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(54) Titre : DISPOSITIF DE RATTRAPAGE DE JEU POUR UN FREIN A DISQUE
(54) Title: ADJUSTING DEVICE FOR A DISK BRAKE

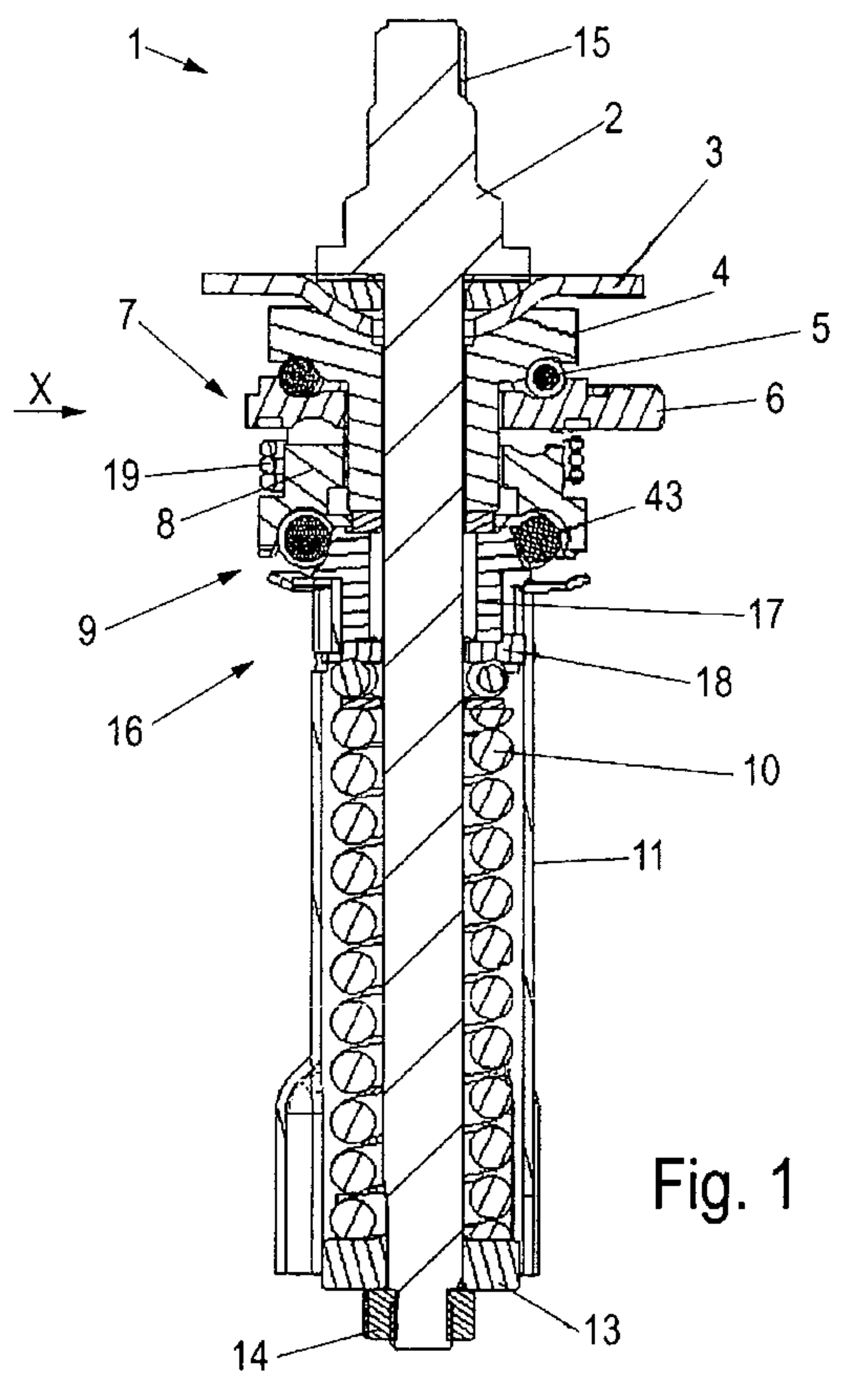

Fig. 1

(57) Abrégé/Abstract:
An adjusting device (1) for adjusting for wear of brake linings (23) and of a brake disk (21) of a pneumatically actuated disk brake (20), having a rotary-lever-actuated brake application device which can preferably be inserted into an adjusting spindle (25) of the

(57) **Abrégé(suite)/Abstract(continued):**
disk brake (20) and attached to a brake caliper (22) of the disk brake (20) by means of a mounting disk (3), wherein an axial bearing (5) is formed axially on one side of a drive ring (6) and a ball ramp coupling (7) with a freewheel function is formed axially on the opposite side of the drive ring (6); the ball ramp coupling (7) has balls (42), has the drive ring (6) arranged at the drive-input side axially between the axial bearing (5) and the balls (42) thereof, and has a drive-output-side coupling ring (8), a cone coupling (9) is arranged between the drive-output-side coupling ring (8) and a spring sleeve (11) for a cylindrical spring (10), is characterized in that a torque-dependent coupling (16) with positive restraint is arranged axially between the cone coupling (9) and the spring sleeve (11), and a corresponding disk brake.

Abstract:

An adjusting device for adjusting for wear of brake linings and of a brake disk of a pneumatically actuated disk brake, having a rotary-lever-actuated brake application device which can preferably be inserted into an adjusting spindle of the disk brake and attached to a brake caliper of the disk brake by means of a mounting disk, wherein an axial bearing is formed axially on one side of a drive ring and a ball ramp coupling with a freewheel function is formed axially on the opposite side of the drive ring; the ball ramp coupling has balls, has the drive ring arranged at the drive-input side axially between the axial bearing and the balls thereof, and has a drive-output-side coupling ring, a cone coupling is arranged between the drive-output-side coupling ring and a spring sleeve for a cylindrical spring, is characterized in that a torque-dependent coupling with positive restraint is arranged axially between the cone coupling and the spring sleeve, and a corresponding disk brake.

Adjusting device for a disk brake

The invention relates to an adjusting device for a disk brake, more preferably a pneumatically actuated disk brake, as claimed in the preamble of claim 1.

Adjusting devices for disk brakes are available in different designs. From DE 10 2004 037 771 A1 an adjusting device for a disk brake is known, to the full content of which publication reference is hereby made. Said device is suitable for a pneumatically actuated disk brake, more preferably in floating calliper design. However, it can also be utilized in pneumatically actuated fixed or pivot calliper disk brakes.

