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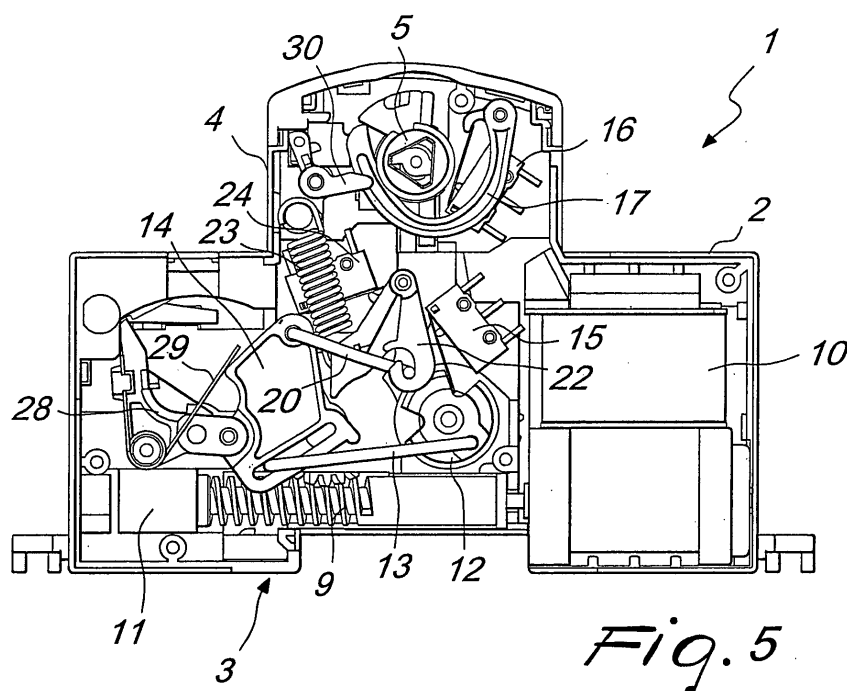
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(54) **Automatic reset and self-test device particularly for residual current operated circuit breakers and the like**

(57) An automatic reset and self-test device, particularly for residual current operated circuit breakers and the like, comprising a containment body which can be coupled to an electrical device, such as a residual current operated circuit breaker provided with main contacts and secondary or auxiliary contacts, the containment body

including a drum which is kinematically associated with the control for opening and closing the main contacts of the circuit breaker; characterized in that it comprises an electric motor suitable to drive a gear train by means of a worm screw, turning round in one direction only, for closing the main contacts and the secondary contacts.



Description

[0001] The present invention relates to an automatic reset and self-test device, particularly for residual current operated circuit breakers and the like.

[0002] More particularly, the invention relates to a device which allows to perform automatically a test of the circuit and subsequently to reset automatically a residual current operated circuit breaker.

[0003] As known, residual current operated circuit breakers are normally provided in both domestic and industrial systems in order to prevent a fault current from causing danger for users and for the loads connected to the electrical line.

[0004] Essentially, the residual current operated circuit breaker, when it detects the presence of the fault current, releases the line, thus interrupting the power supply to the load or loads arranged downstream.

[0005] After the release of the residual current operated circuit breaker, and once the correct operating conditions for the system have been restored, the residual current operated circuit breaker must be reset.

[0006] The operating conditions often restore themselves spontaneously because the fault is of a transient type caused by overvoltages.

[0007] This reset normally occurs manually by acting on a reset lever.

[0008] Furthermore, the residual current operated circuit breakers of the known type are provided with a test button, by means of which it is possible to release the breaker, simulating a fault, in order to check the correct operation of the release system.

[0009] However, as it is known, the test is not always performed, both because of forgetfulness and because the interruption of electric power causes inconvenience.

[0010] In order to obviate the drawback of the interruption of electric power during the test, breakers have been introduced which are provided with secondary contacts ensuring the electric power supply when the primary contacts are released for testing the system.

[0011] The aim of the present invention is to provide an automatic reset device, particularly for residual current operated circuit breakers and the like, which allows to test the system without interrupting the electric power supply to user devices.

[0012] Within this aim, an object of the invention is to provide an automatic reset device which is highly reliable, relatively simple to provide and at competitive costs.

[0013] Another object of the invention is to provide a device capable of performing the test periodically and in a fully automatic and autonomous manner, without operator interventions.

[0014] This aim and these and other objects, which will become better apparent hereinafter, are achieved by an automatic reset and self-test device, particularly for residual current operated circuit breakers and the like, comprising a containment body which can be coupled to an electrical device, such as a residual current operated circuit breaker, provided with main contacts and secondary or auxiliary contacts, said containment body comprising a drum kinematically associated with the control for opening and closing the main contacts of said circuit breaker; characterized in that it comprises an electric motor suitable to drive a gear train by means of a worm screw, turning round in one direction only, for closing the main contacts and the secondary contacts.

[0015] Further characteristics and advantages will become better apparent from the following detailed description of preferred but not exclusive embodiments of the invention, illustrated by way of non-limiting example in the accompanying drawings, wherein:

Figure 1 is a perspective view of the automatic reset and self-test device according to the invention;

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

Figure 3 is a perspective view of the reset device applied to a residual current operated circuit breaker;

Figure 4 is a perspective view of the internal components of the device;

Figure 5 is a front view of the device, shown in longitudinal section in the condition in which the handle is open, the secondary contacts and the main contacts being open;

Figure 6 is a rear view of the device, shown in longitudinal section in the same condition as in Figure 5;

Figure 7 is a front view of the device, shown in longitudinal section in the condition in which the handle is closed, the secondary contacts being open and the main contacts being closed;

Figure 8 is a rear view of the device, shown in longitudinal section in the same condition as in Figure 7;

Figure 9 is a front view of the device, shown in longitudinal section in the condition in which the handle is open, the secondary contacts being closed and the main contacts being open;

Figure 10 is a front view of the device, shown in longitudinal section in the tripped position with the handle open, the secondary contacts and the main contacts being open;

Figure 11 is a rear view of the device, shown in longitudinal section in the same condition as in Figure 10;

Figure 12 is a front view of the device, shown in longitudinal section in the condition in which the handle is closed, the secondary contacts being closed and the main contacts being closed;

Figure 13 is a rear view of the device, shown in longitudinal section in the same condition as in Figure 12;

Figure 14 is a rear view showing in detail the mechanism of the secondary contacts and of the release coil, shown in the conditions in which the handle is open, the main contacts being open and the secondary contacts being open;

Figure 15 is a view, taken from the opposite side, of

the mechanism of the secondary contacts and of the coil, shown in the same condition as in Figure 14; Figure 16 is a rear view showing in detail the mechanism of the secondary contacts and of the release coil, shown in the conditions in which the handle is closed, the main contacts being closed and the secondary contacts being open;

Figure 17 is a view, taken from the opposite side, of the mechanism of the secondary contacts and of the coil, shown in the same condition as in Figure 16; Figure 18 is a rear view showing in detail the mechanism of the secondary contacts and of the release coil, shown in the conditions in which the handle is open, the main contacts being open and the secondary contacts being closed;

Figure 19 is a view, taken from the opposite side, of the mechanism of the secondary contacts and of the coil, shown in the same condition as in Figure 18; Figure 20 is a perspective view showing in detail the mechanism of the secondary contacts and of the release coil, shown in the conditions in which the system has tripped with the main and secondary contacts open;

Figure 21 is a perspective view, taken from the opposite side, of the mechanism of the secondary contacts and of the coil, shown in the same condition as in Figure 20;

Figure 22 is a perspective view showing in detail the mechanism of the secondary contacts and of the release coil, shown in conditions in which the main contacts are open and the secondary contacts are closed;

Figure 23 is a perspective view, taken from the opposite side, of the mechanism of the secondary contacts and of the coil, shown in the same condition as in Figure 22;

Figure 24 is a perspective view of the internal components of the device;

Figure 25 is a perspective view, taken from the opposite side with respect to Figure 24, of the internal components of the device.

[0016] With reference to the figures cited above, a device according to the invention, generally designated by the reference numeral 1, comprises a containment body 2, which has the classic standardized shape and forms, at a rear face 3, a means for mating with other devices associated with a DIN rail (not shown).

[0017] The containment body 2 has, at its front face, a protrusion 4 in which an actuation drum 5 is positioned which is associated with a gear train 6 by means of a bar 7.

[0018] One end of the bar 7 is pivoted to a first gear 61 of the gear train 6 and the other end can slide in a slot 8 of a member being rotatably associated with the drum 5.

[0019] The gear train 6 draws motion from a worm screw 9 actuated by an electric motor 10, more particularly a single-phase synchronous motor.

[0020] The free end of the worm screw 9 is associated

with a one-way bearing, or freewheel 11, allowing the worm screw to turn round in one direction only; the single-phase synchronous motor might in fact start to turn in both directions and it is instead necessary that the gear train rotates always in the same direction.

[0021] The first gear 61 of the gear train 6 is rigidly coupled to a crank 12 to which is connected a linkage 13 actuating a double actuation lever 14.

[0022] The crank 12 is constituted by a wheel provided with cams suitable to act on a first microswitch 15 for controlling the electric motor 10.

[0023] A second microswitch 16 is suitable to indicate the position of the handle or of the drum 5 which is connected kinematically thereto. For this purpose a circular lever 17 is provided with a tab 18 acting on the second microswitch 16.

