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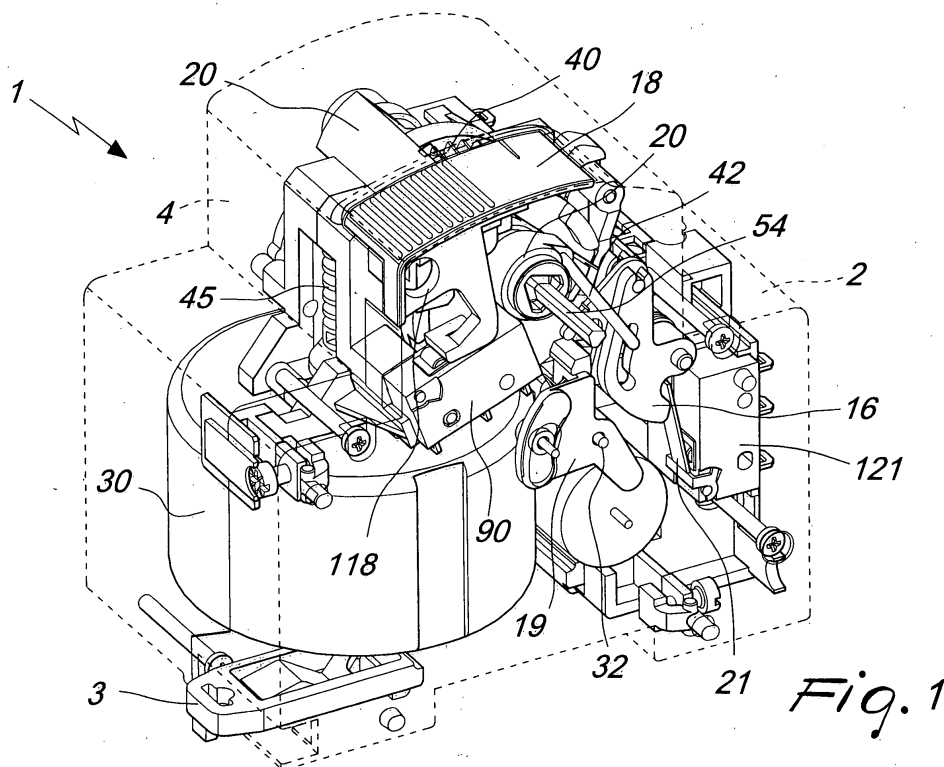
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(54) **Electrical remote actuation device**

(57) An electrical remote actuation device that includes an electric motor (30) that, through a control mechanism, actuates the rotation of an actuation shaft (102) that is associated with a kinematic system for the

actuation of an electrical circuit breaker. The control mechanism includes a preloaded spring (28) that provides the actuation shaft with the impulse to open or close the circuit breaker with sufficient speed.



EP 1 487 002 A2

Description

[0001] The present invention relates to an electrical remote actuation device.

[0002] As it is known, in electrical systems the master switches may be located in places that are not easily accessible, such as cabinets and the like, or in any case at a distance from operators.

[0003] This remote placement causes many problems, and therefore remote actuations have been adopted which include servomotors that are capable of acting on the handle of the circuit breakers in order to close them or open them.

[0004] Remote actuations must meet certain fundamental requirements, such as the ability to apply the force required to operate the levers and to do so with sufficient speed.

[0005] Another important requirement is compact size, since the controls must be usable together with the other electrical devices on the omega-shaped rails that are now generally used in electrical systems.

[0006] The aim of the present invention is to provide an electrical remote actuation device that is improved with respect to devices of the background art.

[0007] Within this aim an object of the invention is to provide a remote actuation device that is particularly compact.

[0008] Another object of the invention is to provide a device that offers the greatest assurances of safety and reliability in operation.

[0009] Another object is to provide a device that can be integrated perfectly with existing electrical units.

[0010] This aim and these and other objects that will become better apparent hereinafter are achieved by an electrical remote actuation device, including an electric motor that is suitable to actuate, through a control mechanism, the rotation of an actuation shaft that is associated with a kinematic system for the actuation of an electrical circuit breaker, characterized in that the control mechanism includes a preloaded spring that is suitable to provide the actuation shaft with the impulse to open or close the circuit breaker.

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

Figure 1 is a cutout perspective view of the remote actuation device according to the invention;

Figure 2 is a cutout perspective view of the device, taken from the opposite side with respect to Figure 1;

Figure 3 is another cutout perspective view of the device;

Figure 4 is a side elevation view of the device;

Figure 5 is another cutout perspective view of the device in the condition in which it is locked by a pad-

lock;

Figure 6 is a side elevation view of the device in the condition in which it is locked by a padlock;

Figures 7 to 10 are schematic side elevation views of the actuation system of the lever of the circuit breaker in the various steps;

Figures 11 and 12 are mutually opposite elevation views of the device in a first step of the closure transition;

Figures 13 and 14 are mutually opposite elevation views of the device in a subsequent step of the closure transition;

Figures 15 and 16 are mutually opposite elevation views of the device in a subsequent step of the closure transition;

Figures 17 and 18 are mutually opposite elevation views of the device in a subsequent step of the closure transition;

Figure 19 is an enlarged-scale view of the preloaded spring shown in the open position, which corresponds to the position shown in Figures 13 and 14;

Figure 20 is a view of the kinematic system for microswitch actuation in the open-tripped position;

Figure 21 is a view of the kinematic system for microswitch actuation in the open-armed position;

Figure 22 is a view of the kinematic system for microswitch actuation in the closed-armed position;

Figure 23 is a view of the kinematic system for microswitch actuation in the closed-tripped position;

Figure 24 is a schematic view of the self-powering system in position 0;

Figure 25 is a schematic view of the self-powering system during rotation;

Figure 26 is a perspective view of the kinematic system for motor direction changing, shown in the open position;

Figure 27 is a perspective view of the kinematic system for motor direction changing, shown in the closed position;

Figure 28 is an elevation view of the kinematic system for motor direction changing, shown in the open position;

Figure 29 is an elevation view of the kinematic system for motor direction changing, shown in the closed position;

Figure 30 is a schematic view of the possibilities of application of the device according to the invention.

[0012] With reference to the cited figures, a device according to the invention, generally designated by the reference numeral 1, includes a containment body 2, which has the classic standardized configuration and forms, at its rear face, a means 3 for coupling to an omega-shaped rail (not shown), according to DIN standards.

[0013] The containment body 2 has, at its front face, a protrusion 4 that contains the actuation assembly of a handle lever 20, which in turn actuates a handle bar 54 that has a triangular cross-section, protrudes in a per se

known manner from the containment body 2, and is associated with the lever for actuating the circuit breaker, not shown, that is coupled to the device.

[0014] An electric motor 30 actuates a worm screw 45 that engages a gear 40 that is coaxial to the handle lever 20, together with a spring support 41 for a coiled spring 28, and with a pawl 13 that cooperates, in operation, with a release cam 8 that is pivoted on a release cam pivot 31.

[0015] The lever actuation unit further includes a driving wheel 39, which is also coaxial to the handle lever and to the bar 54 and is suitable to actuate a self-powering lever 17, which in turn acts on a pushbutton 61 of a self-powering microswitch 60.

[0016] The handle lever 20 is connected, by means of a handle cross-member 42, to an engagement lever 16 that is suitable to act on a microswitch lever 21 of a tripping microswitch 121.

[0017] A reset hook 15 is further associated with the engagement lever 16 by means of a return spring; the hook is suitable to act on a driving lever 19 that rotates about a pivot of the kinematic system 32.

[0018] The system for changing the direction of the motor 30 includes a handle position lever 22, which is provided with an elastic arc-like portion 122 that includes a stud 222 that acts in contrast with a fixed pivot 322.

[0019] The handle position lever 22 acts, by virtue of feet 422, on a pushbutton 71 of a handle position microswitch 70 and on a pushbutton 81 of a rotation reversal microswitch 80.

[0020] The device further includes a locking microswitch 90 on which a locking lever 18 acts, the lever having a portion that is external to the containment body 2 and is provided with a hole 118 for the insertion of a padlock 218 or other device suitable to prevent the locking lever 18 from being moved from the open circuit breaker position shown in Figures 5 and 6.

[0021] In addition to the electrical locking provided by the actuation of the locking microswitch 90, the locking lever 18 provides mechanical locking of the handle lever 20 by acting on an abutment 120 on the handle, as shown more clearly in Figure 6.

[0022] Figures 3 and 4 show an intermediate position that the locking lever 18 can assume. In this intermediate position, the locking lever 18 deactivates the device only electrically, by pressing on the pushbutton of the microswitch 90, allowing to actuate the electrical device that is associated with the device without the device being activated.

[0023] Figures 7 to 10 are views of the steps of the actuation of the circuit breaker and illustrate the relation between the position of the gear and the position of the handle.

[0024] Figures 11 to 18 are views of the fundamental steps of the closure transition of the circuit breaker by virtue of the device.

[0025] As shown in Figures 11 and 12, the preloaded

spring 28 pushes the engagement pawl 13 onto an iron tooth 141 of the spring support 41 and the handle of the circuit breaker is in the 0° position, i.e., the open position.

[0026] The preloaded spring 28 in the open position is shown in Figure 19.

[0027] After a rotation through 35° of the gear 40, the engagement pawl 13 engages the release cam 8 and the handle of the circuit breaker moves through approximately 14°.

[0028] The gear 40 continues to turn for another 110°, while the engagement pawl 13, rigidly coupled to the shaft 102, remains motionless, further loading the spring 28.

[0029] After 110°, the cam 140, rigidly coupled to the gear 40, moves the release cam 8, releasing the engagement pawl 13, which by being pushed by the spring 28 completes the stroke, driving the shaft 102.

[0030] Instantaneously, the handle of the circuit breaker moves from approximately 14° to approximately 84° in the closed circuit breaker position.

[0031] This has an important advantage: if a current interruption occurs during the closure step, the closure action is in any case completed or interrupted, depending on the position reached by the cam, without the contacts being able to move dangerously closer, as occurred instead in conventional devices.

[0032] The gear 40 completes the stroke through another 7° and makes the circuit breaker handle also cover another 6° of rotation, thus reaching 90°, and then resumes rotating in the opposite direction in order to return to the initial position.

[0033] In the opening transition, the spring 28 does not act, and the gear 40 pushes the circuit breaker directly without preventing its natural movement.

[0034] Figures 24 and 25 are views of the self-powering system of the device, which is based on the driving wheel 39, the rotation of which is actuated by the shaft 102. In the "0" position, the protrusion 117 of the self-powering lever 17 is inserted in a recess 139 so that the foot 217 of the lever 17 does not engage the pushbutton 61 of the self-powering microswitch 60.

[0035] During rotation, the protrusion 117 instead slides on the surface of the driving wheel 39 and forces the lever 17 to rotate toward the microswitch so that the foot 217 of the lever acts on the pushbutton 61.

