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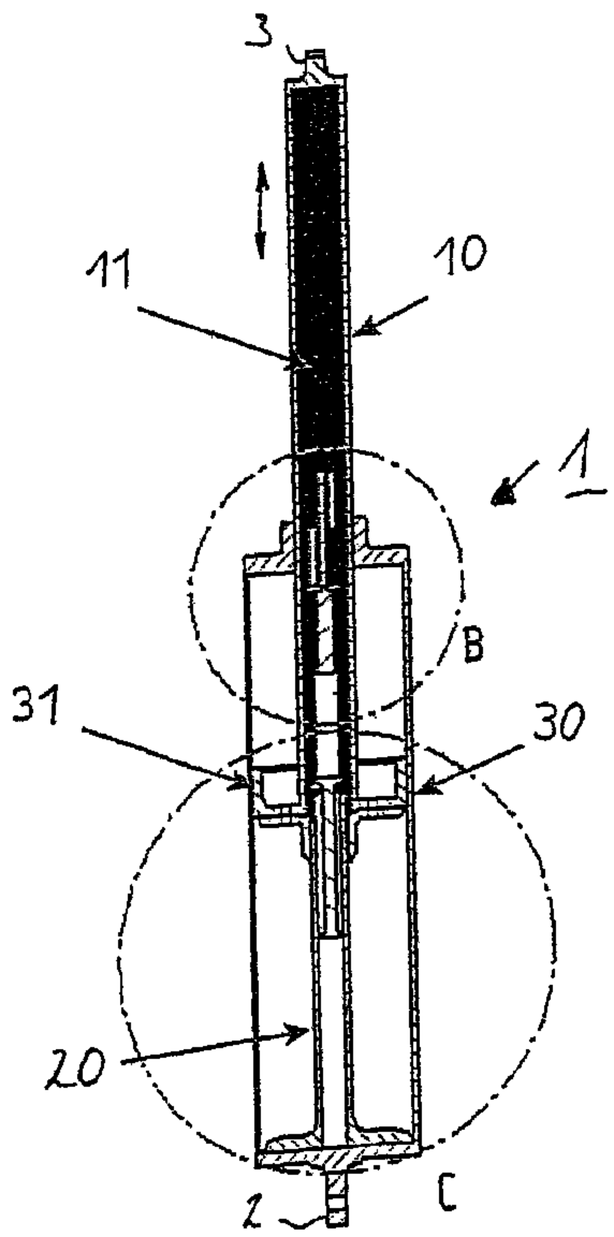
(54) Titre : DISPOSITIF DE VERROUILLAGE POUR DES ACTIONNEURS LINEAIRES
(54) Title: LOCKING MECHANISM FOR LINEAR ACTUATORS



(57) Abrégé/Abstract:
The invention relates to a locking mechanism for linear actuators, especially fluid-actuated adjusting devices, with a piston rod (10) that is mounted so as to be movable in an axial direction relative to a receiving device (30). The aim of the invention is to create a locking mechanism for linear actuators by means of which locking is possible along the entire travel path of the linear actuators. Said aim is achieved by the fact that the piston rod (10) comprises a hollow space (11) which extends in an axial direction and within which form-fitting devices (12) are disposed so as to be distributed in said axial direction while form-fitting elements (22) which correspond to the form-fitting devices (12) and are mounted so as to be axially stationary relative to the receiving device (30) are arranged inside the piston rod (10) in a radially movable manner. Furthermore, an actuating device (40) which radially displaces the form-fitting elements (22) is allocated to the form-fitting elements (22).

Abstract

The invention relates to a locking device for linear actuators, in particular for fluid-actuated adjusting devices, with a piston rod (10) mounted in an axially displaceable manner relative to a receiving device (30). The object of the invention is to provide a locking device for linear actuators, with which a secure locking is possible over the entire travel path of the linear actuators. This object is attained in that the piston rod (10) has a hollow space (11) extending in the axial direction, in which form-fitting devices (12) are arranged distributed in the axial direction, that form-fitting elements (22) corresponding to the form-fitting devices (12) are arranged in the piston rod (10) in a radially displaceable manner, which elements are mounted in an axially stationary manner relative to the receiving device (30), and that an actuating device (40) that displaces the form-fitting elements (22) radially is assigned to the form-fitting elements (22).

Locking device for linear actuators

The invention relates to a locking device for linear actuators, in particular for fluid-actuated adjusting devices, with a piston rod mounted in an axially displaceable manner relative to a receiving device. The invention is suitable in particular for hydraulic adjusting devices that are used for safety-critical applications.

From prior art, hydraulic lockings in the form of a flow check valve are known for hydraulic adjusting devices. In particular for safety-critical applications in aviation, flow check valves for locking the hydraulic adjusting device are disadvantageous, since there is the possibility of leakage at each seal situated in the system. A malfunction of the valve can have serious consequences. Furthermore, volume changes of the hydraulic fluid are brought about by the temperature variations present in flight operation, which volume changes in the case of the hydraulic locking could lead to the exit of hydraulic fluid due to positive pressure or the entry of ambient air due to negative pressure.

Furthermore, frictional lockings via various clamping principles are known. The disadvantage of these is the high Hertzian pressure necessary to provide the required holding power. Moreover, the constructive expenditure of the clamping connections is extremely high and results in a high structural weight. The disadvantage of clamping connections is their tendency to be irreversible, so that after a locking, a release of the clamping connections is impossible or only possible with great difficulty.

