. This is extremely complicated and expensive from the manufacturing and measuring point of view. For example, switching elements must be completely assembled, the lash then measured, following which the switching element must again be disassembled and mated to a suitable coupling piston. It is equally conceivable to classify the top stops on the longitudinal groove of the outer element.

A further top stop is provided in the aforesaid prior art for a pressure piston of the lash adjuster and is configured as a ring.

If two pistons are provided for coupling, as is the case in DE 42 06 166, the aforesaid stop measures prove to be quasi unfeasible. The aligned position of the coupling bores situated diametrically opposite each other in the inner element is realized when the two axially movable parts of the switching element make contact with the base circle of the cam. An adjustment of the coupling lash in this case is effected by extremely complicated manufacturing and measuring techniques by mating the switching elements (in this case, cup tappets) to cam pairs or camshafts. Under certain circumstances, an excessive lash variation will have to be tolerated.

Object of the invention

It is an object of the invention to provide a switching element of the pre-cited type in which the aforesaid drawbacks are eliminated by implementing simple measures.

Summary of the invention

The invention achieves the above object by the fact that

each of the top stops is configured in the form of at least one annular element such as a securing ring and the top stops are arranged on top of each other in the bore of the outer part, as seen when looking into the bore of the outer part, a lower securing ring forms the second top stop and an upper, first securing ring forms the first top stop, variable-thickness first securing rings and constant-thickness second securing rings being provided for mounting as securing rings, and, in a direction leading out of the bore, a stack formed by a first and a second securing ring bears through the first securing ring against a stop such as an annular shoulder of the bore.

Due to the at least two, or two securing rings, as the case may be, a simple, tilt-free and adjustable top stop and, at the same time, a safety device against loss of the pressure piston of the hydraulic lash adjuster is obtained. Preferably, two coupling means (pistons) are provided in the inner element. However, the invention applies equally to embodiments with only one piston or with a plurality of pistons.

The invention also provides a method of adjusting the coupling lash in a switching element of the invention.

The aforesaid measures lead to an effective elimination of the aforesaid drawbacks using simple measures. On the one hand, it is assured that the

pressure piston of the lash adjuster and thus also the inner element cannot be lost (second top stop) during the assembly of the switching element. On the other hand, the provision of variable-thickness first rings to form first top stops is a very simple possibility of adjusting the idling path of the at least one coupling means (piston) relative to its surrounding reception. This idling path is preferably adjusted so that each reception surrounds the coupling means concerned with equal spacing in both axial directions. If the reception is a bore and not an annular groove, it is particularly advantageous if the bore surrounds the coupling means concerned concentrically.

At this point, in place of the securing rings, a person skilled in the art will think of other easy-to-mount stop elements such as discs, insert-pins, wedges, rings etc. It goes without saying that these elements may also be arranged at other height levels than on the edge of the switching element. If need be, a plurality of securing rings can be mated for realizing the coupling lash or the anti-loss device.

It is thus guaranteed that, in the coupled state, the coupling means will always have the same idling path in the surrounding reception of the outer part over a large number of switching elements.

As mentioned above, the coupling means is constituted preferably by two pistons that extend in the reception made in the form of a radial bore in the inner element where they are situated diametrically opposite each other. This is a particularly tilt-resistant mechanism that produces only a slight component loading in the coupled state. In place of the radial bore in the inner element, it is also conceivable to use a pocket bore or another similar feature.

As a further development of the invention it is proposed, as already mentioned, to make the reception of the outer part in the form of an annular groove in its bore. This is particularly advantageous from the manufacturing point of view. Bores may also be used in place of the annular groove.

According to a further advantageous provision of the invention, the inner element is secured against rotation relative to the outer part, for instance, by a pin-like element. In this way, during the entire operative life of the switching element, the coupling means has the same position relative to its reception as at the adjustment of the coupling lash. As a result, tolerances no longer have any effect if the reception is configured as an annular groove.

