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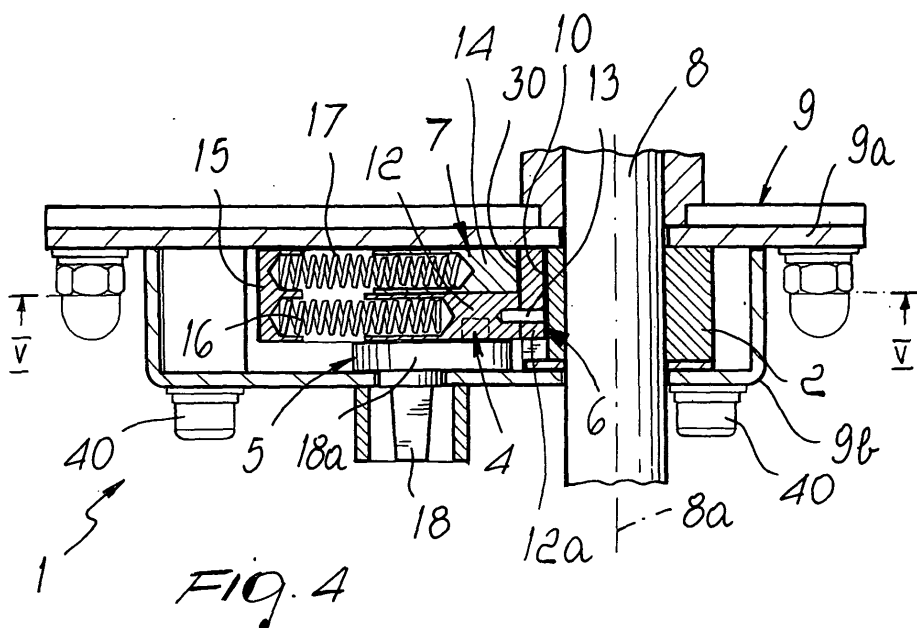
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(54) **Device for locking an item of switchgear, particularly for grounding disconnectors of electrical lines, with high safety against unauthorized actuation**

(57) A device for locking an item of switchgear, particularly for grounding disconnectors of electrical lines, with high safety against unauthorized actuations, comprising an abutment element (2), which is connected to the item of switchgear (3) to be locked and can move along a path in order to pass from at least one first position to at least one second position, these positions being mutually spaced along the path, or vice versa. The device comprises first locking means (4), which can engage the abutment element (2) in order to lock it in the two men-

tioned positions, and control means (5) for disengaging the first locking means (4) from the abutment element (2). The first locking means (4) comprise a calibrated-shear element (6) adapted to allow, following its breakage, the passage of the abutment element (2) from the first position to the second position without acting on the control means (5). The device comprises second locking means (7), which can engage the abutment element (2) in order to lock it in the second position despite the breakage of the calibrated-shear element (6).



Description

[0001] The present invention relates to a device for locking a control member or item of switchgear, particularly for grounding disconnectors of electrical lines, with high safety against unauthorized actuation.

[0002] Locking devices for items of switchgear are known which are designed to prevent the actuation of the items of switchgear by unauthorized individuals. Generally, these devices lock the item of switchgear by way of a mechanism which can be deactivated exclusively by means of a key or other controlled-access element which is available only to authorized personnel.

[0003] Locking devices of this kind are used, for example, in disconnectors of electrical lines in order to allow the grounding of a portion of electrical line and the subsequent restoring of the connection to the electrical network exclusively on the part of authorized personnel.

[0004] In various applications, such as for example in the application to disconnectors of electrical lines, there is the need to allow the actuation of the item of switchgear even without the key or other controlled-access element in emergency situations. In order to meet this need, the mechanism which locks the item of switchgear of these devices is provided with a calibrated-shear element, which breaks when the item of switchgear is operated with a force greater than a preset force, thus allowing the actuation of the item of switchgear even though the locking mechanism has not been released beforehand. In this manner, the actuation of the item of switchgear is allowed even in the absence of the key or equivalent element.

[0005] With locking devices of this kind a problem arises, in that once the calibrated-shear element has been broken, the locking device is entirely inactive and the item of switchgear can be actuated freely even by unauthorized individuals. This fact, particularly in the application of the device to disconnectors of electrical lines, constitutes a serious danger, since the electrical line, previously grounded in emergency conditions, can be reconnected without authorization to the electrical line, recreating the emergency situation that had required the grounding or even entailing danger for people working on the electrical line in order to eliminate the problem that caused the emergency.

[0006] The aim of the present invention is to solve the problem described above by providing a device for locking a control member or item of switchgear, particularly for grounding disconnectors of electrical lines, which following an emergency actuation of the item of switchgear prevents further actuation of the item of switchgear and necessarily requires intervention on the part of authorized personnel to restore the operating conditions that preceded the emergency actuation.

[0007] Within this aim, an object of the invention is to provide a locking device provided with a calibrated-shear element which breaks during emergency actuation and necessarily requires the replacement of said calibrated-

shear element in order to allow subsequent actuation of the item of switchgear.

[0008] Another object of the invention is to provide a locking device which is highly reliable in operation.

[0009] Another object of the invention is to provide a locking device which can be manufactured at competitive costs.

[0010] This aim and these and other objects, which will become better apparent hereinafter, are achieved by a device for locking an item of switchgear, particularly for grounding disconnectors of electrical lines, which comprises:

- an abutment element, which is connected to the item of switchgear to be locked and can move along an actuation path in order to pass from at least one first position to at least one second position, said positions being mutually spaced along said path, and vice versa;
- first locking means, which can engage said abutment element in order to lock it in said at least two mutually spaced positions along said path;
- control means, which are connected to said first locking means and can be actuated to disengage said first locking means from said abutment element in order to allow the movement of said abutment element from said first position to said second position or vice versa;

said first locking means comprising a calibrated-shear element adapted to allow, following its breakage, which can be caused by moving said abutment element from said first position to said second position with a force greater than a preset force despite the engagement of said first locking means with said abutment element, the passage of said abutment element from said first position to said second position, characterized in that it comprises second locking means, which can engage said abutment element in order to lock it in said second position despite the breakage of said calibrated-shear element.