Pneumatically actuated disk brakes meanwhile belong to the standard equipment of heavy commercial vehicles.

Such disk brakes require a mechanical transmission for generating the required clamping force since the force of the pneumatically actuated brake cylinders is limited because of the pressure level (currently approximately 10 bar) and the limited size of the brake cylinders. The currently known pneumatically actuated disk brakes have transmission ratios between 10:1 and 20:1. The piston strokes of the brake cylinders range from 50 to 75mm, which produces clamping travels for pressing the brake linings against the brake disk of approximately 4mm.

The friction material thickness of the brake linings is in the range of 20mm, since two linings are installed, a wear travel of approximately 40mm thus being obtained without consideration of the disk wear. This travel is a multiple greater than the abovementioned clamping travel. It is therefore necessary to adjust the brake by means of a device in accordance with the lining wear. The state of the art is an automatically operating wear adjustment, by means of which it is achieved that the so-called lift clearance, meaning the gap between the brake linings and the brake disk in the unactuated stated, is kept constant independently of the wear state and wear characteristic of the brake linings.

Frequently, disk brakes having an adjuster that is arranged concentrically in the hollow space of a threaded ram and eccentrically driven by the brake lever via a drive element (e.g.: shifting finger), are very frequently found in commercial vehicles. During a braking operation the brake lever coupled with the piston rod of the brake cylinder performs a rotary movement. Before the rotary movement of the lever is introduced into the adjuster via the coupling mechanism of the adjustment (e.g.: shifting fork and shifting finger or gears), a so-called idle travel has to be overcome. This travel is decisive for the size of the lift clearance since during this movement the adjustment is not activated and the clamping travel thus constitutes the lift clearance. Once this idle travel has been overcome, the adjuster is put into a rotary motion and an adjusting operation is initiated through the coupling to the threaded ram or tube.

DE 10 2004 037 771 A1 describes such an adjusting device, which is shown in Fig. 5. It substantially consists of the following function elements:

- shaft 2
- mounting disk 3

- axial bearing 4
- collar bush 5
- shifting fork, or drive ring 6
- ball ramp coupling 7
- coupling ring 8
- cone coupling 9
- cylindrical spring 10

With respect to the description, reference is made to DE 10 2004 037 771 A1.

Substantially, the adjusting device has to fulfill two functions:

1. the automatic lift clearance setting (normal operation); and

2. the manual resetting of the adjusting mechanism when renewing the brake linings.

When installing new brake linings the thrust pieces, which press the brake linings against the brake disks, have to be set back. This is carried out by turning back threaded rams (threaded tubes) which during the use of the brakes were turned out through the automatically operating adjusting device in accordance with the lining wear.

During this turning back the adjusting device is manually turned back with a spanner from the so-called wear position into the starting position. When doing so, the adjusting device has to be turned against the locking direction of a freewheel. However, since the freewheel has a 100% locking action, turning back is not easily possible.

The object of the present invention therefore consists in providing an adjusting device with improved manual resetting.
The object is solved through an adjusting device with the features of claim 1.

The object is also solved through a disk brake with the features of claim 9.

Accordingly, an adjusting device for adjusting the wear of brake linings and brake disk of a pneumatically actuated disk brake with a rotary lever-actuated clamping device, which preferentially can be inserted in an adjusting spindle of the disk brake and attached to a brake calliper of the disk brake by means of a mounting disk, wherein axially on a side of a drive ring an axial bearing and axially on the opposite side of the drive ring a ball ramp coupling with freewheel function is formed; the ball ramp coupling comprises balls, a drive bush arranged axially between the axial bearing and its balls on the drive end and a coupling ring on the output side, a cone coupling between the coupling ring on the output side and a spring sleeve for a cylindrical spring is arranged, characterized in that axially between the cone coupling and the spring sleeve a torque-dependent coupling with positive restraint is arranged.

Because of this it is possible that installation space and interface targets are taken into account and largely maintained, as a result of which a simple replacement is possible. The torque-dependent coupling with positive restraint additionally offers a typical noise upon manual resetting as acoustic feature, which in a simple manner already known to him signals to an actuating person a certain state as a result of which a training process is simplified.

In that the cone coupling preferably is a ball cone coupling which comprises the drive-end coupling ring and a cone bush interacting with the torque-dependent coupling, wherein between the output-side coupling ring and the cone bush, cone balls are arranged, it is possible to achieve a compact design. More particularly since the torque-dependent coupling is formed as ratchet coupling from a portion of the cone bush of the cone coupling and a coupling disk. The positive restraints are formed from corresponding toothings in each case. The coupling disk is connected to the spring sleeve.

This design offers the following advantages:

- The known, typical noise occurs upon manual turning-back.
- By retaining a locking function of the freewheel in the rest position, an improved shake-proof feature against turning-open of the adjusting mechanism is obtained.
- Cost-effective manufacture of the components through non-cutting forming.

In a preferred embodiment the corresponding toothings are embodied on the portion of the cone coupling and on the coupling disk as opposing spur toothings. Such components can be cost-effectively produced through non-cutting forming.

Turning back the adjusting device is carried out against the locking direction of the freewheel. The torque-dependent coupling through matching of the spur toothings makes possible that the toothings "over-ratchet" when a certain torque is exceeded. The preload of this coupling is performed via the cylindrical spring already present in the adjusting device, which cylindrical spring is preferably adjustable. The torque-dependent coupling is designed for a higher transmission moment than the ball ramp coupling. If the ratchet coupling were to respond before the ball ramp coupling, which can also be called a load shift coupling, major wear of the ratchet coupling would occur because of the high stress cycle number involved.

With this adjusting device a directional coupling acting in the axial direction is installed. The directional coupling is formed of a ball ramp system and a friction coupling, more preferably the ball cone coupling.

Upon manual turning back, the rotary movement is initially introduced into the torque-dependent ratchet coupling and into the ball cone coupling via the shaft and the spring sleeve. From there, the torque is directed into the ball ramp coupling via the friction connection in the ball cone coupling. Since ball cone and ball ramp coupling are matched for retention by friction, a clamping effect occurs.