[0024] The double actuation lever 14 comprises a slot 19 in which the free end of the linkage 13 slides and a bar 20 for actuating the secondary contacts; for this purpose the bar 20 has a portion 21 constituting a cross-member for connection to a residual current operated circuit breaker 101 coupled to the device 1.

[0025] The bar 20 is pivoted to a second lever 22 for actuating the secondary contacts which in turn is connected to a return spring 23 of the secondary contacts.

[0026] The second lever 22 for actuating the secondary contacts acts also on a third microswitch 24 indicating the position of the secondary contacts.

[0027] The device 1 is provided with a release system which intervenes in the case of tension failure during the self-test.

[0028] The release system is based on a minimum-tension coil 25, which acts, by means of its piston 26, on a coil lever 27.

[0029] The coil lever 27 is suitable to trip a tripping lever 28.

[0030] The tripping lever 28 is provided with a return spring 29 and is associated with the double actuation lever 14.

[0031] In the case of tension failure during the self-test and the release system has tripped while restoring the tension, the device performs the self-test procedure again, restarting from the beginning.

[0032] As mentioned before, the device 1 is constituted by a containment body having a standardized shape so that it can be arranged adjacent to other modules and most of all to a circuit breaker 101.

[0033] The mechanism of the reset device is connected to the mechanism of the circuit breaker 101 by means of a bar having a triangular cross-section that constitutes the rotation axis of the drum 5, so that the rotation of the drum 5 matches exactly the rotation of the drum of the circuit breaker 101 being provided with the usual external actuation lever.

[0034] The reset device 1 comprises a sliding access panel 50 suitable to cover the actuation lever 70 of the circuit breaker when the access panel 50 is in the closed position.

[0035] The function of the access panel 50 is to indicate the device activation or deactivation and prevent any accidental activation of it. In fact, it is obvious that the device must not reset automatically a circuit breaker which has been deactivated intentionally, for example for intervention on the line.

[0036] The access panel 50 deactivates the device when it is in the open position, by means of a deactivation lever 30 indicating the position of the access panel 50 to the electronic systems of the device.

[0037] Thus, since in order to open the contacts of the breaker 101 it is necessary to act on the control lever 70; by opening the access panel 50, the automatic reset device is automatically deactivated.

[0038] When the access panel is open and the lever of the circuit breaker is in the open position, it is not possible to close the access panel unless the circuit breaker has been closed first.

[0039] The operation of the automatic reset device is the following.

[0040] The steady-state condition of the system is shown in Figures 7 and 8, in which the drum 5, which is rigidly coupled to the drum of the lever for actuating the breaker, is in the position that corresponds to the closed handle condition, with the secondary contacts open and the main contacts closed.

[0041] The microswitches 15, 16 and 24 are closed.

[0042] When the breaker trips, the drum 5 turns and the device arranges itself in the tripped position, shown in Figures 10 and 11, which corresponds to a condition in which both main and secondary contacts are open.

[0043] The secondary contacts are open due to the intervention of the return spring 23 acting on the actuation lever 22. The electronic card of the device 1 checks the circuit and, if no anomalies have been detected, commands the actuation of the motor 10 which, by means of the worm screw 9 and the gear train 6, turns the drum 5, thus moving the handle of the circuit breaker into the initial position in which the main contacts are closed.

[0044] The device 1 is designed to perform automatically a test of the residual current operated circuit breaker.

[0045] This test can be performed with a preset frequency, for example every week.

[0046] In order to avoid a lack of power supply to user devices during the test, the residual current operated circuit breaker is provided with secondary or auxiliary contacts being closed during the test, thus bypassing the main circuit of the circuit breaker.

[0047] To perform the test, the electronics of the device control the closure of the secondary contacts, placing the device in the condition shown in Figures 12 and 13, in which both main and secondary contacts are closed.

[0048] At this point, the circuit breaker is tripped, thus opening the main contacts and the device 1 assumes the condition shown in Figure 9.

[0049] After the test has been performed, the electronics start the motor 10, turning the drum 5 which closes

the handle of the circuit breaker. Hence, the main contacts get closed and the secondary contacts, by means of the minimum-voltage coil, get open, restoring the normal operating condition shown in Figures 7 and 8.

[0050] The operation for testing and resetting the circuit breaker lasts only a few seconds.

[0051] In practice it has been found that the invention achieves the intended aim and objects, providing a device capable, in association with a residual current operated circuit breaker, of resetting the circuit breaker in case of inappropriate tripping and of performing periodic tests of the circuit breaker.

[0052] The materials used, as well as the dimensions, may of course be any according to the requirements and the state of the art.

[0053] This application claims the priority of Italian Patent Application No. MI2006A002033, filed on October 23, 2006, the subject matter of which is incorporated herein by reference.

Claims

1. An automatic reset and self-test device, particularly for residual current operated circuit breakers and the like, comprising a containment body which can be coupled to an electrical device, such as a residual current operated circuit breaker, provided with main contacts and secondary or auxiliary contacts, said containment body comprising a drum kinematically associated with the control for opening and closing the main contacts of said circuit breaker; **characterized in that** it comprises an electric motor suitable to drive a gear train by means of a worm screw, turning round in one direction only, for closing the main contacts and the secondary contacts.
2. The device according to claim 1, **characterized in that** said actuation drum is associated with said gear train by means of a bar, which one end is pivoted to a first gear of said gear train and which other end can slide within a slot of a member rigidly coupled to said drum.
3. The device according to claim 1 or 2, **characterized in that** said electric motor is a single-phase synchronous motor.
4. The device according to one or more of the preceding claims, **characterized in that** a free end of said worm screw is associated with a one-way bearing, or freewheel allowing the worm screw to turn round in one direction only.
5. The device according to one or more of the preceding claims, **characterized in that** said first gear of said gear train is rigidly coupled to a crank to which a linkage is connected that controls a double actuation

lever, said crank being constituted by a wheel provided with cams suitable to act on a first microswitch for controlling said electric motor.

6. The device according to one or more of the preceding claims, **characterized in that** it comprises a second microswitch suitable to indicate the position of said drum, or of the control for opening and closing the main contacts of said circuit breaker, by means of a circular lever provided with a tab acting on said second microswitch. 5
7. The device according to one or more of the preceding claims, **characterized in that** said double actuation lever comprises a slot in which the free end of said linkage slides and a bar for actuating the secondary contacts; said bar having a cross-member for connection to said circuit breaker coupled to the device. 10
8. The device according to one or more of the preceding claims, **characterized in that** said bar is pivoted to a second lever for actuating the secondary contacts which in turn is connected to a return spring of the secondary contacts. 20
9. The device according to one or more of the preceding claims, **characterized in that** said second lever for actuating the secondary contacts also acts on a third microswitch indicating the position of the secondary contacts. 25
10. The device according to one or more of the preceding claims, **characterized in that** it comprises a release system which intervenes in the case of tension failure, during self-testing, in order to open all the contacts of said circuit breaker. 30
11. The device according to one or more of the preceding claims, **characterized in that** said release system comprises a minimum-voltage coil acting, by means of a piston, on a coil lever, said coil lever being suitable to trip a tripping lever. 35
12. The device according to one or more of the preceding claims, **characterized in that** the mechanism of the reset device is connected to the mechanism of the circuit breaker by means of a bar having a triangular cross-section which constitutes the rotation axis of said drum so that the rotation of said drum matches exactly the rotation of the drum of the circuit breaker being provided with the usual external actuation lever. 40
13. The device according to one or more of the preceding claims, **characterized in that** it comprises a sliding access panel suitable to cover the actuating lever of the circuit breaker when the access panel is in the closed position, said access panel being suitable to 45

indicate the activation or deactivation of the device and to prevent any accidental activation of it, said access panel deactivating the device when it is in the open position, by means of a deactivation lever which indicates the position of said access panel to the electronics of the device.

14. The device according to one or more of the preceding claims, **characterized in that** it comprises an electronic control circuit suitable to perform an automatic test of said circuit breaker and- other functions for controlling the downstream system, including the user devices. 50
15. The device according to one or more of the preceding claims, **characterized in that** said test is performed with a preset frequency.
16. The device according to one or more of the preceding claims, **characterized in that** during said test the device closes the secondary contacts of said circuit breaker and then the breaker that opens the main contacts is tripped; once the test has been performed, said electronic circuit starts said motor, which starts turning the drum which closes the handle of the circuit breaker, so as to close the main contacts, said secondary contacts being opened by means of said minimum-voltage coil, thus restoring the normal operating condition. 55