[0036] Figures 20 to 23 are views of the condition of the tripping microswitch 121 in relation to the four fundamental positions of the circuit breaker.

[0037] As shown in Figure 20, the tripping microswitch 121 is open when the circuit breaker is in the open-tripped position; as shown in Figure 21, the tripping microswitch 121 is closed when the circuit breaker is in the open-armed position; as shown in Figure 22, the tripping microswitch 121 is closed when the circuit breaker is in the closed-armed position; and finally, as shown in Figure 23, the tripping microswitch 121 is open when the circuit breaker is in the closed-tripped position.

[0038] The position of the handle that corresponds to the position in which the circuit breaker is open or closed determines the direction of rotation of the motor depending on the basis of the system shown in Figures 26-29, which is characterized by the presence of the handle position lever 22 that is provided with an elastic arc-like portion 122 that includes the stud 222 that acts in contrast with a fixed pivot 322 in order to produce a bistable condition of the position lever. Figures 26 and 28 illustrate the position of the handle and of the position lever 22 that corresponds to the open condition of the circuit breaker, and Figures 27 and 28 illustrate the position of the handle and of the position lever 22 that corresponds to the position in which the circuit breaker is closed.

[0039] The action of the position lever 22 on the handle position microswitch 70 and on the rotation reversal microswitch 80 indicates to the device the position of the handle and the direction of rotation of the motor.

[0040] In practice it has been found that the invention achieves the intended aim and objects, an electrical remote actuation device having been provided that uses, by virtue of its particular kinematic structure, a low-power motor.

[0041] It should be noted that the device according to the invention can be used with a complete range of electrical units, generally designated by the reference numeral 101, and accessories such as contacts, generally designated by the reference numeral 201.

[0042] The device can also be associated with a unit that does not have the coupling for a triangular bar, such as a pure residual current-operated device, generally designated by the reference numeral 301, by means of a module 401 that is provided with an external actuation member 402 that is suitable to act on the handle of the residual current-operated device 301.

[0043] The module 401 may also act as an automatic reset device in case of tripping following a fault of the circuit breaker with a selector of the number of authorized reclosings and adjustment of the maximum time within which the auxiliary device can perform the set reclosings.

[0044] The device according to the invention is susceptible of numerous modifications and variations within the scope of the appended claims. All the details may be replaced with technically equivalent elements.

[0045] The materials used, as well as the dimensions, may of course be any according to requirements and to the state of the art.

Claims

1. An electrical remote actuation device, comprising an electric motor that is adapted to actuate, through a control mechanism, the rotation of an actuation shaft that is associated with a kinematic system for the actuation of an electrical unit, **characterized in that** said control mechanism comprises a preload-

ed spring that provides the actuation shaft with the impulse to open or close said electrical unit.

2. The device according to claim 1, **characterized in that** said control mechanism comprises an assembly for actuating a handle lever that in turn actuates a handle bar that has a triangular cross-section and is associated with the actuation lever of the electrical unit.

3. The device according to claim 1 or 2, **characterized in that** said electric motor drives a worm screw that engages a gear that is coaxial to said handle lever, together with a spring support for said spring, which is constituted by a coiled spring, and with an engagement pawl that cooperates in operation with a release cam that is pivoted on a release cam pivot.

4. The device according to one or more of the preceding claims, **characterized in that** said lever actuation assembly comprises a driving wheel that is coaxial to the handle lever and to the bar and is adapted to actuate a self-powering lever that in turn acts on a pushbutton of a self-powering microswitch.

5. The device according to one or more of the preceding claims, **characterized in that** said handle lever is connected, by means of a handle cross-member, to an engagement lever that is adapted to act on a microswitch lever of a tripping microswitch.

6. The device according to one or more of the preceding claims, **characterized in that** a rearming hook is associated with the engagement lever by means of a return spring and is adapted to act on a driving lever that rotates about a pivot of the kinematic system.

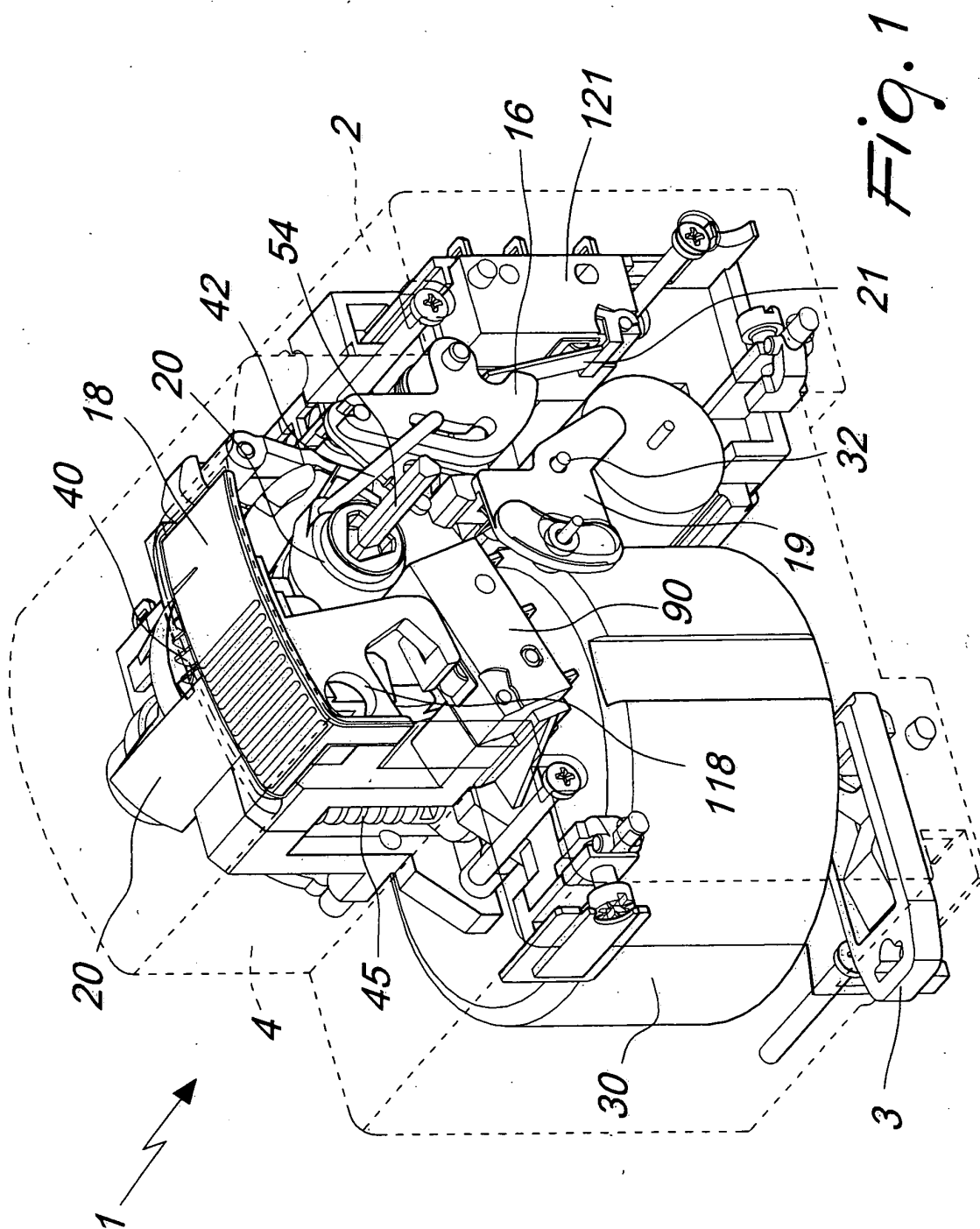
7. The device according to one or more of the preceding claims, **characterized in that** the motor comprises a direction changing system that comprises a handle position lever provided with an elastic arc-like portion comprising a stud, which acts in contrast with a fixed pivot.

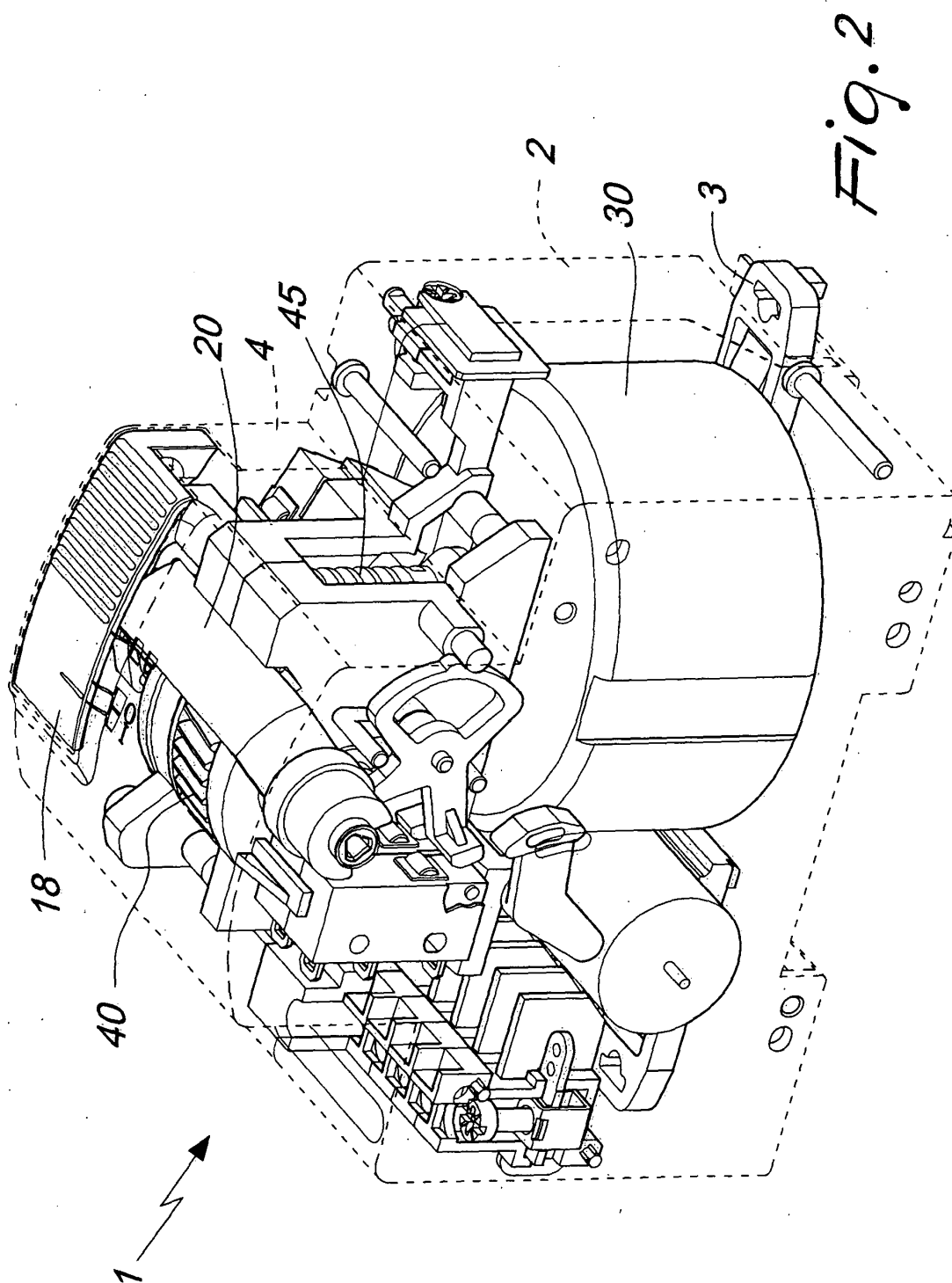
8. The device according to one or more of the preceding claims, **characterized in that** said handle position lever acts, by means of feet, on a pushbutton of a handle position microswitch and on a pushbutton of a rotation reversal microswitch.