It is further proposed that if two pistons are used as a coupling means, the annular groove is intersected by two oil passages such as bores situated diametrically opposite each other. If two ducts situated opposite each other are provided for the switching element in an oil gallery of an ambient structure, for example, a cylinder head or a guide for the switching element connected to the internal combustion engine, it is of no importance which oil passage of the switching element communicates with which duct. What is important for achieving the same switching times is that the oil paths have the same length. However, if there is only one duct, a properly oriented installation of the switching element is required. In this case, for facilitating assembly, appropriate marks can be provided on the switching element. It goes without saying that the oil passages in the outer part may also be arranged on another peripheral portion of the outer part so that they are not aligned to the pistons in the coupled state.

If, as proposed in a further advantageous embodiment of the invention, the switching element is configured as a cam follower in a tappet push rod drive, and this cam follower comprises a cam-contacting element in the form of a roller, it is necessary, also for a correct allocation of the ducts from the ambient structure to the oil passages, to secure the switching element against rotation. Appropriate anti-rotation devices such as flattened portions on the outer peripheral surface of the outer part are proposed in this connection,

Other elements such as latches, balls, wedges or similar elements that produce a positive engagement may also be used as a coupling means in place of the

pistons. If necessary, a combination of positive engagement and force-locking is also feasible.

The scope of protection of this invention extends explicitly to all kinds of switching elements in valve trains such as the aforesaid cam followers in tappet push rod drives, cup tappets or support elements for finger levers etc.

Brief description of the drawing

The invention will now be explained more closely with reference to the appended drawing in which

Fig. 1 is a longitudinal section through a switching element configured as a roller tappet for a tappet push rod drive, and

Fig. 2 is a partial longitudinal section of the switching element of Fig. 1 turned through 90°.

Detailed description of the drawing

Figs. 1 and 2 disclose a switching element 1 for a valve train of an internal combustion engine. The switching element 1 is configured in this case as a roller tappet for a tappet push rod drive and comprises an outer part 2 having a bore 3 in which an axially movable inner element 4 extends. The inner element 4 and the outer part 2 are biased away from each other by a lost motion spring 5, not requiring further specification here.

In the illustrated axially spaced-apart position of the outer part 2 relative to the inner element 4, the receptions 6, 7 of these are aligned to each other. The reception 6 of the outer part 2 is configured as a circumferential annular groove.

The reception 7 in the inner element 4, in contrast, is made as a radially extending through-bore. Two coupling means 8, configured here as pistons, are situated diametrically opposite each other in this bore. The coupling means 8 are biased radially outwards (coupling direction) through the force of a compression spring 10. In the radially inward direction i.e., in uncoupling direction, the coupling means 8 can be displaced by hydraulic medium. For this purpose, the outer part 2 appropriately comprises two oil passages 11 situated diametrically opposite each other (see Fig. 1). These passages 11 are configured in the present case as bores and offset at 90° to the coupling means 8 in peripheral direction. Appropriately, these oil passages 11 communicate with two hydraulic medium ducts from an ambient structure, not needed to be specified here.

A person skilled in the art will further see in the figures that a means 13 for preventing rotation is provided on the outer peripheral surface 12 of the outer part 2. This means 13 is configured in the form of opposite flattened portions. This measure proves to be necessary, on the one hand, for connecting the oil passages 11 to their respective ducts and, on the other hand, for properly orienting a roller 14 with respect to a cam, not shown.

It can be seen further that the inner element 4 is likewise secured against rotation relative to the outer part 2. For this purpose, an anti-rotation device 15 (made here as a pin) is fixed in the outer part 2 and projects radially into the bore 3 of the outer part 2. The inner element 4, in return, comprises a longitudinal recess 16 facing the anti-rotation device 15 and having flanks on which the anti-rotation device 15 is guided.

