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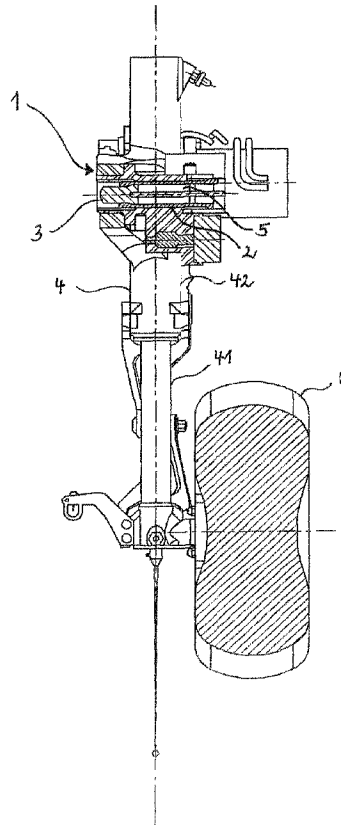
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(54) Title: LOCKING DEVICE OF AN AIRCRAFT LANDING GEAR



(57) Abrégé/Abstract:

This invention relates to a locking device of an aircraft landing gear for locking the landing gear in a retracted and an extended position, comprising a locking cylinder which is arranged on a landing gear leg, and a locking bolt which is movably arranged in the locking cylinder, wherein in the retracted position and in the extended position of the landing gear the locking bolt serves to fix the landing gear leg.

### **Abstract**

This invention relates to a locking device of an aircraft landing gear for locking the landing gear in a retracted and an extended position, comprising a locking cylinder which is arranged on a landing gear leg, and a locking bolt which is movably arranged in the locking cylinder, wherein in the retracted position and in the extended position of the landing gear the locking bolt serves to fix the landing gear leg.

## **LOCKING DEVICE OF AN AIRCRAFT LANDING GEAR**

The present invention relates to a locking device of an aircraft landing gear.

Typically, landing gears of aircraft, in particular of airplanes, but also in helicopters, are extended out of an aircraft main body for a landing or takeoff operation. In a flight phase, however, the landing gear is retracted, in order to minimize the air resistance.

According to the prior art, the landing gear is locked in its extended condition via a drag brace. This drag brace prevents the unwanted retraction of the landing gear when a force is applied. In addition, the drag brace serves for transmitting the forces acting on the landing gear during a takeoff or landing phase. The locking device of the landing gear in an extended condition also analogously is referred to as “downlock”.

In a retracted condition, the landing gear is retained via a so-called “uplock”. For example, such uplock device comprises a hook which catches a bolt attached to the landing gear and prevents an extension of the landing gear.

The uplock and downlock device of a conventional aircraft landing gear requires a multitude of components and a certain installation space. In addition, the total weight of the aircraft also is increased by the components, which in turn leads to an increased fuel consumption of the aircraft.

It is an objective of the present invention to create a locking device which overcomes the aforementioned problems.

This is achieved with a locking device of an aircraft landing gear with the features as described herein.

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Accordingly, the inventive locking device of an aircraft landing gear for locking the landing gear in a retracted and an extended position comprises a locking cylinder which is arranged on a landing gear leg and a locking bolt which is movably arranged in the locking cylinder. In the retracted position and in the extended position of the landing gear the locking bolt serves to fix or secure the landing gear leg.

The locking cylinder is equipped such that the locking bolt accommodated therein can completely be pushed into the locking cylinder or also can protrude out of the same. The locking bolt accordingly is movably arranged in the locking cylinder. As both in a retracted condition of the landing gear and in an extended condition of the landing gear the locking bolt serves to fix the landing gear leg, it no longer is necessary to provide two separate units for fixing the landing gear leg in a retracted condition (uplock) and for fixing the landing gear leg in an extended condition (downlock). Both the uplock and the downlock are realized by means of the locking bolt movably arranged in the locking cylinder.

