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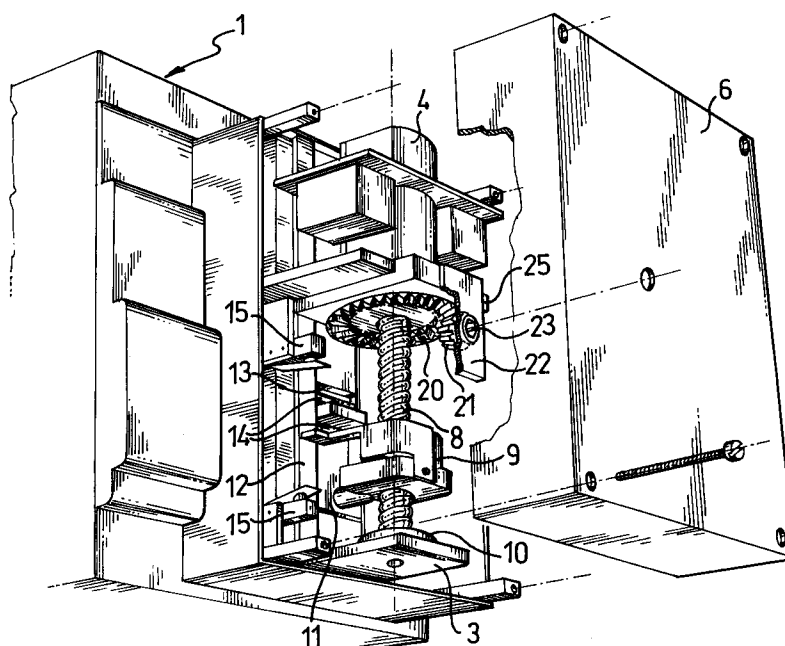
(54) **A device for the remote actuation of an electric switch.**

(57) Two embodiments are described of a device for the remote actuation of electric switches, particularly power switches and switches to be mounted on "OMEGA" guides, each including an actuator (4,8,9;33,34,35) of the recirculating-ball lead-screw type, which drives a slider (11) or a lever (41) which

engages the operating lever (2;42) of the switch.

Operation of the actuator (4,8,9;33,34,35) causes the slider (11) or the lever (41) to move in one direction or the other thereby switching the switch.

One embodiment provides means (20,23) for enabling the device to be operated manually.

**FIG.1****EP 0 625 788 A2**

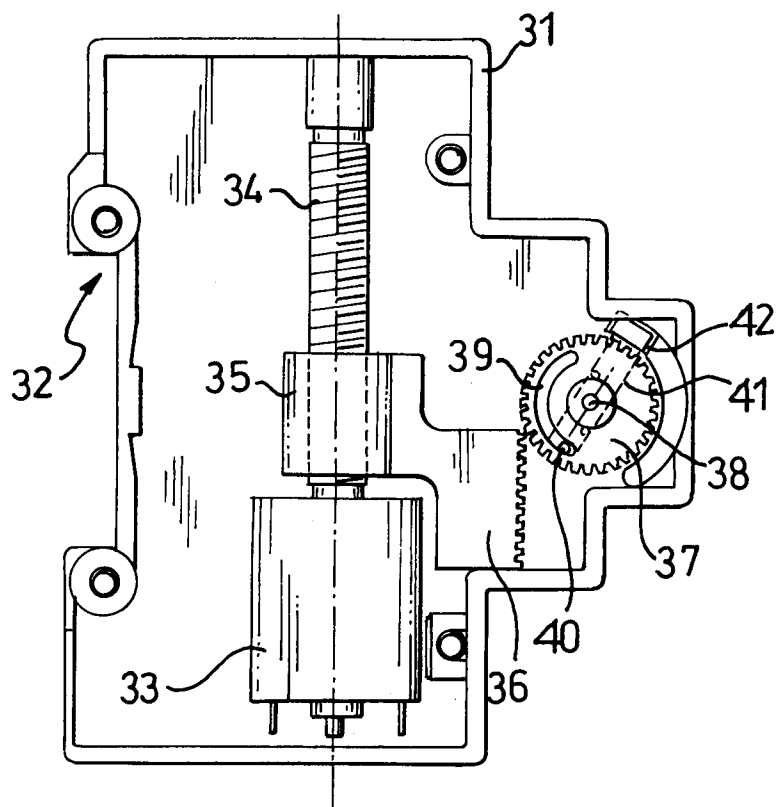


FIG. 4

The present invention relates to a device for the remote actuation of an electric switch, with an electric motor and transmission means for driving a member coupled to the opening and closing mechanism of the switch.