[0011] Further characteristics and advantages of the invention will become better apparent from the description of two preferred but not exclusive embodiments of the device according to the invention, illustrated by way of non-limiting example in the accompanying drawings, wherein:

Figures 1 to 9 are views showing a first embodiment of the device according to the invention, and more particularly:

Figure 1 is a partially exploded perspective view of the device, with part of the support and containment structure omitted;

Figure 2 is a perspective view of the device in the assembled condition, with part of the support and containment structure omitted;

Figure 3 is a partially sectional front elevation

view of the device, with part of the support and containment structure removed, in a first operating condition;

Figure 4 is a sectional view of Figure 3, taken along the line IV-IV;

Figure 5 is a sectional view of Figure 4, taken along the line V-V;

Figure 6 is a partially sectional front elevation view of the device, with part of the support and containment structure removed, in another operating condition;

Figure 7 is a partially sectional front elevation view of the device, with part of the support and containment structure removed, in another operating condition;

Figure 8 is a sectional view of Figure 7, taken along the line VIII-VIII;

Figure 9 is a sectional view of Figure 8, taken along the line IX-IX;

Figures 10 and 11 illustrate a second embodiment of the device according to the invention, and more particularly:

Figure 10 is a partially sectional front elevation view of the device, with part of the support and containment structure removed, in an operating condition similar to the one shown in Figures 3 to 5;

Figure 11 is a sectional view of Figure 10, taken along the line XI-XI.

[0012] With reference to Figures 1 to 9, the device according to the invention, in its first embodiment, generally designated by the reference numeral 1, comprises an abutment element 2, which is connected to the control member or item of switchgear 3 to be locked and can be moved along an actuation path in order to pass from at least one first position to at least one second position or vice versa. These at least two positions are mutually spaced along the path of the motion of the abutment element 2 and correspond to two actuation conditions of the item of switchgear 3, for example connection to the electrical mains and grounding in the case of the application of the device to an electrical line disconnecter.

[0013] The device comprises first locking means 4, which can engage the abutment element 2 in order to lock it in the at least two positions, and control means 5 are provided which are connected to the first locking means 4 and can be actuated in order to disengage the first locking means 4 from the abutment element 2 so as to allow, during the normal use of the device, the movement of the abutment element 2 from the first position to the second position or vice versa.

[0014] The first locking means 4 comprise a calibrated-shear element 6, which is adapted to allow, following its breakage, which can be produced by moving the abutment element 2 from the first position to the second position with a force which is greater than a preset force although the first locking means 4 are engaged with the

abutment element 2, the passage of the abutment element 2 from the first position to the second position.

[0015] According to the invention, the device comprises second locking means 7, which can engage the abutment element 2 in order to lock it in the second position despite the breakage of the calibrated-shear element 6.

[0016] The item of switchgear, in the illustrated embodiments, is constituted by a shaft 8, rotatable about its own axis 8a, and the abutment element 2 is constituted by a substantially circular body, which is rigidly coupled to the shaft 8 in rotation about its axis 8a with respect to a box-like structure 9, which contains and supports the various components of the device. The connection of the abutment element 2 to the shaft 8 in rotation about its axis 8a can be achieved by means of grub screws, as shown, or by way of other known types of connecting means.

[0017] In these embodiments, the path followed by the abutment element 2 in passing from the first position to the second position or vice versa is a circular path centered on the axis 8a, but, more generally, the abutment element can move, in the case of applications with items of switchgear which perform a translational motion or in the case of a different connection between the item of switchgear and the abutment element, also along a different path, such as for example a straight path.

[0018] The abutment element 2 can rotate with respect to the first locking means 4 about the axis 8a and has at least one first seat 10 and at least one second seat 11, which are open on the perimeter of the abutment element 2 and are angularly spaced with respect to each other around the axis 8a.

[0019] The first locking means 4 comprise a first slider 12, which faces the perimeter of the abutment element 2 and can move along a radial direction with respect to the abutment element 2 toward the axis 8a in order to engage the first seat 10 or the second seat 11, thus locking the abutment element 2 in the first position or in the second position, and away from the axis 8a in order to disengage from the first seat 10 or from the second seat 11, thus releasing the abutment element 2, which can pass freely from the first position to the second position or vice versa.

[0020] The calibrated-shear element 6 is constituted by a tooth 12a of the first slider 12, which constitutes the part of the first slider 12 which can engage selectively the first seat 10 or the second seat 11. Said tooth 12a is connected to the remaining part of the first slider 12 by means of connecting elements, such as pins 13 which have a preset breaking strength.

[0021] The second locking means 7 comprise a second slider 14, which faces the perimeter of the abutment element 2 and can move along a radial direction with respect to the abutment element 2 toward the axis 8a in order to engage the second seat 11 as an alternative to the tooth 12a of the first slider 12 in order to lock the abutment element 2 in the second position in the absence of the tooth 12a, following its separation from the remain-

ing part of the first slider 12.

[0022] The first slider 12 and the second slider 14 are preferably superimposed and are inserted in a sliding guide, which is oriented radially with respect to the abutment element 2 and is formed by a block 15, which is fixed to the box-like structure 9.

[0023] The first slider 12 and the second slider 14 are pushed in the direction of the axis 8a, so as to facilitate their engagement with the first seat 10 or with the second seat 11, respectively by first elastic means 16 and second elastic means 17, constituted for example by helical springs, which are interposed between the corresponding slider 12 or 14 and the block 15.

[0024] The tooth 12a of the first slider 12 has a tab which defines a stop element 30 for the second slider 14, thus preventing the engagement of the second slider 14 with the seats 10 and 11 in contrast with the action of the second elastic means 17. Substantially, as long as the tooth 12a of the first slider 12 is connected to the remaining part of the first slider 12, the second slider 14 cannot engage the abutment element 2.

[0025] The control means 5 comprise an element, such as a pivot 18 provided with a prism-like head, which can be accessed from the outside of the box-like structure 9 and can be operated by means of a key given to authorized personnel.

[0026] More particularly, the pivot 18 is supported, so that it can rotate about its own axis, which is parallel to the axis 8a, by the box-like structure 9 and is provided with an arm 18a which engages a groove 19 provided in the first slider 12. As a whole, the key and the pivot 18 constitute a lever-like connection, which allows to move the first slider 12 away from the axis 8a in contrast with the action of the first elastic means 16.

[0027] The second slider 14 is disengaged from the control means 5, or rather, it is connected to them by means of the tooth 12a of the first slider 12 and therefore is disengaged from the control means 5 in the absence of the tooth 12a of the first slider 12.

[0028] As mentioned above, the abutment element 2 might have another shape and might move along a path other than a circular one. In this case, the first slider 12 and the second slider 14 can move, more generally, along a direction which is substantially perpendicular to the path followed by the abutment element 2 in passing from the first position to the second position or vice versa.