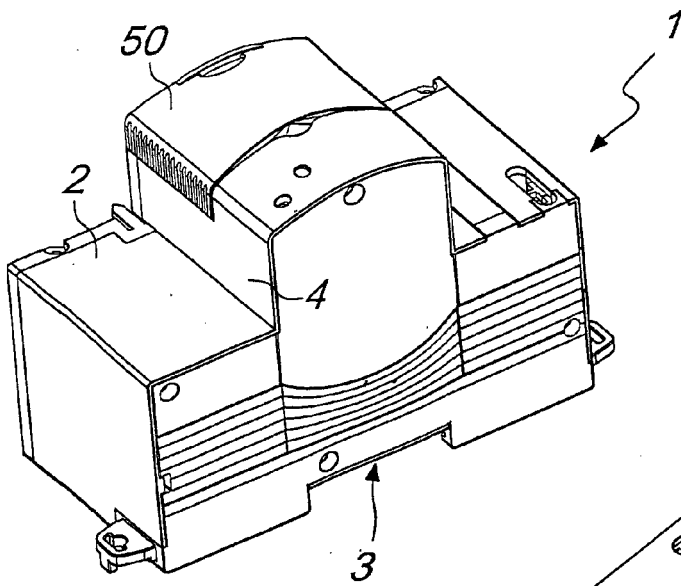


Fig. 1

Fig. 2

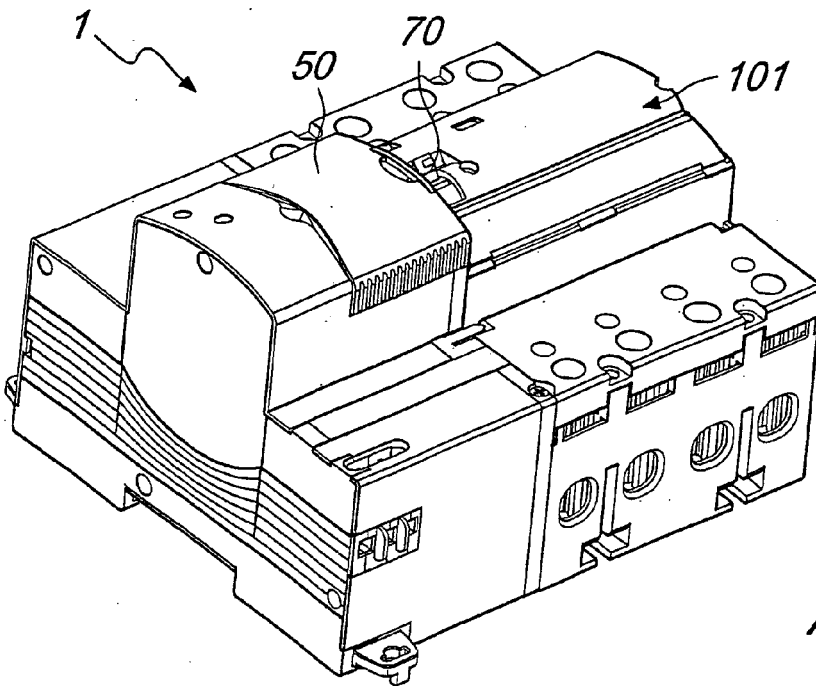
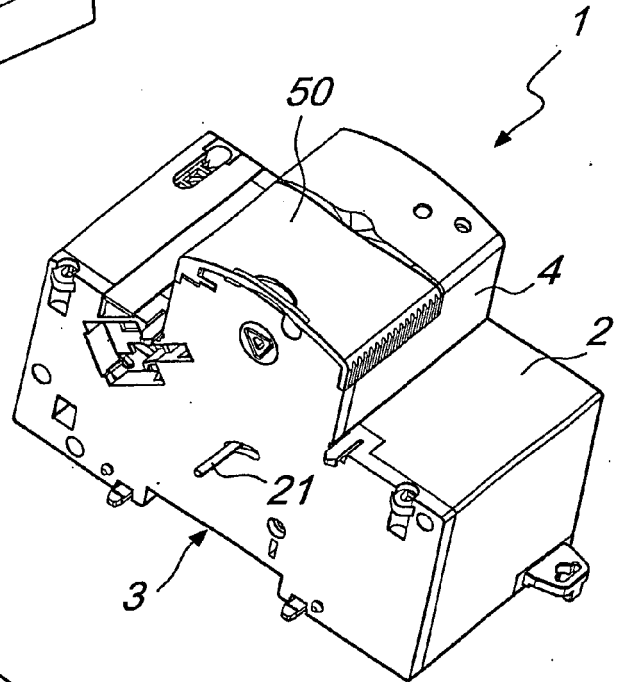


