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(54) Linear cylinder unit with locking means

(57) Linear cylinder unit (1), in particular a pressure cylinder (2), comprising a cylinder tube (3), at least one end cover member (4), a piston (5), which is axial displaceable within said cylinder tube (3), a piston rod (6), which is connected to said piston (5) and at least one piston locking unit (7), whereas said piston locking unit (7) is arranged on at least one end of the body of the said pressure cylinder (2), whereas the piston locking unit (7) comprises a locking element (8), which is linear movable in a perpendicularly direction to the piston rod (6), in order to achieve a form- fitted connection between the piston rod (6) and the locking element (8), whereas the said locking element (8) features a plane profile including a bore (10), where the piston rod (6) is guided through, whereas the edge of the bore (10) engages in at least one recess (18) arranged in the said piston rod (6), in order to block the movement of the piston rod (6). By this invention the objective can be reached, to provide a linear cylinder locking unit, which offers a high accessibility, an optional removability and which features the transmission of high blocking forces through a high contact area and with a high stiffness.

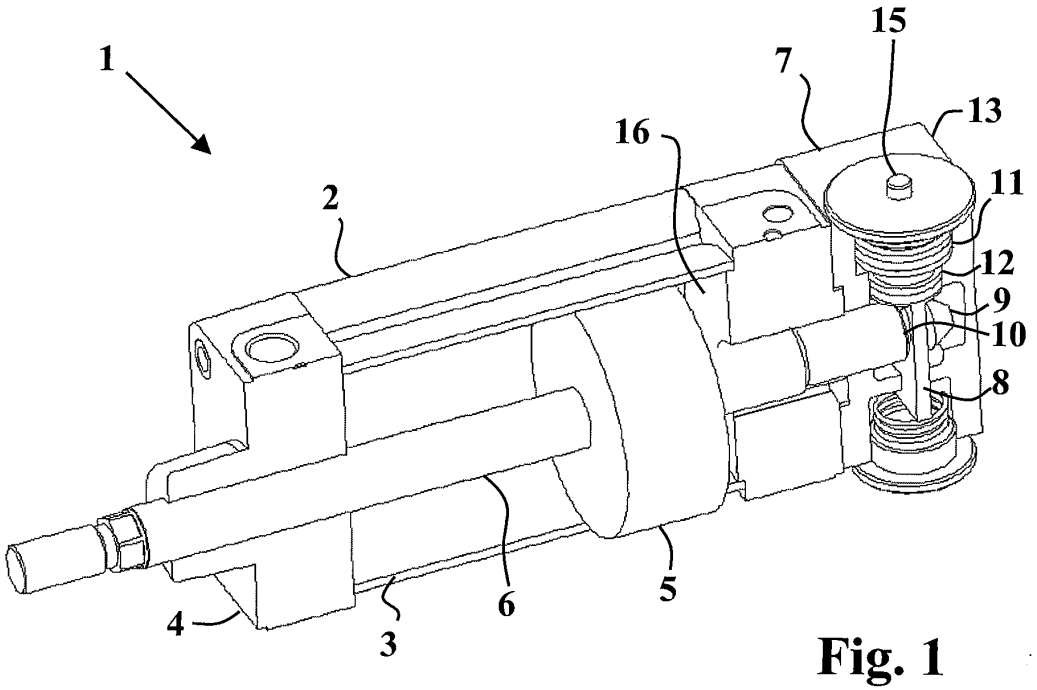

Fig. 1

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Description

[0001] Linear cylinder unit, in particular a pressure cylinder, comprising a cylinder tube, at least one end cover member, a piston, which is axial displaceable within said cylinder tube, a piston rod, which is connected to said piston and at least one piston locking unit, whereas said piston locking unit is arranged on at least one end of the body of the said pressure cylinder, whereas the piston locking unit comprises a locking element, which is linear movable in a perpendicularly direction to the piston rod, in order to achieve a form- fitted connection between the piston rod and the locking element.