The coupling ring and the drive ring which are connected to the shifting fork or form a portion thereof, are each provided with an inner profiling with the help of which it is possible to prevent the two components in the rest position from turning back further. Supporting the drive ring and the coupling ring is effected on a collar bush mounted in a rotationally fixed manner, which comprises an outer profiling matching the inner profiling of the coupling ring and of the drive ring. When the introduced torque exceeds the response moment of the ratchet coupling "ratcheting-through" of the ratchet coupling occurs. With stops of the outer profile on the inner profile of the drive ring and the coupling ring it is achieved that on the one hand the clamping action of the freewheel is retained and on the other hand no rotation in the ball ramp coupling occurs. Otherwise the ratchet coupling would not respond immediately but the ball ramp coupling could be initially rotated until reaching an end position of the balls on the ramp tracks (torque of the ball ramp coupling < torque of the ratchet coupling).

In addition it is provided that when positioning the stops of the inner profiles of the drive ring and the coupling ring the stop of the outer profile of the collar bush with the inner profile of the drive ring becomes effective slightly earlier than the stop with the inner profile of the coupling ring. This is effected in that between the outer profile and the inner profiles an angular clearance for the advance of a stop between outer profile and drive ring inner profile before a stop between outer profile and coupling ring inner profile is formed.

It is furthermore preferred that the other end of the collar bush, which forms the fixed portion of the axial bearing, is fastened in a rotationally fixed manner to the mounting disk attached to the brake calliper.

The axial bearing is formed by the one side of the drive ring, rolling elements and a collar of a collar bush, which extends axially through the ball ramp coupling. This likewise reduces parts variety and a compact construction is achieved.

A disk brake, more preferably a pneumatically actuated disk brake comprises an adjusting device as claimed in the above description.

The invention is now explained in more detail by means of an exemplary embodiment making reference to the attached drawings in which:

Fig. 1 Shows a longitudinal section representation of an exemplary embodiment of an adjusting device as claimed in the invention;

Fig. 2 Shows a perspective sectional representation of the exemplary embodiment as claimed in Fig. 1;

Fig. 3 Shows an enlarged perspective representation of a ratchet coupling as claimed in Fig. 1 and 2;

Fig. 4 Shows a schematic cross-sectional representation of the exemplary embodiment as claimed in Fig. 1 in the region X;

Fig. 5 Shows a part-sectional representation of an adjusting device as claimed in the prior art; and

Fig. 6 Shows a schematic representation of a disk brake.

Elements with the same or similar functions are provided with the same reference characters in the figures.

With respect to construction and function of a pneumatic disk brake as claimed in Fig. 6, reference is made to the corresponding description of DE 19729024C1. In Fig. 6, the following components are stated here: disk brake 20, brake disk 21, brake calliper 22, brake linings 23, crossbeam 24, adjusting spindles 25 and 26, thrust pieces 27, sprockets 28, chain 29, eccentric 30 and rotary lever 31, which comprises a drive element 32, which is in interaction with a shifting fork of an adjusting device 1. The adjusting device 1 in this case is arranged in the adjusting spindle 25. Such an adjusting device 1 is now explained in more detail. The adjusting device 1 would also be suitable for a disk brake operated by an electric motor.

To this end, reference is made to Fig. 1 and 2.

Fig. 1 is a longitudinal sectional representation of an exemplary embodiment of an adjusting device 1 according the invention and Fig. 2 shows a perspective sectional representation of the exemplary embodiment as claimed in Fig. 1.

The adjusting device 1 comprises the following: a shaft 2 with a drive end 15 at its upper end; a mounting disk 3 for fastening the adjusting device 1 in the brake calliper 22 (see Fig. 6); a collar bush 4, which is attached to the mounting disk 3 in a rotation-proof manner and comprises an upper collar with a running surface for balls of an axial bearing 4 arranged below; a drive ring 6, which is connected to a shifting fork, which is coupled to the drive element 32 (see Fig. 6) of the rotary lever 31; a ball ramp coupling 7, with a coupling ring 8, which interacts with a cone bush 17, which is connected to a spring sleeve 11 in a rotationally fixed manner via a torque-dependent coupling 16 with positive restraint; a cylindrical spring 10 which is arranged in the spring sleeve 11 and supports itself on a profile disk 13; and an adjusting element 14, for example a nut, which is arranged on the lower end of the shaft 2 and serves for tensioning the cylindrical spring 10 and for the axial cohesion of the elements of the adjusting device 1.

With this adjusting device 1, a directional coupling (freewheel) acting in the axial direction is installed. The directional coupling is formed of a ball ramp coupling 7 and a friction coupling or cone coupling 9, more preferably a ball cone coupling.

The ball ramp coupling 7 consists of the drive ring 6, ramp balls 42 or rolling elements and the coupling ring 8, wherein the coupling ring 8 comprises an upper portion for receiving the balls and a lower portion forming a part of the cone coupling 9. The general function of the adjusting device 1 is extensively described in DE 10 2004 037 771 A1 with reference to Fig. 5, to which reference is made here.

A first difference to the adjusting device as claimed in Fig. 5 is formed by a torque-dependent coupling 16 with positive restraint, which is also designed as a so-called ratchet coupling (designated as such in the following), and which is still explained in more detail below. This ratcheting coupling 16 interacts with a portion of the cone bush 17 and is connected to the spring sleeve 11 with a coupling disk 18 in a rotationally fixed manner.

As a further difference to the adjusting device as claimed in Fig. 5 the axial bearing 4, with the adjusting device 1 as claimed in the present invention, is formed of the collar of the collar bush 5, a side of the drive ring 6 and rolling elements.

The lower end of the collar bush 5 extending through the ball ramp coupling 7 forms an axial stop for the cone bush 17 directly or via a thrust washer. The cone bush 17 is pressed upwards by the cylindrical spring 10 via the ratchet coupling 16, wherein the components ratchet coupling 16 and cone coupling 9, ball ramp coupling 7 and axial bearing 4 are axially held together and compressed. The collar bush 5 with its stop serves to maintain a minimum play of the bearings. In addition, a compression spring 19 is arranged between the coupling ring 8 and the drive ring 6. The cone bush 17 can continue to support itself via its upper end via the thrust washer (shown here) on the lower end of the collar bush 5 (will still be explained in more detail below).

Fig. 3 illustrates an enlarged perspective representation of the ratchet coupling 16 as claimed in Fig. 1 and 2. The ratchet coupling 16 consists of a lower section of the cone bush 17 with a first spur toothing 34 and a coupling disk 18 with a corresponding second spur toothing 35 located opposite the first spur toothing 34. In addition, the coupling disk 18 comprises recesses 36 for coupling to the spring sleeve 11, which is not explained in more detail.

The portion of the cone bush 17 of the cone coupling 9 located at the top in Fig. 3 is provided with pockets 33 for interaction with the cone balls 43 in a manner not described in more detail.