With the invention it hence is possible to replace the conventionally used drag brace for fixing the extended landing gear leg and the uplock with which the retracted landing gear is fixed at the aircraft main body. At the same time, the positioning of the locking device on the landing gear leg reduces the necessary installation space as well as the number of the necessary components which so far have been necessary for the uplock and downlock. The total weight necessary also is reduced thereby, so that a saving can be achieved in operation of the aircraft provided with the locking device according to the invention.

Preferably, the locking bolt is movably arranged in the locking cylinder transversely to the longitudinal direction of the landing gear leg. For example, the landing gear leg has a linearly extending shape, wherein the locking bolt is aligned vertically to this shape and also can be moved vertically thereto. By extending the locking bolt out of the locking cylinder, the movement of the landing gear leg, which is executed for transitioning between a retracted and an extended condition, is prevented. By

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moving the locking bolt transversely to the longitudinal direction of the landing gear leg, it is particularly easily possible to fix and to secure the landing gear leg.

According to a further advantageous modification of the invention the locking bolt in a condition extended out of the locking cylinder is designed to fix the landing gear leg.

For example, in a retracted condition of the landing gear the locking bolt engages into a receptacle provided for this purpose, which prevents an extension of the landing gear.

This also comprises the extended condition of the landing gear leg, for whose stabilization or fixation the locking piston is extended out of the locking cylinder, in order to cooperate with a connecting point.

Preferably, the present device comprises a connecting point for interacting or engaging with the locking piston extended out of the locking cylinder, in order fix the landing gear leg in a retracted or an extended condition.

Preferably, the connecting point is a sleeve for accommodating the locking piston extended out of the locking cylinder. However, it is conceivable just as well that the connecting point is a form other than a sleeve surrounding the locking piston.

According to another advantageous, optional development of the invention the locking bolt is pretensioned by an elastic element, preferably a spring or the like.

Preferably, pretensioning the locking bolt is performed by two springs independent of each other. This prevents a system failure of the device according to the invention in the case of the failure of one spring. Thus, when one of the at least two independent springs breaks, pretensioning the locking bolt is performed by the other, still intact spring. Due to the redundancy of the springs, the failure probability of the locking device is reduced.

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It is advantageous when the spring pretensioning force of the locking piston urges the locking piston in a direction out of the locking cylinder. This is advantageous, as in the case of a failure of the moving mechanism for moving the locking piston into the cylinder or out of the same, the piston is urged to the outside by the spring pretensioning force and thus cannot be moved out of a fixed and secured condition. As a result, there is no risk that a landing gear leg extended already will buckle under force application in the case of a damaged moving mechanism of the locking piston and leads to an uncontrollable takeoff or landing phase of an aircraft. According to the invention, it is advantageous that the fixed or secured condition of the landing gear leg is present with an extended locking bolt.

According to an advantageous development of the invention the device furthermore comprises a motor, preferably an electric motor, for moving the locking piston in the locking cylinder. The electric motor can be coupled with the locking piston via a transmission, in order to for example convert a rotatory movement of the motor into a linear movement.

In addition, the device according to the invention furthermore can include a switch for monitoring a position of movement of the locking piston.

Preferably, the device comprises at least two switches independent of each other, wherein one switch is provided for monitoring an extended condition and the other switch is provided for monitoring a retracted condition of the locking piston.

It furthermore is advantageous when the device comprises at least two independent switches for monitoring a retracted condition of the locking piston and at least two independent switches for monitoring an extended condition of the locking piston. It thereby is possible to execute an emergency extension by separate signals of the switches independent of each other. In the optimal case, an electric motor comprises a second coil as well as a separate electric cabling and hence builds up a completely redundant signaling circuit.

According to a further development of the invention, the device furthermore comprises a temperature sensor which is integrated into windings of the electric motor, in order to measure a motor temperature. It thereby is possible to switch off said motor upon detection of a motor temperature deviating from a standard range and to inhibit a retracting or extending function of the landing gear, before too high a temperature of the motor can lead to damages.