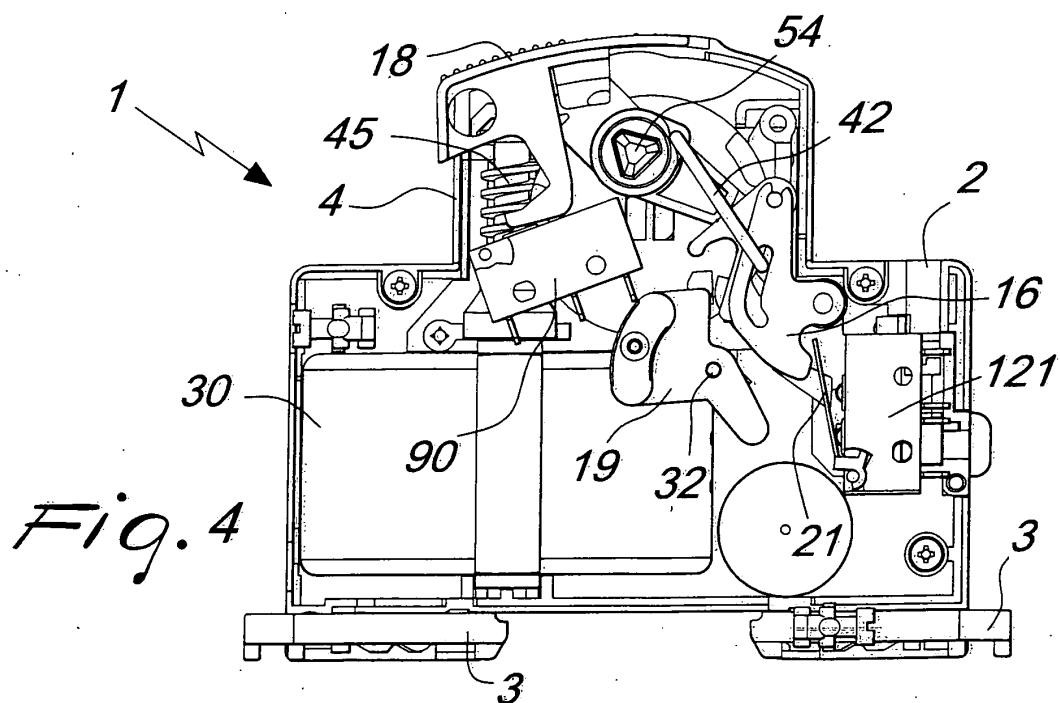
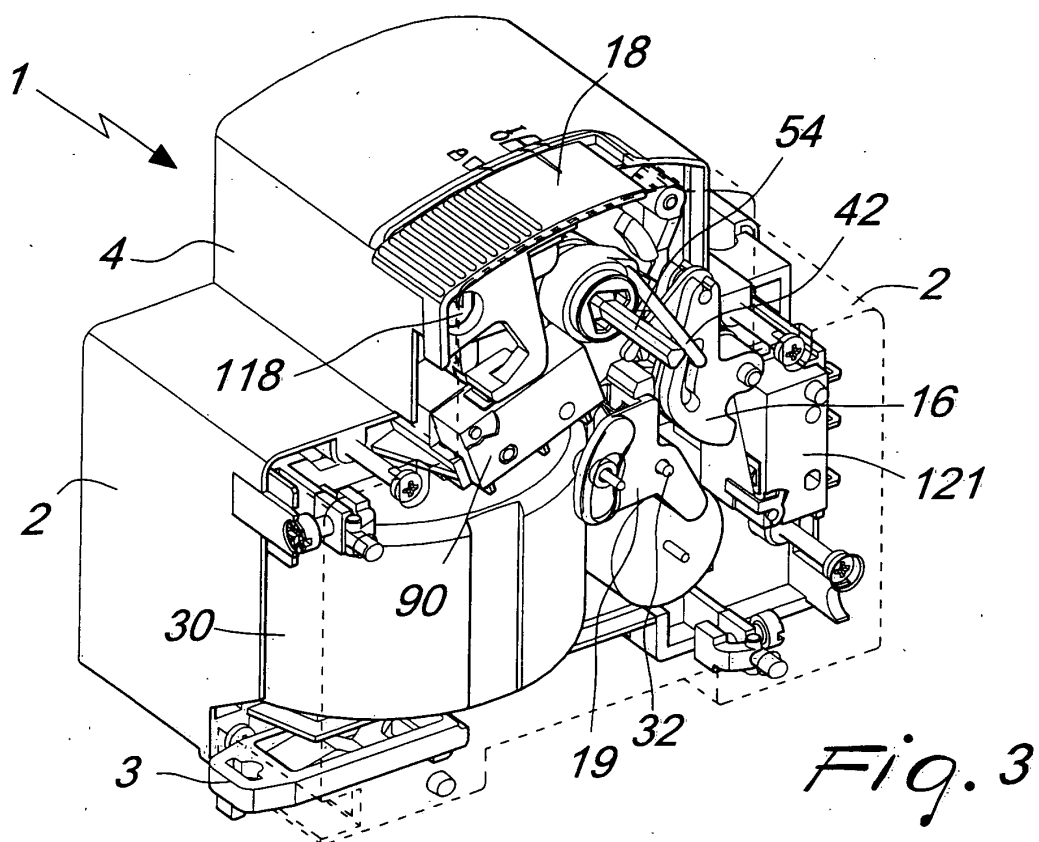
9. The device according to one or more of the preceding claims, **characterized in that** it comprises a locking microswitch on which a locking lever acts, said locking lever having a portion that is external to a casing and is provided with a hole for the insertion of a padlock or other device adapted to prevent the locking lever from being moved from the posi-

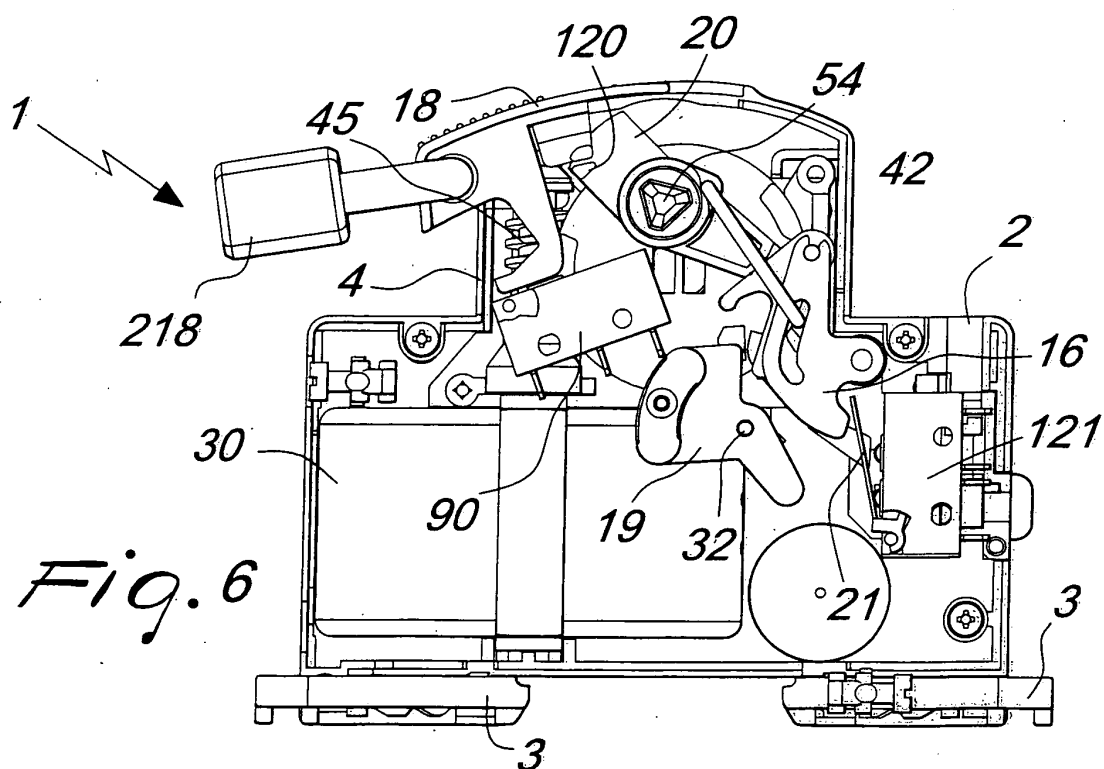
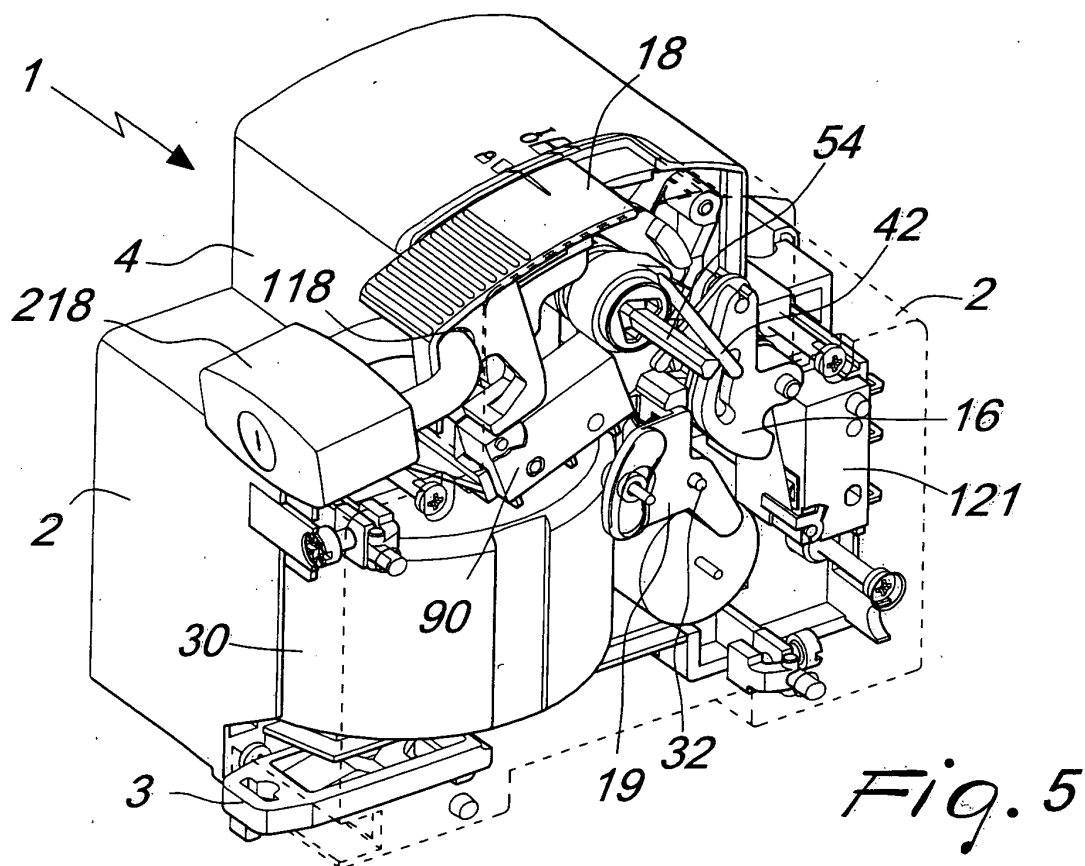
tion in which the circuit breaker is open.