In a bore-distant region, the outer part 2 possesses an annular groove 17 comprising a stop 18. Two securing rings 19, 20 are snapped into the annular groove 17. These rings form a second and a first top stop 21, 22 respectively. As a whole, the securing rings 19, 20 bear against the stop 18. The second, lower securing ring 19 serves as an anti-loss device of a pressure piston 23 of a hydraulic lash adjuster 24 that is installed in the inner element 4. An adjustment of

the coupling lash of the coupling means 8 in the surrounding reception 6 is achieved through the first securing ring 20 that is situated on the second securing ring 19 and is kept at hand in different thicknesses during assembly.

It is clear that, after the mounting of the second securing ring 19, the pressure piston 23 together with the inner element 4 can no longer be pushed out of the bore 3 of the outer part 2 by the force of a compression spring 25 of the lash adjuster 24 or by the force of the lost motion spring 5. The pressure piston 23 thus bears against the second securing ring 19 through its edge 26.

Before adjusting the coupling lash of the coupling means 8 relative to their reception 6, this lash has to be determined. This is done in the extended position of the coupling means 8, to put it simply, as follows: at first the idling path of the coupling means 8 in the reception 6 is measured after loading of the inner element 4 and its displacement in the bore 3 till a lower surface 27 of the reception 6 is reached. For a person skilled in the art it is then relatively simple to calculate, on the basis of the measured idling path of the coupling means 8, at which height a central position of the coupling means 8 in the reception 6 is reached. When this value has been determined, a first securing ring 20 of appropriate thickness is snapped into the annular groove 17 directly above the second securing ring 19. The lost motion spring 5 thus presses the inner element 4 with its edge 28 against the second securing ring 19. In this position, (coupling position) the adjustment of the coupling lash is completed, advantageously in such a manner that the coupling means 8 has the same, small traveling path within the reception 6 in both axial directions.

To sum up, the idling path of the inner element 4 relative to the outer part 2, which it covers with its coupling means 8 in the receptions 6 after coupling with the outer part 2 and upon commencement of cam loading, can be kept uniformly small over a series of switching elements 1 in internal combustion engines of the same type. An excessive and undesired variance of valve timings is excluded.

Reference numerals

1	Switching element
2	Outer part
3	Bore
4	Inner element
5	Lost motion spring
6	Reception of outer part
7	Reception of inner part
8	Coupling means
9	not used
10	Compression spring
11	Oil passage
12	Outer peripheral surface
13	Means
14	Roller
15	Anti-rotation device
16	Longitudinal recess
17	Annular groove
18	Stop
19	Securing ring
20	Securing ring
21	Top stop
22	Top stop
23	Pressure piston
24	Lash adjuster
25	Compression spring
26	Edge of pressure piston
27	Lower surface
28	Edge of inner element

WHAT IS CLAIMED IS:

1. A switching element for a valve train of an internal combustion engine, comprising an outer part and an inner element that is axially displaceable in a bore of the outer part, said outer part and said inner element comprising at least one reception each, which receptions are aligned to each other in an axially spaced-apart relative position effected by a lost motion spring, one of said receptions comprising at least one coupling means that can be displaced toward the other of said receptions for coupling the inner element to the outer part in said relative position, a first top stop being arranged between the inner element and the outer part for defining said relative position, a hydraulic lash adjuster comprising a pressure piston being installed in the inner element, which pressure piston is fixed against moving axially out of the inner element by a second top stop, wherein each of the top stops is configured in the form of at least one securing ring and the top stops are arranged on top of each other in the bore of the outer part, as seen when looking into the bore of the outer part, a second constant-thickness securing ring forms the second top stop and a first variable-thickness securing ring forms the first top stop, the securing rings being provided for mounting, and, in a direction leading out of the bore, a stack formed by the first and second securing rings bears through the first securing ring against a stop.

2. A switching element of claim 1, wherein the coupling means comprises two pistons that extend diametrically opposite each other in the reception of the inner element, said reception being configured as a radial bore.

3. A switching element of claim 2, wherein the reception of the outer part is made as an annular groove in the bore of the outer part and is intersected by two opposite oil passages in the outer part, and the inner element is guided in the bore of the outer part by an anti-rotation device.