According to one aspect of the invention, there is provided a nose or tailwheel landing gear for a helicopter, which comprises a locking device for locking the landing gear in a retracted and an extended position, wherein a locking cylinder which is arranged on a landing gear leg, and a locking bolt which is movably arranged in the locking cylinder, wherein in the retracted position and in the extended position of the landing gear the locking bolt serves to fix the landing gear leg, characterized by a connecting point for interacting with the locking bolt extended out of the locking cylinder, in order fix the landing gear leg in a retracted or an extended condition.

In the following, further particulars and details will be set forth with reference to drawings which represent exemplary embodiments of the invention, in which:

Fig. 1: shows a schematic diagram of an unlocked locking device of an aircraft landing gear,

Fig. 2: shows a schematic diagram of a locked locking device of an aircraft landing gear,

Fig. 3: shows a perspective representation of a locking device of an aircraft landing gear according to the invention, and

Fig. 4 shows a sectional view of the locking device according to the invention.

Fig. 1 shows an aircraft landing gear with the locking device 1 according to the invention. There is shown a tire 6 which is connected with an aircraft main body (not shown) by a landing gear leg 4. The landing gear leg 4 consists of a rigid element 42 firmly connected with the aircraft main body, which partly encloses a resilient element 41. It can also be seen that the locking unit 1 is arranged on the rigid element 42 of the landing gear leg 4. It can be seen that the locking cylinder 2 supports a locking bolt 3 in itself, which via a spring 5 is pretensioned such that the locking bolt 3 is urged out of the locking cylinder 2. With reference to dashed orientation lines it can also be recognized that the locking bolt 3 and the locking

cylinder 2 are arranged approximately transversely to the longitudinal direction of the landing gear leg 4. However, other orientations of the locking bolt 3 and of the locking cylinder 2 relative to the longitudinal direction of the landing gear leg 4 also are conceivable. They need not necessarily be transverse to each other. In addition, the locking unit 1 is shown in a condition in which the locking unit 1 is in an unlocked condition. The locking bolt 3 hence is in a retracted condition.

In the condition shown in Fig. 1, the landing gear leg can be retracted or extended, as the locking bolt 3 completely is in the locking cylinder 2. To be able to change between an extended and a retracted condition, a motor is provided. Typically, a transmission is arranged between the sleeve 2 and the motor.

Fig. 2 shows the locking unit 1 in a locked condition. It can be seen that the locking bolt 3 protrudes out of the locking cylinder 2. In this condition it typically engages into a connecting point (not shown), which renders a retraction or extension of the landing gear leg 4 impossible. In such a locked condition a total movement of the landing gear leg 4 accordingly no longer is possible. In a completely retracted or a completely extended condition the movement is inhibited by engagement into a corresponding connecting point. In a retracted condition a sleeve for example is imaginable, which is firmly connected with the aircraft main unit and upon engagement of the locking bolt 3 inhibits an extension movement of the landing gear leg 4. In an extended condition, on the other hand, the landing gear bolt 3 engages into a corresponding counterpart which prevents a retraction of the landing gear leg 4.

Providing a drag brace, which inhibits an unwanted retraction or an unwanted movement in retracting direction, thereby is superfluous. In addition, the uplock mechanism, which retains the landing gear leg 4 in its landing gear well, no longer is required either.

In general, a saving on weight or the reduction of components is achieved, which leads to a better efficiency of an aircraft landing gear.

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Fig. 3 shows a perspective representation of the locking device according to the invention. It can be seen that the locking bolt 3 rests in the locking cylinder 2 in the retracted condition. In such a condition, pivoting of the landing gear leg 4 out of the aircraft main body into an extended condition or retracting the landing gear leg 4 into the aircraft main body hence is possible.