[0002] Usually a locking unit is used in combination with a pressure cylinder, in order to block the movement of a piston rod, so as to fix the piston respectively the piston rod against the pressure cylinder. During the operation of pressure cylinders the piston rod is free movable by pressurising the corresponding chambers of the cylinder, but in case of an inactive condition of the cylinder in many applications the piston has to be blocked, in order to keep an unchanged position of the piston and the corresponding mechanism to be moved.

[0003] In other cases a cycle of repetitive movements of pressure cylinders comprising at least one stop position as a part of a duty cycle, it is necessitated to provide a piston rod clamping mechanism, which can easily be controlled to clamp and to release the piston rod either by a pressure fluid, connected to the system or manually by activating a releasing screw or similar. Often such locking units are installed in order to increase the security of mechanical systems where pressure cylinders are used as linear drives, for example during maintenance or when an operator is on the system.

[0004] The blocking effect can not be realised by the fluid system supplying the pressure cylinder, because the resilience of the fluid is too high. Therefore a direct mechanical locking system is necessary.

[0005] Another security feature is the blocking position of the locking unit in a bleed status of each pressure chamber, which is normally connected to a central pressure medium supply, because in case of a system breakdown the piston rod is blocked and no further, uncontrolled movement of the linear system is possible. The blocking effect of the locking element is realised by a spring element.

[0006] According to the state of the art in the publication US 6 598 513 B2 is disclosed a cylinder apparatus, comprising a cylinder tube which is connected between a first cover member and a second cover member each having a cylindrical configuration, an axial displaceable piston which inscribes the cylinder tube, a piston rod which is connected to the piston, an intermediate member which is connected between the cylinder tube and the second cover member, an axially movable member which inscribes the intermediate member, a first spring member which is connected between the second cover member and the movable member, and a piston pin mechanism which is inserted into a recess of the piston rod in a direction perpendicular to the axis.

[0007] Under the terms of the prior art different problems rise regarding the construction and the function of the disclosed locking unit. In the publications of the prior art the piston locking unit is designed as a one piece construction. In the prior art the linear cylinder is not usable without the locking system, because the end cover member and the locking unit is integrated in one part. However, the integrated construction of the end section of the linear system and the piston locking unit complicates maintenance and repair operations due to its disadvantageous accessibility.

[0008] In publication WO 0192732A1 is disclosed a pneumatic or hydraulic cylinder, having a bore cooperating with a piston. Extending from the piston is a piston rod. There is further provided a pawl which is engageable with the piston to retain the piston at a desired location. The pawl is moved from engagement with the piston upon fluid under pressure being delivered to one end of the cylinder.

[0009] This prior art discloses locking system, which is even integrated in the cylinder tube. In case of that construction the linear system is exclusively usable in combination with the locking system, whereby the field of feasible application of the said invention is limited. Regarding the constructed space the disclosed solution is disadvantageously, because it needs additional space due to its protruding construction perpendicular to the axis of the main cylinder body.

[0010] With respect to the disclosed locking systems in the prior art the locking mechanism between the piston or the piston rod, respectively, and the engaging locking element is form- fitted. The contact area between the locking element and the shoulder and accordingly the recess in the moved part like the piston or the piston rod is small and not sufficient. Therewith the transmittable forces are limited due to the asymmetrically and angular transmission of the force into the piston rod or the piston itself.

[0011] Therewith it is the objective of the present invention, to provide a linear cylinder locking unit, which offers the transmission of high blocking forces through a high contact area and with a high stiffness.

[0012] The problem can be solved basing on a locking unit, in particular for a linear pressure cylinder, according to claim 1 in conjunction to the representative features. Advantageous embodiments of the invention are given in the pending claims.

[0013] This object is achieved in the linear cylinder unit of claim 1. The invention discloses, that the said locking element features a plane profile including a bore, where the piston rod is guided through, whereas the edge of the bore engages in at least one recess arranged in the said piston rod, in order to block the movement of the piston rod.