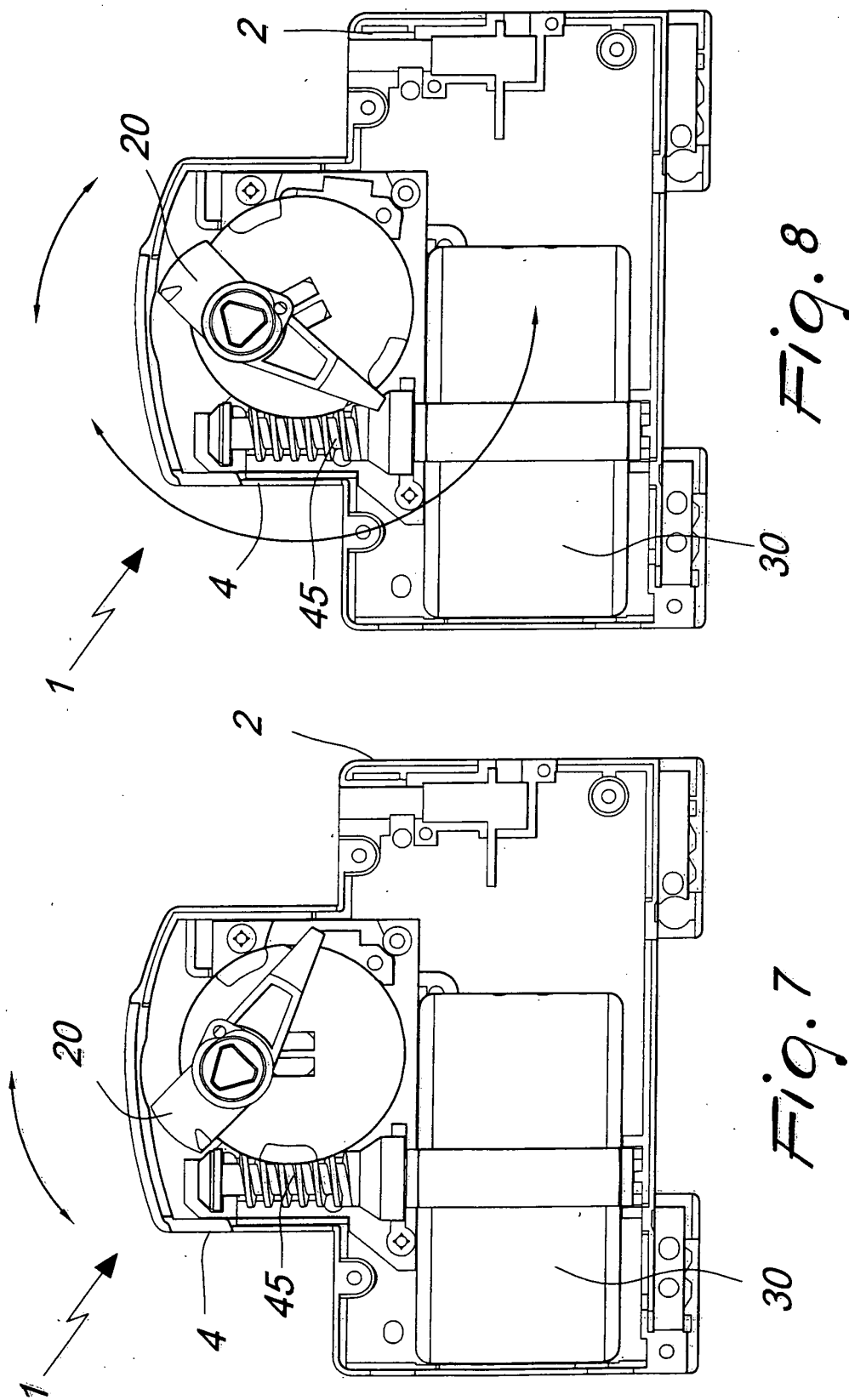
10. The device according to one or more of the preceding claims, **characterized in that** said locking lever can assume an intermediate position, in which the locking lever deactivates the device only electrically, by pressing on the pushbutton of the microswitch, allowing to operate the electrical unit associated with the device without causing said device to intervene.
11. The device according to one or more of the preceding claims, **characterized in that** in addition to the electrical locking produced by the actuation of the locking microswitch, the locking lever performs a mechanical locking of the handle lever by acting on an abutment on said handle.
12. The device according to one or more of the preceding claims, **characterized in that** the preloaded spring pushes the engagement pawl onto an iron tooth of the spring support and the handle of the circuit breaker is in the 0° position, i.e., the open position; after a rotation through approximately 35° of the gear, the engagement pawl engages the release cam and the handle of the circuit breaker moves through approximately 14°; the gear continues to rotate through approximately another 110° while the engagement pawl, rigidly coupled to the shaft, remains motionless, further loading the spring; after approximately 110°, the cam rigidly coupled to the gear moves the release cam, releasing the engagement pawl, which being pushed by the spring completes the stroke by driving the shaft; instantaneously, the handle of the circuit breaker passes from approximately 14° to approximately 84°, in the position in which the circuit breaker is closed; the gear completes the stroke through approximately another 7° and makes the handle of the circuit breaker also perform approximately another 6° of rotation, thus reaching approximately 90°, and then resumes rotating in the opposite direction in order to return to the initial position; in the opening transition, the spring is not active and the gear pushes the circuit breaker directly without preventing its natural movement.
13. The device according to one or more of the preceding claims, **characterized in that** said self-powering system of the device is based on a driving wheel whose rotation is actuated by the shaft; in the "0" position, a protrusion of the self-powering lever is inserted in a recess so that the foot of the lever does not engage the pushbutton of the self-powering microswitch; during rotation, the protrusion instead slides over the surface of the driving wheel and forces the lever to rotate toward the microswitch so that the foot of the lever acts on the pushbutton.
14. The device according to one or more of the preceding claims, **characterized in that** the condition of the tripping microswitch with respect to the four fundamental positions of the circuit breaker is as follows: the tripping microswitch is open when the circuit breaker is in the open-tripped position; the tripping microswitch is closed when the circuit breaker is in the open-armed position; the tripping microswitch is closed when the circuit breaker is in the closed-armed position; and the tripping microswitch is open when the circuit breaker is in the closed-tripped position.
15. The device according to one or more of the preceding claims, **characterized in that** the position of the handle that corresponds to the position in which the circuit breaker is open or closed determines the direction of rotation of the motor according to said self-powering system, **characterized by** the presence of the handle position lever, provided with an elastic arc-like portion that comprises the stud that acts in contrast with a fixed pivot in order to produce a bistable condition of said position lever; the action of the position lever on the handle position microswitch and on the rotation reversal microswitch indicating to the device the position of the handle and the direction of rotation of the motor.