As is known, in electrical installations, mains switches, and power switches in particular, are arranged in places which are not easily accessible such as cabinets, wall cupboards and the like. This arrangement involves considerable problems when the switches need to be actuated and has given rise to a need for devices able to carry out the operation at a distance.

Prior-art remote-actuation devices generally include electric or electromagnetic motors which act on the lever of the switch through a complex series of levers to move it from its open to its closed position or vice versa.

However, these prior art devices have the disadvantage of being very heavy and bulky as well as being expensive to produce which makes them uneconomical in many cases.

In addition, in many applications, for example when an emergency power supply must be switched on when the switch is opened, the switches must have very fast switching times which means that very powerful and thus very large actuating devices must be used.

For these reasons, a need has been felt in the industry for devices that are able to actuate a switch from a distance but which, unlike known devices, are compact, light and inexpensive while ensuring fast switching times. In addition, any such device should preferably be simply designed, making it both quick to assemble and economical to service.

These requirements are satisfied, according to the invention, by an actuating device characterised in that the transmission means include a recirculating-ball lead screw arrangement as the coupling means.

The invention will now be described in detail, purely by way of non-limitative example, with reference to the appended drawings, in which:

Figure 1 is a perspective view showing a first embodiment of the device of the invention applied to a switch;

Figure 2 is a vertical section of the device of Figure 1;

Figure 3 is a vertical section in a plane perpendicular to that of Figure 2; and

Figures 4 and 5 are sectioned views of a second embodiment of the device of the invention in two different working positions.

With reference to Figures 1 to 3, a power switch is indicated 1, its operating lever is indicated 2, the support structure of the remote actuation device applied to the switch is indicated 3 and a

cover for the device is indicated 6.

A motor 4, preferably a direct-current motor, is fixed to a plate 25 rigidly fixed to the structure 3 and is coupled to a lead screw transmission member. In particular, the shaft 7 of the motor is axially coupled to a screw 8, the ends of which are supported on the structure 3 by bearings 5, 10, in particular thrust bearings, and the screw 8 is coupled with a recirculating-ball nut 9.

A slider 11 is coupled to the nut 9 for translation and slides along a pair of guides 12 formed in the support structure 3 parallel to the axis of the screw 8 and to the direction in which the switch lever 2 moves to pass from its open to its closed position and vice versa.

The slider 11 has a slot 13 with a pair of pins 14 between which the lever 2 of the switch is inserted.

Two microswitches (shown only in Figure 1) are arranged at the upper and lower ends of one of the guides 12 to stop the motor 4 when they are engaged by the slider 11 in its travel-limit positions along the guides 12.

A direct current motor is chosen as the motor 4 because of its rapid response and the high torque which characterises this type of motor.

Thanks to its high efficiency and despite its compact dimensions and relatively low-power motor, the recirculating-ball actuator provides an extremely compact device which is able to operate a switch remotely with a switching time of less than 100 milliseconds (in one actual case, a few tens of milliseconds).

The device is put into operation by the insertion of the operating lever 2 in the slot 13 in the slider 11 in such a way that the lever itself is between the pins 14 and then fixing the support structure 3 to the body of the switch with appropriate fixing means, not shown.

At this point, the device is ready for operation. It is supposed, for example, that the device is in the position shown in the drawings. Operation of the motor 4 rotates the screw 8 which causes the nut 9 to move upwards, carrying with it the slider 11 which in turn slides along the guides 12. The lever 2 is then engaged by the lower pin 14 and urged upwards. The pins 14 are mounted idly on the slider and their presence serves to avoid friction between the lever and the slider, due to the fact that the latter has a rectilinear movement while the lever moves through an arc and there is thus relative movement between them. However the pins are not indispensable: in some cases direct engagement of the lever in the slider slot may be acceptable.

When the nut reaches its travel limit, it activates the upper microswitch 15 which cuts power to the motor 4.

Reverse operation of the motor returns the nut downwards, returning the slider, and therefore the lever 2 of the switch, to its starting position.