[0029] For the sake of completeness in description, it should be noted that the box-like structure 9 is composed of a bottom element 9a, which supports the various components of the device according to the invention, and of a cover 9b, which is connected detachably, for example by means of screws 40, to the bottom element 9a and closes the box-like structure 9, allowing the actuation of the device, in conditions of normal operation, exclusively by acting on the control means 5 by means of a key or other controlled-access element.

[0030] Operation of the device according to the invention in the embodiment shown in Figures 1 to 9 is as

follows.

[0031] In conditions of normal operation, when the abutment element 2 is in the first position, the first seat 10 is aligned with the first slider 12, which engages by means of its tooth 12a in said first seat 10, locking the item of switchgear 3, as shown in Figures 2, 3, 4 and 5. When authorized personnel must act on the item of switchgear 3, by means of a key or other controlled-access element, such personnel acts on the pivot 18 so as to move the first slider 12 away from the axis 8a in contrast with the action of the first elastic means 16, as shown in Figure 6. It should be noted that the second slider 14 is pushed by the second elastic means 17 against the stop element 30 defined by the tab of the tooth 12a of the first slider 12 and therefore the second slider 14 is moved rigidly with the first slider 12 in contrast also with the second elastic means 17.

[0032] In this manner, the item of switchgear 3 is released and can be turned freely.

[0033] If, with the abutment element 2 in the first position, i.e., with the first slider 12 engaged with the first seat 10, an emergency situation occurs which requires actuation of the item of switchgear 3, which corresponds to the passage of the abutment element 2 to the second position, and the key or other controlled-access element is not available, it is possible to operate the item of switchgear 3 by applying thereto a force which is greater than the force required to break the pins 13. As a consequence of this breakage, the tooth 12a of the first slider 12 is detached from the remaining part of the first slider 12 and the second slider 14 is free to move, due to the action of the second elastic means 17, toward the axis 8a. For this reason, when, as a consequence of the rotation of the abutment element 2 about the axis 8a, the second seat 11 is aligned with the second slider 14, said second slider engages said second seat 11, locking the abutment element 2 and therefore the item of switchgear 3 connected thereto, as shown in Figures 7, 8 and 9.

[0034] It should be noted that owing to the fact that the second slider 14, in the absence of the tooth 12a of the first slider 12, is in no way connected to the pivot 18, this locking of the item of switchgear 3 cannot be removed even by means of the key or other controlled-access element but requires replacement of the first slider 12 with an intact one. Owing to this fact, the possibility of unauthorized or negligent action on the item of switchgear 3 after an emergency intervention is assuredly prevented.

[0035] The second embodiment, shown in Figures 10 and 11, relates to a device according to the invention, generally designated by the reference numeral 1a, which allows to lock the abutment element 2 in a position which is intermediate between the first position and the second position, for example in order to delay the passage of the abutment element 2, and therefore of the item of switchgear 3 connected thereto, from the first position to the second position. This second embodiment, in addition to the elements already described in the preceding figures and designated by the same reference numerals, pro-

vides for additional locking means 20, which are connected to corresponding additional control means 21 and can engage an intermediate seat 22 provided in the abutment element 2 between the first seat 10 and the second seat 11 in order to lock the abutment element 2 in a position which is intermediate between the first position and the second position.

[0036] The additional locking means 20 can be constituted by a slider 23, which is provided in a manner similar to the first slider 12, i.e., with a tooth 23a which can engage the intermediate seat 22 and is connected to the remaining part of said slider 23 by pins 13 which have a preset breaking strength. The slider 23 is guided, in its movement in a radial direction with respect to the abutment element 2, by a block 24, which is similar to the block 15 and is pushed toward the axis 8a by additional elastic means 25, for example helical springs which are interposed between the slider 23 and the block 24. Moreover, the slider 23 is connected to the additional control means 21, which are similar to the control means 5, which can be accessed from the outside of the box-like structure 9 and on which it is possible to act by means of a key or other controlled-access element in order to move the slider 23 away from the axis 8a in contrast with the action of the additional elastic means 25.

[0037] For the sake of completeness in description, it should be noted that a spacer block 26 is interposed between the slider 23 and the bottom element 9a so as to render the components 21, 23, 23a, 25 similar to the components 5, 12, 12a, 16, thus reducing the range of components required to manufacture the device.

[0038] Operation of the device in this constructive variation is similar to the one already described with reference to Figures 1 to 9, with the difference that in order to actuate the item of switchgear 3 it is necessary to act in two steps with the key or other controlled-access element, respectively on the control means 5 and on the additional control means 21 in order to disengage the first locking means 4 and the additional locking means 20 from the abutment element 2.

[0039] In case of emergency, if the key or other controlled-access element is not available, it is still possible to actuate the item of switchgear 3, breaking the tooth 12a of the first slider 12 and subsequently breaking the tooth 23a of the slider 23. At the end of the maneuver, the second seat 11 is aligned with the second slider 14, which engages said seat 11, locking the item of switchgear 3. In order to allow further actuations of the item of switchgear 3, it is necessary to replace the first slider 12 and the slider 23.

[0040] In practice it has been found that the locking device according to the invention fully achieves the intended aim, since following an emergency actuation of the item of switchgear it prevents with absolute assurance a further actuation of the item of switchgear, forcing the intervention of authorized personnel to restore the operating conditions which preceded the emergency actuation.

[0041] The device thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims; all the details may further be replaced with other technically equivalent elements.

[0042] In practice, the materials used, as well as the dimensions, may be any according to requirements and to the state of the art.

[0043] The disclosures in Italian Patent Application No. MI2005A001473 from which this application claims priority are incorporated herein by reference.

[0044] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A device for locking an item of switchgear, particularly for grounding disconnectors of electrical lines, which comprises:

- an abutment element (2), which is connected to the item of switchgear (3) to be locked and can move along an actuation path in order to pass from at least one first position to at least one second position, said first and second positions being mutually spaced along said path, and vice versa;
- first locking means (4), which can engage said abutment element (2) in order to lock it in said at least two mutually spaced positions along said path;
- control means (5), which are connected to said first locking means (4) and can be actuated to disengage said first locking means (4) from said abutment element (2) in order to allow the movement of said abutment element (2) from said first position to said second position or vice versa;

said first locking means (4) comprising a calibrated-shear element (6) adapted to allow, following its breakage, which can be caused by moving said abutment element (2) from said first position to said second position with a force greater than a preset force despite the engagement of said first locking means (4) with said abutment element (2), the passage of said abutment element (2) from said first position to said second position, **characterized in that** it comprises second locking means (7), which can engage said abutment element (2) in order to lock it in said second position despite the breakage of said calibrated-shear element (6).

