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(54) Electrically assembly with actuating device for a switch

(57) Electrical assembly with a switch and an actuating device (103) comprising a bar (154) for positioning an operating lever of the switch, a motor (203) for moving the positioning bar (154) and a transmission device (206) for connecting the motor (203) to the positioning bar (154), in which the transmission device (206) during

a closing operation connects the motor (203) to the positioning bar (154) so as to move the operating lever into a release position and then disengages the positioning bar (154) from the motor (203) in order to cause displacement of the positioning bar (154) by the operating lever.

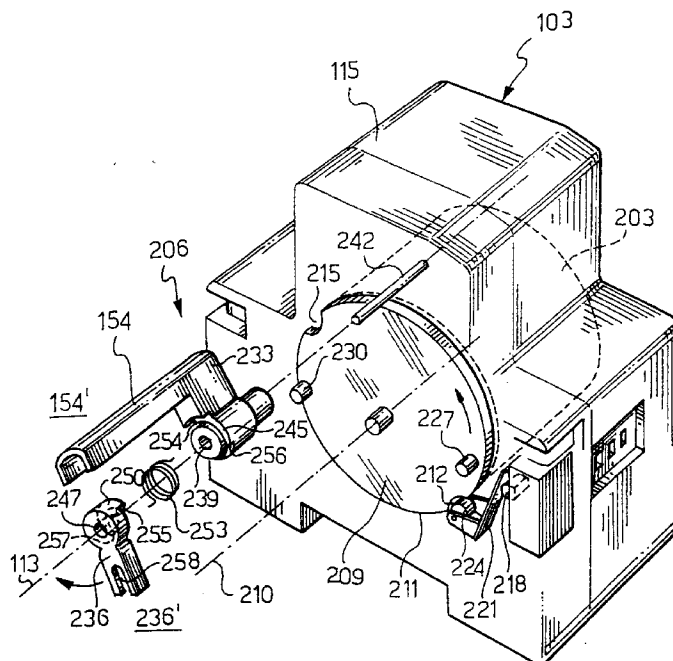


FIG. 2a

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Description

The present invention relates to an electrical assembly comprising a switch and an actuating device for the switch and in particular to an electrical assembly according to the preamble of the first Claim.

A switch is an electrical device able to interrupt or establish a flow of current in a circuit by means of suitable contacts which can be separated; in particular, the contacts are pressed together with a suitable force in a closed condition of the switch, while they are separated by an isolating distance in an open condition of the switch. These operating conditions are stable in the sense that the switch remains in each of them in the absence of external forces.

Actuating devices (or actuators) are commonly used, for example in control systems for industrial installations, in order to perform switching operations (opening or closing) of the switch using energy other than manual energy. Typically, the actuating devices use an electric motor in order to move an operating lever of the switch from an open position into a closed position, and vice versa, in response to a suitable external command signal.

It is known that, during the switch opening operation, an electric arc may be generated between the contacts which are about to separate, this being maintained subsequently by a violent phenomenon involving ionization of the medium (for example air) located between the separated contacts. In order to avoid this phenomenon, the switches are commonly provided with an opening mechanism in order to increase the speed of the operation; in particular, when the operating lever, leaving the closed position, reaches a given middle release position, this mechanism imparts a sudden acceleration to the operating lever, pushing it with force towards the open position.

A drawback of the known electrical assemblies consists in the fact that the actuating devices require the use of motors which are extremely fast, and therefore complex and costly, in order to be able to adapt to the high opening speed of the switch. On the other hand, the use of simpler and slower motors, with a speed suitable for the closing operation, creates problems during opening of the switch; in particular, when the operating lever reaches the release position, the opening mechanism drives the motor at too high a speed or else the motor brakes the operating lever, slowing down the opening operation. In both cases, a malfunction situation arises, with consequent possible damage to the switch or the motor of the actuating device.

The object of the present invention is to overcome the aforementioned drawbacks. This object is achieved by an electrical assembly as described in the first Claim.

The electrical assembly according to the present invention ensures a high speed of opening of the switch using, for the constructional design of the actuating device, a slow motor which has a speed suitable for the

closing operation and therefore has a simple and extremely low-cost design.