In the case of a power failure or a fault, it is possible to operate the device manually. To this end, an externally-operable mechanism is provided to act on the screw 8. This mechanism includes a first bevel gear 20 securely fixed to the screw 8 and a second, smaller bevel gear 21 mounted on an arm 22 securely fixed to the plate 25 so as to be rotatable in mesh with the first gear 20. The second gear has a central hexagonal hole 23 into which a key with a corresponding hexagonal section may be inserted from outside the device to enable it to be operated.

In the embodiment shown in Figures 4 and 5, the actuator device includes a box structure 31 with an attachment 32 for fitting to an "OMEGA" guide, that is a guide defined by European Standards EN50022 and EN50023, and with means, not shown, for coupling to a switch mounted in a box structure similar in shape to the box structure 31 of the device. Inside, it contains an actuator which includes a motor 33, preferably a direct current motor, the shaft of which is fixed for rotation with a screw 34 along which moves a recirculating-ball nut 35.

A rack 36 is fixed to the nut 35 and moves, when the motor 33 is operated in one sense or the other, into one or the other of the two travel-limit positions shown in Figure 4 and Figure 5 respectively.

During part of its travel, the rack 36 engages the teeth of a gear 37 mounted idly on a shaft 38 fixed to the body 31. The gear has an arcuate slot 39 in which slides a shaft 40 fixed to a lever 41 pivoted on the shaft 38 and engaging, at its opposite end, the lever, indicated 42, of the switch to be actuated.

A spiral spring, not shown in the drawings, returns the gear 37 to its starting position when it is free of the rack.

The travel of the rack 36 is longer than the length of the rack itself so that it engages the gear only in one portion of its path, freeing itself at the end of its travel so as to free the gear which is thus returned to its starting position by the spring.

Operation is as follows.

With the device, for example, in the position of Figure 4, the motor 33 is operated to rotate the screw 34 which causes the nut 35 to move upwards.

The rack 36 moves with the nut and, after a brief distance of free travel, engages the teeth of the gear 37 causing it to rotate clockwise.

During this rotation, the shaft 40 fixed to the lever 41 is engaged by the end surface of the slot and urged upwards, causing the lever 41 to rotate

about the axis of the shaft 38.

As the travel of the rack 36 is longer than its length, in the end portion thereof it disengages from the gear 37 which is then returned to its starting position by the spiral spring. At this point, the device is in the condition shown in Figure 5 with the rack 36 and the shaft 40 at the upper limit of their travel.

The motor is preferably stopped by means of microswitches or the like, not shown in the drawings, operated by the rack when it reaches its travel limits.

If the motor is now activated to rotate in the opposite sense, the nut 35 moves downwards with the rack 36 which again engages the teeth of the gear 37 causing this to rotate anticlockwise and drawing the shaft 40 downwards. At the end of its return travel, the rack once again disengages from the gear 37 which is returned to its initial position (Figure 4) by the spiral spring.

At this point the device is ready to begin a new cycle.

This embodiment has provided a remote-actuation device which is made up of few parts, which may be made in inexpensive material, for example moulded plastics, which is easy to assemble and which may be applied to the "OMEGA" guide of an ordinary electrical panel.