Fig. 4 shows a sectional view of the locking device according to the invention. There can again be seen the arrangement of locking cylinder 2 and locking bolt 3 extending substantially transversely to the longitudinal direction of the landing gear leg 4. It should again be noted that an orientation transversely to the landing gear leg is not absolutely necessary, but also can adopt other orientations. There can also be seen the redundant design of the springs 51, 52, which urge the locking bolt 3 in a direction out of the locking cylinder 2. By means of an electric motor, the locking bolt 3 is moved into the locking cylinder 2. Reference numeral 6 designates the guide bushing.

By providing the locking device according to the invention it no longer is necessary to provide a drag brace and an uplock in a landing gear for an aircraft. At the same time, the positioning of the locking device on the landing gear leg 4 reduces the number of necessary components and reduces the installation space necessary therefor.

**Claims:**

1. A nose or tailwheel landing gear for a helicopter, which comprises a locking device (1) for locking the landing gear in a retracted and an extended position, wherein a locking cylinder (2) which is arranged on a landing gear leg (4), and a locking bolt (3) which is movably arranged in the locking cylinder (2), wherein in the retracted position and in the extended position of the landing gear the locking bolt (3) serves to fix the landing gear leg (4),

characterized by

a connecting point for interacting with the locking bolt (3) extended out of the locking cylinder (2), in order fix the landing gear leg (4) in a retracted or an extended condition.

2. The nose or tailwheel landing gear according to claim 1, wherein the locking bolt (3) for example is movably arranged in the locking cylinder (2) transversely to the longitudinal direction of the landing gear leg (4).

3. The nose or tailwheel landing gear according to claim 1 or 2, wherein the locking bolt (3) in a condition extended out of the locking cylinder (2) is designed to fix the landing gear leg (4).

4. The nose or tailwheel landing gear according to any one of claims 1 to 3, wherein the connecting point is a sleeve for accommodating the locking bolt (3) extended out of the locking cylinder (2).

5. The nose or tailwheel landing gear according to any one of claims 1 to 4, wherein the locking bolt (3) is pretensioned by a spring (5).

6. The nose or tailwheel landing gear according to claim 5, comprising at least two springs (51, 52) independent of each other, in order to pretension the locking bolt (3).

7. The nose or tailwheel landing gear according to claim 5 or 6, wherein the spring pretensioning force of the locking bolt (3) urges the locking bolt into a direction

out of the locking cylinder (2).

8. The nose or tailwheel landing gear according to any one of claims 1 to 7, further comprising an electric or hydraulic motor for moving the locking bolt (3) in the locking cylinder (2).

9. The nose or tailwheel landing gear according to any one of claims 1 to 8, further comprising a switch for monitoring a position of movement of the locking bolt (3) out of the locking cylinder (2).

10. The nose or tailwheel landing gear according to claim 9, further comprising at least two switches independent of each other for monitoring a retracted and an extended condition of the locking bolt (3) out of the locking cylinder (2).

11. The nose or tailwheel landing gear according to claim 9, further comprising at least two independent switches for monitoring a retracted condition of the locking bolt (3) and at least two independent switches for monitoring an extended condition of the locking bolt (3).

12. The nose or tailwheel landing gear according to claim 8, further comprising a temperature sensor which is integrated into windings of the electric motor, in order to measure a motor temperature.