Further characteristic features and advantages of the electrical assembly according to the present invention will emerge from the following description of a preferred embodiment thereof, provided hereinbelow by way of a non-limiting example with reference to the accompanying drawings, in which:

Fig. 1 is a view, with separated parts, of the electrical assembly according to the present invention; Figs. 2a and 2b show an exploded view of the actuating device of Fig. 1 in different operating conditions.

With reference in particular to Fig. 1, this shows an electrical assembly 100 comprising an actuating device 103 for a switch 106. Typically, the actuating device 103 is used as a servomotor in a closed-chain control system, although its use for different applications, for example for simple remote control of the switch 106, is not excluded.

The switch 106 comprises an insulating body 107, the side walls of which are provided with one or more pairs of terminals 109 for connection of the switch 106 to corresponding pairs of electric cables of an external circuit (not shown in the figure). An operating component 112, typically consisting of a lever, is movable rotationally about an axis 113 between a position 112' and a position 112'' for opening and closing the switch 106, respectively. The insulating body 107 houses internally an opening mechanism (not shown in the figure) which, when the operating lever, leaving the closed position 112'', reaches a middle release position 112''', triggers movement of the operating lever towards the open position 112'. Commonly, this opening mechanism, which is known per se and conventional, consists of a spring tensioned during an operation involving closing of the switch 106 and released when the operating lever 112 reaches, during an opening operation, the position 112'''.

The actuating device 103 comprises an insulating body 115 formed by two half-shells joined together by suitable screws. One lateral flank of the insulating body 115 is provided with a terminal strip 118 for connection of the actuating device 103 to an electrical power supply network. The terminal strip 118 is also used to apply to the actuating device 103 suitable command signals (for opening and closing) supplied by a remote control device (not shown in the figure); the actuating device 103 may, however, be designed also using different systems for transmission of the command signals, for example by means of radio waves.

The actuating device 103 is provided with a bar 154 (or other equivalent positioning means known per se) which is parallel to the axis of rotation 113 and the bottom surface of which has, formed in it, a longitudinal channel 157 into which the operating lever 112 of the

switch 106 is inserted.

The operating lever 112 is slidable inside the channel 157, in the direction of the axis 113, so as to allow assembly of the electrical group 100, while the operating lever 112 and the positioning bar 154 move locked in rotation about the axis 113.

The switch 106 and the actuating device 103 are connected together by means of special locking components. In a preferred embodiment of the present invention on each side surface of the electrical assembly 100 there is provided an L-shaped component 166 (only one of which is shown in the figure). The L-shaped component 166 terminates, along the smaller arm of the L, in a tractional hook 169 which engages in a slit 172 formed in a rear surface of the switch 106. The L-shaped component 116 is housed in a matching seat 173 formed in the actuating device 103 along a front vertical edge. The larger arm of the L-shaped component terminates, at its free end, in an opening 175 which is situated opposite a threaded hole 178 formed in the seat 173 perpendicularly with respect to a side surface of the actuating device 103. A screw 181 seated in the opening 175 and screwed into the threaded hole 178 removably fixes the L-shaped component 166 to the actuating device 103. The connection system described above is particularly stable and strong; moreover, this structure is extremely safe since the locking components are subject to shearing and not to flexural stresses.

With reference now to Fig. 2a (the components already shown in Fig. 1 are identified by the same reference numbers), the actuating device 103 includes a motor 203 (for example a reversible synchronous electric motor) connected to the positioning bar 154 by means of a special transmission device 206. In particular, a disc 209 is connected to the motor 203 so as to be rotationally moved about an axis 210 parallel to the axis of rotation 113. A side surface 211 of the disc 209 is provided with two recesses 212 and 215 which are diametrically opposite. A micro-switch 218 is located in the vicinity of the disc 209 and has, associated with it, a flat spring 221 (or other equivalent resilient means) terminating in an idle wheel 224 which is free to rotate about an axis parallel to the axis of rotation 210. When the positioning bar 154 is located in a position corresponding to the open position or closed position of the operating lever of the switch, one of the recesses (the recess 212 in the example illustrated in the figure) is located opposite the wheel 224 which is kept pressed against the disc 209 by the spring 221. When a closing or opening command signal is supplied to the actuating device 103, the motor 203 causes rotation of the disc 209 in an anti-clockwise or clockwise direction, respectively. The wheel 224 is disengaged from the recess 212 and is pushed towards the micro-switch 218 by the side surface 211 of the disc 209, so that the spring 221 closes the contact of the micro-switch 218. When the disc 209 has performed a rotation through 180°, the other recess 215 is located opposite the wheel 224; the spring 221 pushes the wheel

224 inside the recess 215 and opens the contact of the micro-switch 218, which interrupts the movement of the motor 203 (and hence the disc 209).