2. The device according to claim 1, **characterized in that** said second locking means (7) are adapted to be activated by the breakage of said calibrated-shear element (6).
3. The device according to claims 1 and 2, **characterized in that** said abutment element (2) is movable along said path with respect to said first locking means (4) and has at least one first seat (10) and at least one second seat (11), which are mutually spaced and can be positioned at said first locking means (4) when said abutment element (2) reaches respectively said first position and said second position; said first locking means (4) comprising a first slider (12), which can move along a direction which is substantially perpendicular to said path in order to engage said first seat (10) or said second seat (11), respectively, in order to lock said abutment element (2) in said first position and in said second position or to disengage from said seats (10, 11) in order to allow the passage of said abutment element (2) from said first position to said second position or vice versa.
4. The device according to claim 3, **characterized in that** said calibrated-shear element (6) comprises a tooth (12a) of said first slider (12) which can engage selectively said first seat (10) and said second seat (11) of the abutment element (2), said tooth (12a) being connected to the remaining part of said first slider (12) by means of connecting elements (13) which have a preset breaking strength.
5. The device according to one or more of the claims 3,4, **characterized in that** it comprises first elastic means (16), which act on said first slider (12) for its engagement with said first seat (10) or said second seat (11), said control means (5) being actuable in order to disengage said first slider (12) from said first seat (10) or from said second seat (11) in contrast with the action of said first elastic means (16).
6. The device according to one or more of the claims 3-5, **characterized in that** said second locking means (7) comprise a second slider (14), which can move along a direction which is substantially perpendicular to said path in order to engage said second seat (11) as an alternative to said tooth (12a) of the first slider (12) in order to lock said abutment element (2) in said second position in the absence of the tooth (12a) of said first slider (12).
7. The device according to one or more of the claims 3-6, **characterized in that** it comprises second elastic means (17), which act on said second slider (14) for its engagement with said second seat (11) in the absence of said tooth (12a) of the first slider (12).
8. The device according to one or more of the claims 3-7, **characterized in that** said sliders (12, 14) are superimposed and **in that** said tooth (12a) of the first slider (12) has a tab which forms a stop element (30) for said second slider (14) and is adapted to prevent the engagement of said second slider (14) with said seats (10, 11) in contrast with the action of said second elastic means (17).
9. The device according to one or more of the claims 3-8, **characterized in that** said second slider (14), at least in the absence of said tooth (12a) of the first slider (12), is disengaged from said control means (5).
10. The device according to one or more of the claims 3-9, **characterized in that** said path is circular, said abutment element (2) being constituted by a substantially circular body, which can rotate about an axis (8a) and in which said seats (10, 11) are formed along its perimeter; said sliders (12, 14) facing a perimeter region of said abutment element (2) and being able to slide along a direction which is substantially radial with respect to said abutment element (2).
11. The device according to one or more of the preceding claims, **characterized in that** said control means (5) comprise an element (18) which can be operated by means of a key and is connected to said first slider (12), forming a lever-like connection.
12. The device according to one or more of claims 3-11, **characterized in that** it comprises a box-like structure (9) which accommodates said abutment element (2), said first locking means (4), said second locking means (7) and said control means (5); said sliders (12, 14) being slidably supported along said actuation direction by said box-like structure (9) and said elastic means (16, 17) being interposed between the corresponding slider (12, 14) and said box-like structure (9); said control means (5) being adapted to be accessible from the outside of said box-like structure (9).
13. The device according to one or more of claims 3-12, **characterized in that** it comprises additional locking means (20), which are connected to corresponding additional control means (21) and can engage an intermediate seat (22) which is provided in said abutment element (2) between said first seat (10) and said second seat (11) in order to lock said abutment element (2) in a position which is intermediate between said first position and said second position; said additional locking means (20) and the corresponding additional control means (21) being accommodated in said box-like structure (9); the additional control means (21) of said additional locking means (20) being adapted to be accessible from the

outside of said box-like structure (9).