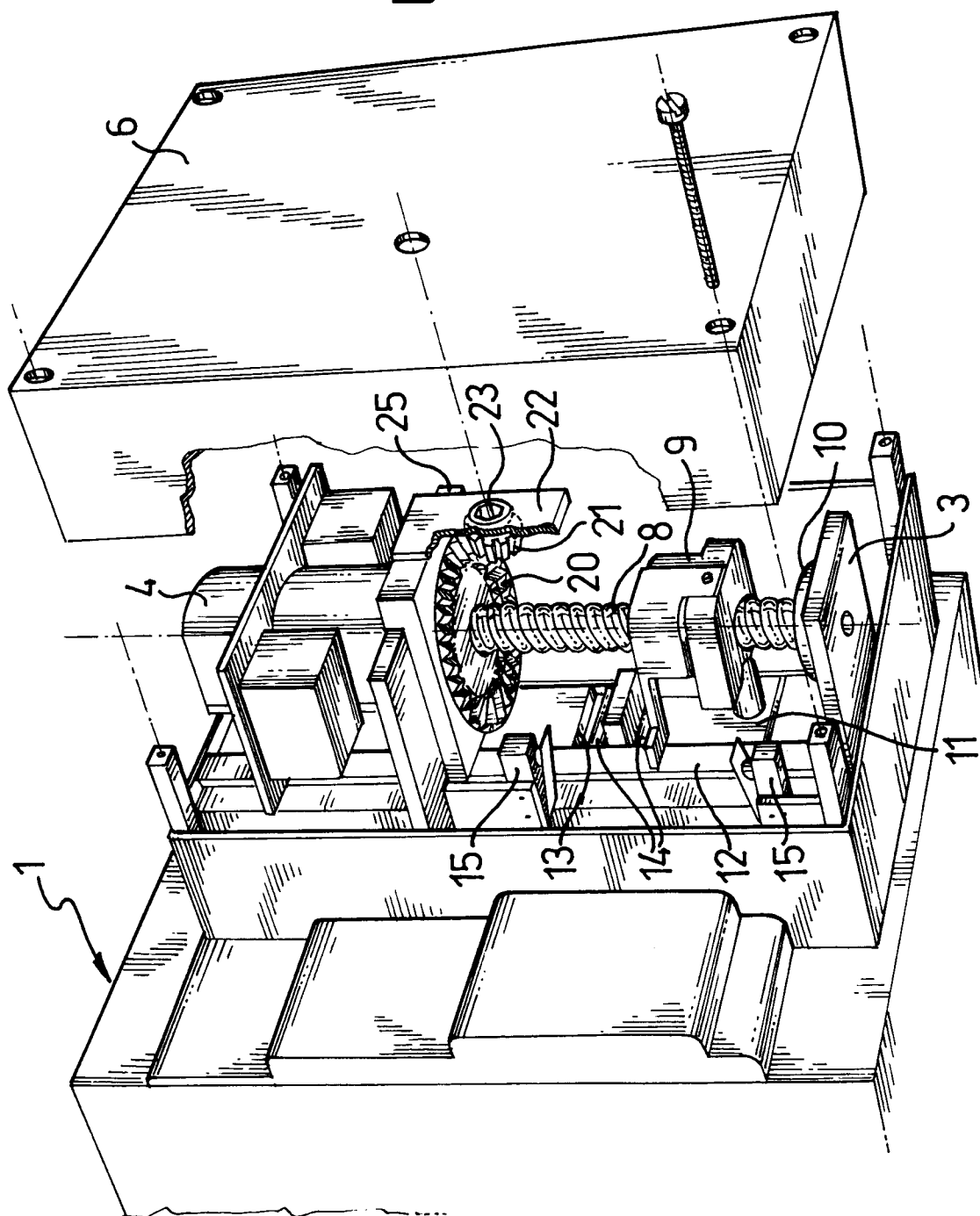
Obviously the dimensions and the materials may vary in accordance with operating requirements.

Claims

1. A device for the remote actuation of an electric switch, with an electric motor (4;33) and with transmission means for driving an actuating member (11;41) able to be coupled to a mechanism for opening and closing the contacts of the switch, characterised in that the transmission means include a recirculating-ball lead-screw arrangement (8,9;34,35) as the coupling means.
2. A device according to Claim 1, characterised in that it includes a support structure (3) and means for fixing this structure to the wall of the switch from which an operating lever (2) projects, in that the screw (8) of the lead-screw coupling member is fixed for rotation with the shaft (7) of the motor (4) and in that the coupling member includes a slider (11) which is fixed for translational movement with the nut (9) is movable along a pair of parallel guides (12) and includes means (13,14) for engaging the operating lever (2) of the switch to open it or close it when the slider (11) moves in one direction or the other.