In a preferred embodiment of the present invention, the disc 209 is connected to the positioning bar 154 by means of a sliding link structure; the present invention may, however, also be realized with connections of a different type, such as the friction type. The front surface 209, in the vicinity of its side surface, is provided with two sliding members 227 and 230, for example in the form of a stud, situated diametrically opposite one another and slightly staggered with respect to the recesses 212 and 215. The positioning mechanism 206 then includes an articulated structure formed by a component 233 and a component 236 movable rotationally about the axis 113. In particular, a hole 239 is formed in one end of the component 233 and receives, inserted inside it, a pin 242 arranged along the axis of rotation 113 and integral with the body 115 of the actuating device 103; the positioning bar 154 is fixed perpendicularly with respect to the free end of the component 233. The component 233 terminates, in the vicinity of the pin 242, in a substantially cylindrical shape; from a front surface of this end there extends perpendicularly a wall 245 in the form of a portion of a cylindrical side surface. Similarly, the component 236 also terminates, at one of its ends, in a substantially cylindrical shape in which a hole 247 for receiving the pin 242 is formed; from a rear surface of this end there extends perpendicularly a further wall 250 in the form of a cylindrical side surface portion.

A helical spring 253 (or other equivalent resilient means), the ends of which are fixed in suitable holes formed in the components 233 and 236, is inserted between the component 233 and the component 236 (specifically in a groove formed on the front surface of the component 233). The spring 253 keeps the components 233 and 236 aligned, with the walls 245 and 250 being arranged in abutment along their upper side edges 254 and 255, respectively. The walls 245 and 250 are of a length such that, in this condition, their bottom side edges, 256 and 257, are separated preferably by an angle of 60° with respect to the axis 113.

The rear surface of the component 236 has, formed in it, a longitudinal groove 258 which is open at the free end of the component 236 and which acts as a guide for the studs 212 and 215. In particular, it is assumed that the actuating device 103 is in the condition shown in the figure, with the positioning bar 154 and the component 236 in a position 154' and 236', respectively, corresponding to the open position of the switch. If the actuating device 103 receives a closing command signal, the disc 209 is rotated through 180° in an anti-clockwise direction. When the stud 227 reaches the component 236, it engages inside the guide 258, causing the component 236 to rotate in an anti-clockwise direction about the pin 242. The connection between the walls 250 and 245 transmits this movement also to the component 233 which moves integrally with the component 236. The po-

sitioning bar 154 (integral with the component 233) during its movement causes displacement of the operating bar of the switch so that the latter is closed. As shown in Fig. 2b (the components already shown in Fig. 2a are identified with the same reference numbers), the component 236 and the positioning bar 154 reach a position 236" and 154", respectively, corresponding to the closed position of the switch; the stud 227 disengages from the guide 258 and the disc 209 completes its rotation until the recess 215 reaches the wheel 224.

If, in the condition shown in the figure, the actuating device 103 receives an opening command signal, the disc 209 is rotated through 180° in a clockwise direction. When the stud 227 reaches the component 236, it engages inside the guide 258, causing the component 236 to rotate in an anti-clockwise direction about the pin 242. In this condition, the component 236 is free to rotate with respect to the component 233; by suitably calibrating the stiffness of the spring 253 so that the force required to deform it is less than the force required to operate the switch, the component 236 rotates against the action of the spring 253, while the component 233 remains stationary. When the component 236 reaches a position 236"', in the example in question after rotation through about 60°, the bottom edge 257 of the wall 250 is arranged in abutment against the bottom edge 256 of the wall 245. The connection between the walls 245 and 250 transmits the movement of the component 236 also to the component 233 which moves integrally with the latter. The positioning bar 154 (integral with the component 233) is thus displaced as far as the position 154"' and during its movement causes displacement of the operating bar of the switch so that it reaches the release position. The stud 227 disengages at this point from the guide 258 and the disc 209 completes its rotation until the recess 212 reaches the wheel 224, while the component 236 is aligned with the component 233 by the spring 253. In the meantime, the positioning bar 154 is disengaged from the disc 209 (and hence from the motor 203), so that it is displaced by the operating lever of the switch until it reaches the position 154' shown in Fig. 2a. It should be noted that, advantageously, the presence of two studs 227 and 230 allows the actuating device 106 to be used independently of the initial position of the component 236 and hence the operating lever 154.