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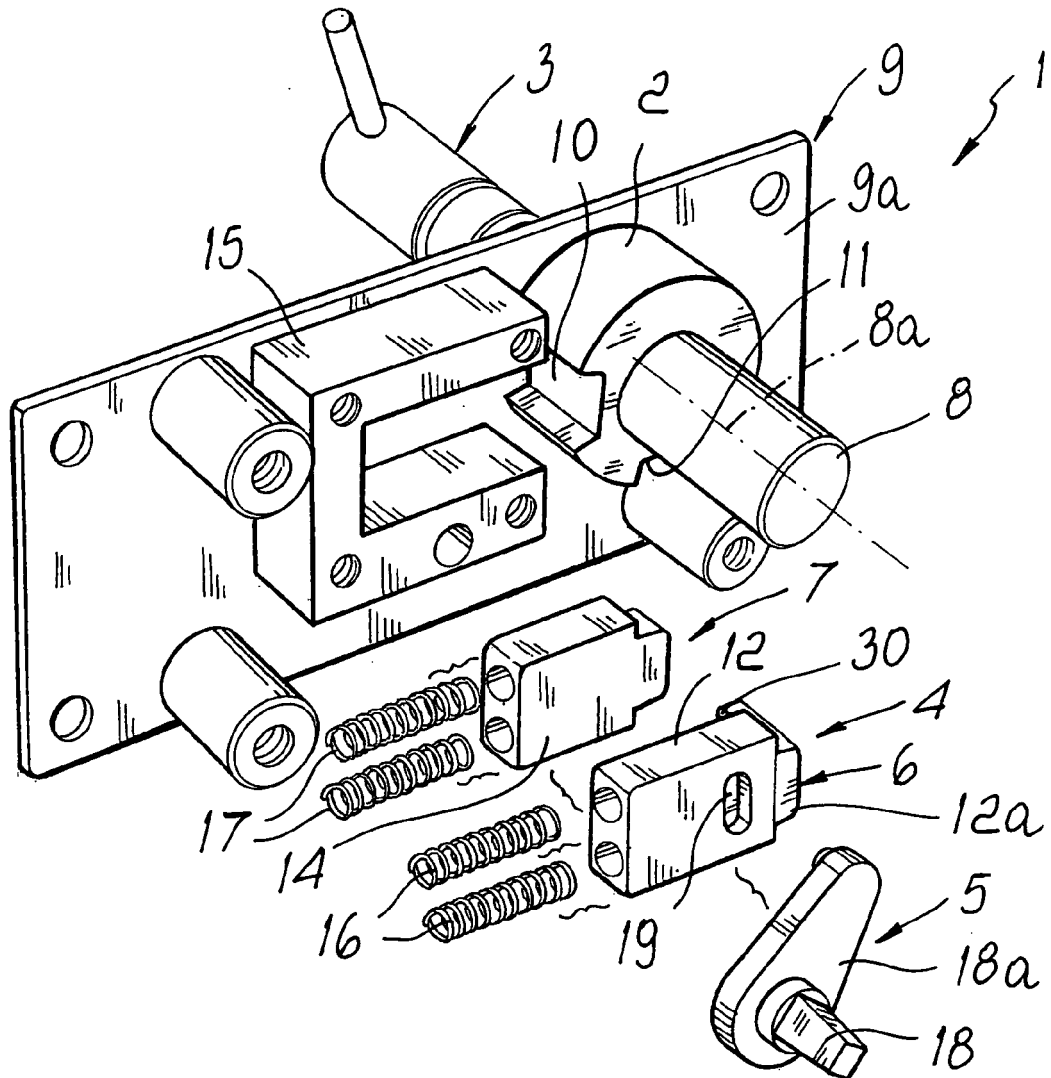
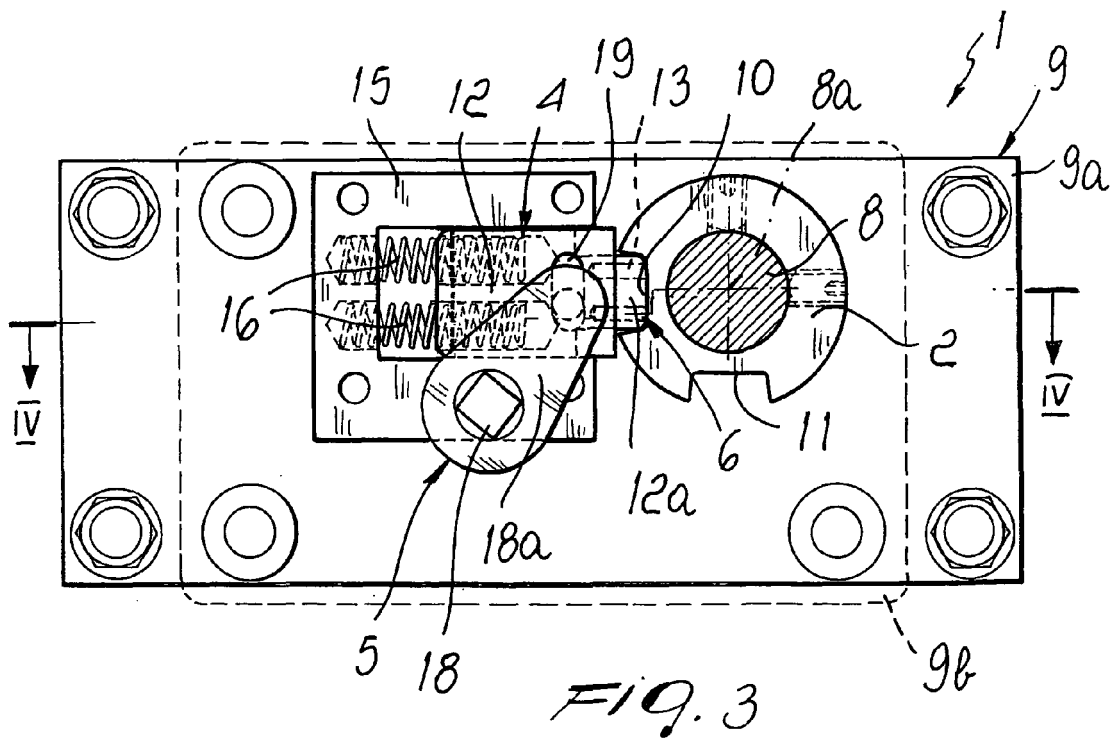