Upon the so-called normal operation, a rotary movement is introduced into the shifting fork and the drive ring 6 of the adjusting device through the brake or rotary lever 31 (see Fig. 6). By way of the ball ramp coupling 7 (between shifting fork 6 and coupling ring 8) the rotary movement is directed into the ball cone coupling 9. Because of the matching of ball ramp coupling 7 and ball cone coupling 9, retention by friction and thus passing-on of the torque into the ratchet coupling 16 connected downstream occurs. From the ratchet coupling 16 the torque is finally directed into the spring sleeve 11 and from there via a longitudinal toothing into the threaded tube or the adjusting spindles 25, 26 (see Fig. 6).

In normal operation, there are two different operating states.

Operating state BZ1: the lift clearance (gap between brake lining 23 and brake disk 21) is too large, an automatic adjustment is carried out. When doing so, the required adjusting moment of the non-clamped adjusting spindle 25, 26 is smaller than the load shifting moment of the ball ramp coupling 7. The adjusting spindle 25, 26 is thus rotated during the forceless actuation phase.

Operating state BZ2: the brake linings 23 contact the brake disk 21 and the adjusting spindles 25, 26 are clamped. Because of deformation in the brake and the brake linings 23 the brake lever continues to perform a rotary movement until an equilibrium of forces is reached. Consequently a rotary movement continues to be introduced into the shifting fork or the drive ring 6 of the adjusting device 1. Since the adjusting spindles 25, 26 in this phase are clamped in a quasi rotationally fixed manner, only the so-called load shift coupling or ball ramp coupling 7 reacts now. During this, a relative movement occurs between shifting fork 6 and coupling ring 8. Through the rolling of the ramp balls 42 on the ball ramps 41 (see Fig. 4) of the shifting fork 6 and of the coupling ring 8 the coupling ring 8 is pushed away in the axial direction against the force of the cylindrical spring 10. The coupling ring 8 transmits the force to the ratchet coupling 16 via the ball cone coupling 9. Since the response moment of the ratchet coupling 16 is greater than the load shift moment of the ball ramp coupling 7, no movement and no wear loading occur in the ratchet coupling 16.

On releasing the brake the movement reversal occurs in the adjusting device 1. When this happens, the ramp balls 42 initially roll back again down the ball ramps 41 as far as the original position. On reaching the original ball position the cylindrical spring 10 no longer supports itself via the ball ramp coupling 7, but via a stop on the collar bush 5. The ball cone coupling 9 and the ball ramp coupling 7 are thus practically free of forces. If upon actuation of the brake an adjustment has taken place, the ball cone coupling 9 is now rotated within itself (freewheel function) through the shifting fork 6 turning back. The adjusting spindle 25, 26 thus remains in the previously adjusted position.

The shaft 2 at its upper end in Fig. 1, 2 has a drive end 15 which for a corresponding spanner for example has a hexagonal profiling. With a tool, for example an offset ring spanner, applied to said hexagonal profiling, the shaft 2 is now rotated in the anti-clockwise direction indicated by the arrow. During this manual resetting the torque is initially introduced into the ratchet coupling 16 and into the ball cone coupling 9 via the shaft 2 and the spring sleeve 11. From there, the torque is directed into the ball ramp coupling 7 via the friction connection of the ball cone coupling 9. Since ball cone coupling 9 and ball ramp coupling 7 are matched for retention by friction, a clamping action occurs.

The coupling ring 8 and the shifting fork or the drive ring 6 each have an inner profiling with the help of which it is possible to prevent the two components from turning back further in the rest position. To this end, Fig. 4 shows a schematic cross-sectional representation of the exemplary embodiment as claimed in Fig. 1 in the region X. The drive ring 6 and the coupling ring 8 support themselves on the collar bush 5 mounted in a rotationally fixed manner, which comprises an outer profile 37 matching a coupling ring inner profile 38 and a drive ring inner profile 39. When the introduced torque exceeds the response moment of the ratchet coupling 16, ratcheting-through of the ratchet coupling 16 occurs. With the stops between the outer profile 37 with the inner profiles 38 and 39 of drive ring 6 and coupling ring 8 it is achieved that on the one hand the clamping action of the freewheel is retained and on the other hand no rotation in the ball ramp coupling 7 occurs. Otherwise the ratchet coupling 16 would not respond immediately but the ball ramp coupling 7 would initially be rotated on the tracks of the ball ramps 41 until the end position of the ramp balls 42 is reached. (Torque of the ball ramp coupling 7 < torque of the ratchet coupling 16).

On positioning the stops of drive ring 6 and coupling ring 8 with the outer profile 37 of the collar bush 5 it must be ensured that the stop for the drive ring 6 (drive ring inner profile 39) becomes effective slightly earlier than the stop of the coupling ring inner profile 38, otherwise the clamping action of the freewheel in the rest position of the adjusting device 1 is not ensured.

This is achieved with a so-called advance of the stop of the drive ring inner profile 39 over the stop of the coupling ring inner profile 38 in each case with the outer profile 37 of the collar bush 5 in that an angular clearance 40 is provided.

The invention is not restricted to the exemplary embodiments described above. It can be modified within the scope of the attached claims.

As positive restraints of the coupling 16, combinations of different spur toothings are also possible.

The inner and outer profiles 37, 38, 39 can also have other shapes.

List of reference numbers

1 Adjusting device
2 Shaft
3 Mounting disk
4 Collar bush
5 Axial bearing
6 Drive ring
7 Ball ramp coupling
8 Coupling ring
9 Cone coupling
10 Cylindrical spring
11 Spring sleeve
12 Sleeve cone
13 Profile disk
14 Adjusting element
15 Drive end
16 Coupling
17 Cone bush
18 Coupling disk
19 Torsion spring
20 Disk brake
21 Brake disk
22 Brake calliper
23 Brake linings
24 Crossbeam
25 First adjusting spindle
26 Second adjusting spindle
27 Thrust piece
28 Sprockets
29 Chain
30 Eccentric
31 Rotary lever
32 Drive element
33 Pockets
34 First spur toothing
35 Second spur toothing

36 Recess
37 Outer profile
38 Coupling ring inner profile
39 Drive ring inner profile
40 Angular clearance
41 Ball ramp
42 Ramp ball
43 Cone ball

Patent claims

1. An adjusting device (1) for adjusting the wear of brake linings (23) and brake disk (21) of a pneumatically actuated disk brake (20) with a rotary lever-actuated clamping device, which preferentially can be inserted in an adjusting spindle (25) of the disk brake (20) and can be attached to a brake calliper (22) of the disk brake (20) by means of a mounting disk (3), wherein
   (a) axially on a side of a drive ring (6) an axial bearing (4) and axially on the opposite side of the drive ring (6) a ball ramp coupling (7) with freewheel function is formed;
   (b) the ball ramp coupling (7) comprises balls (42), the drive ring (6) axially arranged between the axial bearing (4) and its balls (42) arranged on the drive end and a coupling ring (8) on the output side,
   (c) a cone coupling (9) is arranged between the coupling ring (8) on the output side and a spring sleeve (11) for a cylindrical spring (10),

   characterized in that
   (d) axially between the cone coupling (9) and the spring sleeve (11) a torque-dependent coupling (16) with positive restraint is arranged.