Fig. 3

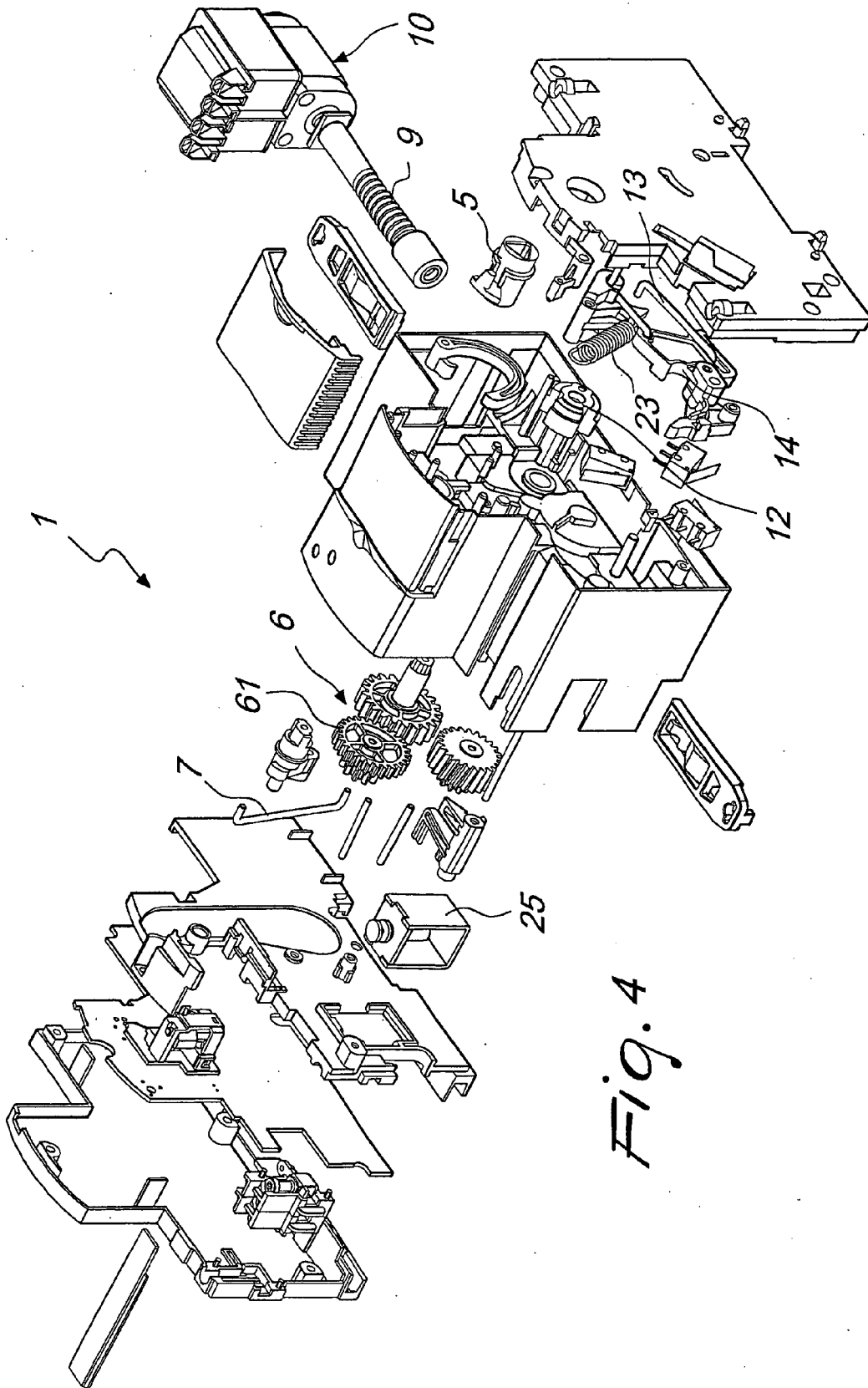
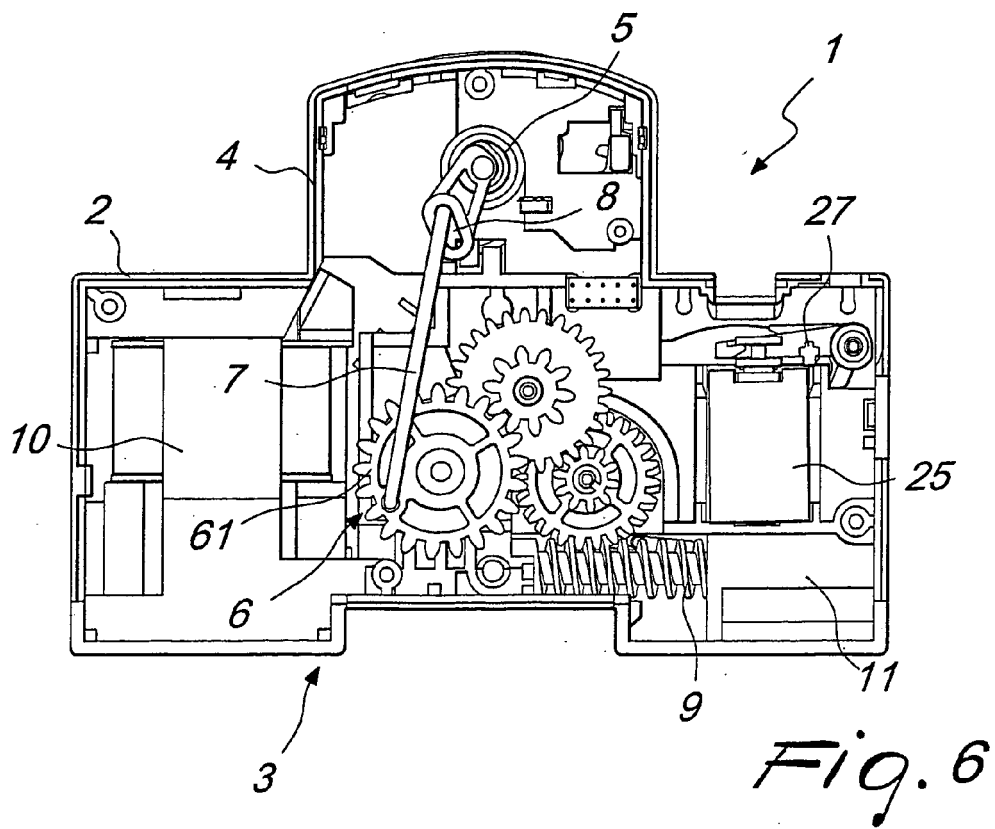