13. An aircraft with the nose or tailwheel landing gear according to any one of claims 1 to 12.

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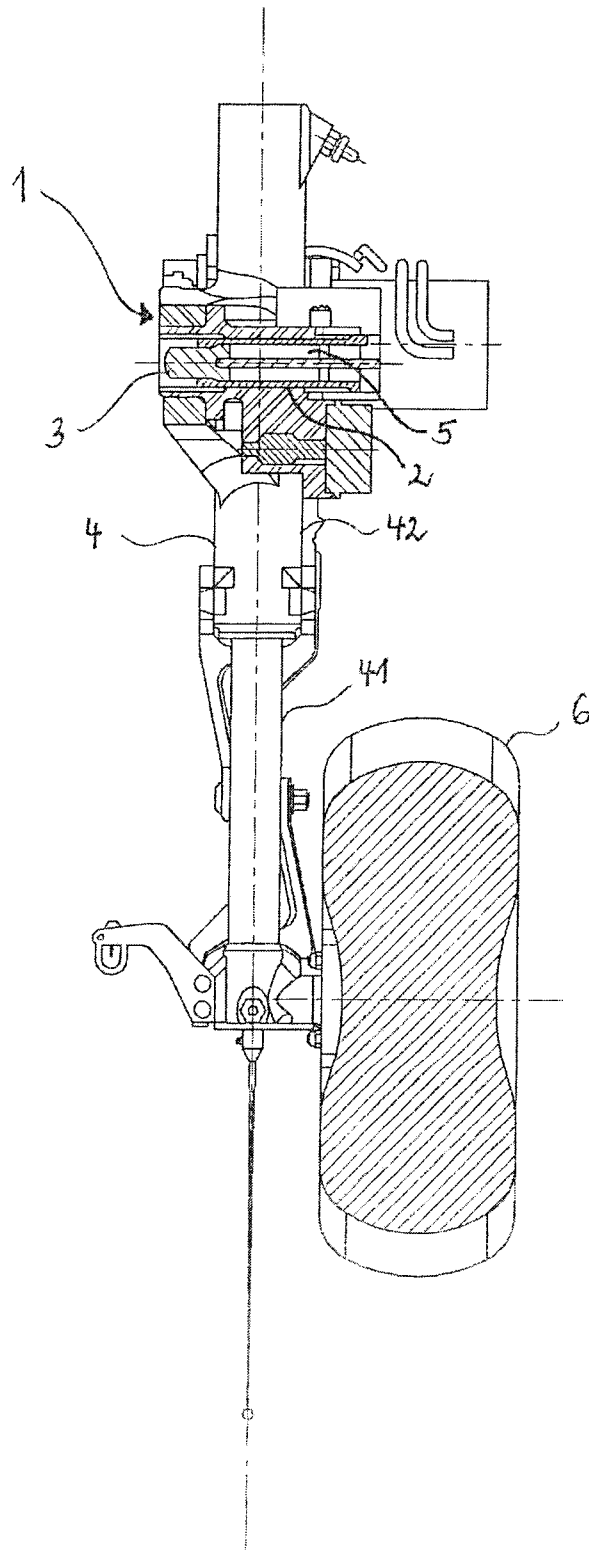