2. The adjusting device (1) as claimed in claim 1, characterized in that the cone coupling (9) is a ball cone coupling comprising the coupling ring (8) on the drive end and a cone bush (17) interacting with the torque-dependent coupling (16), wherein between the coupling ring (8) on

the output side and the cone bush (17), cone balls (43) are arranged.

3. The adjusting device (1) as claimed in claim 2, characterized in that the torque-dependent coupling (16) is designed as a ratchet coupling from a portion of the cone bush (17) of the cone coupling (9) and a coupling disk (18), each of which comprise corresponding toothings, wherein the coupling disk (18) is connected to the spring sleeve (11).

4. The adjusting device (1) as claimed in claim 3, characterized in that the corresponding toothings have a first spur toothing (34) arranged on the portion of the cone coupling (9) and a second spur toothing (35) arranged on the coupling disk (18).

5. The adjusting device (1) as claimed in any one of the preceding claims, characterized in that the torque-dependent coupling (16) is designed for a higher transmission moment than the ball ramp coupling (7).

6. The adjusting device (1) as claimed in any one of the preceding claims, characterized in that the drive ring (6) comprises a drive ring inner profile (39) and the coupling ring (8) on the output side comprises a coupling ring inner profile (38), which interact with an outer profile (37) of a collar bush (4) axially extending through the ball ramp coupling (7) and the coupling ring (8) on the output side, wherein the collar bush at an end located opposite the outer profile (37) comprises a

collar which forms a fixed portion of the axial bearing (5).

7. The adjusting device (1) as claimed in claim 6, characterized in that between the outer profile (37) and the inner profiles (38, 39) an angular clearance (40) for the advance of a stop between outer profile (37) and drive ring inner profile (39) over a stop between outer profile (37) and coupling ring inner profile (39) is formed.

8. The adjusting device (1) as claimed in claim 6 or 7, characterized in that the other end of the collar bush (4), which forms the fixed portion of the axial bearing (5) is fastened in a rotationally fixed manner to the mounting disk (3) that can be attached to the brake calliper (22).

9. A disk brake (20), more preferably a pneumatically actuated disk brake, with an adjusting device (1) as claimed in any one of the preceding claims.