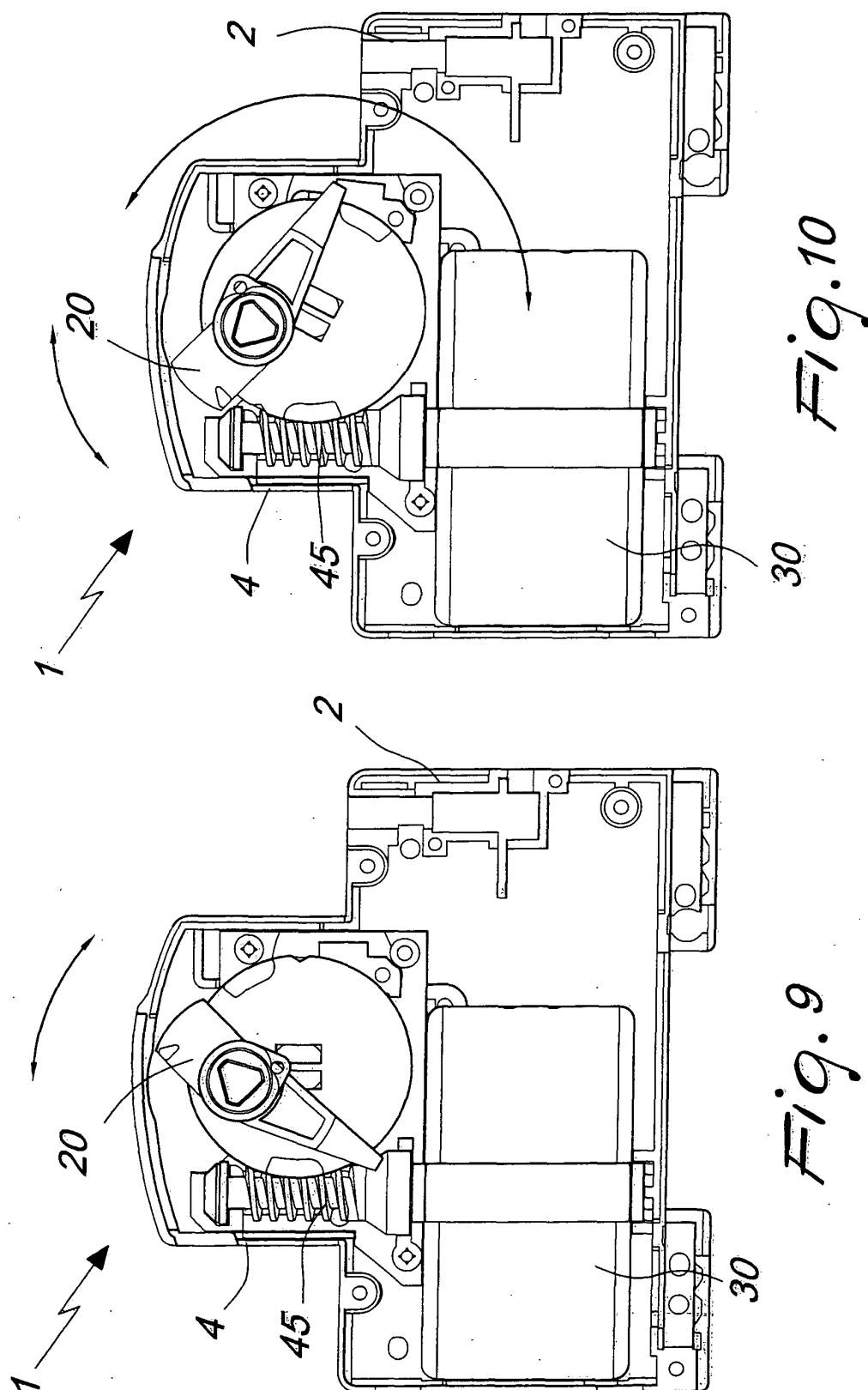












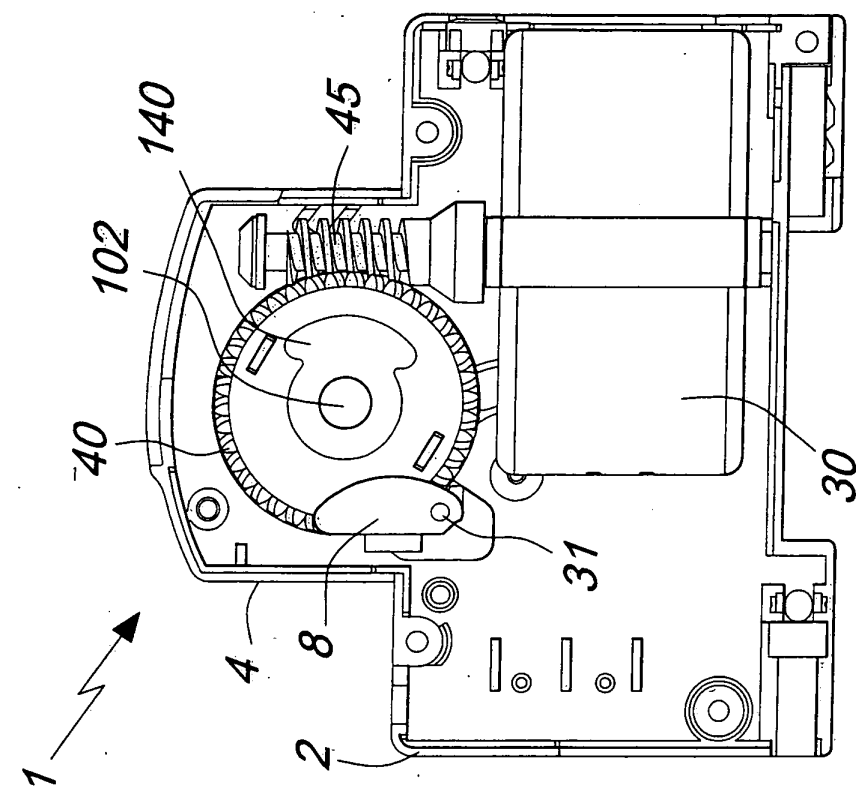


Fig. 11

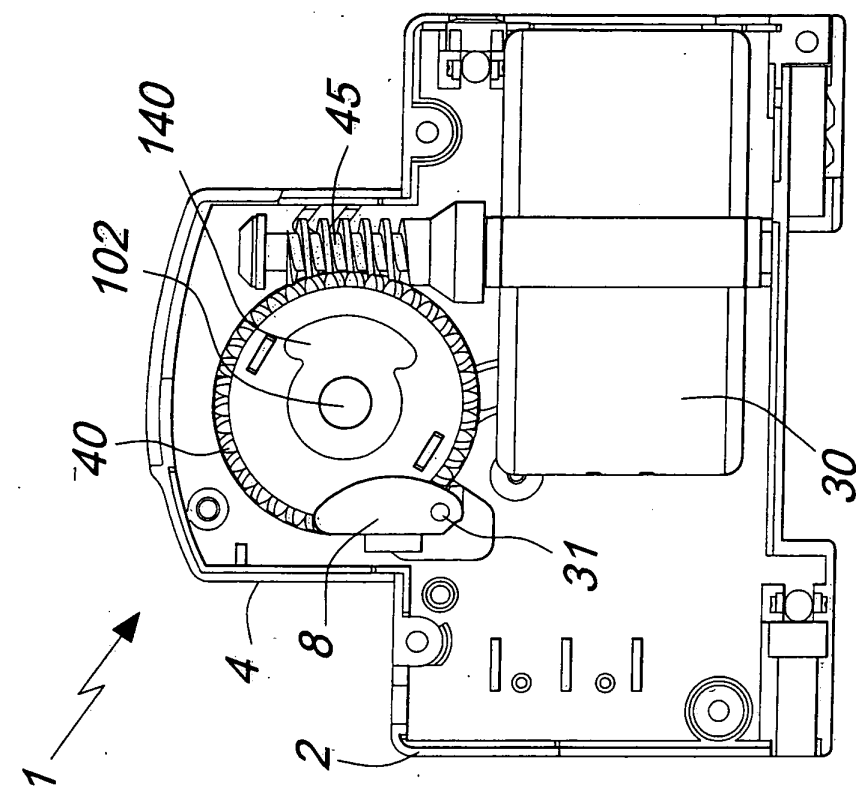


Fig. 12

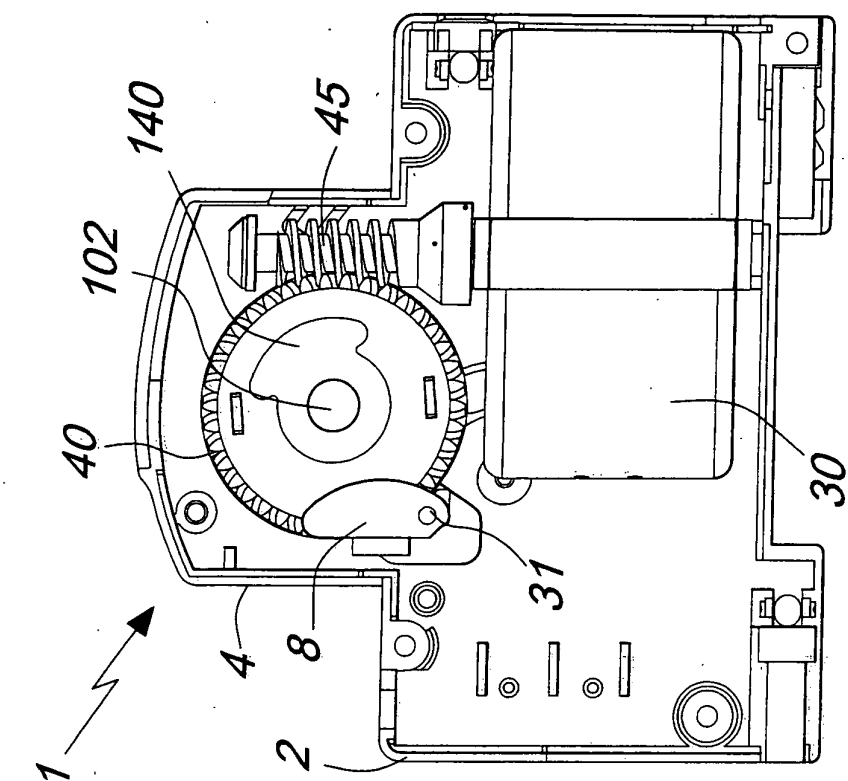


Fig. 14

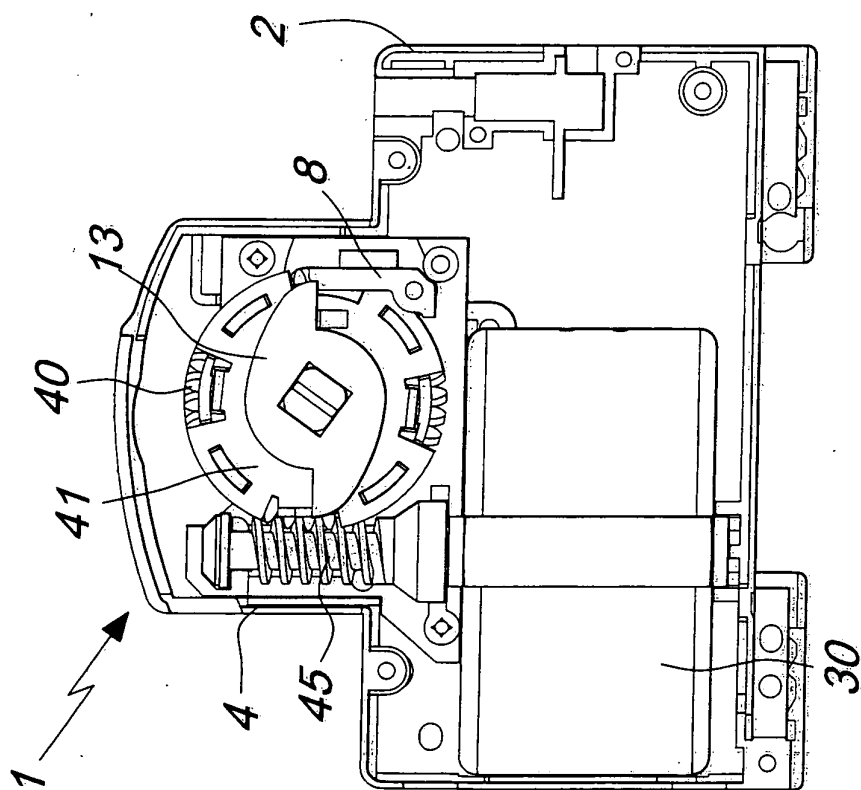


Fig. 13