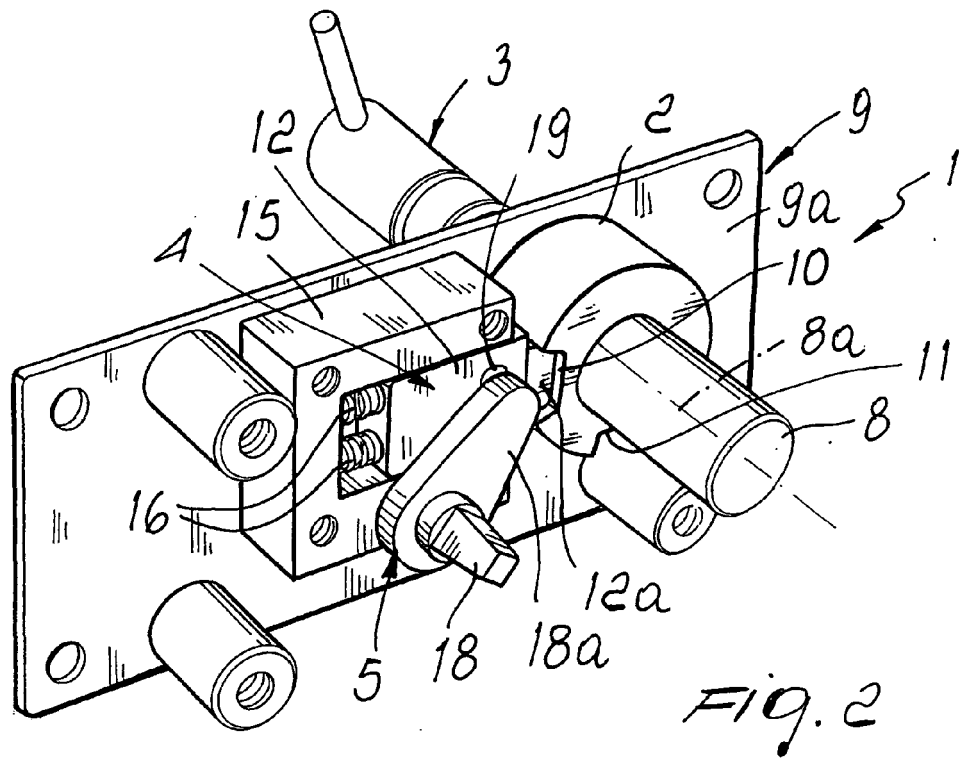
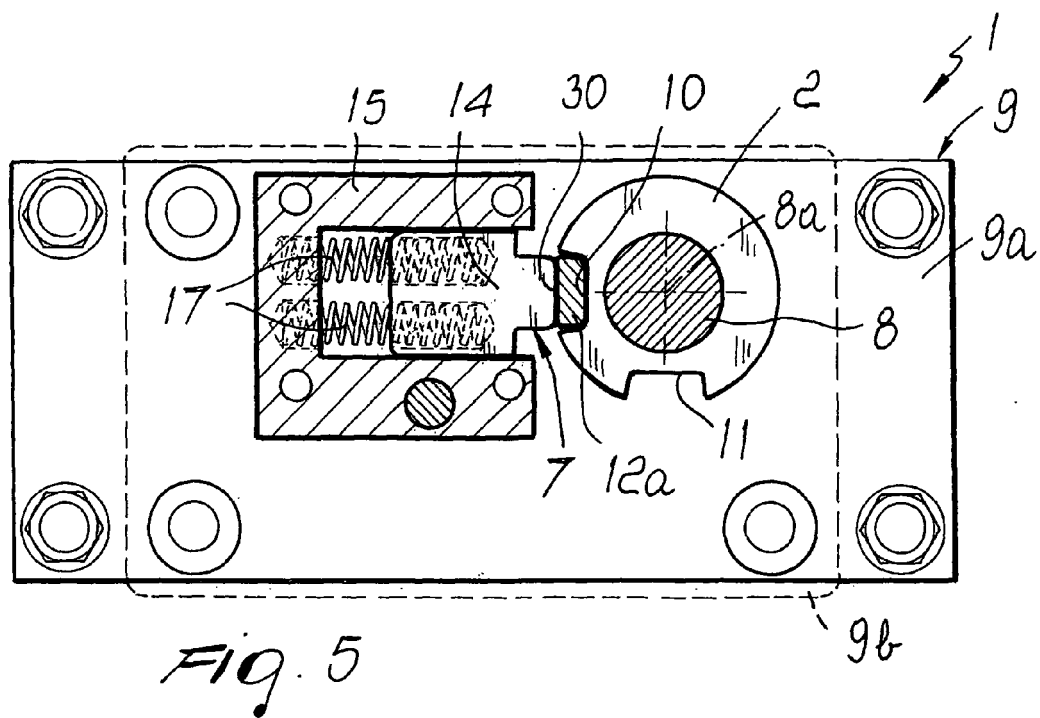
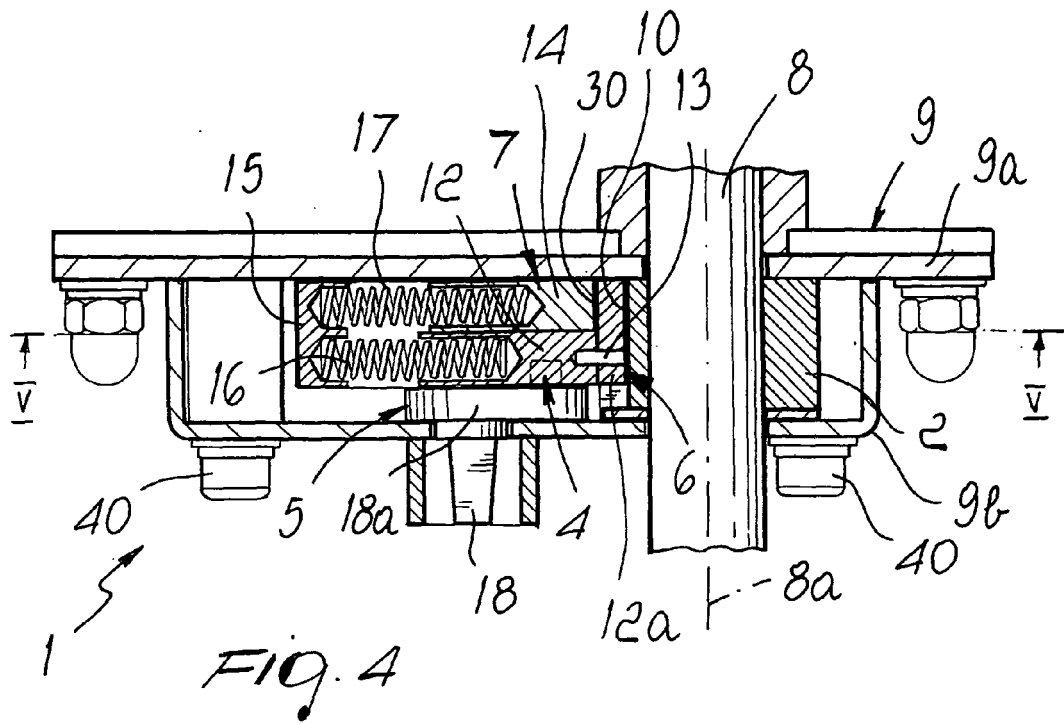