From DE 31 33 117 C2 a support strut for retractable aircraft landing gear, the length of which strut can be changed telescopically, is known in which when a landing gear is completely retracted, a locking takes place in the end position by means of form-fitting. Locking in a non-retracted position is not possible.

The object of the present invention is to provide a locking device for linear actuators, in particular for fluid-actuated adjusting devices, with a piston rod mounted in an axially displaceable manner relative to a receiving device, with which piston rod a secure locking is possible over the entire travel path of the linear actuators.

This object is attained according to the invention by a locking device with the features of claim 1, in which the piston rod has a hollow space extending in the axial direction, in which form-fitting devices are arranged distributed in the axial direction. In addition, form-fitting elements corresponding to the form-fitting devices are arranged in the piston rod in a radially displaceable manner, which elements are mounted in an axially stationary manner relative to the receiving device. An actuating device that displaces the form-fitting elements radially is assigned to the form-fitting elements. It is thus possible via the actuating device to bring the form-fitting elements into form-fitting engagement with the form-fitting devices inside the piston rod, so that a form-fitting locking is possible inside the piston rod at discrete points over the entire travel path. It is thus possible to enable a secure locking of the linear actuators without a hydraulic locking and with a minimal constructive expenditure. Moreover, the mechanical locking through form-fitting inside the piston rod offers the possibility of a protected accommodation of the locking mechanism.

A further development of the invention provides that the form-fitting devices inside the piston rod are embodied as grooves, in particular radially peripheral grooves. In order to avoid a notch effect inside the piston rod and in order not to impair the stability of the piston rod, the form-fitting devices are embodied in the shape of groove rings that are inserted arranged behind one another in the piston rod. In the hollow piston rod, individual rings of different diameter or rings with recessed grooves are introduced and fixed therein. In addition, this has the advantages of a simple manufacture and easy assembly.

A further development of the invention provides that the receiving device for the piston rod is a cylinder, in particular a hydraulic or pneumatic cylinder, in which a piston fixed to the piston rod is mounted displaceably. The piston can be acted on by pressure on both sides, so that the piston rod is mounted so that it can be displaced to and fro in the axial direction.

Moreover it is provided that the form-fitting elements are embodied radially spring-mounted or mounted radially spring-mounted, in order to be able to actuate a reversibility of the form-fitting engagement simply. It is possible thereby that the form-fitting elements are held under tension disengaged from the form-fitting devices

during the operation of the linear actuator and that after the tension has been released, the form-fitting elements are brought by the spring force into engagement with the form-fitting devices. Alternatively it is provided that the form-fitting elements are disengaged in the relaxed position and are brought into the form-fitting engagement with the form-fitting devices only by the actuating device. After removal of the actuating device or after a movement back into the starting position, the form-fitting elements spring back into the relaxed position, so that the free movability of the actuator or the adjusting device is again provided.

One embodiment of the invention provides that the form-fitting elements are projections arranged or embodied on a holder. Alternatively, the form-fitting elements are segments mounted displaceably, which segments are displaced radially, or are spring washers embodied radially spring-mounted that either spring into the form-fitting devices or spring out of them.

An advantageous variant of the invention provides that the holder is embodied as a spreader sleeve that is provided with slots in the axial direction so that the slotted sections can be displaced radially. The form-fitting elements are embodied or arranged on the slotted sections, preferably at the ends of the sections, so that a locking of the piston rod relative to the holder or to the receiving device is possible over the entire displacement area of the piston rod. The form-fitting elements are thereby mounted on the holder in an axially stationary manner relative to the receiving device. The holder or the spreader sleeve is enclosed by the piston rod at least in the area of the form-fitting elements, so that the form-fitting elements can engage in the form-fitting devices symmetrically, preferably in a circumferential circle inside the piston rod.

In order to achieve a radial displacement of the form-fitting elements in a simple and reliable manner, the actuating device is embodied as an axially displaceable gripping cone, by means of whose axial displacement the form-fitting elements are caused to engage with or disengage from the form-fitting devices of the piston rod. To this end it is provided that a mating cone complementary to the gripping cone is embodied on the spreader sleeve, via which mating cone the form-fitting elements are held disengaged from the form-fitting devices. An embodiment of this type is provided

when the form-fitting elements are held disengaged under tension. To this end the gripping cone is embodied as a cap-shaped outer cone in which the mating cone engages. Alternatively it is provided that the gripping cone is embodied as an inner cone that is inserted into a funnel-shaped mating cone of the spreader sleeve. Through an axial displacement of the gripping cone the spreader sleeve is widened and the form-fitting elements are brought into engagement with the form-fitting devices.

In order to prevent the form-fitting elements from escaping radially inwards when the elements are engaged with the form-fitting devices, a tension- and locking sleeve is arranged inside the spreader sleeve as a support sleeve, which support sleeve in the locked state is displaced into the area of the slotted sections and exerts a supporting action. To this end it is provided that the gripping cone is coupled with the tension- and locking sleeve via a spring-loaded tension anchor, so that the tension- and locking sleeve is displaced via a spring automatically when the tension- and locking sleeve is released.

An exemplary embodiment of the invention is described in more detail below based on the attached figures. They show:

Fig. 1 A cross-sectional view of a hydraulic adjusting device;

Fig. 2 Detail C of Fig. 1;

Fig. 3 A detailed view of a spreader sleeve;

Fig. 4 Detail B in Fig. 1; as well as

Fig. 5 Detail D in Fig. 4.