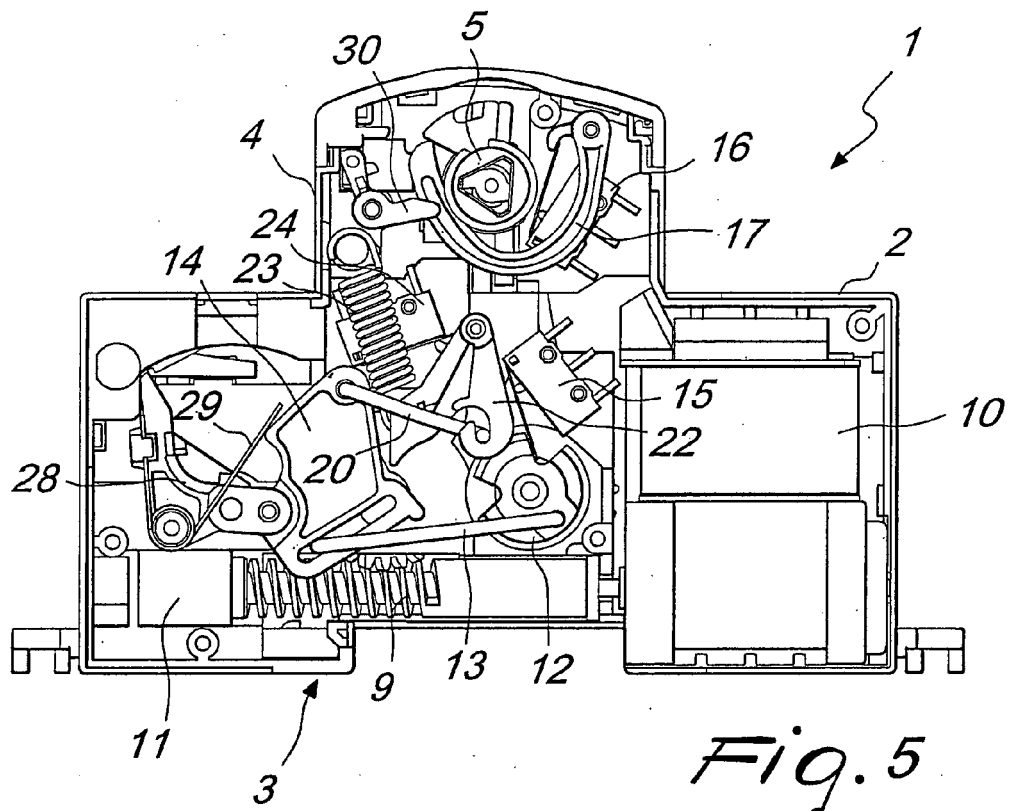
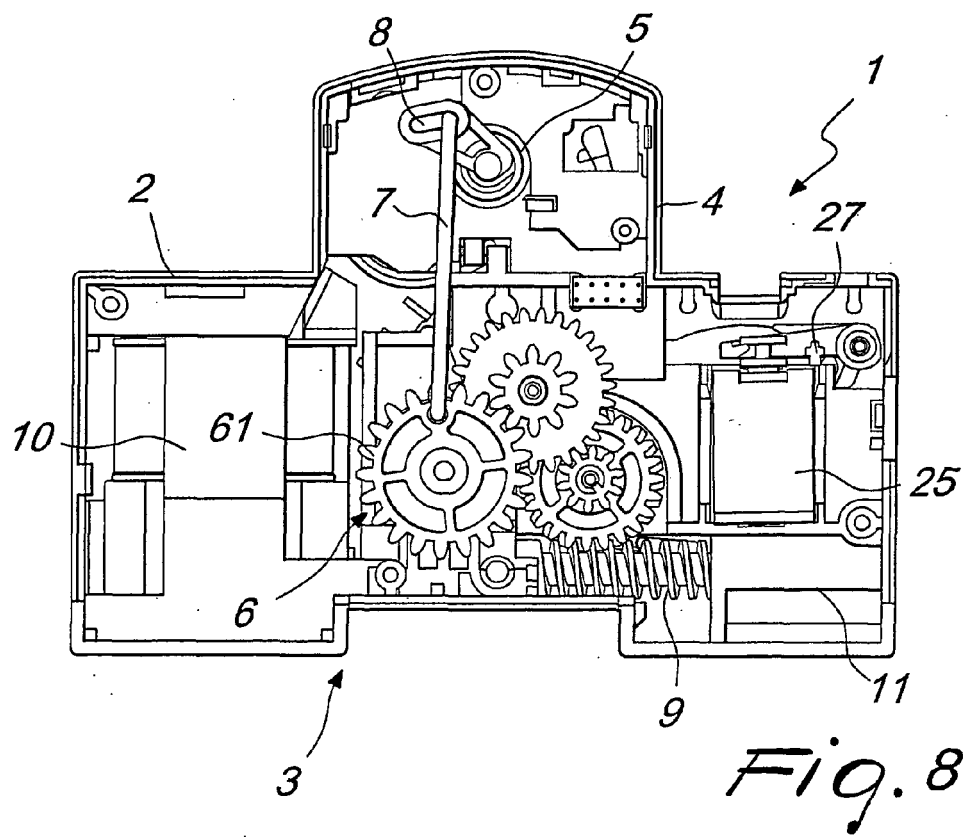
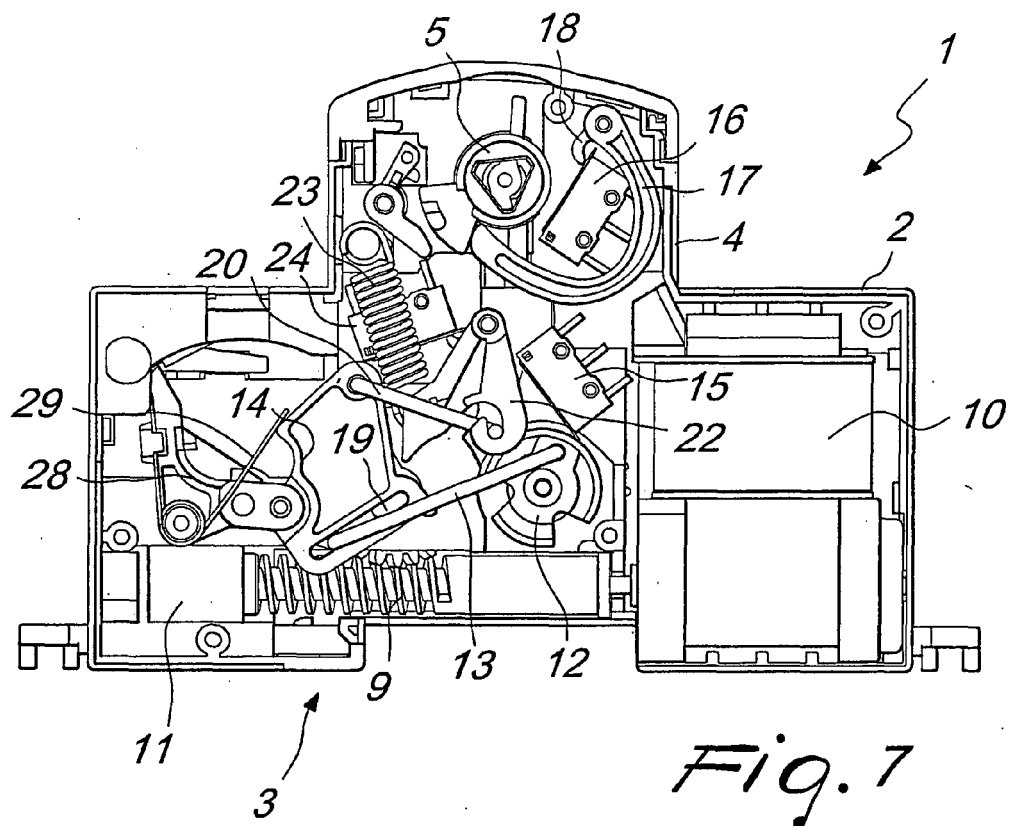