Fig. 1





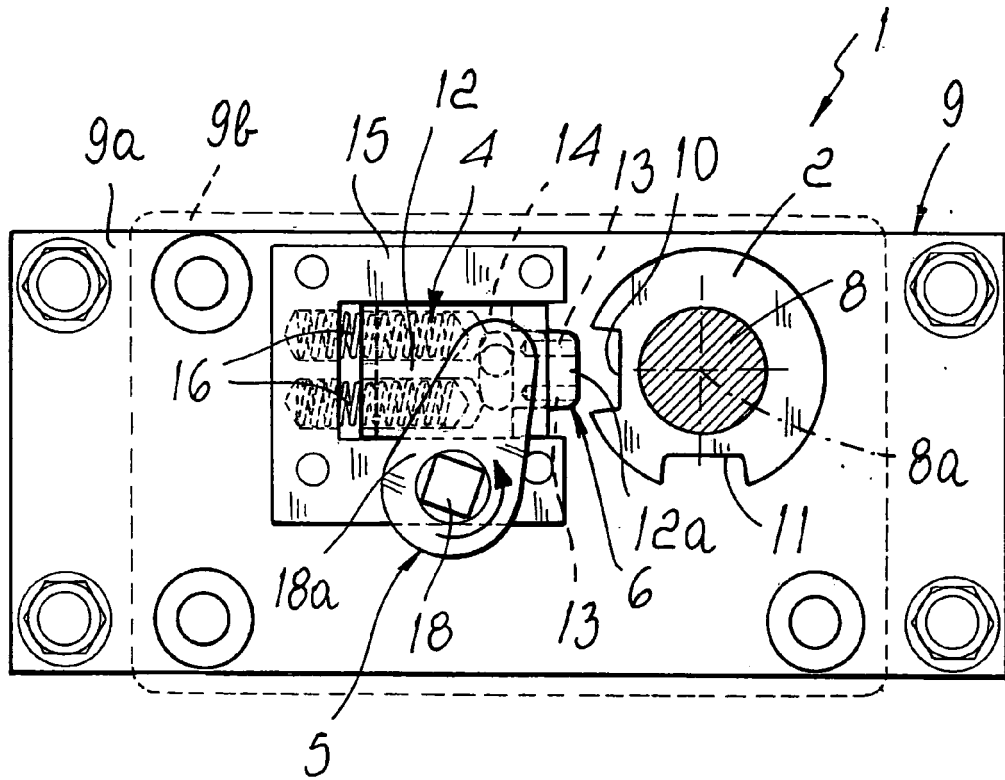


Fig. 6

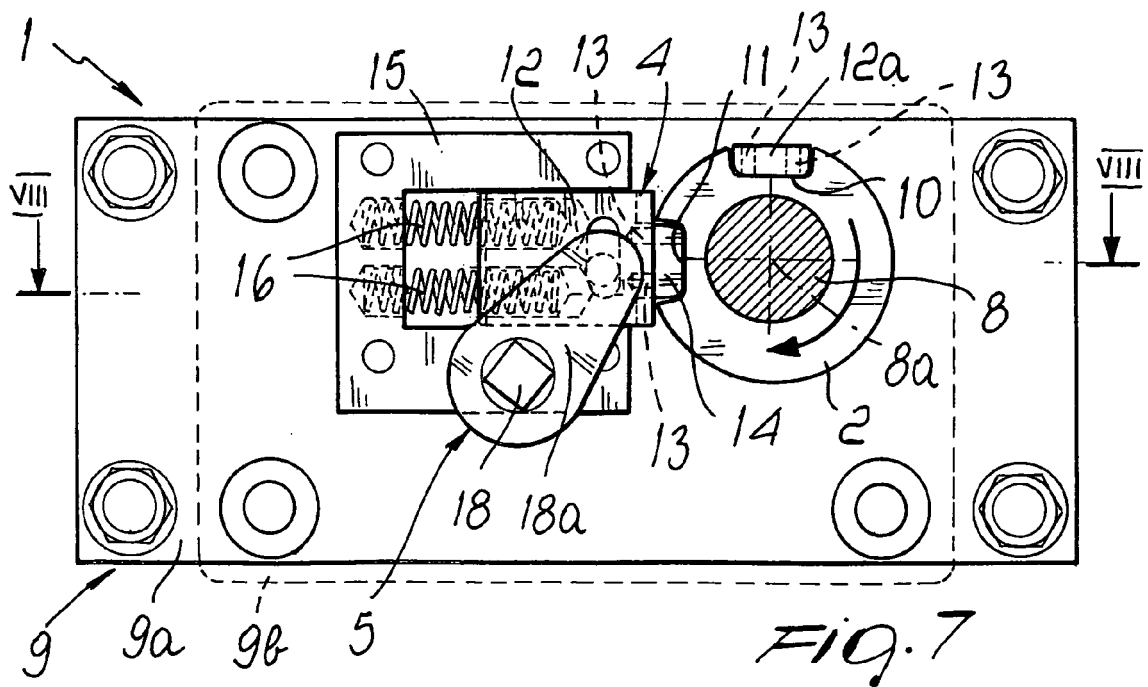


Fig. 7

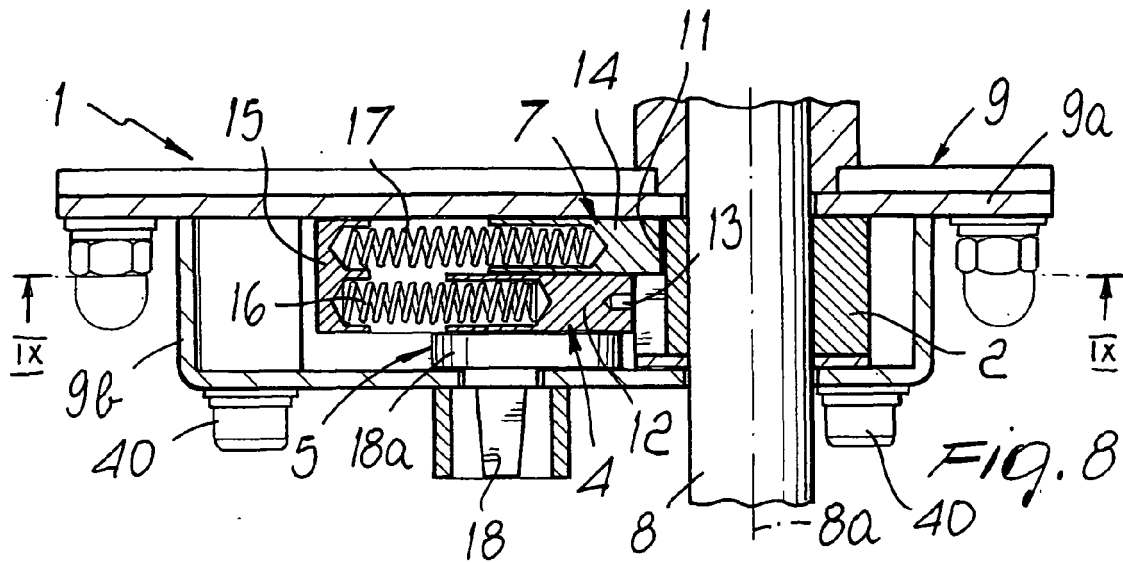


Fig. 8

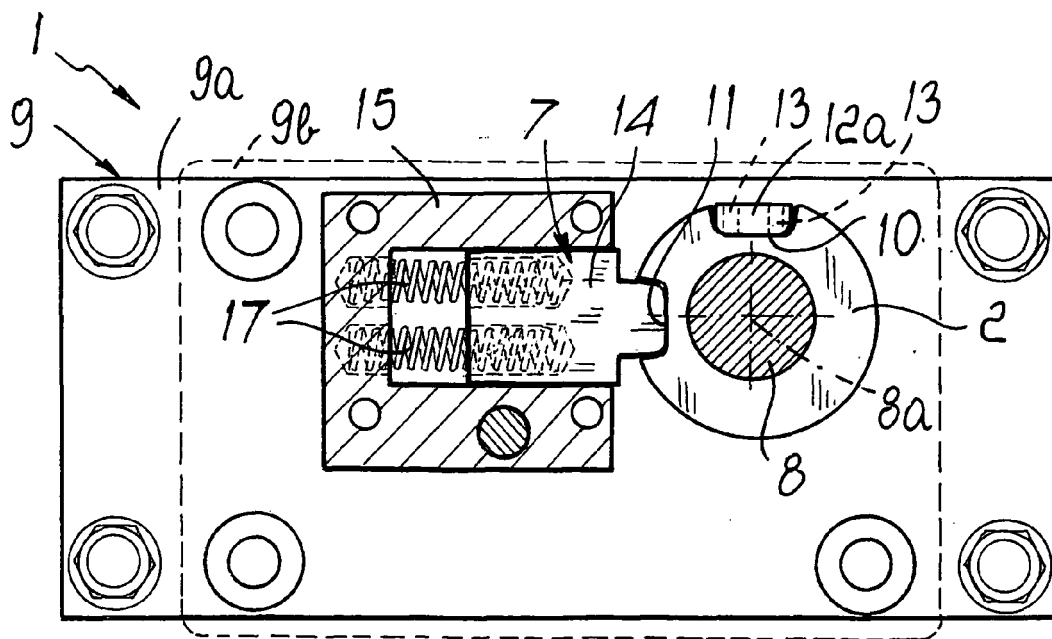