The transmission mechanism described above is particularly compact, reliable and effective. Moreover it is extremely simple and can be mass-produced at a low cost, so that it does not increase the final cost of the entire actuating device.

Obviously, in order to satisfy any specific or other requirements which may arise, the electrical assembly described above may be subject to numerous modifications and variations carried out by a person skilled in the art, all of which, however, are contained within the protective scope of the invention, as defined by the claims which follow.

Claims

1. Electrical assembly (100) comprising a switch (106) having an operating component (112) movable between an open position (112') and a closed position (112'') and comprising means for triggering displacement of the operating component (112) towards the open position (112') when the operating component (112), leaving the closed position (112''), reaches a middle release position (112''');

an actuating device (103) comprising means (154) for positioning the operating component (112) movable between a first position (154') and a second position (154'') corresponding, respectively, to the closed position (112') and open position (112''), a motor (203) for moving the positioning means (154) and a transmission device (206) for connecting the motor (203) to the positioning means (154);

characterized in that

the transmission device (206), during a movement of the positioning means (154) from the second position (154'') to the first position (154'), connects the motor (203) to the positioning means (154) so as to move the operating component (112) from the closed position (112'') to the release position (112''') and disengages the positioning means (154) from the motor (203) in a third position (154''') of the operating means (154) corresponding to the release position (112''') so as to cause displacement of the positioning means (154) towards the first position (154') by the operating component (112).

2. Electrical assembly (100) according to Claim 1, in which the transmission device (206), when there is a movement of the positioning means (154) from the first position (154') to the second position (154''), connects the motor (203) to the positioning means (154) so as to move the operating component (112) from the open position (112') to the closed position (112'').
3. Electrical assembly (100) according to Claim 1 or 2, in which the transmission means (206) include an articulated structure (233,236,253) comprising a first component (233) associated with the positioning means (154) and a second component (236) associated with the motor (203) and movable between a fourth position (236') and a fifth position (236''), the second component (236) during a movement from the fourth position (236') to the fifth position (236'') being integral with the first component (233) so as to move the positioning means (154) from the

first position (154') to the second position (154''), the second component (236) during a movement from the fifth position (236'') to a sixth middle position (236''') being movable with respect to the first component (233) so as not to move the positioning component (154) and during a movement from the sixth position (236''') to the fourth position (236') being integral with the first component (233) so as to move the positioning means (154) from the second position (154'') to the third position (154''').

4. Electrical assembly (100) according to Claim 3, in which the first component (233) and the second component (236) are movable rotationally about a common axis (113) and include, respectively, a first wall (245) and a second wall (250) in the form of a cylindrical side surface having an axis coinciding with said common axis (113), in the fourth position (236') and the fifth position (236'') a first side edge (255) of the second wall (250) being arranged in abutment against a first side edge (254) of the first wall (245) and a second side edge (257) of the second wall (250) being separated from a second side edge (256) of the first wall (245), in the sixth position (236''') the second edge (257) of the second wall (250) being arranged in abutment against the second edge (256) of the first wall (245).

5. Electrical assembly (100) according to Claim 4, in which in the fourth position (236') and the fifth position (236'') the second edge (257) of the second wall (250) is separated from the second edge (256) of the first wall (245) by an angle of 60° with respect to the common axis (113).

6. Electrical assembly (100) according to Claim 4 or 5, in which the articulated structure (233,236,253) further comprises resilient means (253) for keeping the first edge (255) of the second wall (250) in contact with the first edge (254) of the first wall (245), the second component (236) moving from the fifth position (236'') to the sixth position (236''') against the action of said resilient means (253).

7. Electrical assembly (100) according to any one of Claims 3 to 6, in which the transmission means (206) further comprise a rotatable component (209) connected to the motor (203) and provided with at least one sliding member (227,230) for engaging in a guide (258) formed in the second component (236).

8. Electrical assembly (100) according to Claim 7, in which the rotatable component (209) is provided with two of said sliding members (227,230) located diametrically opposite with respect to an axis of rotation (210) of the rotatable component (209).