Fig. 4





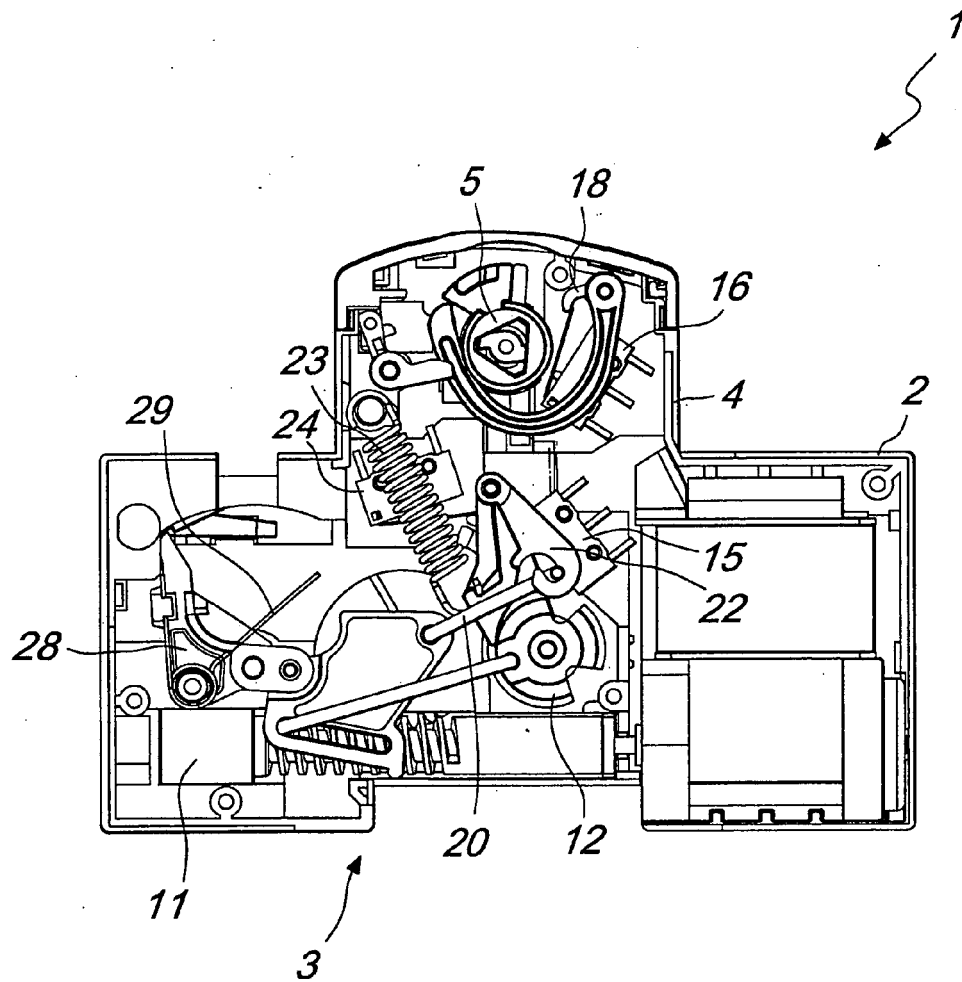
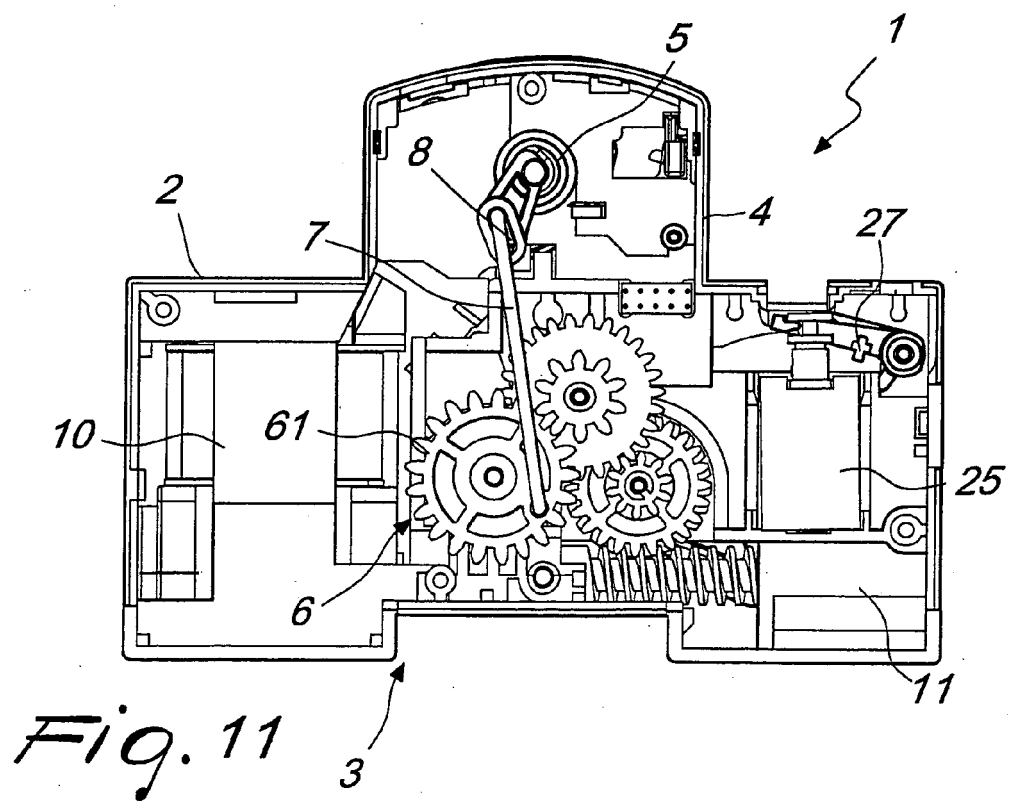
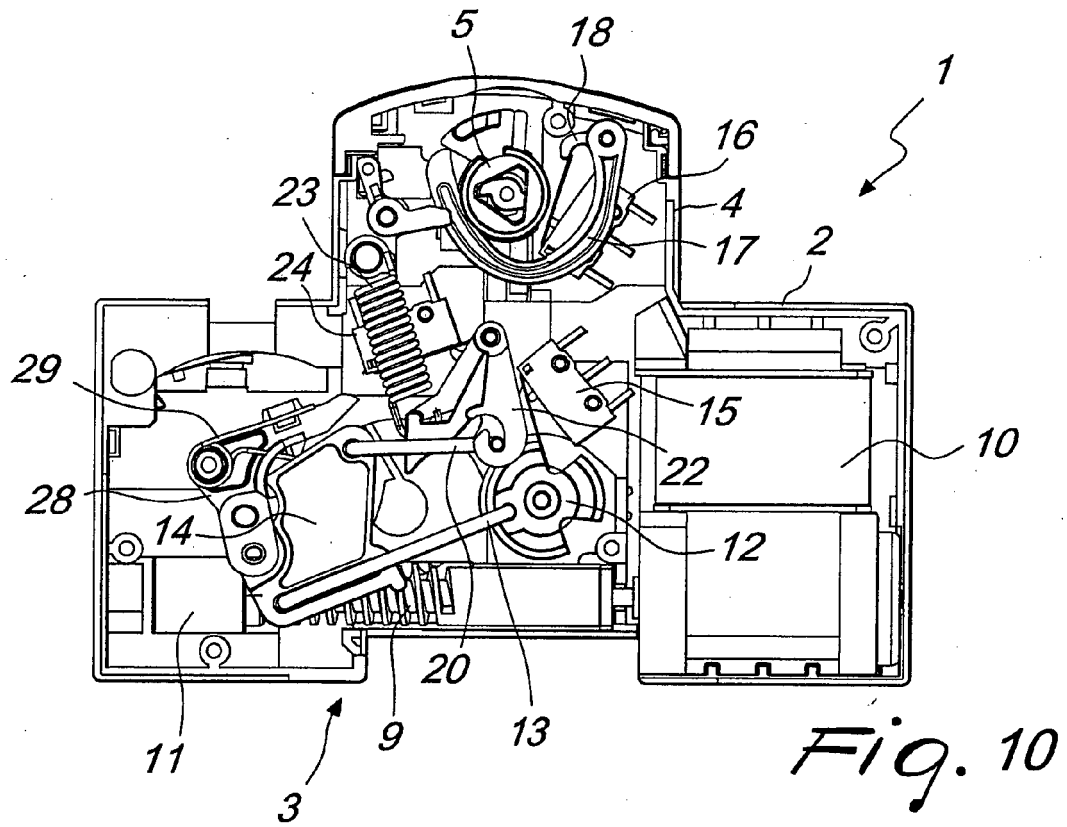
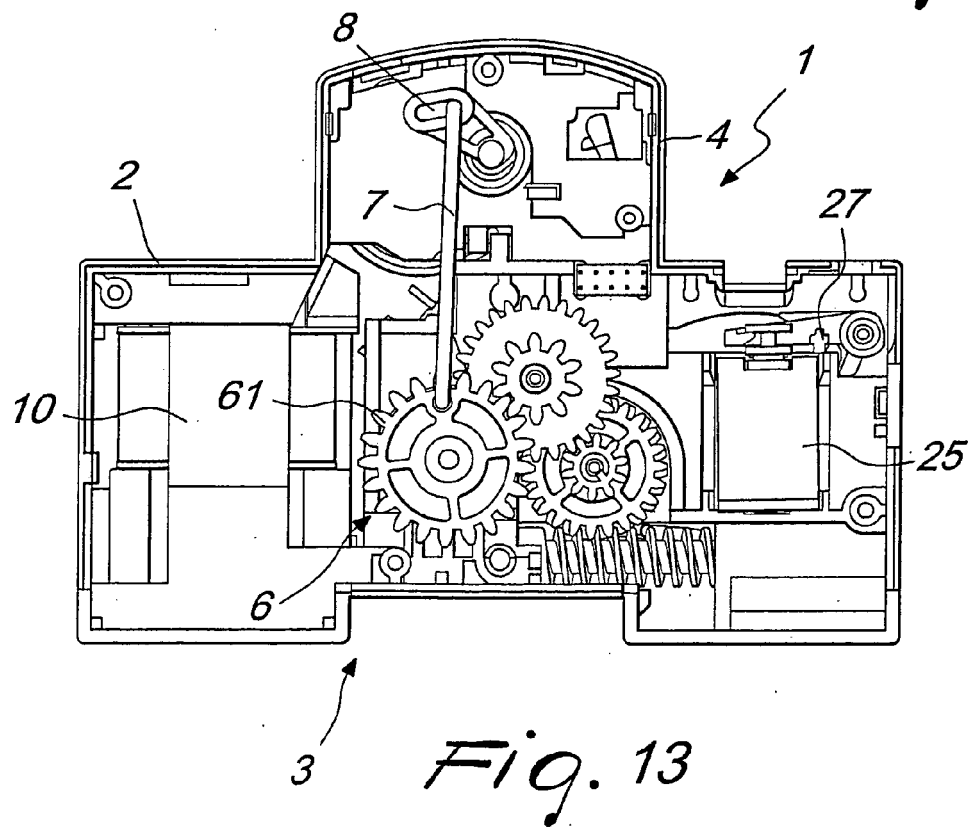
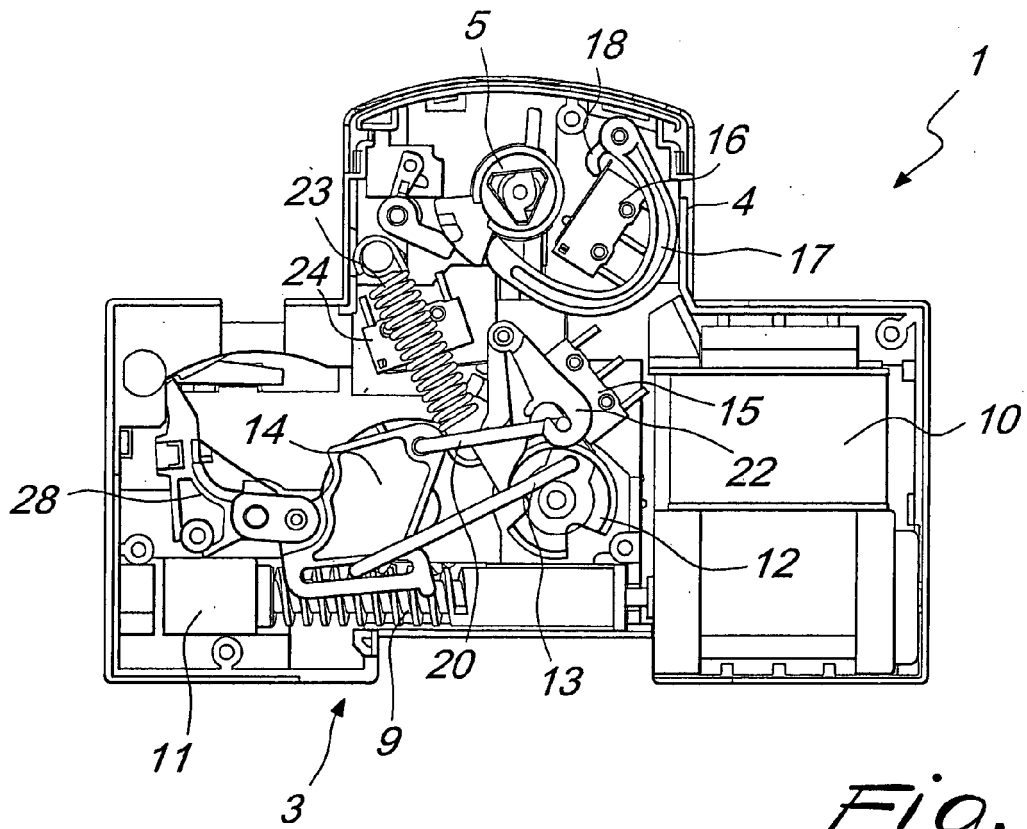