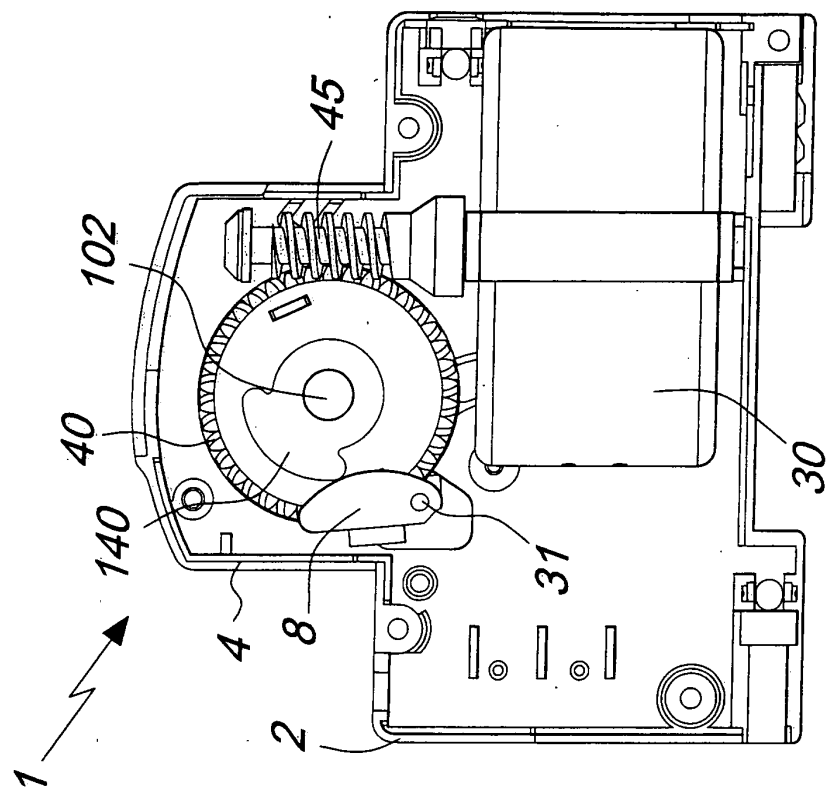


Fig. 15

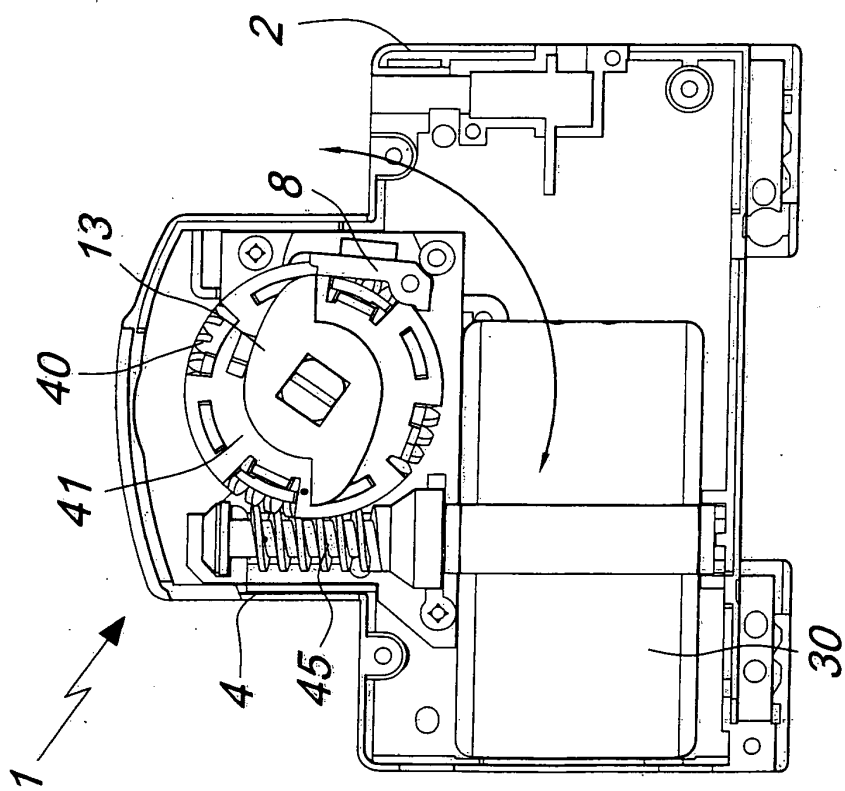


Fig. 16

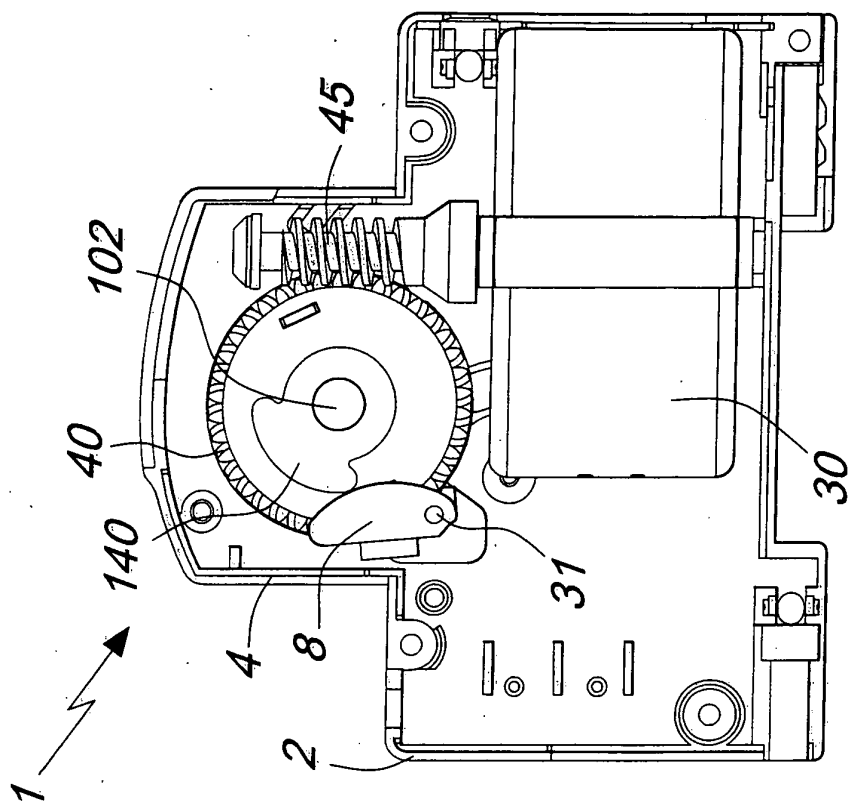


Fig. 17

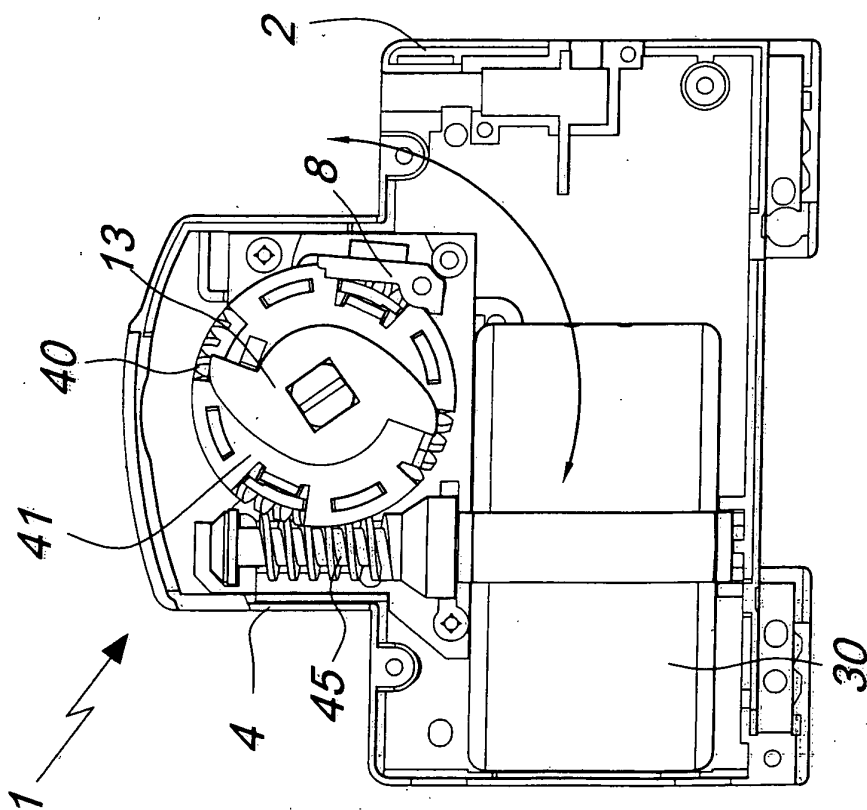


Fig. 18

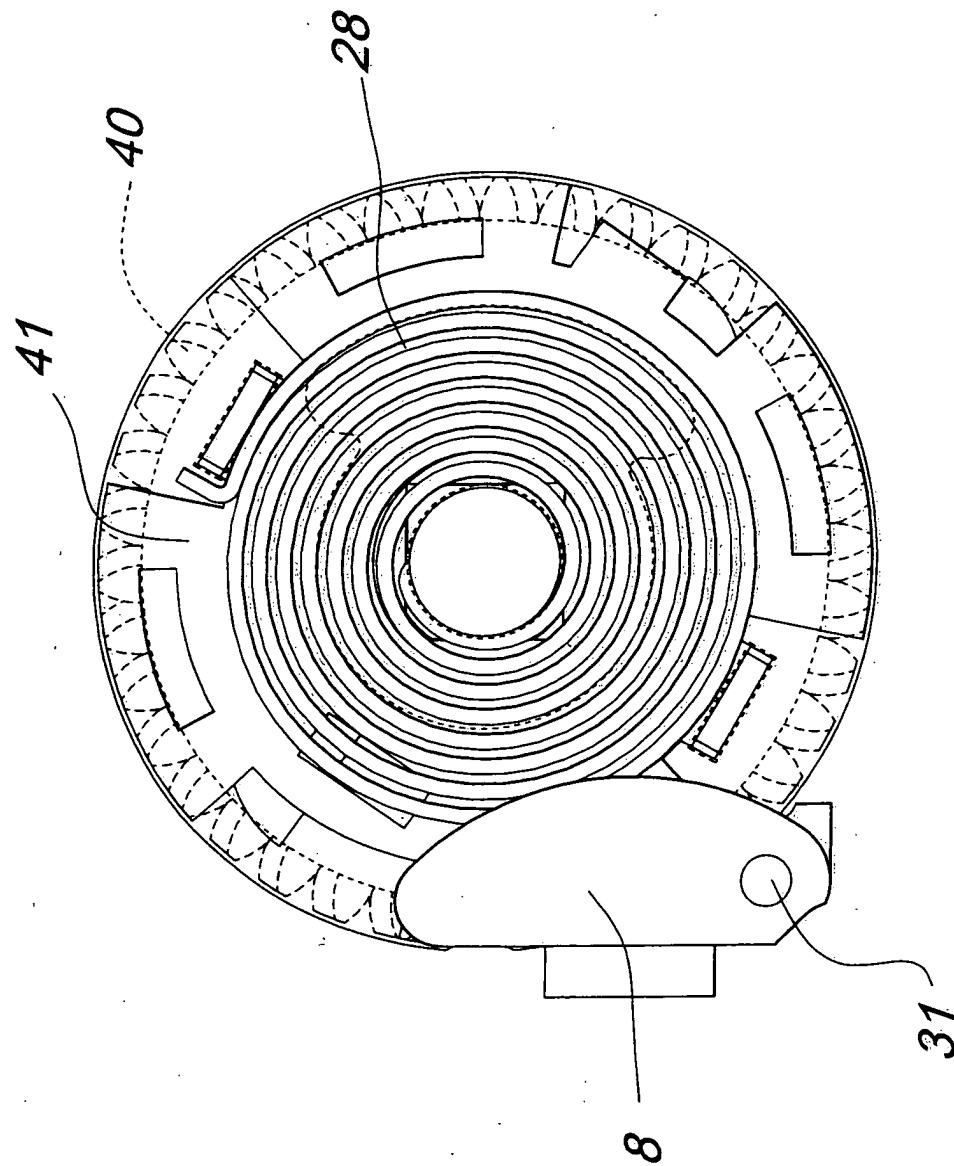


Fig. 19