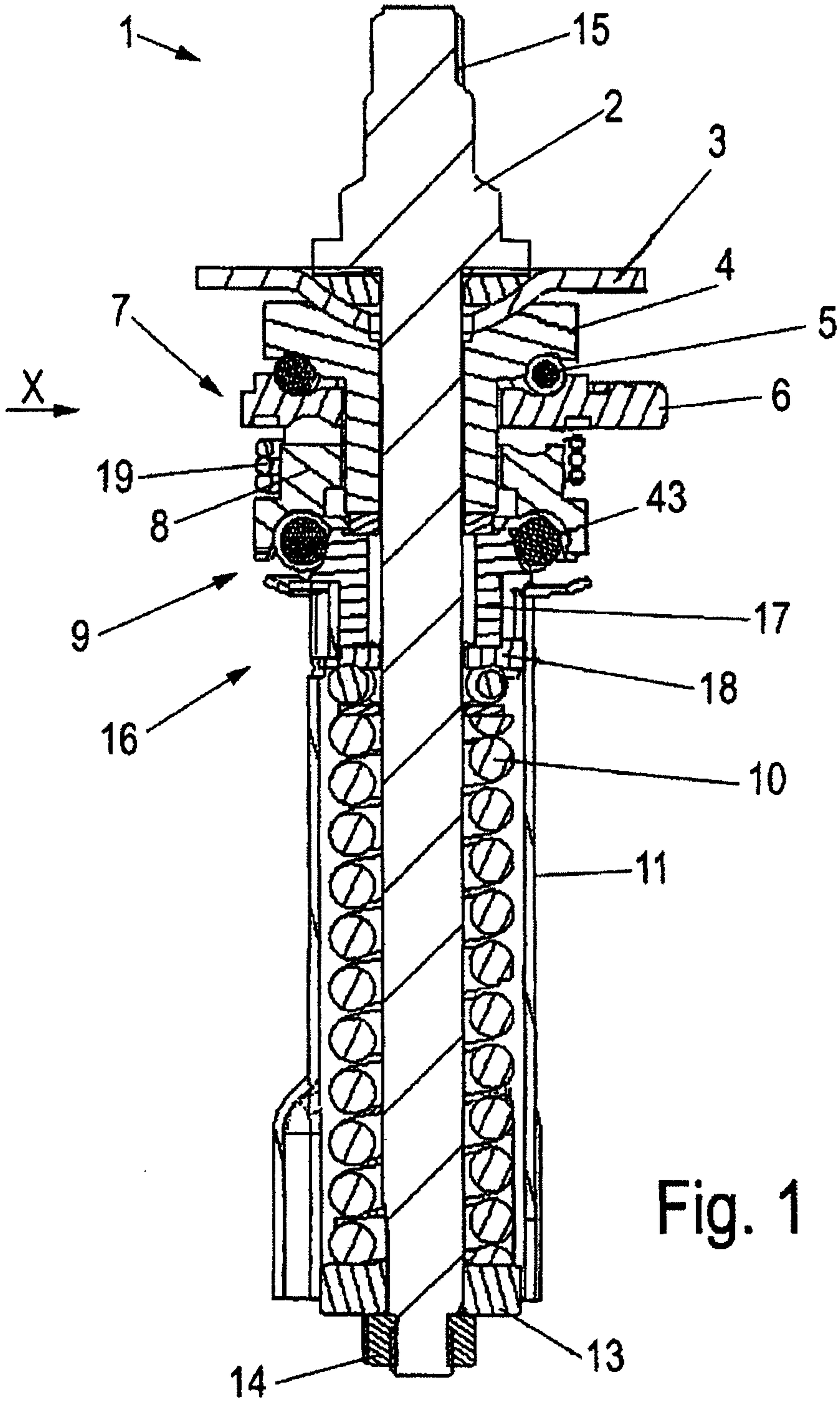

Fig. 1

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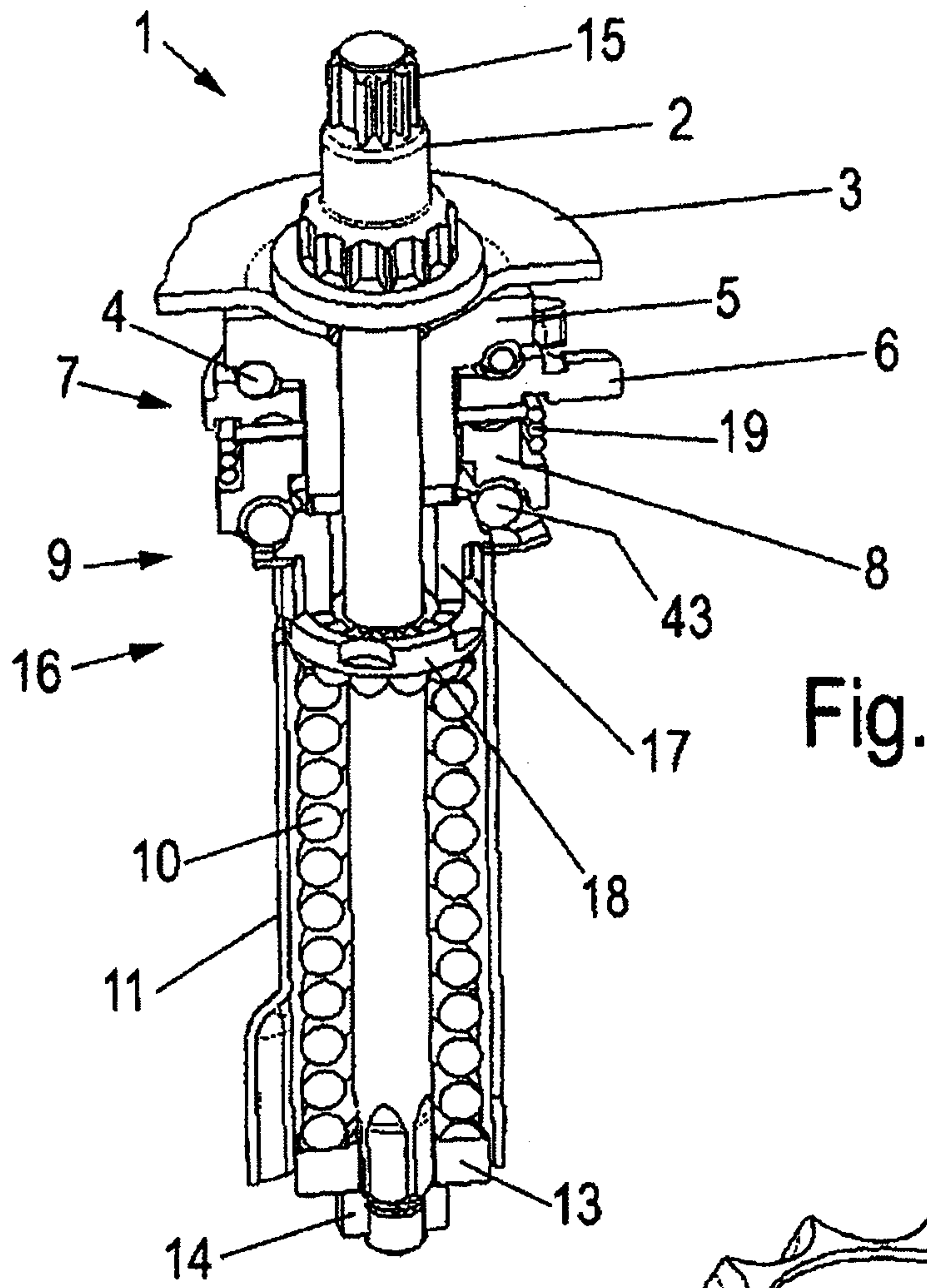
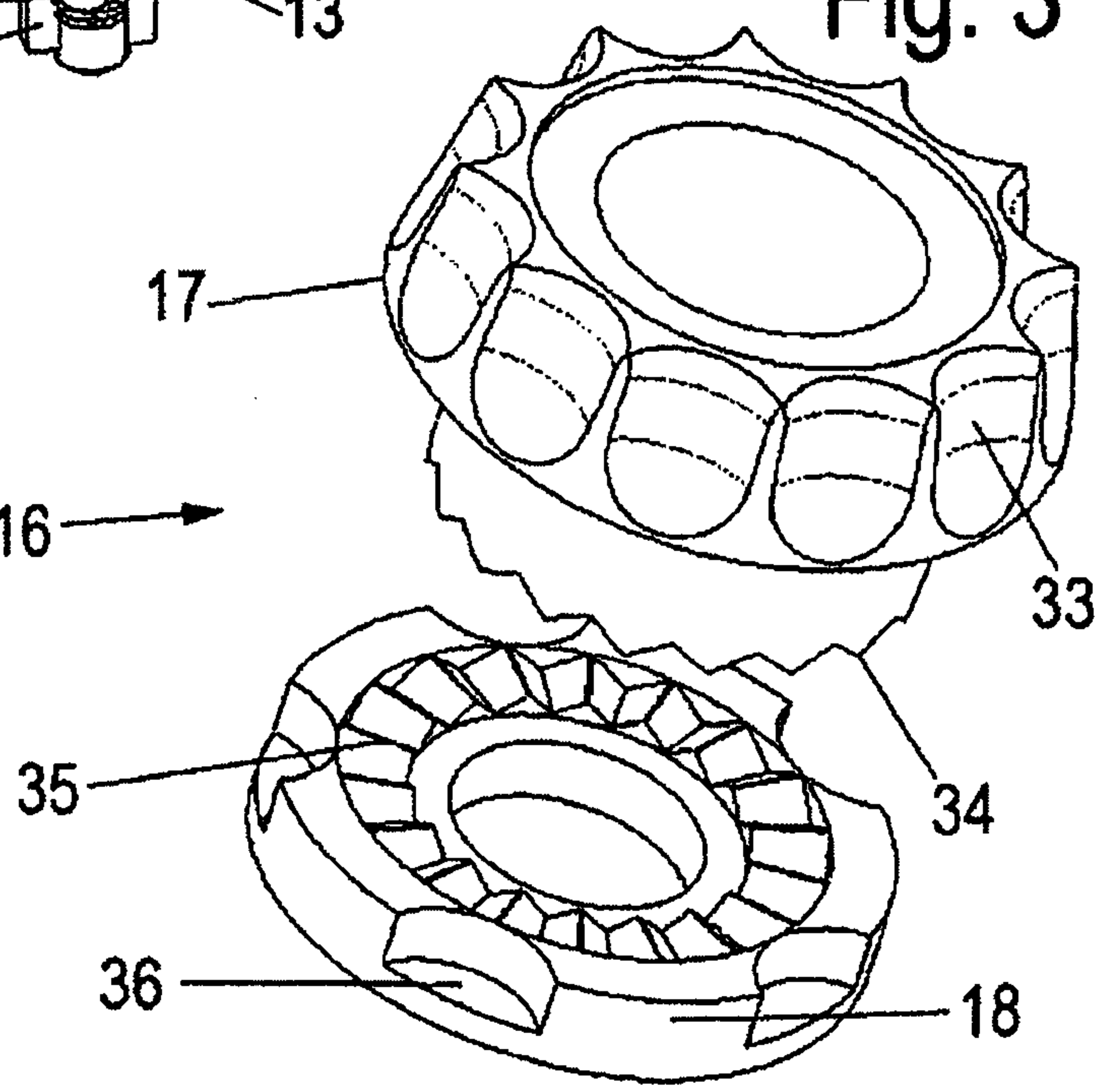