4. A switching element of claim 3, wherein the anti-rotation device is arranged as a radially protruding element that is fixed in one of the outer part and the inner element and is guided in a longitudinal recess of the opposing, other of the inner element and the outer part.

5. A switching element of claim 1, wherein the outer part comprises a means for a rotation-proof guidance of the entire switching element relative to an ambient structure.

6. A switching element of claim 5, wherein the means for the rotation-proof guidance comprises at least one flattened portion on the outer peripheral surface of the outer part.

7. A switching element of claim 1, wherein the switching element is made as a cam follower in a tappet push rod drive.

8. A method of adjusting coupling lash in a switching element for a valve train of an internal combustion engine comprising an outer part and an inner element that is axially displaceable in a bore of the outer part, said outer part and said inner element comprising at least one reception each, which receptions are aligned to each other in an axially spaced-apart relative position effected by a lost motion spring, one of said receptions comprising at least one coupling means that can be displaced toward the other of said receptions for coupling the inner element to the outer part in said relative position, a first top stop being arranged between the inner element and the outer part for defining said relative position, a hydraulic lash adjuster comprising a pressure piston being installed in the inner element, said pressure piston being fixed against moving axially out of the inner element by a second top stop, each of the top stops being configured as at least one securing ring, the bore of the outer element comprising a bore-distant stop and the coupling means comprising at least one piston that extends in the

reception of the inner element and is made as a radial bore, said method comprising the following steps:

a) snapping-in of the at least one second securing ring into a region axially below the stop, so that the pressure piston of the lash adjuster is pressed through its bore-distant edge by the force of a compression spring of the lash adjuster against the second securing ring and this second securing ring is pressed against the stop;

b) with the coupling means extended into the reception of outer part, displacing the inner element in bore direction until the coupling means comes to bear against a lower surface of the reception;

c) measuring an idling path covered by the inner element with the coupling means until contact is established with the lower surface; and

d) mating the at least one first securing ring having such a thickness that, upon a subsequent snapping-in of this first securing ring into a region axially below the stop so as to bear against the second securing ring, the inner element is displaced by the second securing ring, so that the coupling means extends at an equal distance from the reception at least in both axial directions.