Fig. 1 shows a linear actuator 1, in this case a hydraulic adjusting device, with a piston rod 10 that is guided displaceably in a receiving device 30 embodied as a cylinder. The two ends 2, 3 of the adjusting device 1 have fixing devices that can be attached to objects that are to be mounted movably relative to one another. The cylinder 30 serving as receiving device for the piston rod 10 is a hydraulic cylinder in

which a piston 31, which is fixed to the piston rod 10, can be moved in the direction of the double arrow. On the side of the cylinder 30 facing away from the piston rod 10, a holder 20 is fixed that runs through the piston 31 and projects into a hollow space 11 of the piston rod 10. On the end of the holder 20 on the piston rod side, form-fitting elements (not shown) are embodied that if required engage in form-fitting devices (likewise not shown) inside the piston rod 10. A form-fitting locking of the piston rod 10 relative to the cylinder 30 or the holder 20 takes place, whereby the locking can be undertaken in almost every position of the piston rod 10 relative to the cylinder 30, since the form-fitting devices are composed of grooves arranged axially behind one another, which grooves are arranged in the exemplary embodiment in the hollow space 11 over the entire length of the piston rod 10. In the state shown, the form-fitting elements of the holder 20 are disengaged from the form-fitting devices inside the piston rod 10, so that the piston rod 10 is freely movable axially. The holder 20 is connected with the cylinder 30 or with the cylinder housing and attached to the latter, so that the form-fitting elements are also fixed immovably to the cylinder housing 30 in the axial direction.

In Fig. 2 the detail C of Fig. 1 is illustrated in an enlarged scale and shows in a cross-sectional view the cylinder housing 30 with the holder 20 fixed therein. The holder 20 has a central bore 25 in which a tension anchor 43 for a tension- and locking sleeve (not shown) is arranged in a longitudinally displaceable manner, which sleeve is held stationary via a holding device 99. A base plate 32 that is fixed to the piston 31 is arranged around the outer wall of the holder 20. The piston 31 in turn is fixed to the piston rod 10, which has form-fitting devices 12 in its interior. The form-fitting devices 12 are embodied in the form of groove rings that are layered behind one another inside the hollow space 11 of the hollowed-out piston rod 10. The groove rings 12 are held in the piston rod 10 by means of the base plate 32. The groove rings 12 embody peripheral grooves. The piston rod 10 and the groove rings 12 are dimensioned such that the piston 31 and the base plate 32 can slide along on the holder 20. In combination with the base plate 32, the piston 31 serves as guide for the holder 20, which in this way obtains a better buckling strength.

On the upper end of the holder 20 (not shown) a spreader sleeve is embodied, as shown in Fig. 3. The spreader sleeve 20 is composed thereby of slotted sections 21

that are formed by cuts 24 running axially. The slotted sections 21 are radially displaceable and have form-fitting elements 22 on their exterior in the form of elevations or catches. The upper termination of the spreader sleeve 20 is formed by a mating cone 23 that tapers upwards.

In Fig. 4 the detail B of Fig. 1 is shown, in which the cylinder housing 30 with the piston rod 10 mounted displaceably therein can be seen. The form-fitting devices 12 in the form of groove rings are inserted in the hollow space of the piston rod 10; alternatively, the grooves can be recessed in the piston rod 10. Moreover, the grooves can be embodied as screw threads (acme threads or the like), for example as an internal thread inside the piston rod 10. The form-fitting elements can be embodied on the spreader sleeve 20 as an external thread. The holder 20, which is embodied as a tube, is guided inside the piston rod 10 and inside the groove rings 12. In the holder 20 a tension- and locking sleeve 45 is mounted displaceably. Inside the tension- and locking sleeve 45, a tension anchor 43 is mounted that is loaded in the direction of the cylinder-side end of the holder 20 via a spiral spring 45. The spreader sleeve shown in Fig. 3 is embodied at the piston rod-side end of the holder 20, which spreader sleeve is enclosed by the front end of the tension anchor 43. The front end of the tension anchor 43 is provided with a gripping cone that displaces the mating cone 23 radially inwards by applying an axial force, so that the outside diameter of the spreader sleeve 20 is decreased. The form-fitting elements 22 are thus disengaged from the form-fitting devices 12, so that the piston rod 10 is freely movable axially.

In Fig. 5 the detail D of Fig. 4 is shown, based on which it can be seen that the gripping cone 40 as an actuating device displaces the mating cone 23 of the spreader sleeve 20 radially inwards. In this state the spreader sleeve 20 is tensioned and the linear actuator 1 is freely movable. If the axial holding force on the tension- and locking sleeve 45 is eliminated in that a holding device 99 as indicated in Fig. 2 is released, because of the radial tension of the slotted sections 21 of the spreader sleeve 20 the tension anchor 43 is displaced in the direction of the piston rod 10 due to the action of the mating cone 23 on the gripping cone 40. The spreader sleeve 20 relaxes and the slotted sections 21 spring radially outwards. This causes the form-fitting elements 22 to engage with the form-fitting devices 12 and to lock the piston rod 10 in this position. The catches or the projections 22 press against the groove rings 12 due