[0014] With the invented solution it is offered the advantage, that the contact elements for the force trans-

mission in between the locking element and the piston rod feature a large contact area. With that locking element design the engagement of the bore edge in the recess shows a save and tough clamping method. The plane profile of the locking element offers a space- minimal construction, whereby the contact area is not punctual or linear transmitting, but rather plane.

[0015] According to an advantageous embodiment, the edge of the bore, engaging in the said recess of the piston rod is shaped in a manner, that the area of contact between the edge of the bore and the shoulder of the recess is crescent-shaped. Due to the engaging mechanism with a crescent- shaped contact area, the transmittable blocking force is higher, primarily due to the plane contact and therefore due to the improved force condition of transmission. Additionally the force is transmitted into the piston rod more centrically due to the contact against the shoulder of the recess.

[0016] Advantageously, that the locking element features a piston on at least one end section, which is axially displaceable in a pressure chamber of the housing of the locking unit, in order to cause a releasing movement of the locking element by pressurising the piston and the locking position of the locking element is effected by a spring element, whereas the spring element is a compression spring. The construction comprises a security feature due to the fact, that the releasing of the piston rod is exclusively possible by pressurising the piston of the locking element. If the chamber in the piston locking unit is vented, the spring element, placed in the opposite direction, moves the locking element into the locking position. Therewith the locking effect is guaranteed, e.g. in case of a breakdown of the external pressure supply.

[0017] According to an advantageous embodiment, the locking element is guided in the housing of the piston locking unit in at least two guiding sections, whereas the at least two guiding sections are arranged on both sides of the piston rod. Due to the demand of high holding forces, the stability and the maximum load is higher, if the locking element is guided in at least two guiding sections. The loading case on the locking element is improved, if the locking element is guided on both sides of the piston rod, because the bending moment in the case of a single — edge clamping case would be much higher and the stability of the general system and the stiffness would be lower.

[0018] A different embodiment shows the advantage, that the locking element can be displaced in the housing of the piston locking unit by a manual override. The advantage of a manual override is the possibility to displace the locking element by hand or by an external mechanical device. Only with that device the release position or locking position can be changed, e.g. if the pressure supply is broken down or in case of the need of a manual operated locking element movement the manual override is necessary.

[0019] Advantageously, the end of the piston rod features a taper leading shape, in order to enable the piston rod to move through the bore in the locking element. This feature ensures a save snap in of the locking element in the recess of the piston rod. In the case of a vented pressure chamber in the locking unit, the locking element is in the locking position, whereas the piston rod moves through the bore of the locking element. Otherwise the piston rod only can be moved into the snap in position, when the locking element is in the released position.

[0020] To extend the admeasurement of the invention, it is suggested, that a detecting device is comprised in the housing of the piston locking unit, whereby the possibility of detecting the releasing position and/or the locking position of the locking element is given. The detecting device can be carried out as an electromagnetic device, which detects a magnet washer, couplet to the locking element. In the case of an electromagnetic device the detecting device can easily be integrated in a control unit to use the information of the locking unit position for the control of the linear cylinder unit. However, the detecting device can likewise be based on a mechanical detector which is able to detect the position of the locking device and be coupled to an external electrical switch or for instance a valve control for the air supply of the linear cylinder unit.

[0021] According to an advantageous embodiment, the bore comprises at least two sections, whereas a releasing section features a large diameter for releasing the piston rod and a locking section features a small diameter, in order to engage in the shoulder of the recess and the crescent-shaped contact area between the edge of the bore of the locking element and the shoulder of the recess is the edge of the locking section. With that shaping of the bore the contact area for the force transmission between the locking element and the shoulder of the recess is maximal extended. The transmission of the force into the piston rod happens centred, whereas a side torque can be avoided and the piston rod is not stressed in bending.