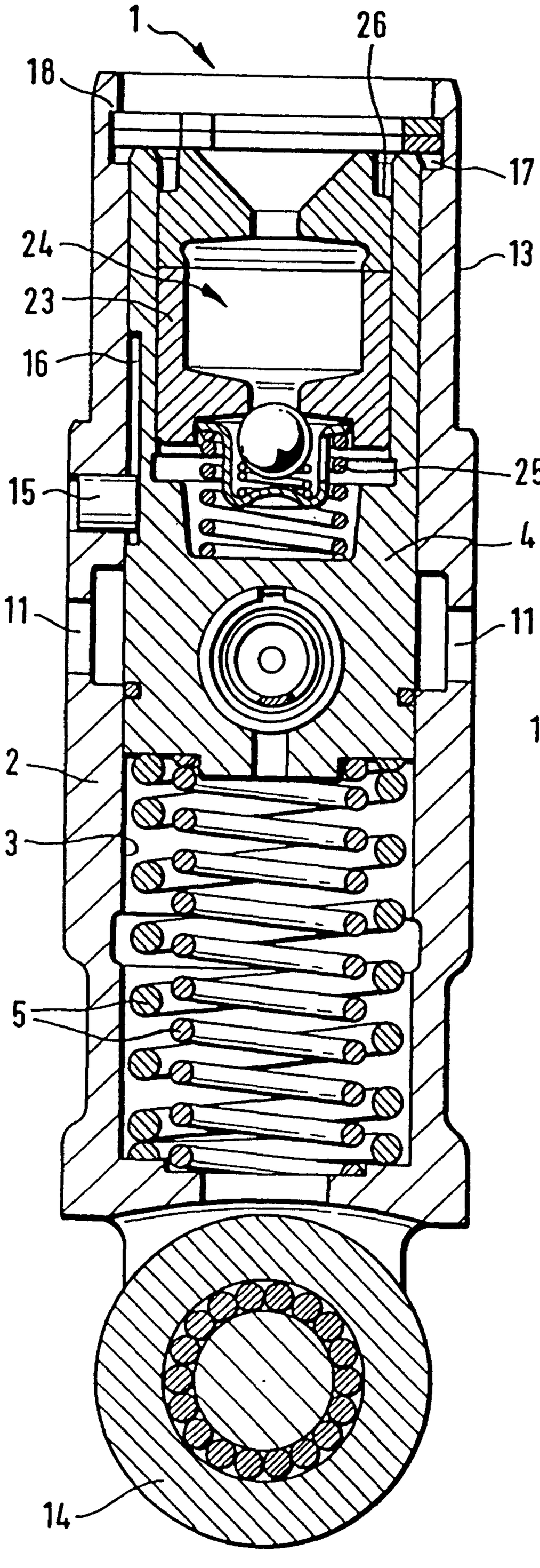


Fig. 1

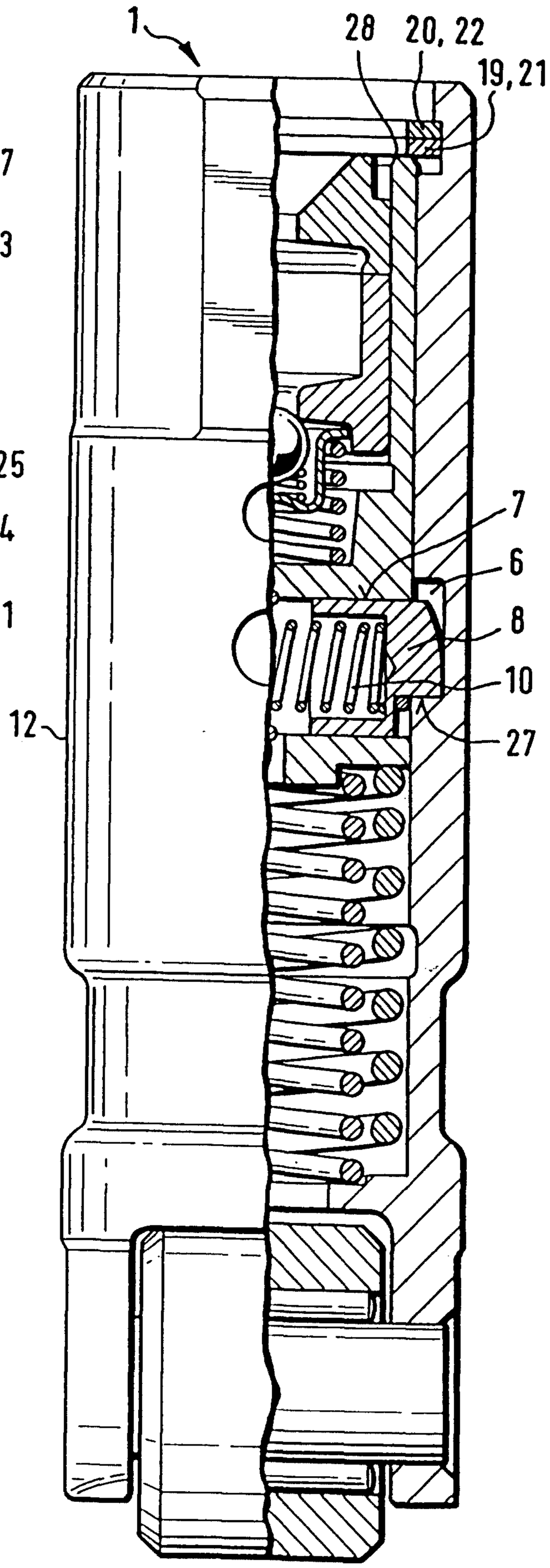