Fig. 9





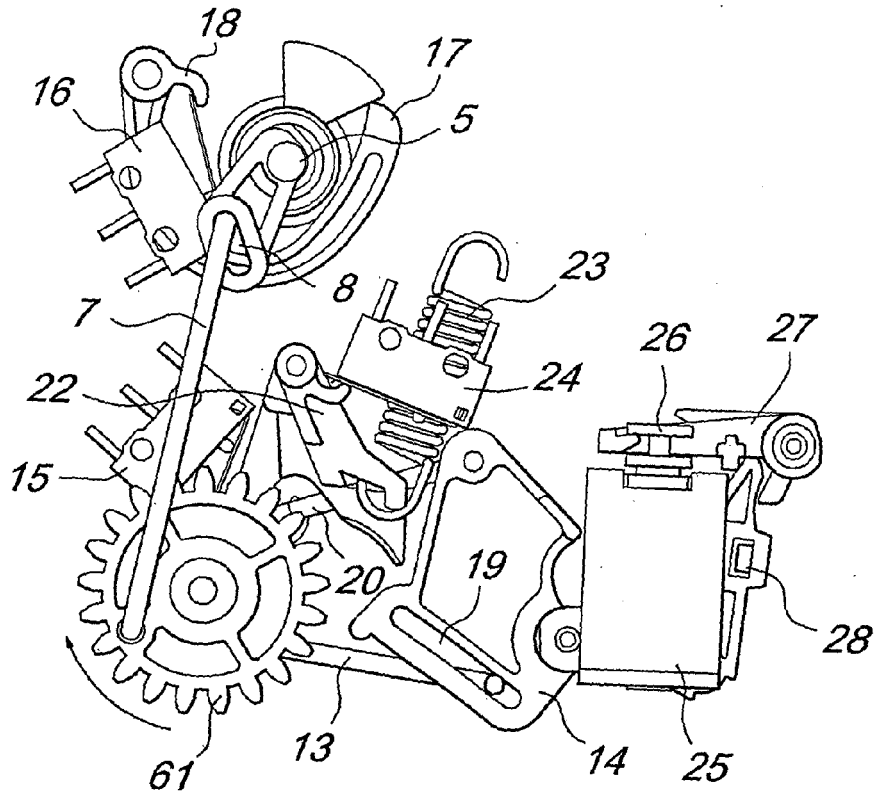


Fig. 14

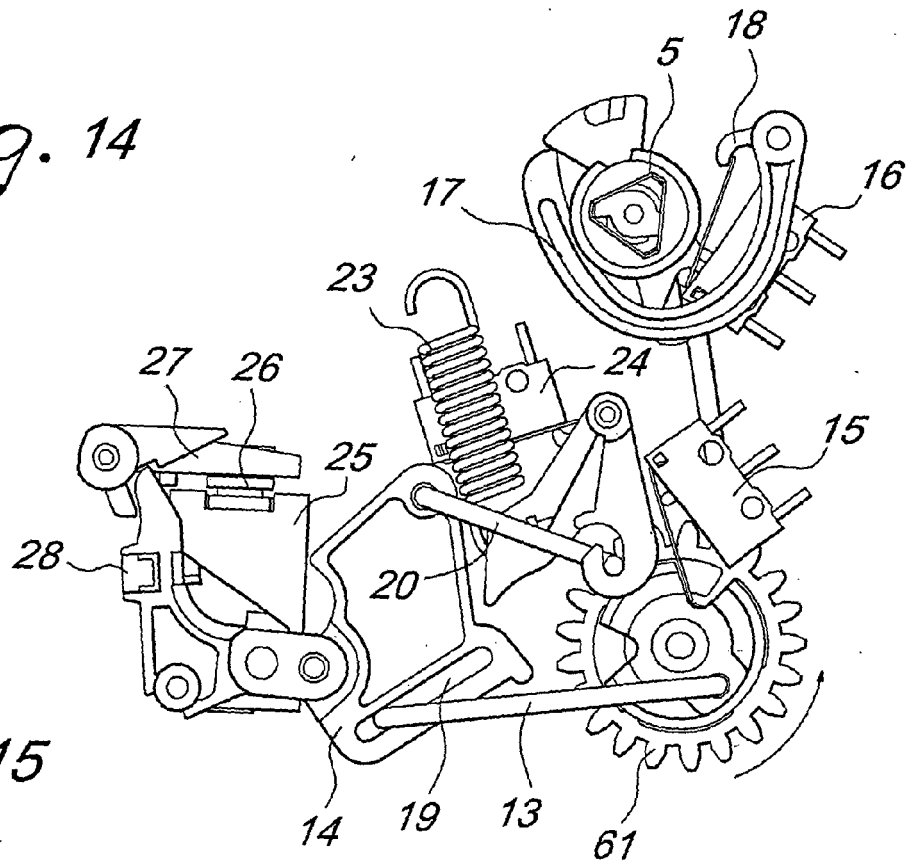


Fig. 15

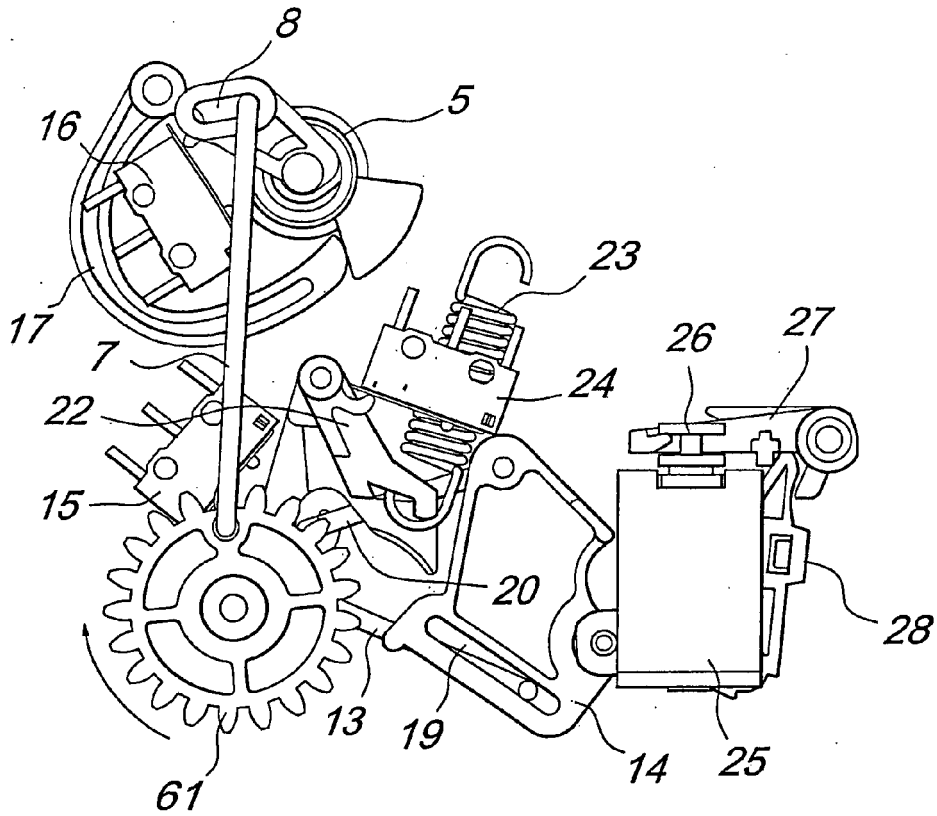


Fig. 16

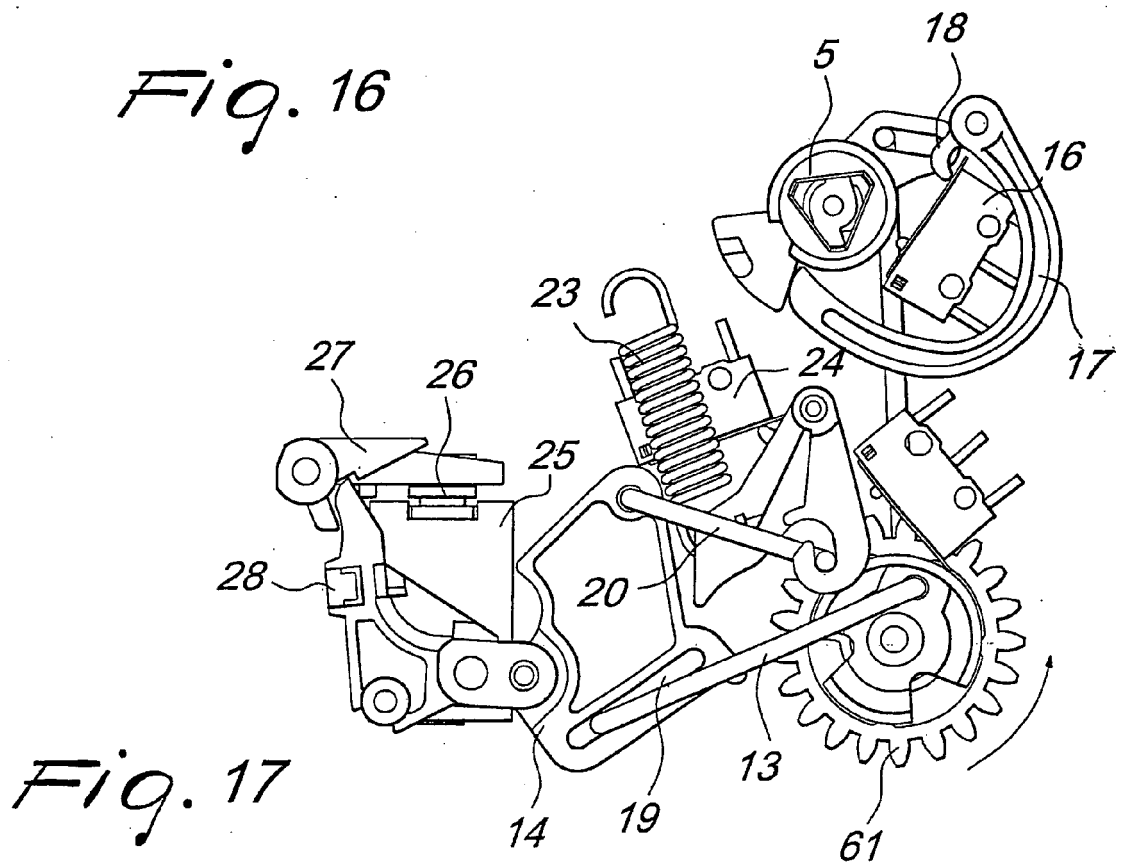


Fig. 17