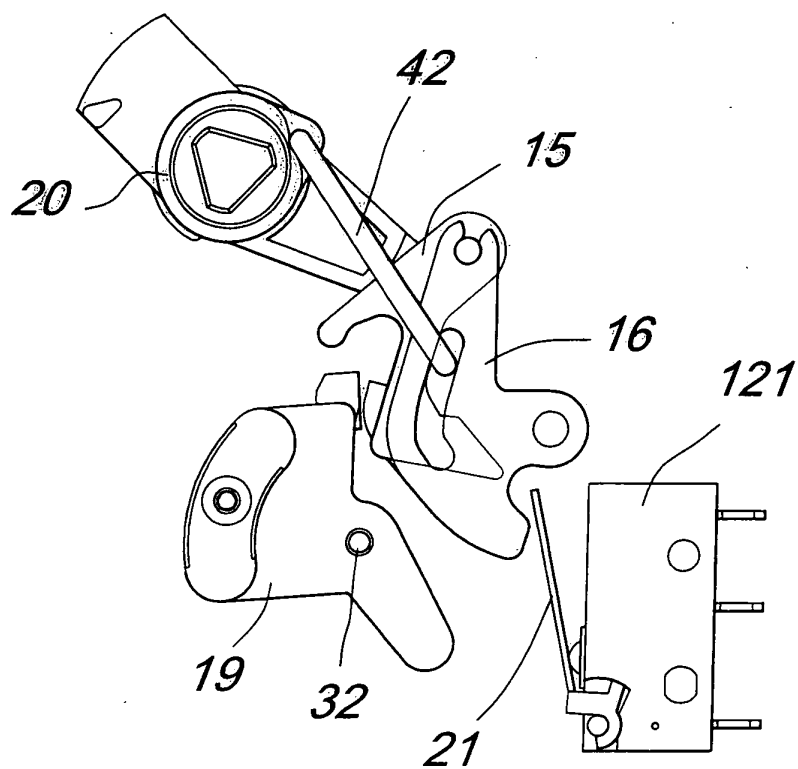


Fig. 20

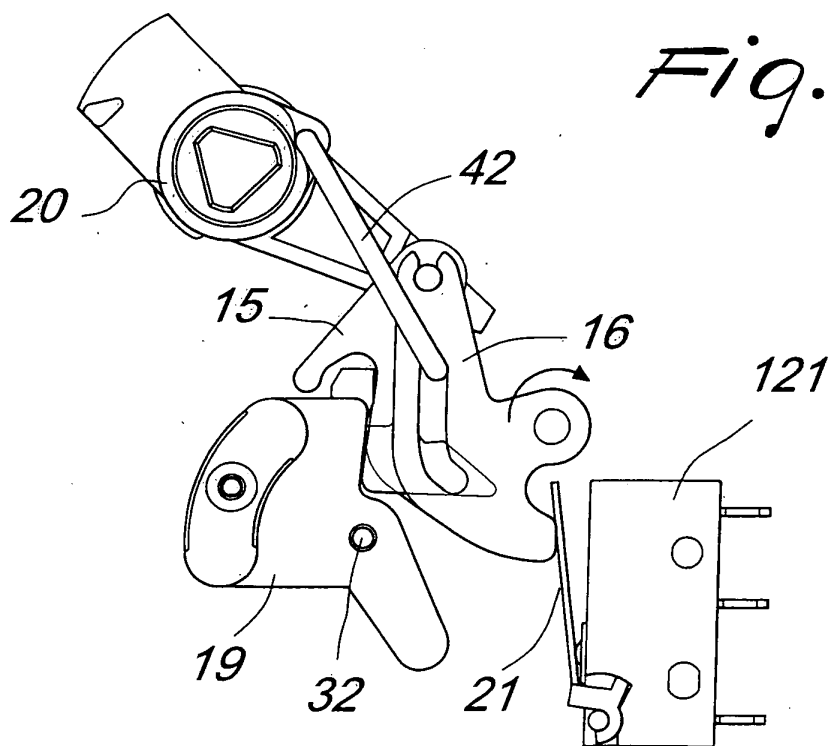


Fig. 21

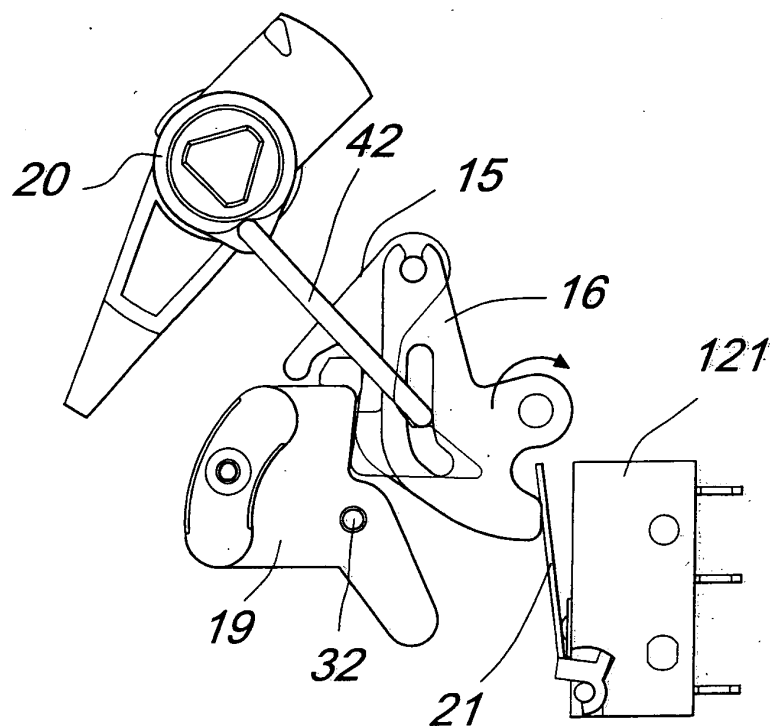


Fig. 22

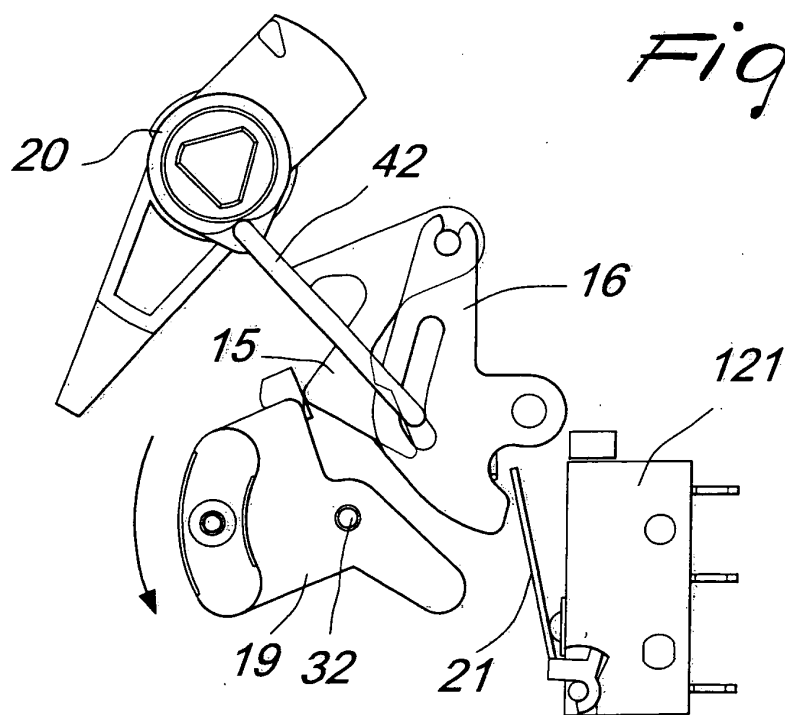
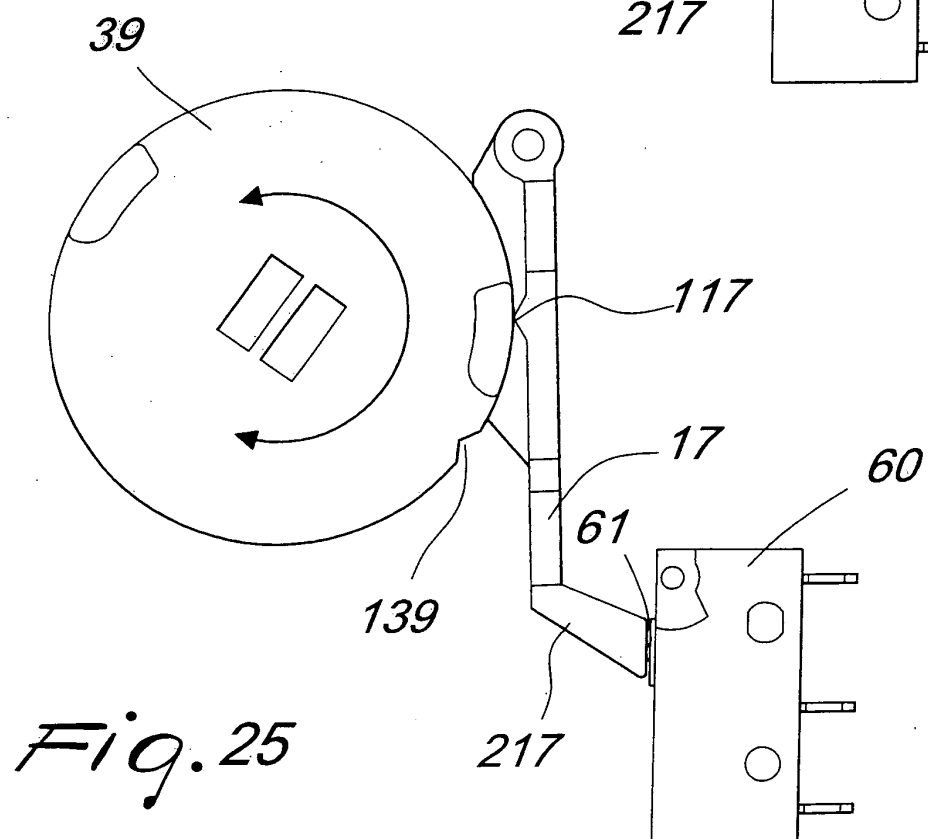
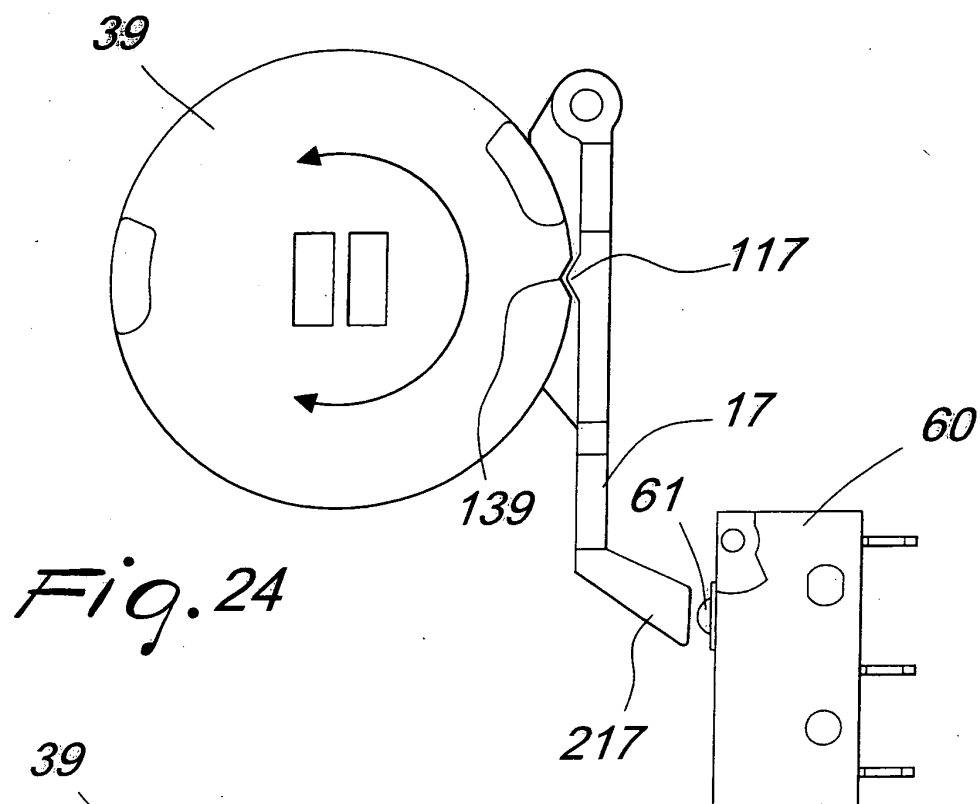