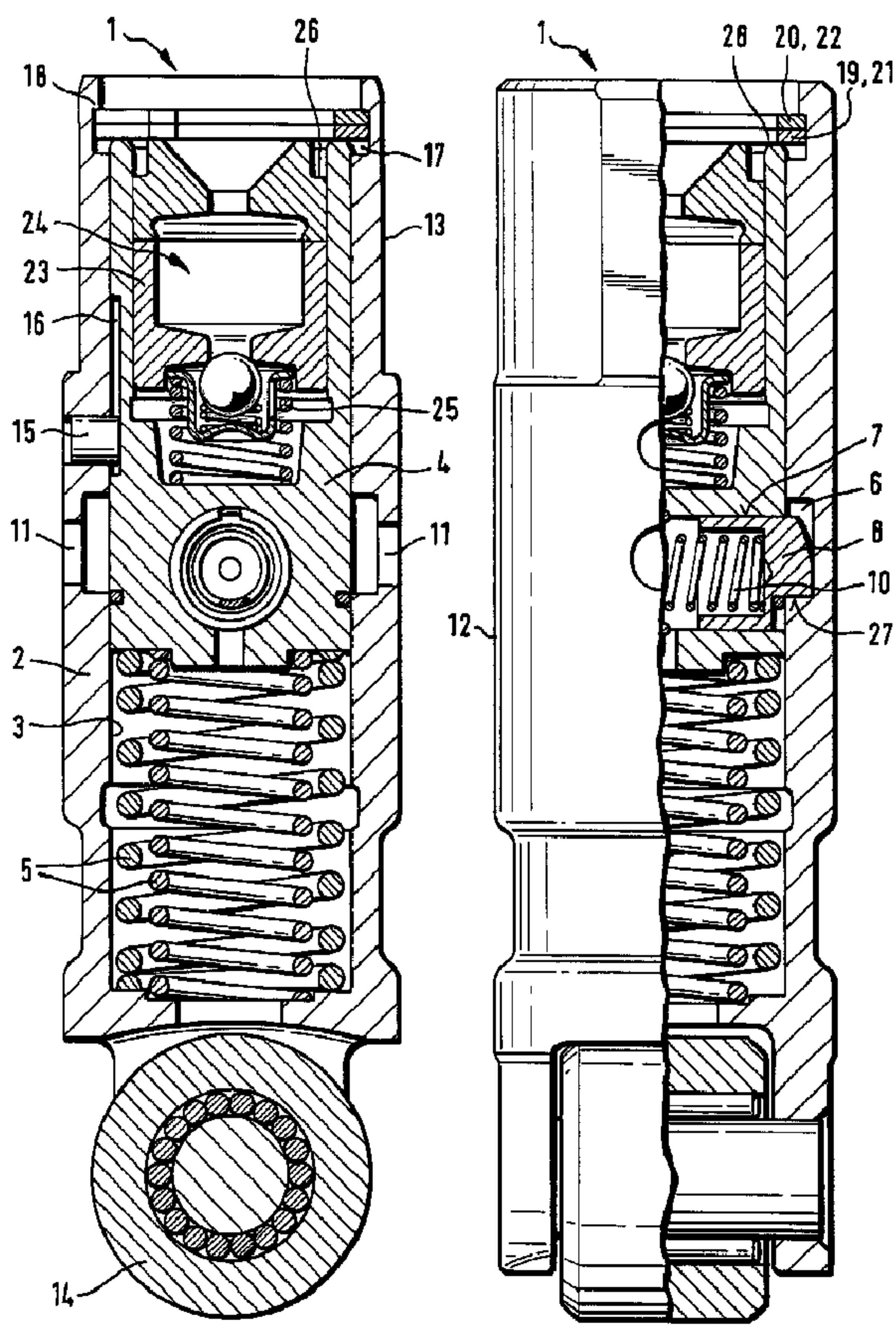


Fig. 2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