to the internal stress brought about by the spring action of the slotted sections 21, as well as due to the tension- and locking sleeve 45 loaded by the coil spring, which tension- and locking sleeve 45 exerts a wedge action on the inner flank of the spreader sleeve 20, which is still deformed inwardly. In so far as the grooves and the projections or catches lie opposite one another, a locking into position occurs. After the locking into position of the form-fitting elements 22 in the groove rings 12, a cylindrical geometry is present inside the slotted sections 21 of the spreader sleeve 20. Now the cylindrical tension- and locking sleeve 45, driven by the tensioned coil spring 44, is displaced completely into the slotted area of the spreader sleeve 20. The tension- and locking sleeve 45 is supported thereby via the coil spring 44 on the tension anchor 43, via the gripping cone 240 and the mating cone 23 axially on the mating cone 23. A slipping back of the tension- and locking sleeve is thus prevented. By these means the slotted sections 21 of the spreader sleeve 20 are prevented from buckling inwards. To unlock the locking, the tension- and locking sleeve 45 is transported in the opposite direction, i.e. in the direction of the cylinder 30, the coil spring 44 is prestressed. Then the tension anchor 43 is moved concomitantly in a form-fitting manner through the tension- and locking sleeve 45, the gripping cone 40 engages with the mating cone 23 and displaces the slotted sections 21 radially inwards. The form-fitting elements 22 are thus disengaged from the form-fitting devices 12 and the adjusting device 1 is freely movable axially.

The locking device can be used wherever an axial movement must be blocked reversibly, in a form-fitting manner, and if possible over the entire travel path. An extremely fine gradation of the form-fitting locking is possible through the arrangement of the groove rings 12 behind one another. A very good protection from external influences is provided by the locking device arranged inside the cylinder 30. The entire system is closed, so that damage caused by external influences is almost excluded. The reversible locking at discrete positions over the entire travel path of the adjusting device 1 is guaranteed, so that its use is possible even for safety-critical applications. The actuation of the tension- and locking sleeve 45 can take place through the central bore 25 of the holder 20, for example by hydraulic or electromotive means. An emergency actuation through a detonator is likewise possible.

Alternatively to a hydraulic adjusting device, all linear actuators can be equipped thus. Instead of the version shown of the form-fitting elements 22 held disengaged, it is provided to embody the gripping cone such that it widens the spreader sleeve 20. Likewise it is possible for latches or segments mounted displaceably, to be arranged inside the spreader sleeve 20 or the holder, which latches or segments are engaged with the form-fitting devices 12 in a form-fitting manner, in that these spring-mounted segments are pressed outwards by a cone. If spring washers are used, these can be held disengaged in an analogous manner and can be unlocked if required.

Claims

1. Locking device for linear actuators, in particular for fluid-actuated adjusting devices, with a piston rod mounted in an axially displaceable manner relative to a receiving device, characterized in that the piston rod (10) has a hollow space (11) extending in the axial direction, within which form-fitting devices (12) are arranged distributed in the axial direction, that form-fitting elements (22) corresponding to the form-fitting devices (12) are arranged in the piston rod (10) in a radially displaceable manner, which elements are mounted in an axially stationary manner relative to the receiving device (30), and that an actuating device (40) that displaces the form-fitting elements (22) radially is assigned to the form-fitting elements (22).

2. Locking device according to claim 1, characterized in that the form-fitting devices (12) are grooves.

3. Locking device according to claim 1 or 2, characterized in that the form-fitting devices (12) are groove rings that are arranged behind one another in the piston rod (10).

4. Locking device according to one of the preceding claims, characterized in that the receiving device (30) is a cylinder in which a piston (31) fixed to the piston rod (10) is mounted displaceably.

5. Locking device according to one of the preceding claims, characterized in that the form-fitting elements (22) are embodied or mounted radially spring-mounted.

6. Locking device according to one of the preceding claims, characterized in that the form-fitting elements (22) are projections arranged or embodied on a holder (20), segments mounted displaceably, or spring washers embodied radially spring-mounted.

7. Locking device according to claim 6, characterized in that the holder (20) is embodied as a spreader sleeve that is slotted in the axial direction and the form-fitting elements (22) are arranged on the slotted sections (21).

8. Locking device according to claim 6 or 7, characterized in that the form-fitting elements (22) are mounted on the holder (20) in an axially stationary manner relative to the receiving device, and the holder (20) is enclosed by the piston rod (10) at least in the area of the form-fitting elements (22).

9. Locking device according to one of the preceding claims, characterized in that the actuating device (40) is embodied as an axially displaceable gripping cone.

10. Locking device according to claim 9, characterized in that the a mating cone (23) complementary to the gripping cone (40) is embodied on the spreader sleeve (20), via which mating cone (23) the form-fitting elements (22) are held disengaged from the form-fitting devices (12).

11. Locking device according to one of claims 6 through 10, characterized in that a tension- and locking sleeve (45) that prevents an escape of the form-fitting elements (22) radially inwards is arranged inside the spreader sleeve (40).

12. Locking device according to claim 11, characterized in that the gripping cone (40) is coupled with the tension- and locking sleeve (45) via a spring-loaded tension anchor (43).