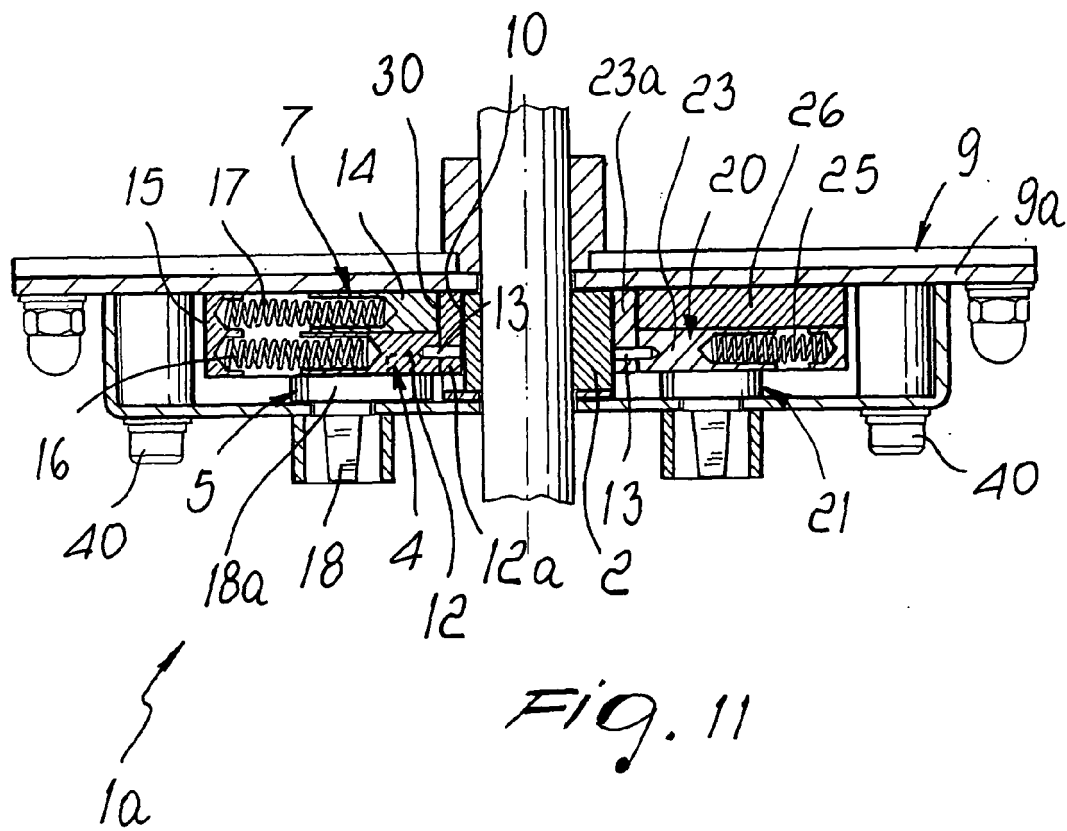
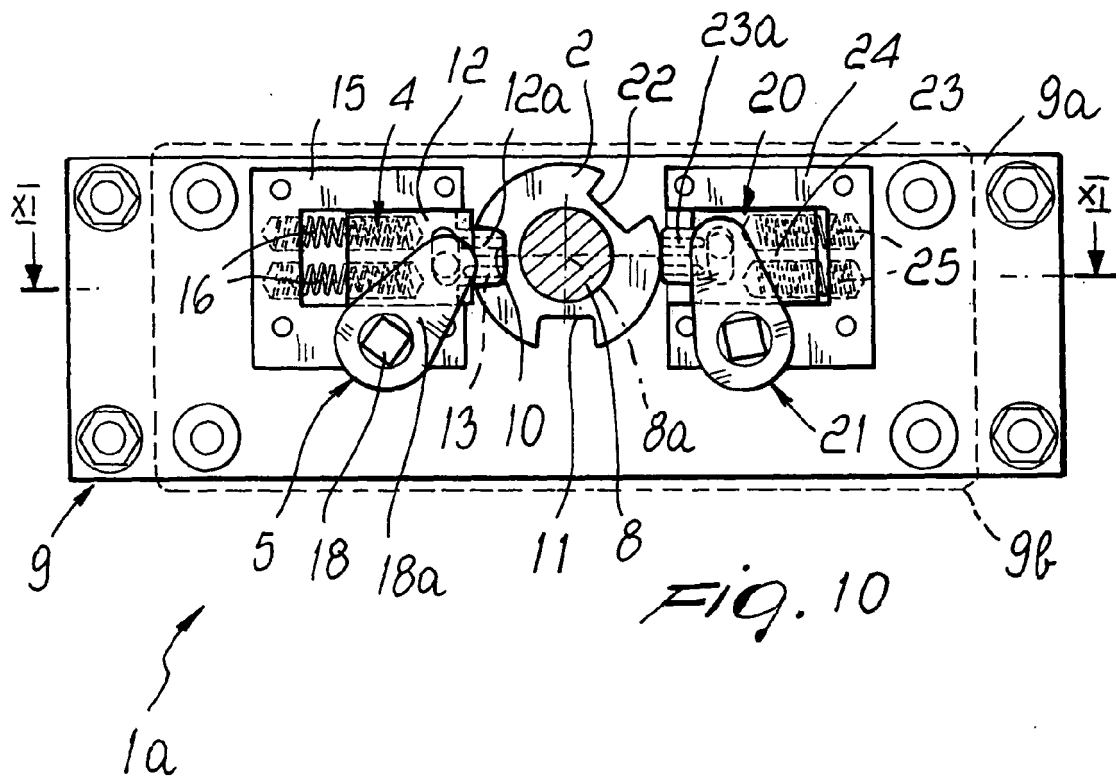


Fig. 9



REFERENCES CITED IN THE DESCRIPTION

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