[0022] The foregoing and other aspects will become apparent from the following detailed description of the invention when considered in conjunction with the enclosed drawings. Herein

Fig. 1 shows a perspective drawing of the linear cylinder unit and the piston locking unit;

Fig. 2 shows a detailed view of the piston locking unit with an engaged locking element in the recess of the piston rod.

Fig. 3 shows schematically a contact area relating to the state of the art between a locking element and a piston; and

Fig. 4 shows a contact area relating to the invention between a locking element and a piston.

[0023] In Fig. 1 is shown a linear cylinder unit 1, com-

prising a pressure cylinder 2 with a cylinder tube 3. The end section of the pressure cylinder 2 is sealed up with an end cover member 4. A piston 5 is axial displaceable fitted in the cylinder tube 3, whereas a piston rod 6 is connected to the piston 5. In the present embodiment the piston rod 6 consists of a first part, which is guided through the end cover member 4 to be connected at a peripheral mechanical part and a second part, which extents to the other side of the piston 5 to protrude into the piston locking unit 7. The end of the second part of the piston rod features a taper leading shape 9, in order to snap into a bore 10, arranged in a locking element 8, when the piston 5 moves in the direction to the piston locking unit 7.

[0024] The piston locking unit 7 is removable mounted to the rear end of the pressure cylinder 2, and comprises a locking element 8, which is linear movable in a perpendicularly direction to the piston rod 6. The locking element 8 comprises a bore 10, whereby the end of the piston rod 6 protrudes through the bore 10 in the shown end position of the piston 5. The upper end section of the locking element 8 features a piston 11, which is axially displaceable in a pressure chamber 12 in the housing 13 of the piston locking unit 7.

[0025] The pressure chamber 12 can be pressurised by a pressure medium, in order to cause an axial movement of the locking element 8, whereby in the pressurised condition of the piston 11 the position of the locking element 8, and the bore 10, respectively, releases the piston rod 6. When the pressure chamber 12 is vented, a spring element 14, placed in an opposite direction, resets the locking element 8 into a locking position, whereby the spring element 14 is designed as a compression spring. For the pressurising of the pressure chamber 12 the pressure medium is supplied by an external pressure medium, whereby the feed line is not shown in the drawing in fig. 1.

[0026] In fig. 2 is shown a detailed view of the piston locking unit 8 with an engaged locking element in the recess of the piston rod. The force transmission happens through the shoulder 21 of the recess 18, whereby the shown position of the locking element 8 is the locking position. In the embodiment of Fig. 2 the detecting device 17 is carried out as an electromagnetic sensor, which detects a magnet washer 23, arranged on the locking unit 8 next to the spring 14. The pressure port 24 is performed as the pressure connection to the pressure chamber 12. By pressurising the pressure chamber 12 and therewith the piston 11, the locking unit 8 is moved into the releasing position for a unaffected movability of the piston rod 6. A manual override 15 is performed on the side of the piston 11 of the locking unit 8, which provides a mechanical coupling of the locking unit 8 with an external mechanical device. By this coupling the locking unit 8 can be moved in its linear direction by a thrust into the manual override 15, in particular for a manual releasing of the piston rod 6.

[0027] In fig. 3 is shown a contact area relating to the state of the art between a locking element 8 and a piston rod 6. The contact area is small, because the shape of the locking element 8 is not adapted to the contact area of the shoulder of the recess 18. Therefore the contact area is limited by the diameter of the piston rod and the depth of the recess, and is formed like a section of a circle.

[0028] The contact area related to the invention is shown in fig. 4. The bore 10 consists of a releasing section 19 and a locking section 20. The left part of fig. 4 shows the piston locking unit 7 in a non locking condition, because the releasing section 19 of the bore 10 features a larger diameter as than the piston rod 6, whereby the piston rod 6 runs through the locking element 8 unaffected. The right part of fig. 4 shows the piston locking unit 7 in a locking condition, because the locking section 20 of the bore 10 features a smaller diameter as than the piston rod 6. The diameter of the locking section 20 agrees with the inner diameter of the recess 18. The contact area 22 is crescent - shaped, by what the contact area in between the shoulder 21 of the recess 18 in the piston rod 6 and the edge of the locking element 8 is as large as possible.