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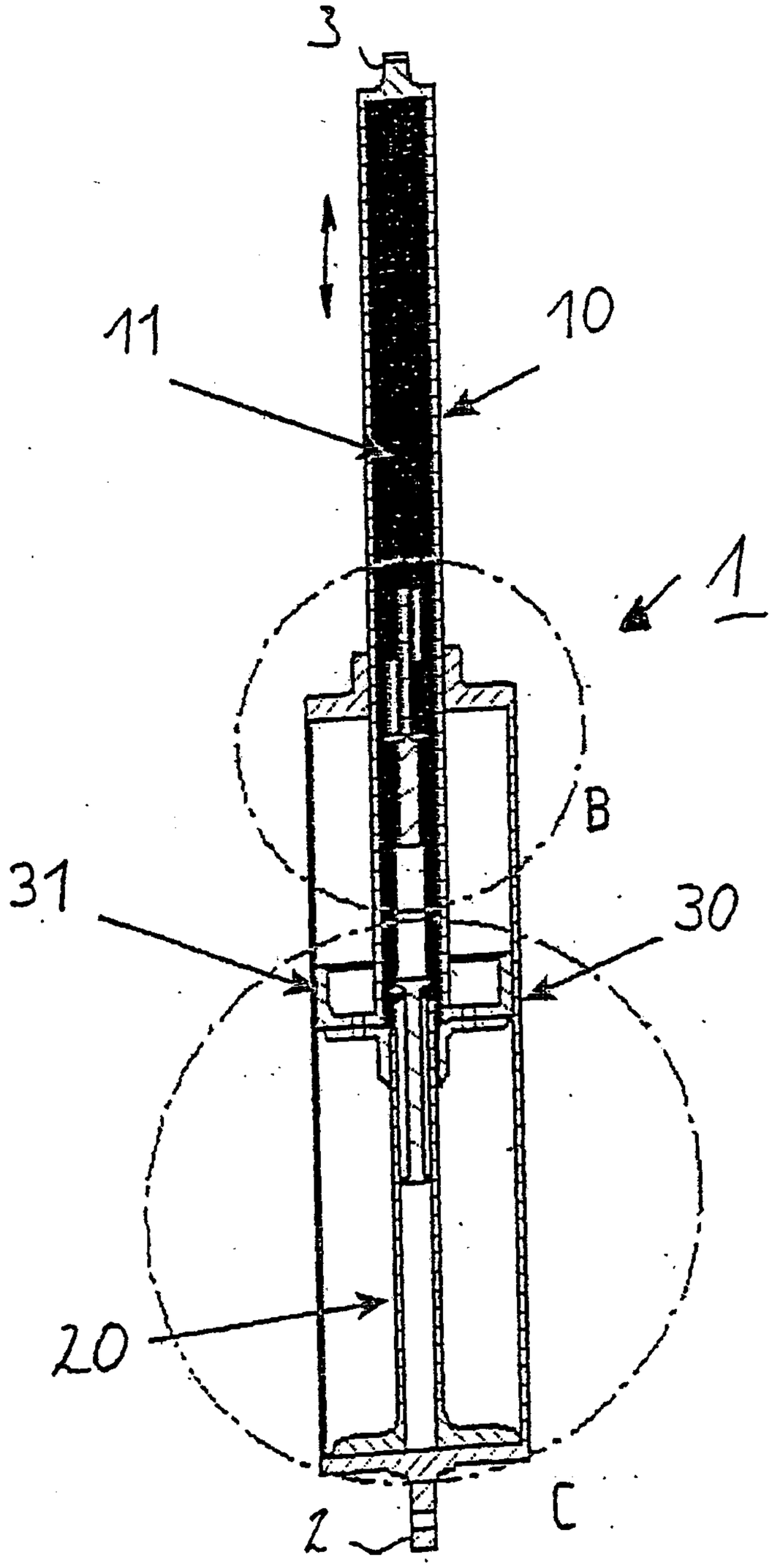