Fig. 2

Fig. 3



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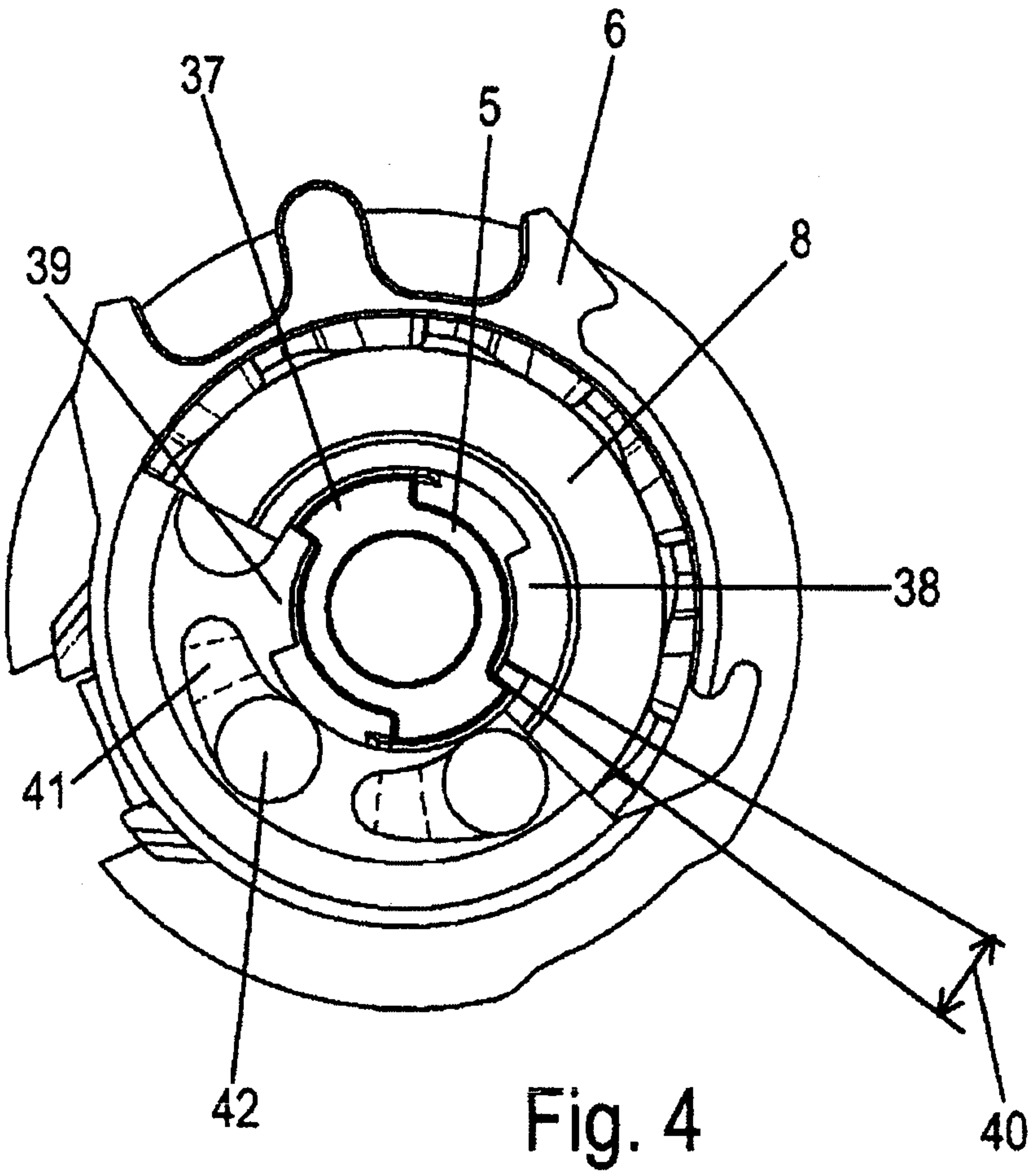