3. A device according to Claim 2, characterised in that the means which engage the operating lever (2) include a slot (13) which houses two idle pins (14) which engage the operating lever of the switch.
4. A device according to Claim 2 or Claim 3, characterised in that the screw (8) is mounted on the support structure (3) with the interposition of thrust bearings (5,10).
5. A device according to any one of the preceding Claims 2 to 4, characterised in that travel-limit microswitches (15) are provided and activated by the slider (11).
6. A device according to any one of the preceding Claims 2 to 5, characterised in that it includes a first bevel gear (20) fixed to the screw (8), a second bevel gear (21) which meshes with the first and is mounted on the support structure (3), and actuating means (23), accessible from outside the device, for rotating the second gear (21).
7. A device according to Claim 1, characterised in that it includes a box support structure (31) and means for fixing this structure to the switch, in that the actuator member (41), the electric motor (33) and the drive-transmission means (34-40) are housed in the box structure (31) and in that the screw (34) of the coupling means (34,35) is coupled for rotation with the shaft of the motor (33), and in that the drive-transmission means include a gear (37), means (39-40) for coupling the gear to the actuator member (41), and a rack (36) fixed for translational movement with the nut (35) of the coupling means and arranged to engage the gear (37) during its translational movement in both directions.
8. A device according to Claim 7, characterised in that the actuator member comprises a lever (41) pivoted at the centre of the gear (37), in that the means for coupling the gear (37) to the actuator member (41) include an arcuate slot (39) in the gear (37) and a shaft (40) fixed to the lever (41) and passing through the slot (39), in that the rack (36) travels a greater distance than its length so that, in its travel limit positions, the gear (37) disengages the rack (36) and in that resilient means are provided for returning the gear (37) to a predetermined position when the rack (36) is in the aforesaid limit positions.
9. A device according to either Claim 7 or Claim 8, which includes travel-limit microswitches activated by the actuator member.
10. A device according to any one of the preceding Claims, in which the motor is a direct-current motor.