Fig. 1

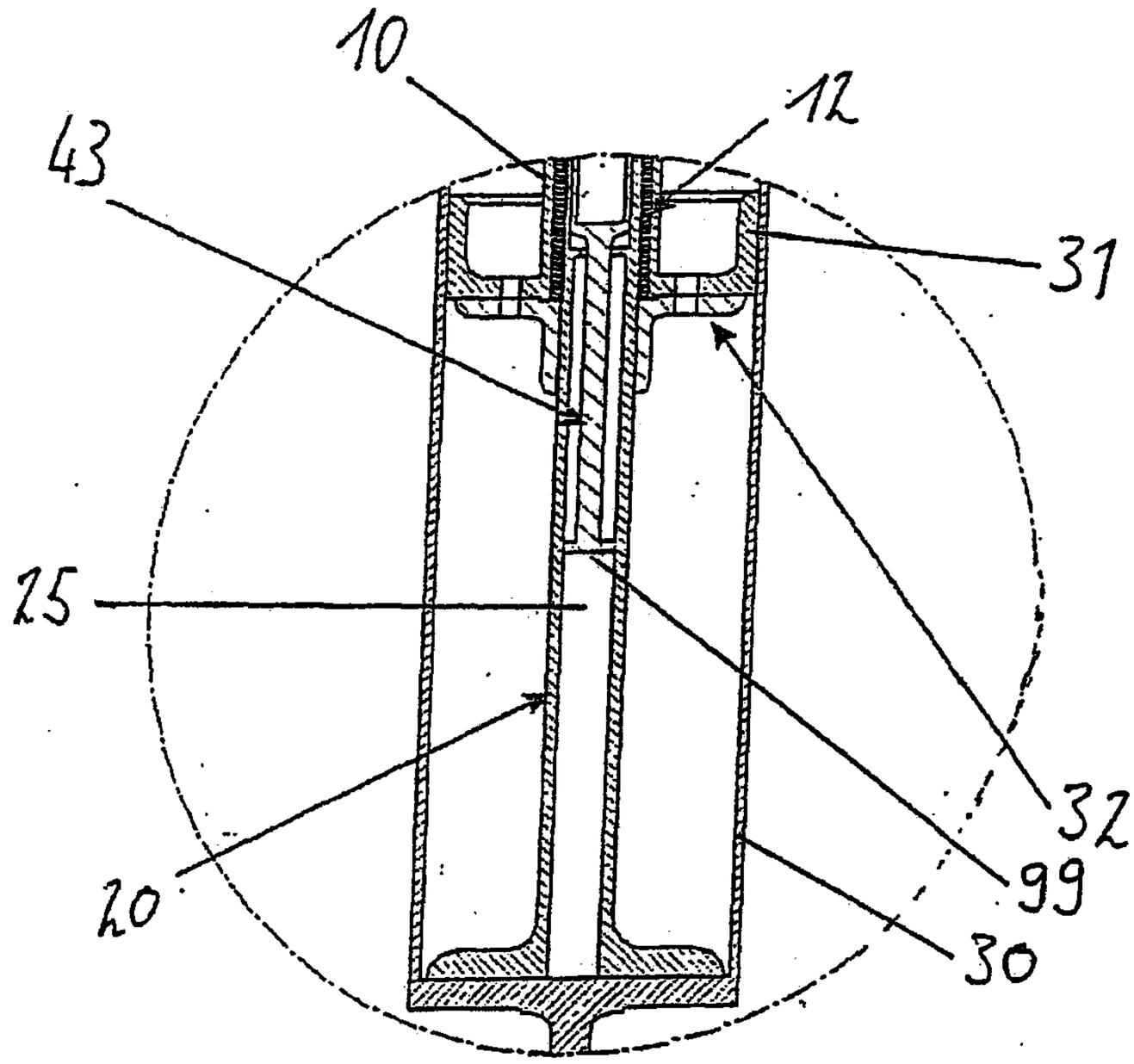


Fig. 2

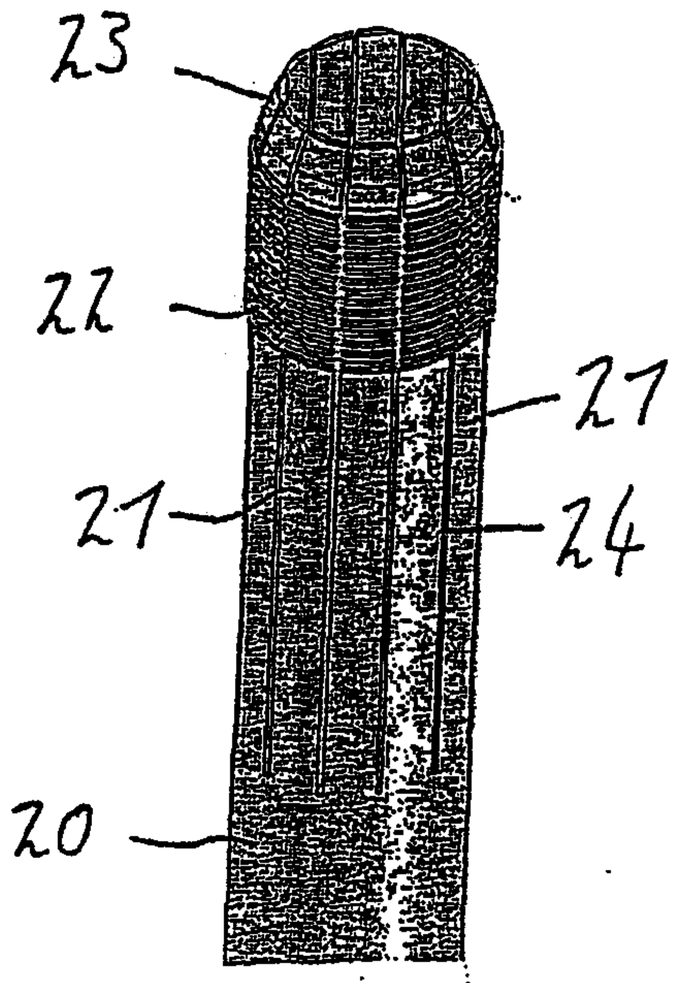