Fig. 4

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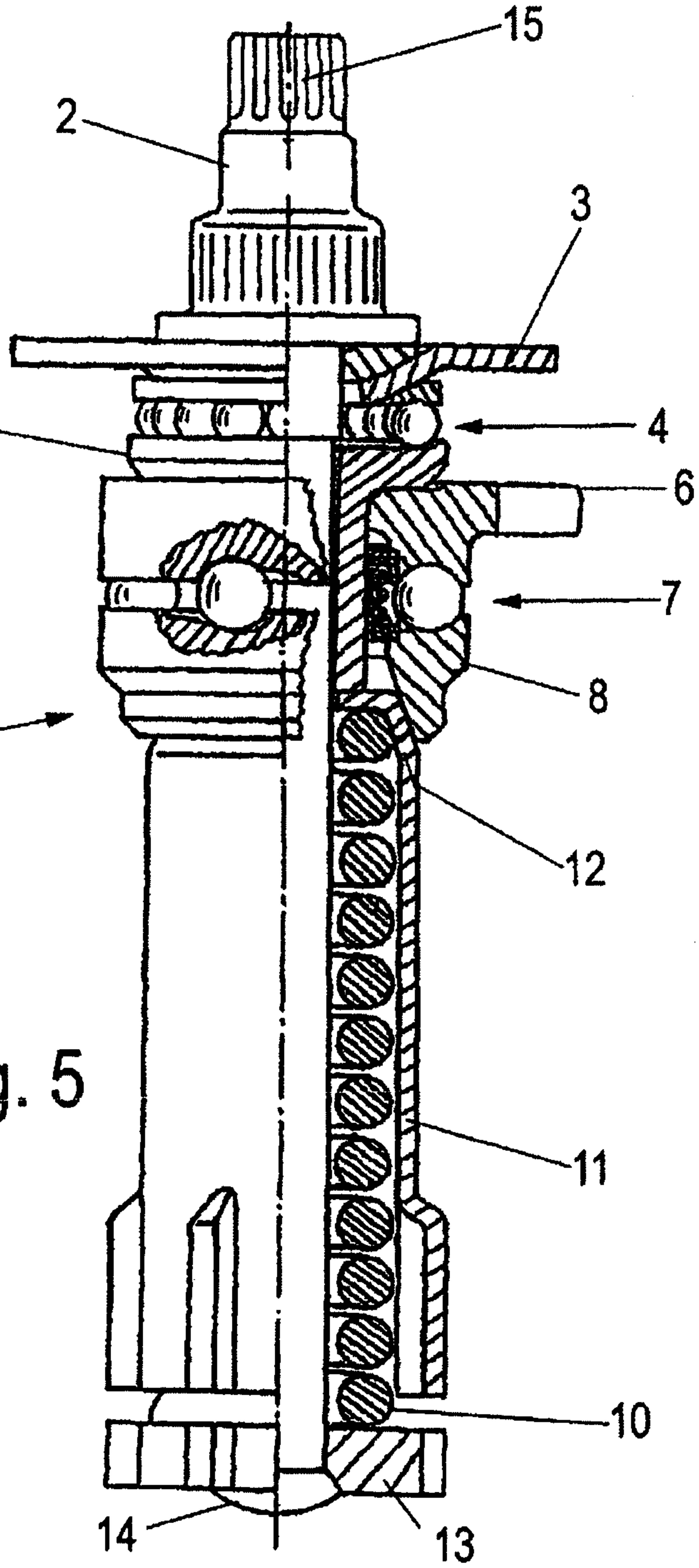

Fig. 5

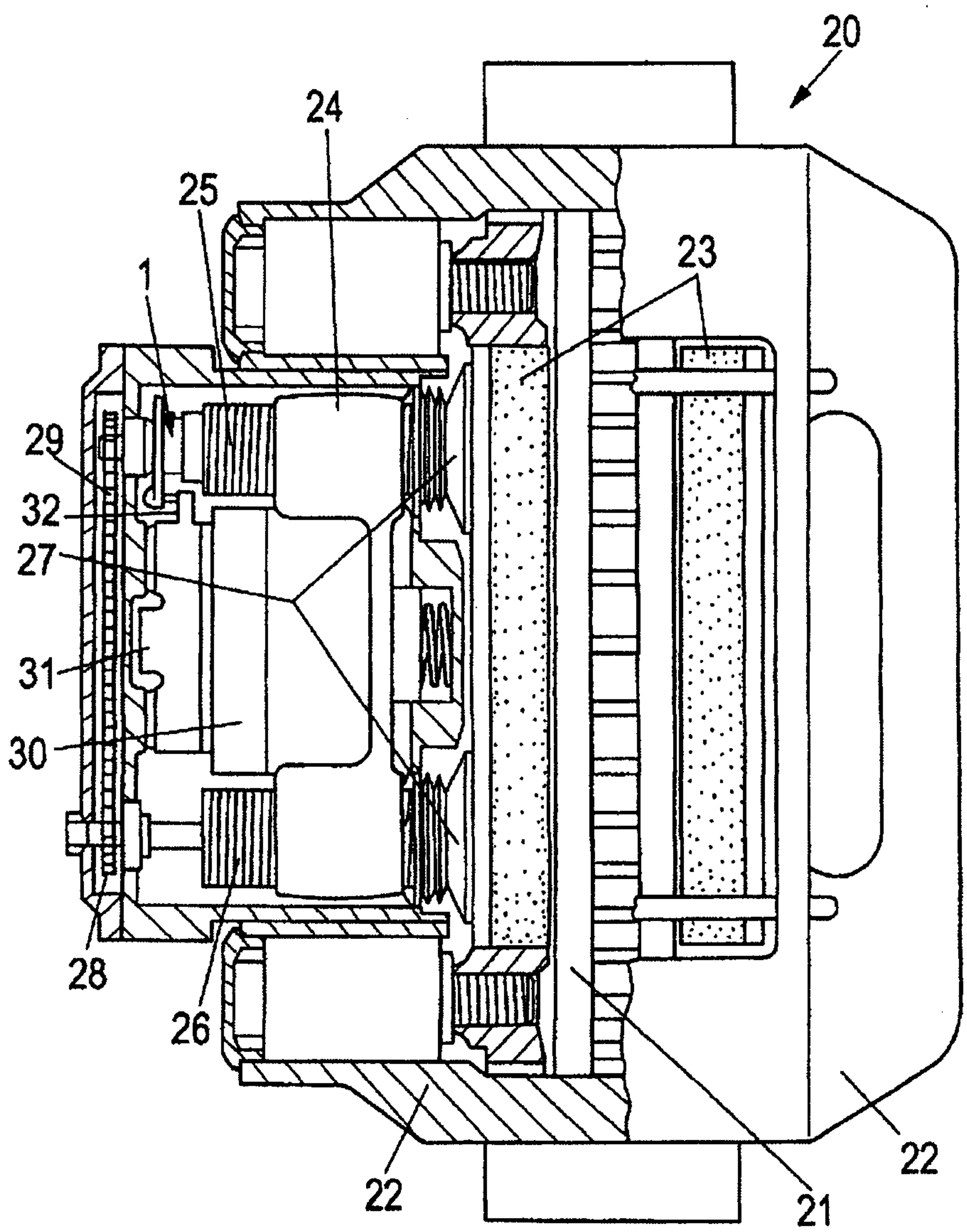

Fig. 6

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Fig. 1