FIG.1



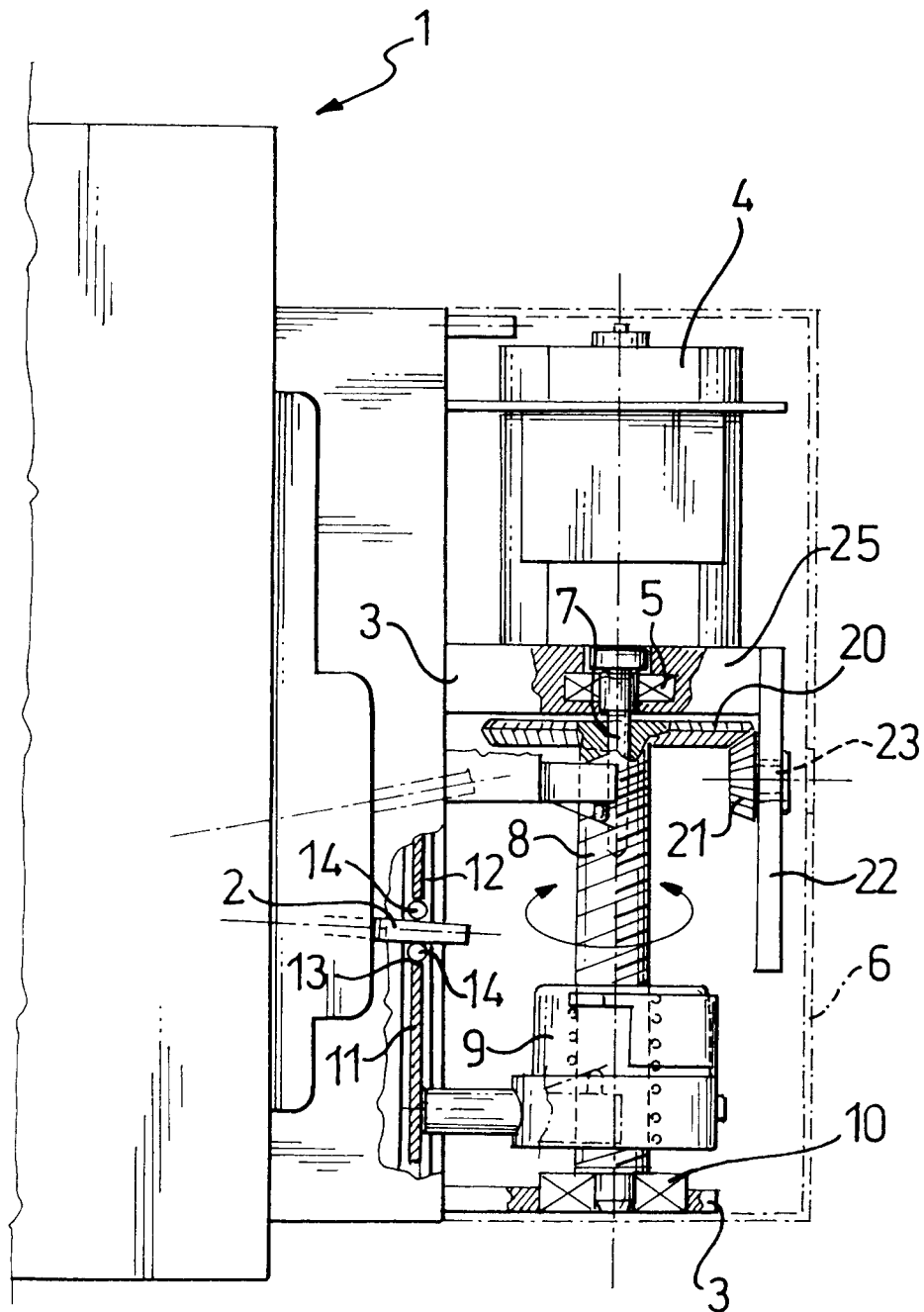


FIG. 2

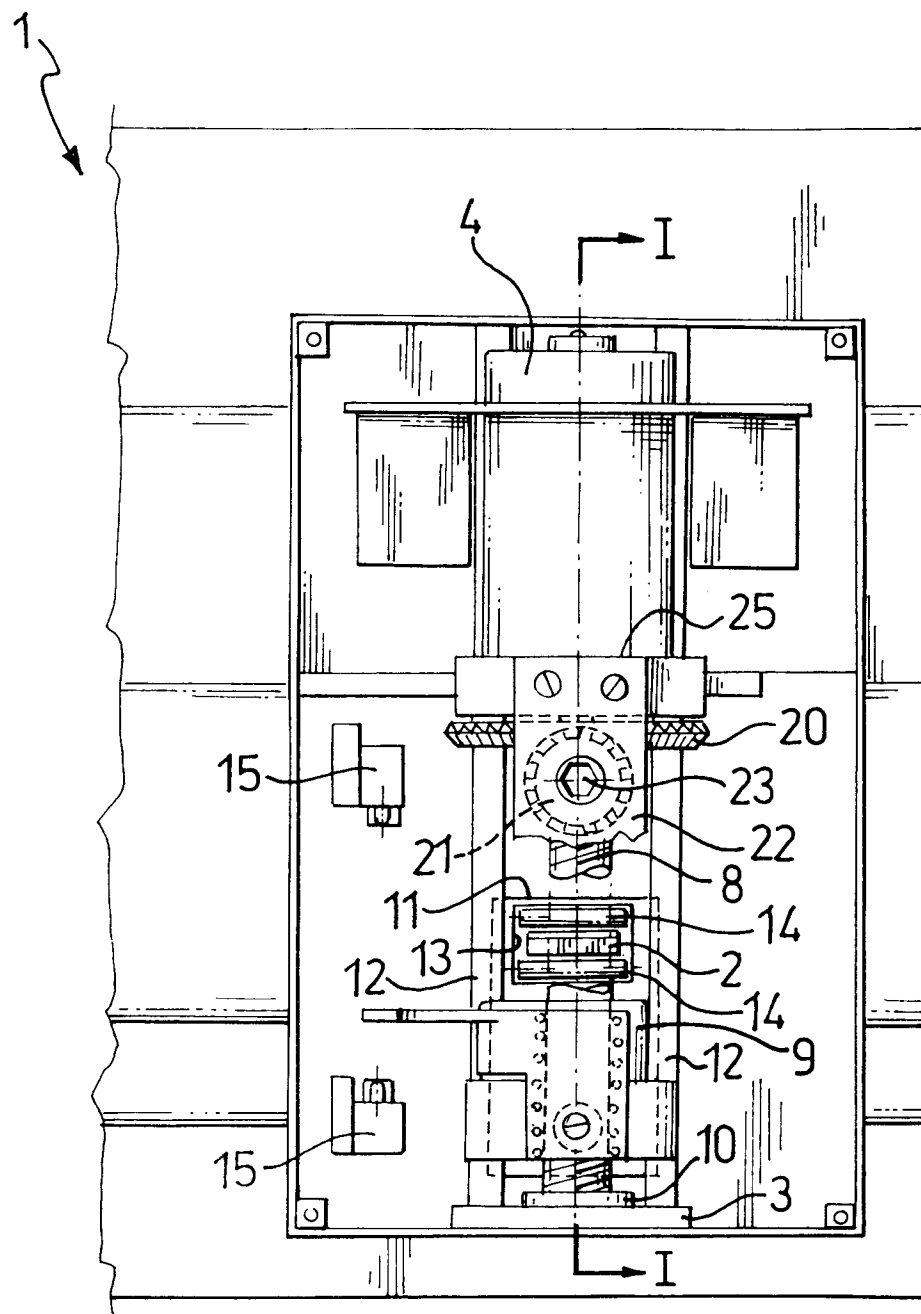