Fig. 3

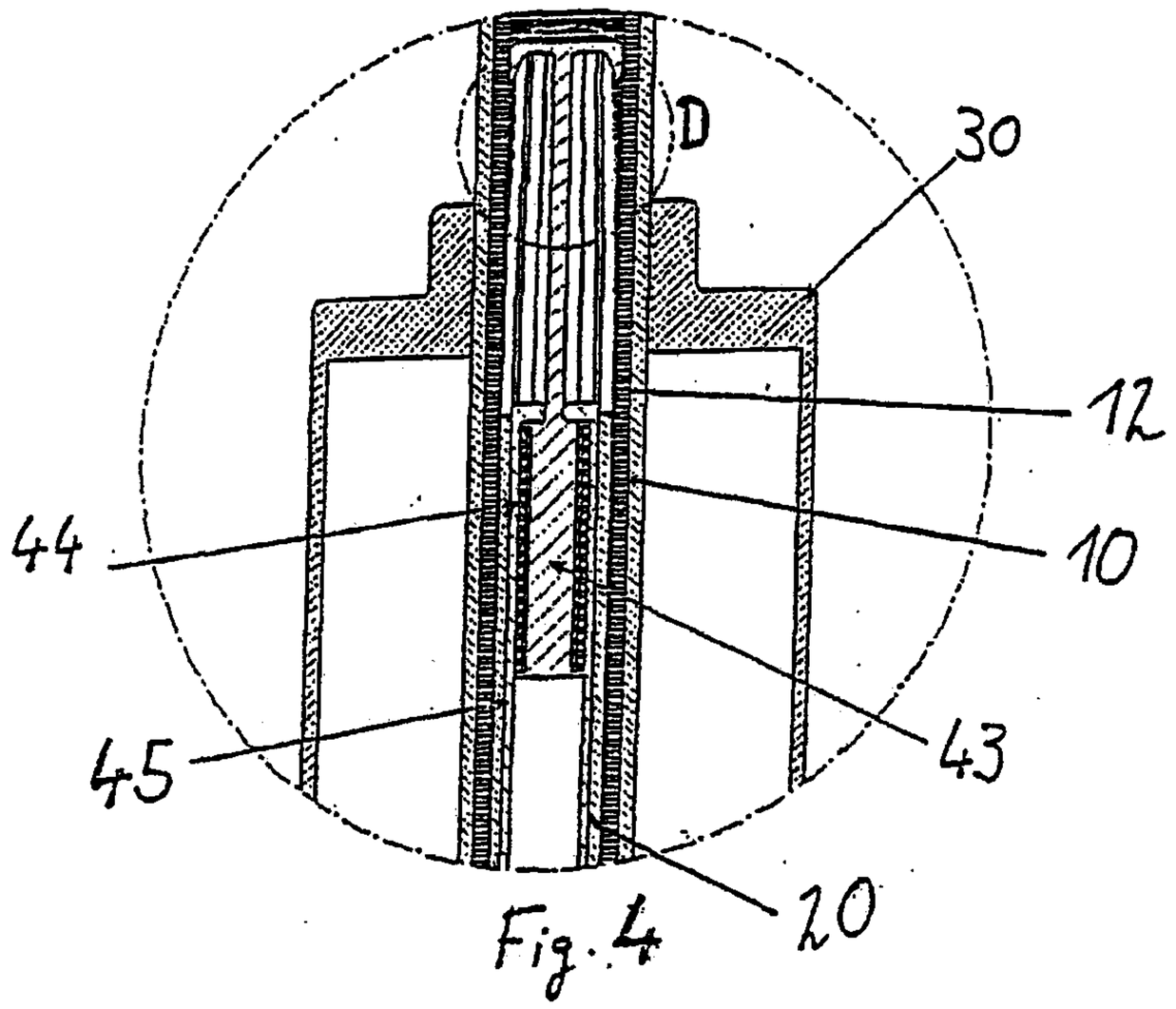


Fig. 4

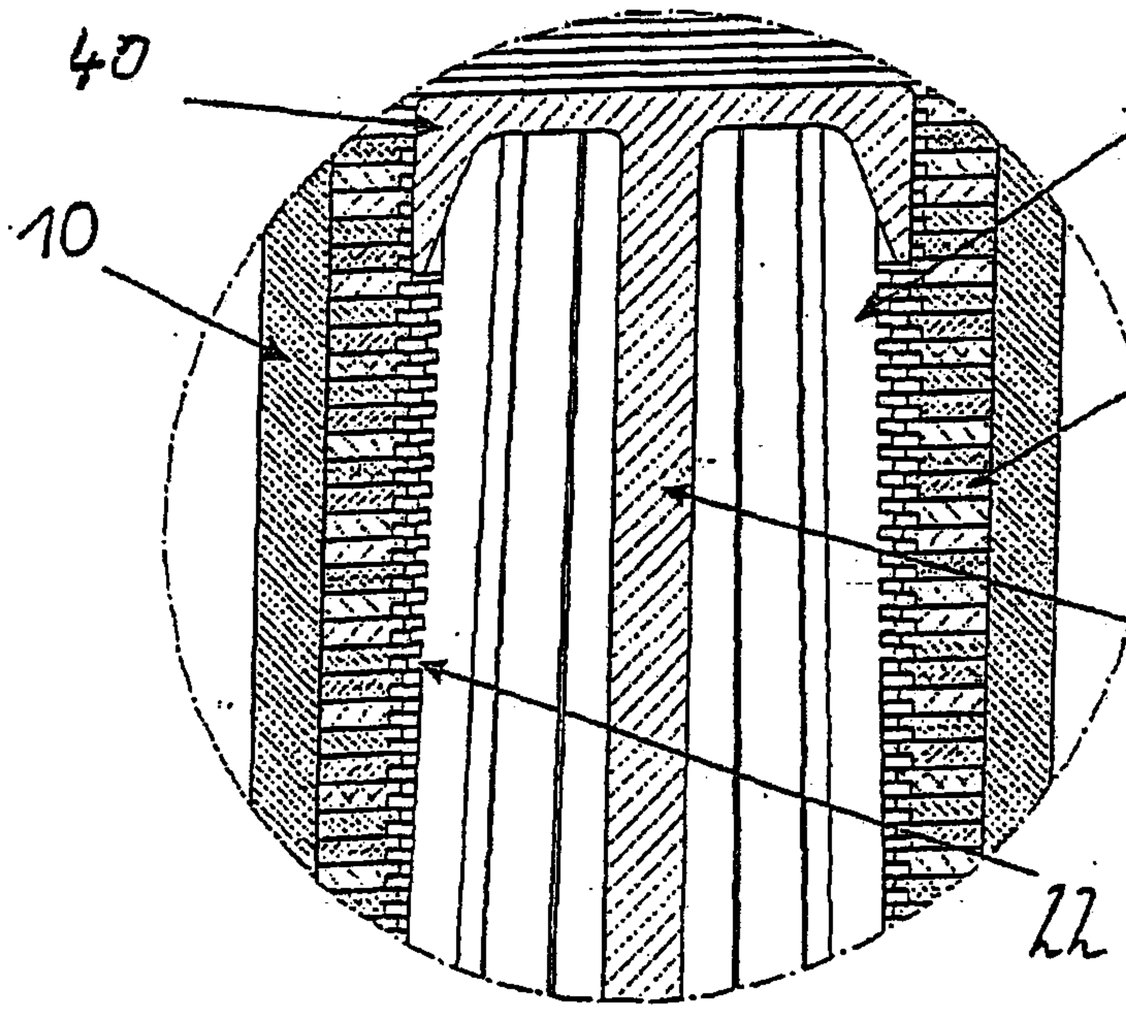