Fig. 1

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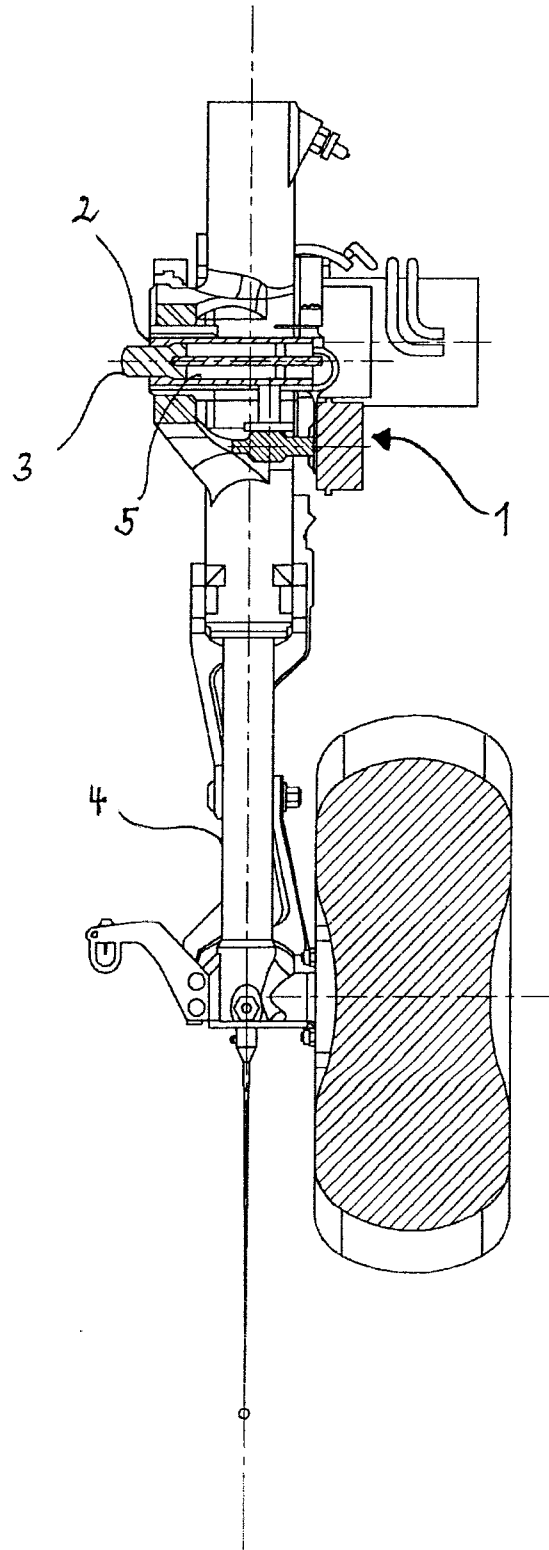


Fig. 2

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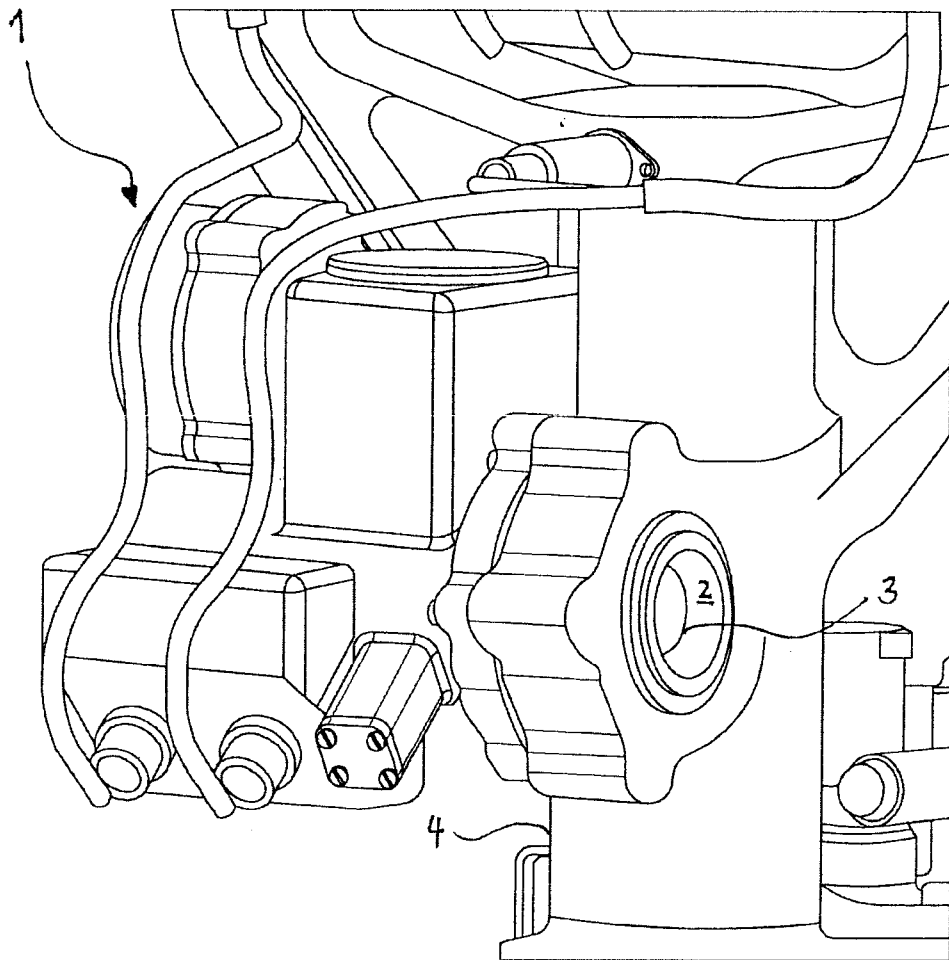