[0029] The present invention is not limited by the embodiment described above, which is represented as an example only and can be modified in various ways within the scope of protection defined by the appended patent claims. Thus the invention is also applicable to different locking units.

Reference Numbers

[0030]

1	linear cylinder unit
2	pressure cylinder
3	cylinder tube
4	end cover member
5	piston
6	piston rod
7	piston locking unit
8	locking element
9	taper leading shape
10	bore
11	piston
12	pressure chamber
13	housing
14	spring element
15	manual override
16	pressure chamber
17	detecting device
18	recess
19	releasing section
20	locking section
21	shoulder
22	contact area
23	magnetic washer
24	pressure port
25, 25'	guiding section

Claims

1. Linear cylinder unit **(1),** in particular a pressure cylinder **(2),** comprising a cylinder tube **(3),** at least one end cover member **(4),** a piston **(5),** which is axial displaceable within said cylinder tube **(3),** a piston rod **(6),** which is connected to said piston **(5)** and at least one piston locking unit **(7),** whereas said piston locking unit **(7)** is arranged on at least one end of the body of the said pressure cylinder **(2),** whereas the piston locking unit **(7)** comprises a locking element **(8),** which is linear movable in a perpendicularly direction to the piston rod **(6),** in order to achieve a form- fitted connection between the piston rod **(6)** and the locking element **(8),**
characterised in that the said locking element **(8)** features a plane profile including a bore **(10),** where the piston rod **(6)** is guided through, whereas the edge of the bore **(10)** engages in at least one recess **(18)** arranged in the said piston rod **(6),** in order to block the movement of the piston rod **(6).**

2. Linear cylinder unit **(1)** according to claim 1,
characterised in that the edge of the bore **(10),** engaging in the said recess **(18)** of the piston rod **(6)** is shaped in a manner, that the contact area **(22)** between the edge of the bore **(10)** and the shoulder (21) of the recess **(18)** is crescent-shaped.

3. Linear cylinder unit **(1)** according to claim 1 and 2,
characterised in that the locking element **(8)** features a piston **(11)** on at least one end section, which is axially displaceable in a pressure chamber **(12)** of the housing **(13)** of the locking unit **(7),** in order to cause a releasing movement of the locking element **(8)** by pressurising the piston **(11).**

4. Linear cylinder unit **(1)** according to claim 1 to 3,
characterised in that the locking position of the locking element **(8)** is effected by a spring element **(14),** whereas the spring element **(14)** is a compression spring.

5. Linear cylinder unit **(1)** according to claim 1 to 4,
characterised in that the locking element **(8)** is guided in the housing **(13)** of the piston locking unit **(7)** in at least two guiding sections **(25, 25'),** whereas the at least two guiding sections **(25, 25')** are arranged on both sides of the piston rod **(6).**

6. Linear cylinder unit **(1)** according to claim 1,
characterised in that the locking element **(8)** can be displaced in the housing **(13)** of the piston locking unit **(7)** by a manual override **(15).**

7. Linear cylinder unit **(1)** according to claim 1,
characterised in that the end of the piston rod **(6)** features a taper leading shape **(9),** in order to enable the piston rod **(6)** to move through the bore **(10)** in the locking element **(8).**

8. Linear cylinder unit **(1)** according to claim 1,
characterised in that a detecting device **(17)** is comprised in the housing **(13)** of the piston locking unit **(7),** whereby the possibility of detecting the releasing position and/or the locking position of the locking element **(8)** is given.