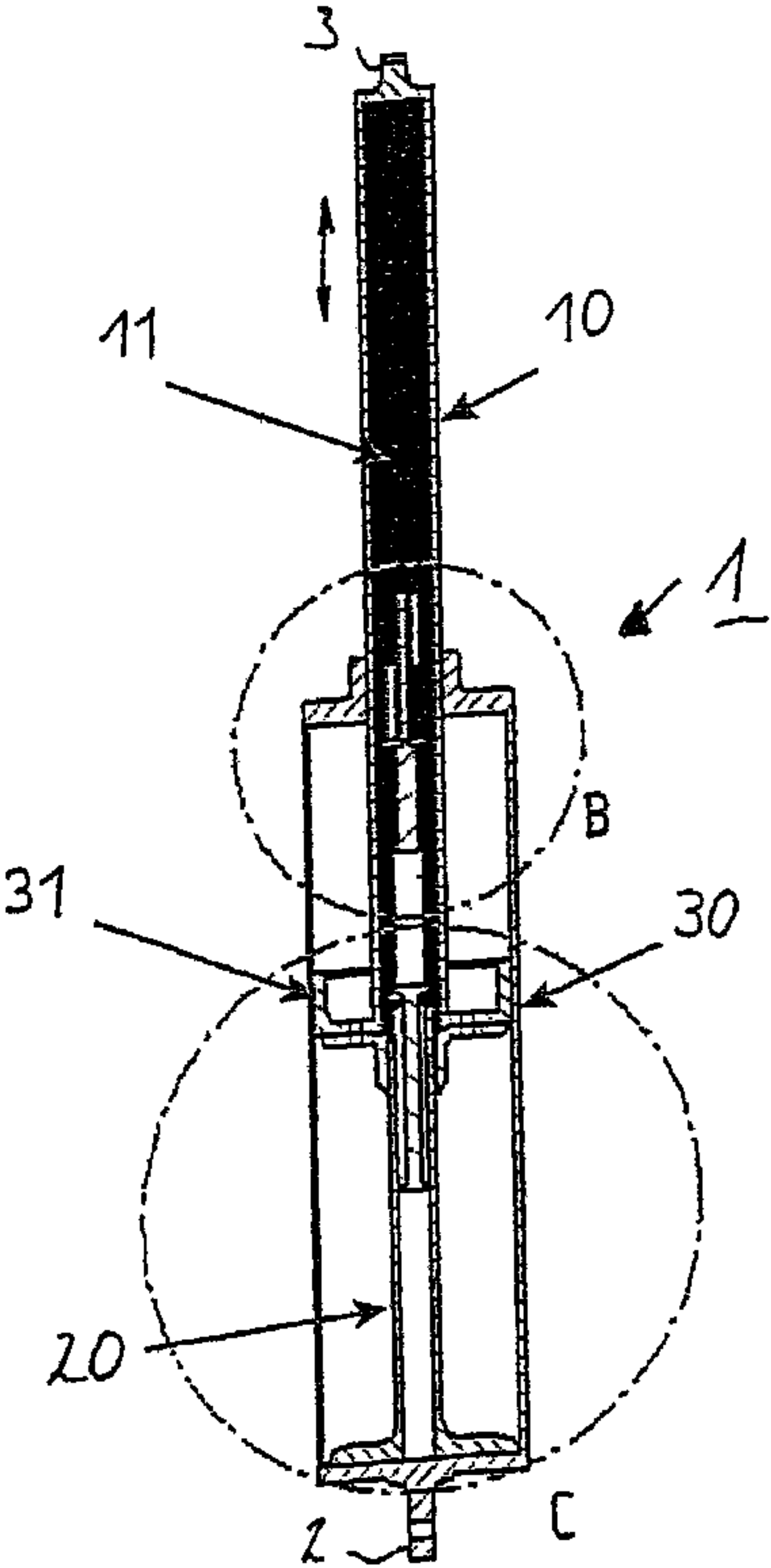


Fig. 5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