Fig. 3

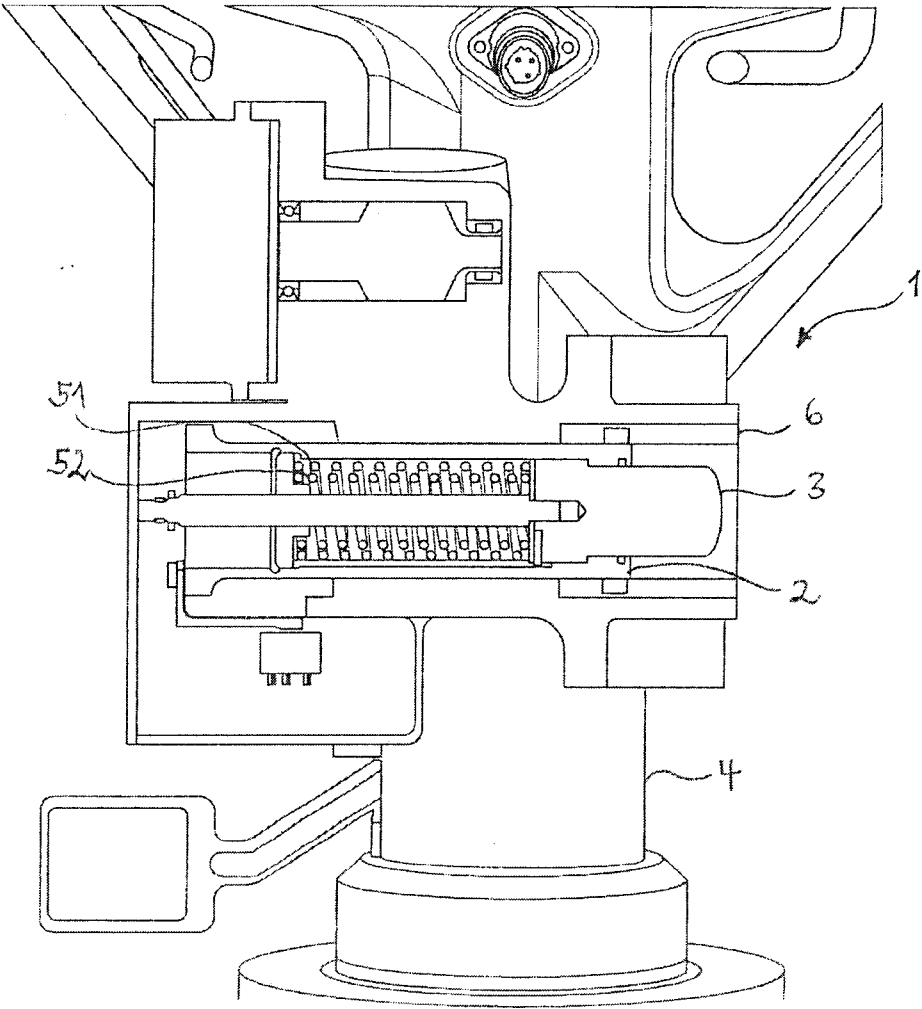


Fig. 4