9. Linear cylinder unit **(1)** according to claim 1,
characterised in that the bore **(10)** comprises at least two sections **(19, 20),** whereas a releasing section **(19)** features a large diameter for releasing the piston rod **(6)** and a locking section **(20)** features a small diameter, in order to engage in the shoulder **(21)** of the recess **(18).**

10. Linear cylinder unit **(1)** according to claim 1,
characterised in that the crescent-shaped contact area **(22)** between the edge of the bore **(10)** of the locking element **(8)** and the shoulder **(21)** of the recess **(18)** is the edge of the locking section **(20).**

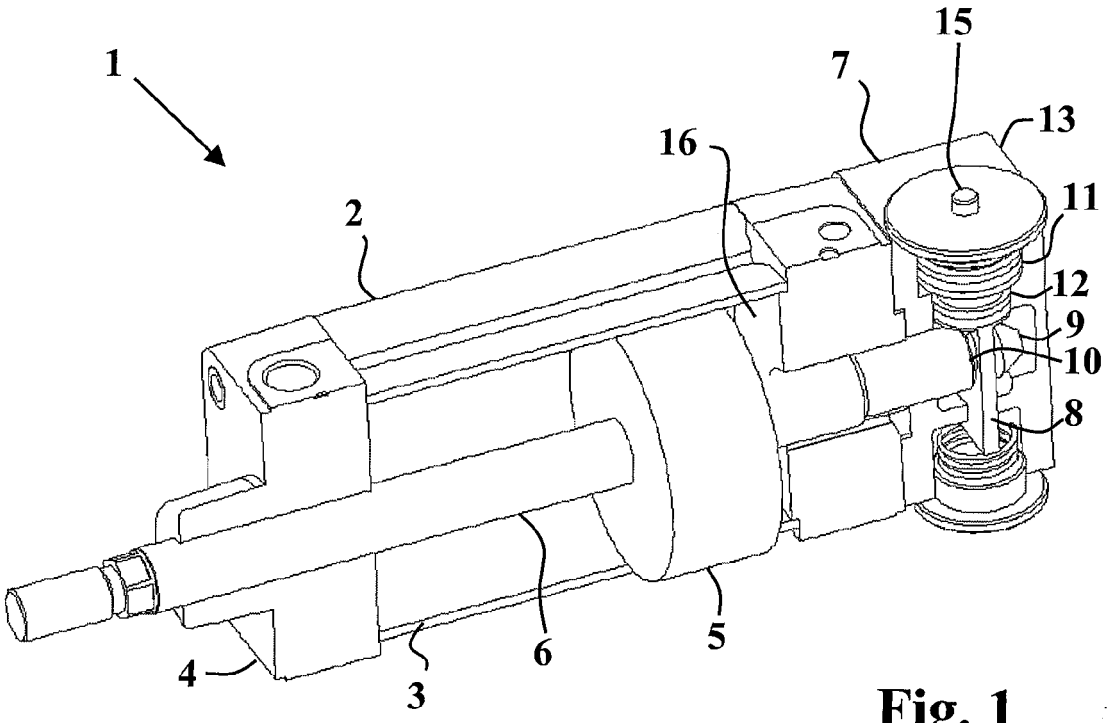

Fig. 1

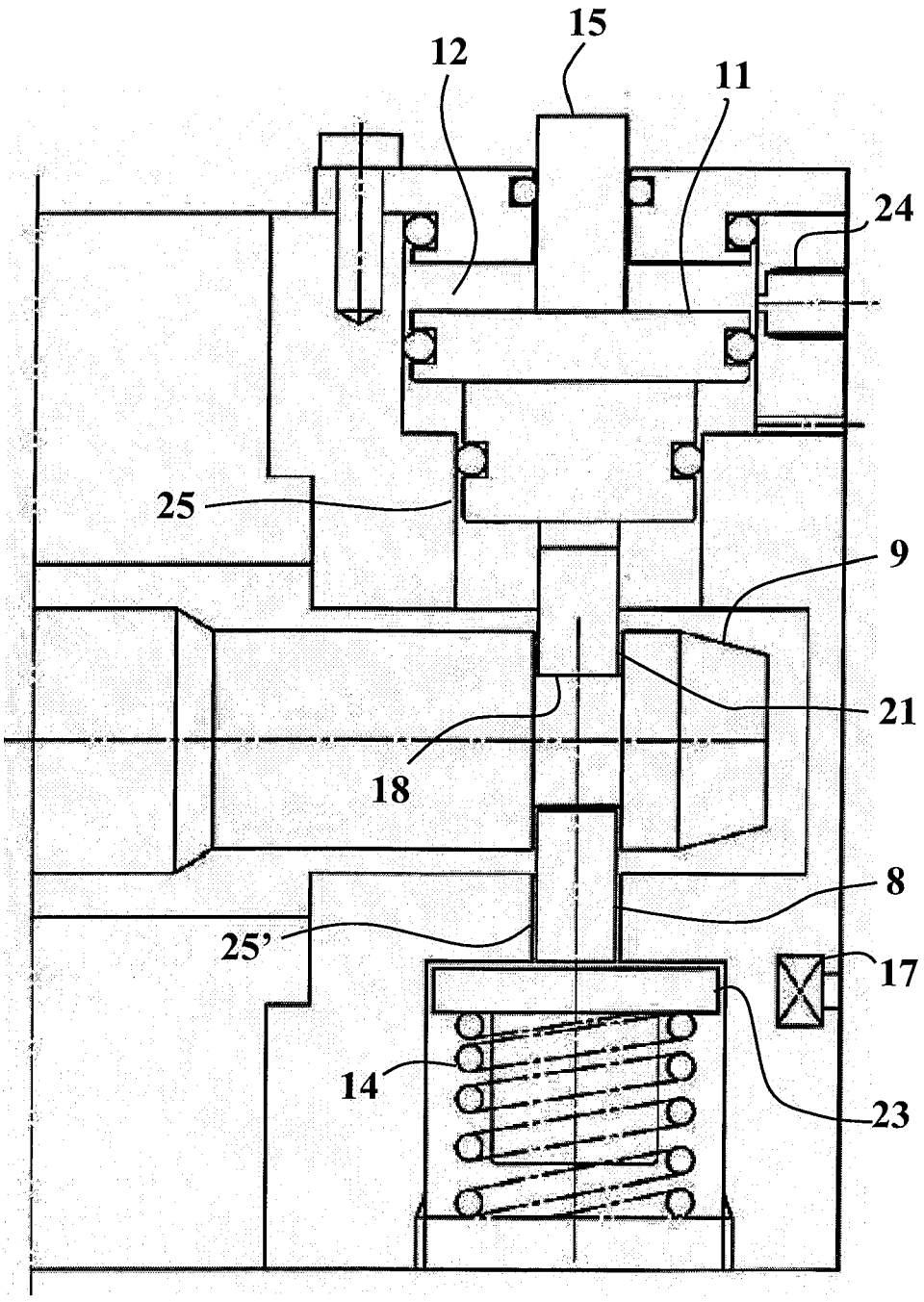

Fig. 2

PRIOR ART

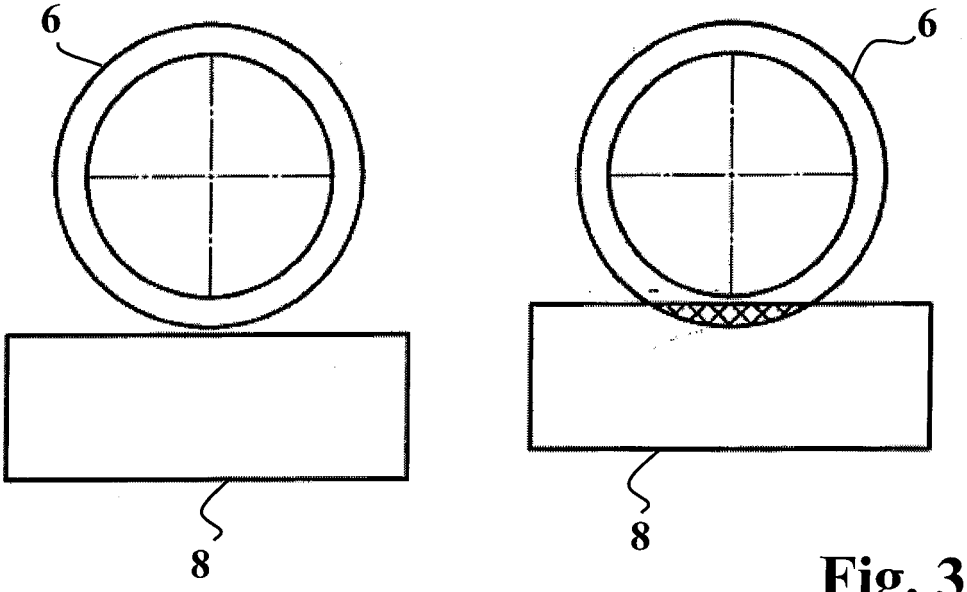

Fig. 3

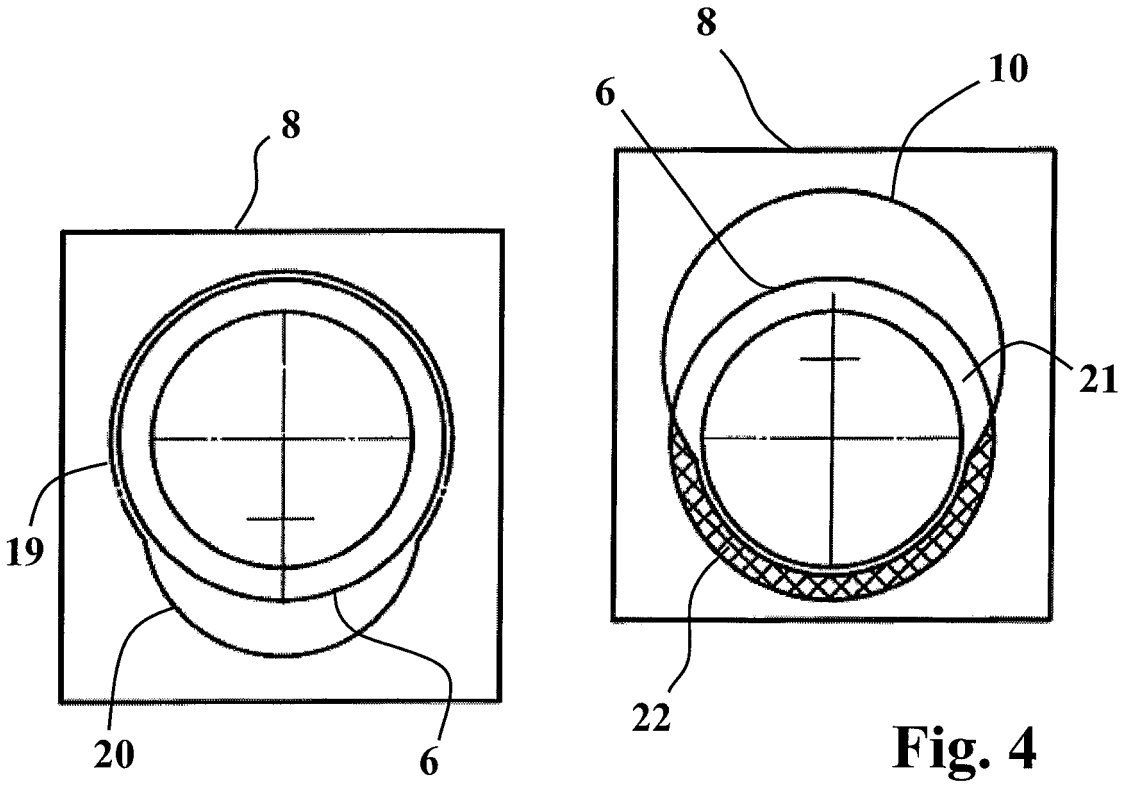

Fig. 4