FIG.3

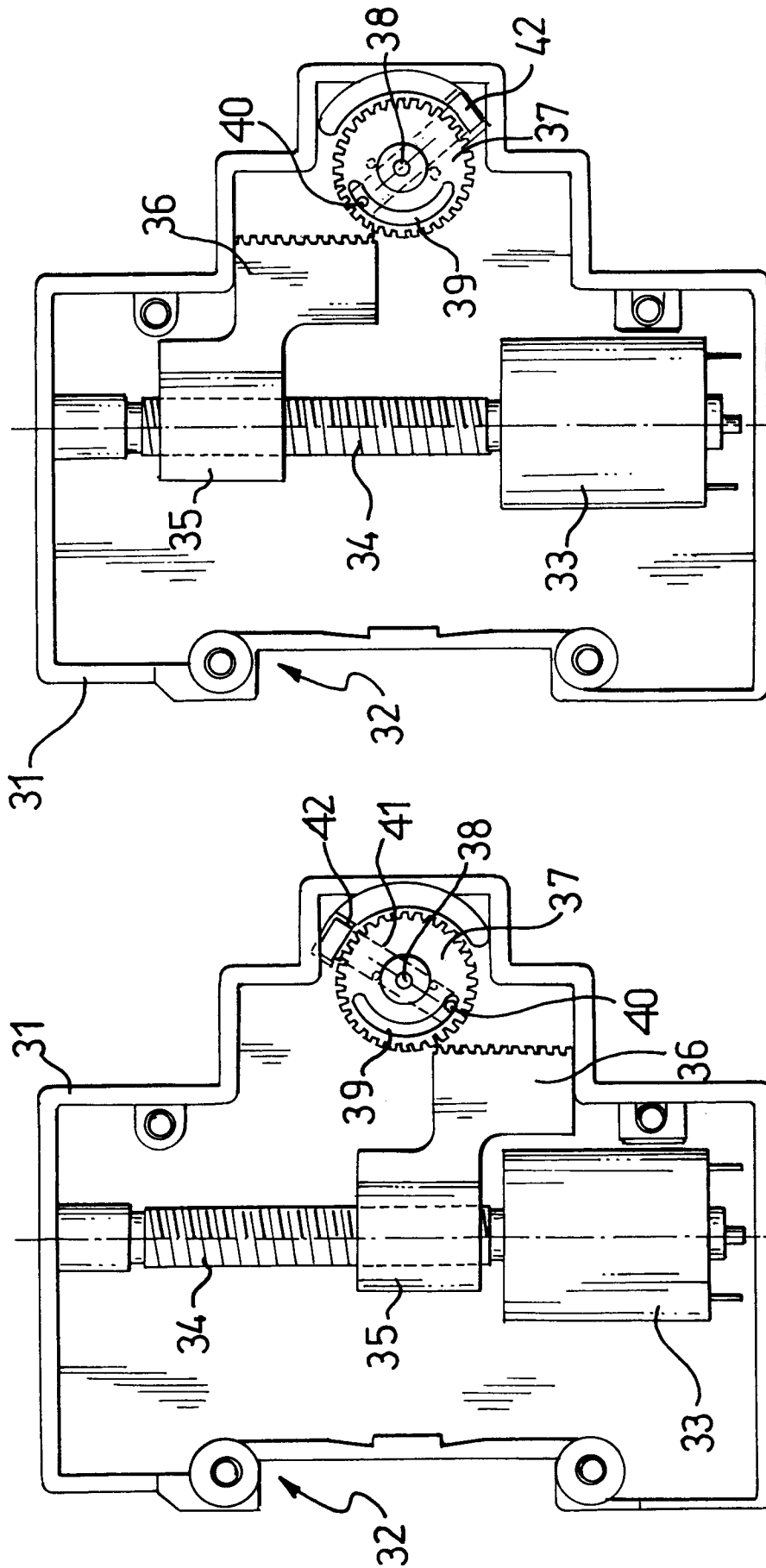


FIG.5

FIG.4