Fig. 23



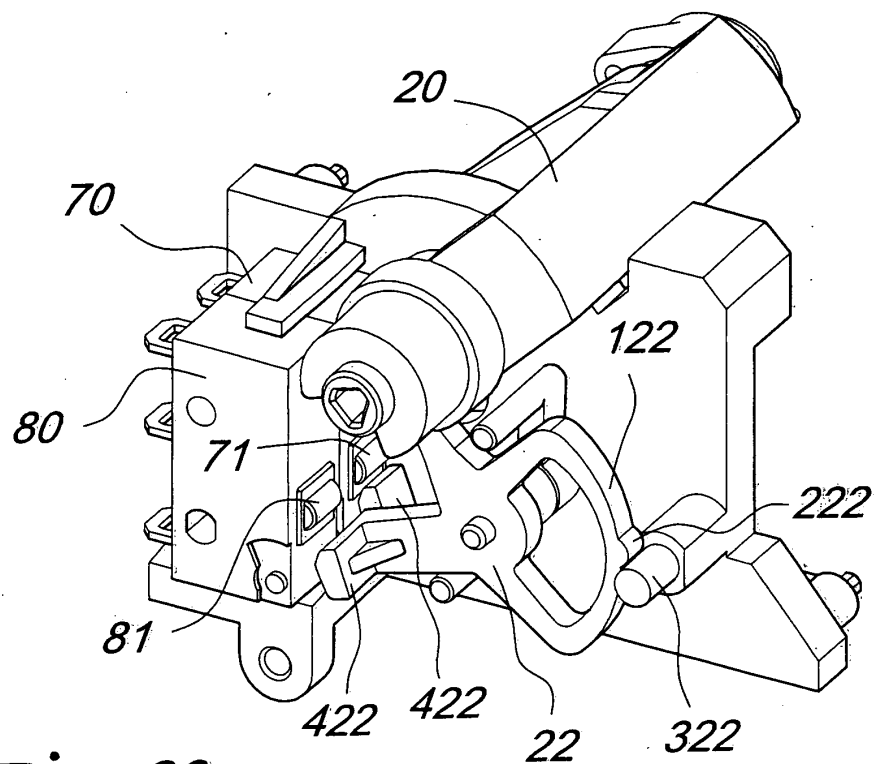


Fig. 26

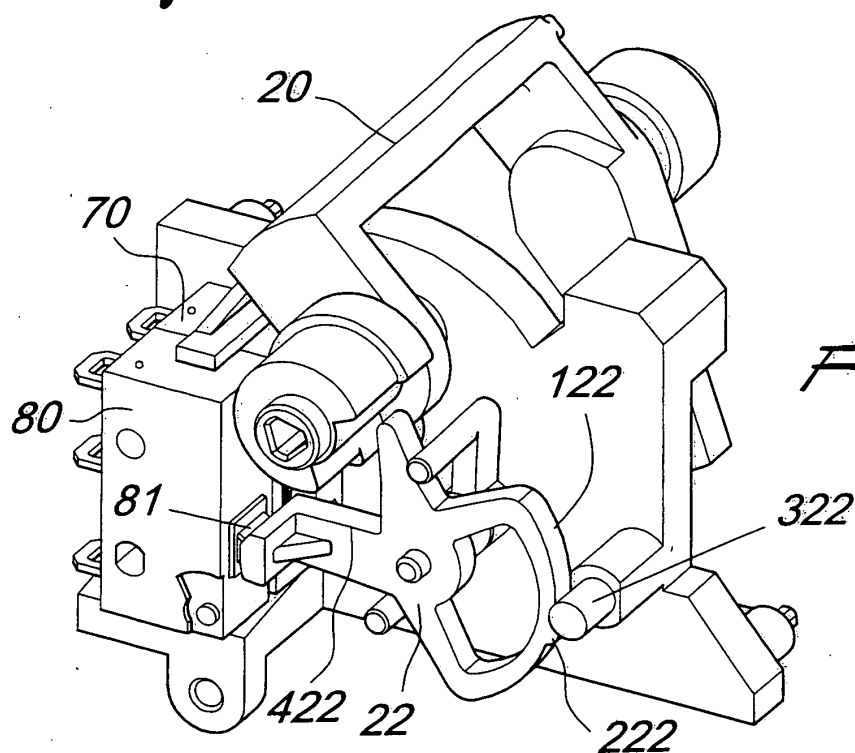


Fig. 27

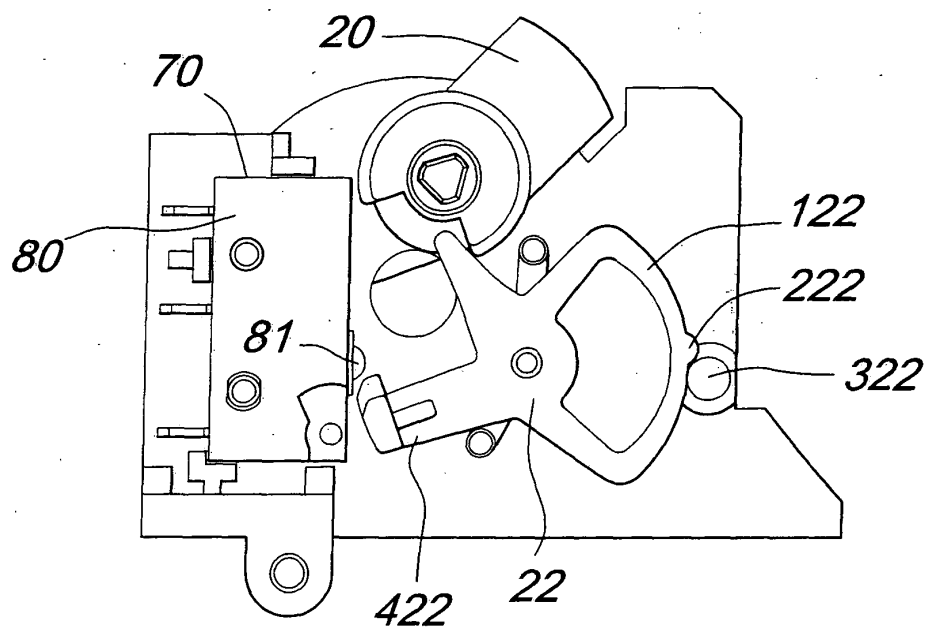


Fig. 28

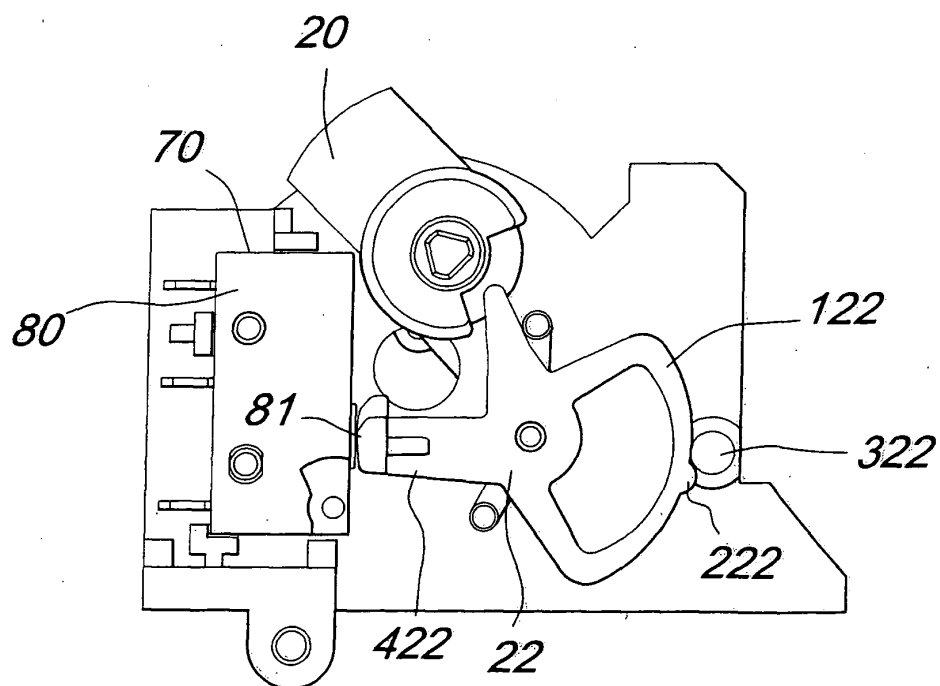


Fig. 29