9. Electrical assembly (100) according to Claim 7 or 8, in which the rotatable component is a disc (209) having two recesses (212,215) formed on a side surface (211) for co-operating with additional resilient means (221,224) associated with a micro-switch (218), said side surface (211) acting on the additional resilient means (221,224) so as to keep the micro-switch (218) in a first condition which enables a movement of the motor (203), the additional resilient means (221,224) being released opposite one of the recesses (212,215) so as to bring the micro-switch (218) into a second condition which interrupts the movement of the motor (203).

10. Electrical assembly (100) according to any one of the preceding Claims 1 to 9, further comprising at least one locking component (166) having a tractional hook (169) engaged in a slit (172) formed on the switch (106) and removably fixed to the actuating device (103) in a matching seat (173).

11. Electrical assembly (100) according to Claim 10, in which the locking component (166) has an L-shaped structure with a smaller arm where the hook (169) is arranged and a larger arm in which there is formed an opening (175) which receives a screw (181) screwed into a hole (178) formed in said seat (173).

12. Actuating device (103) for use in the electrical assembly (100) according to any one of Claims 1 to 11.

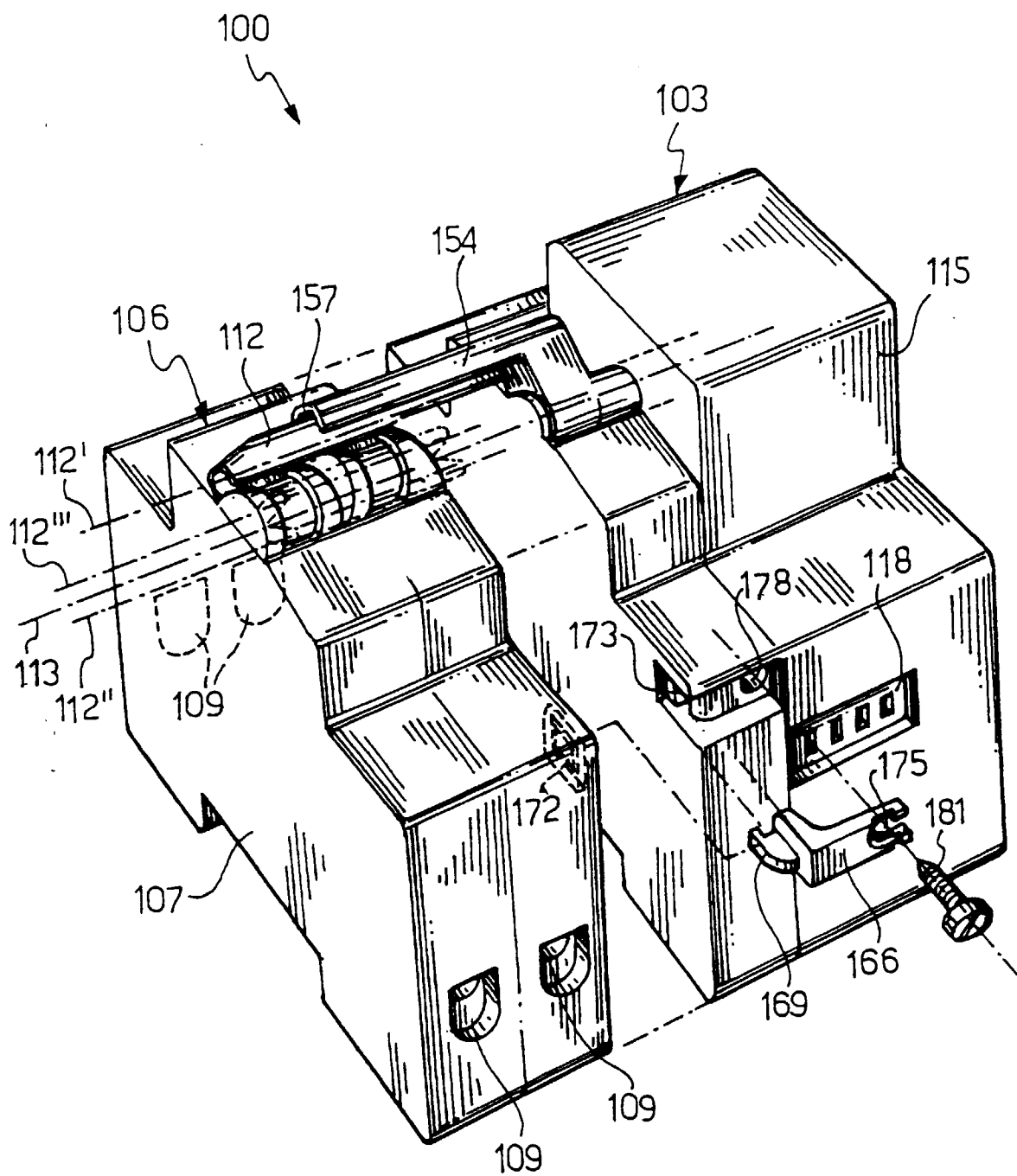


FIG.1

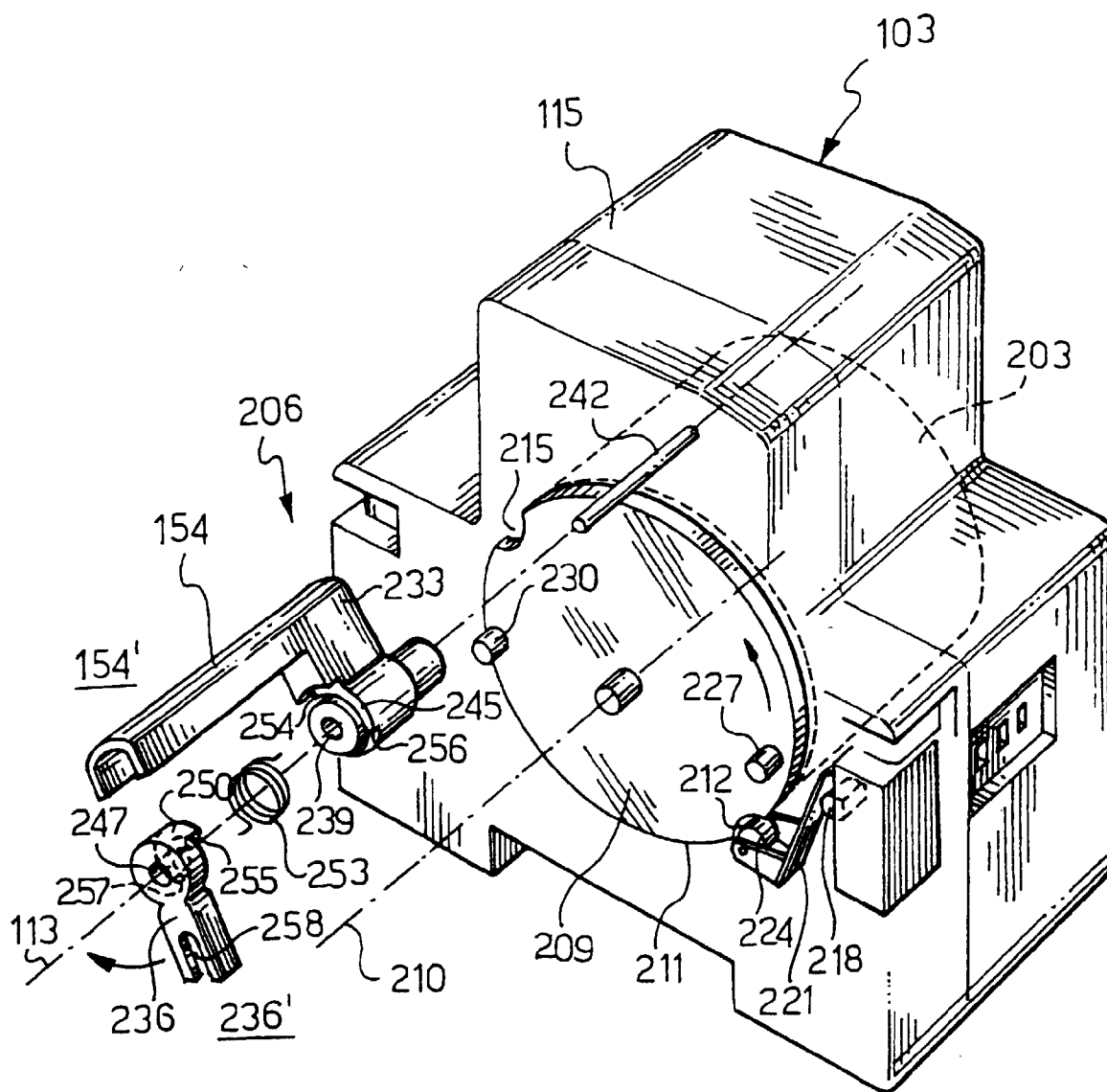


FIG. 2a

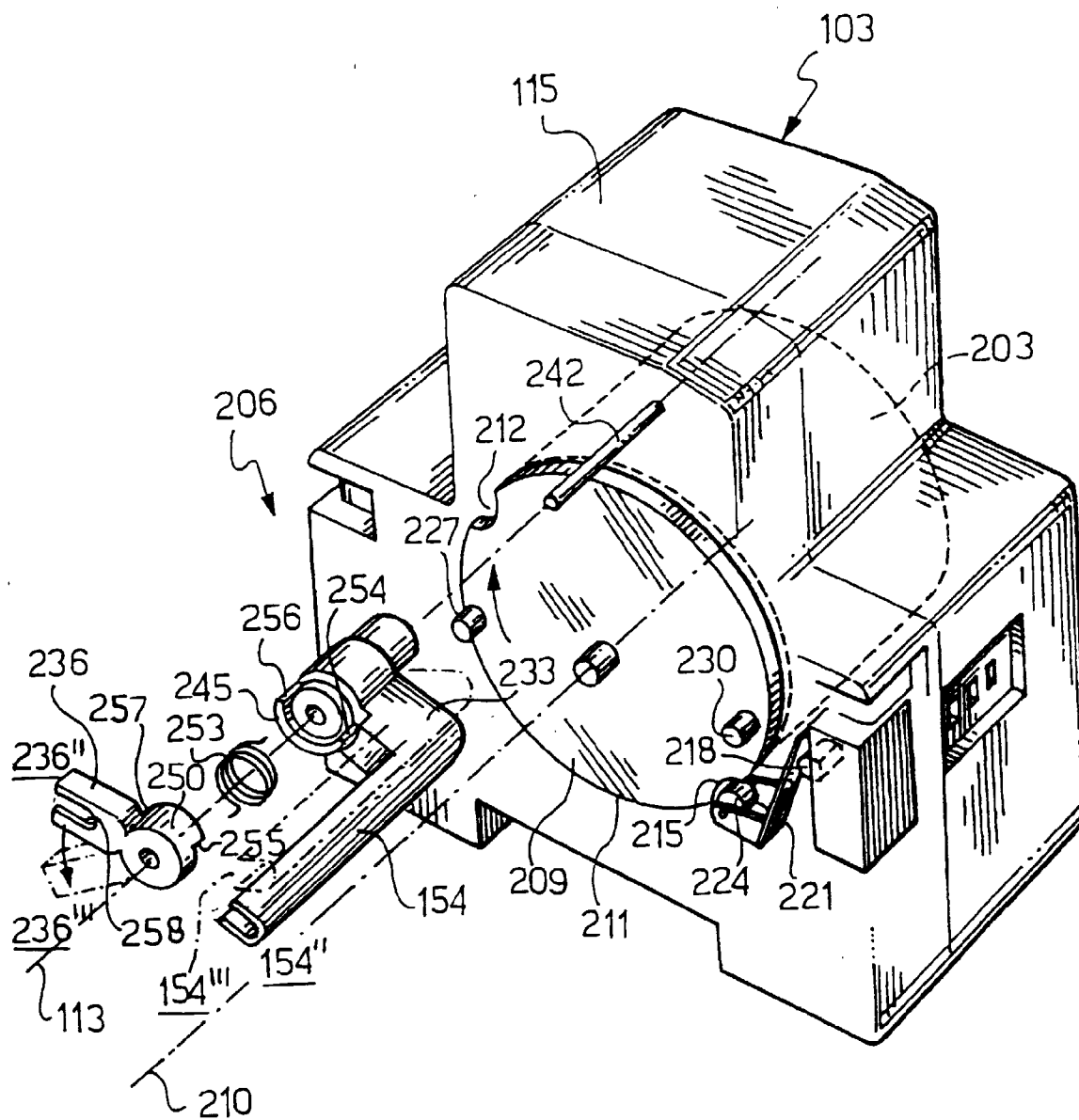


FIG.2b