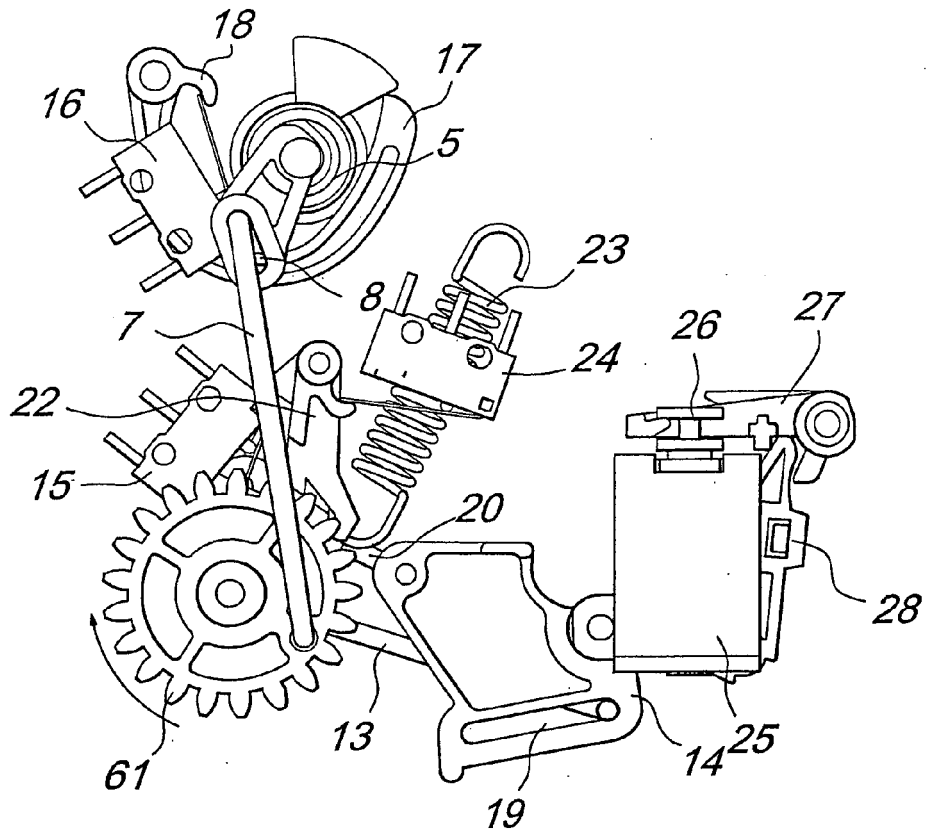


Fig. 18

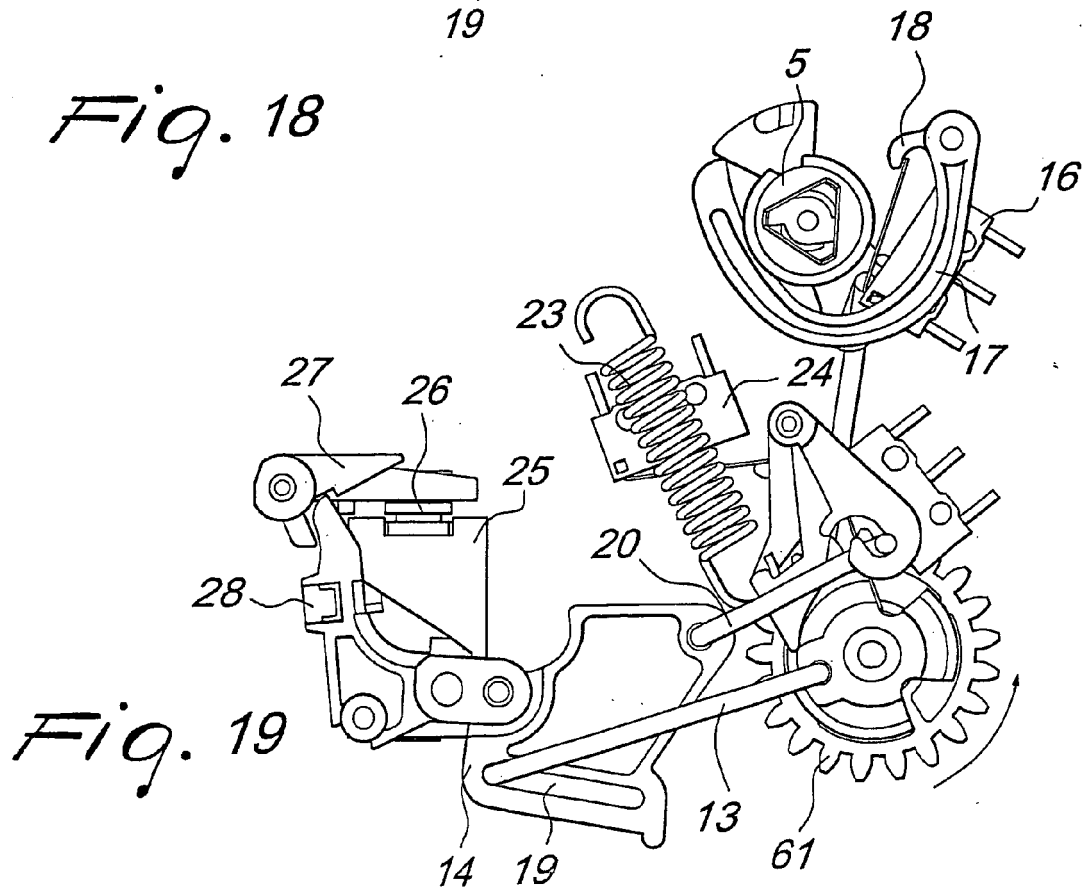


Fig. 19

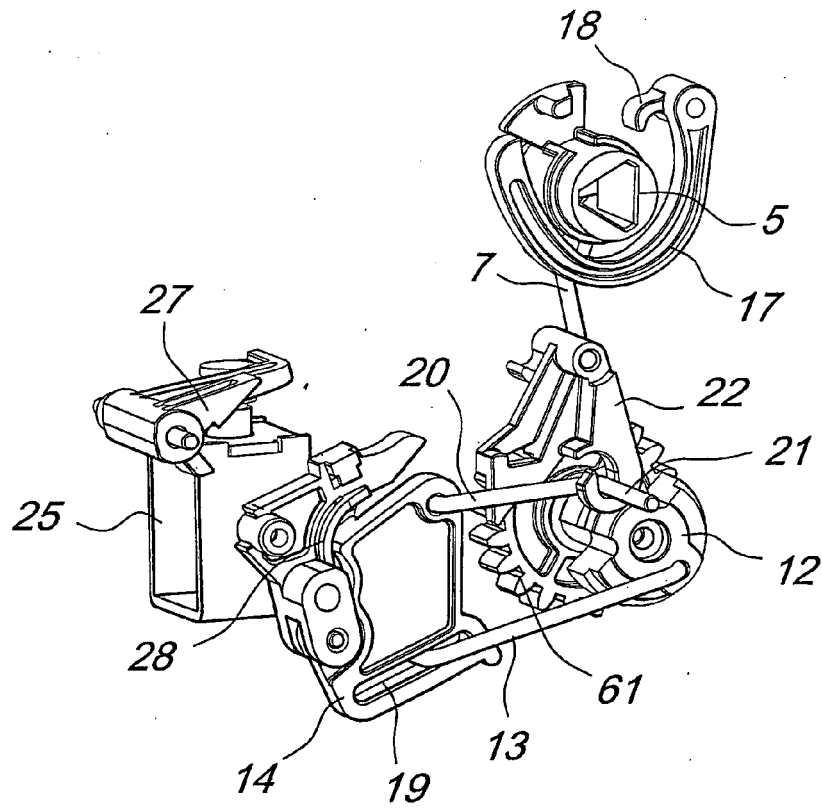


Fig. 20

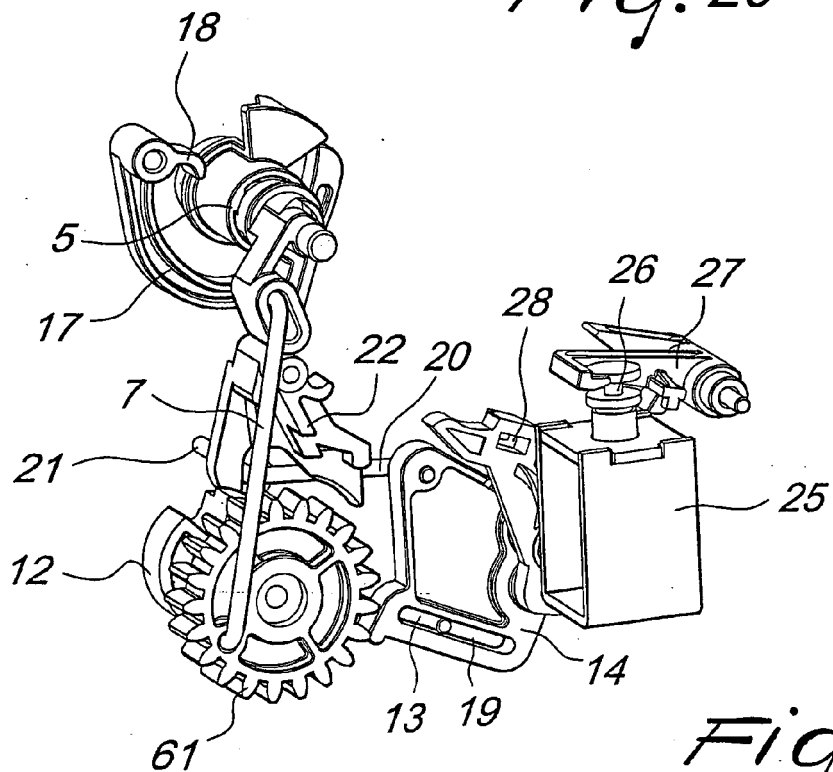
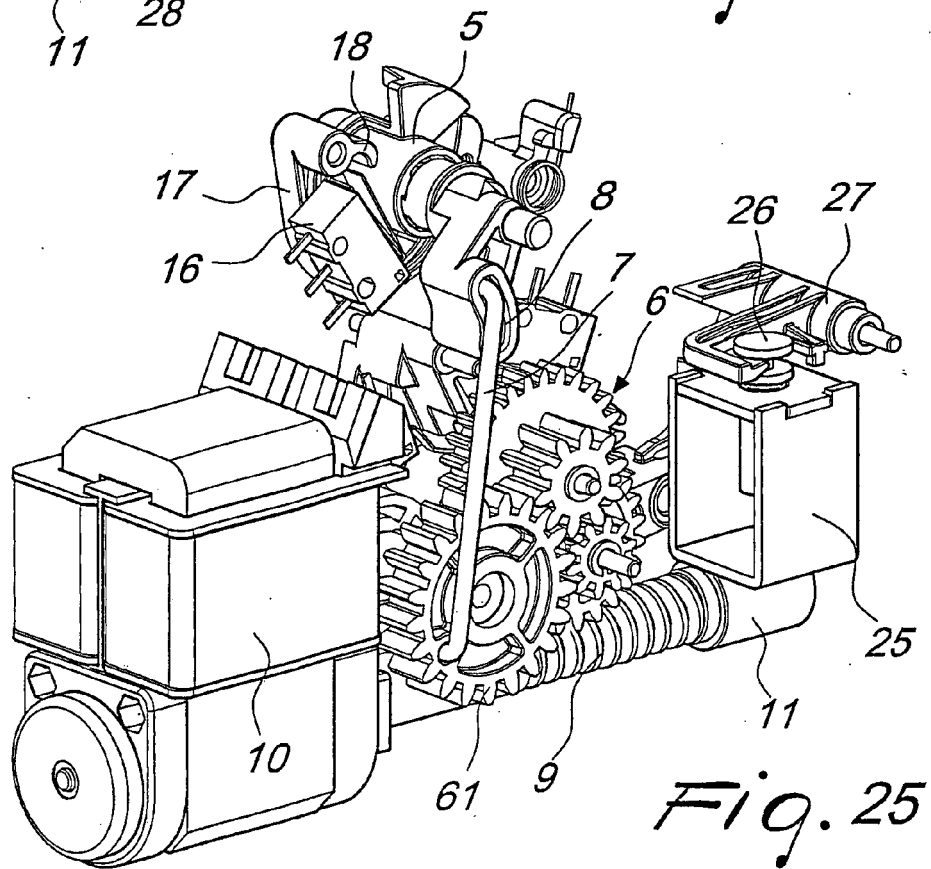
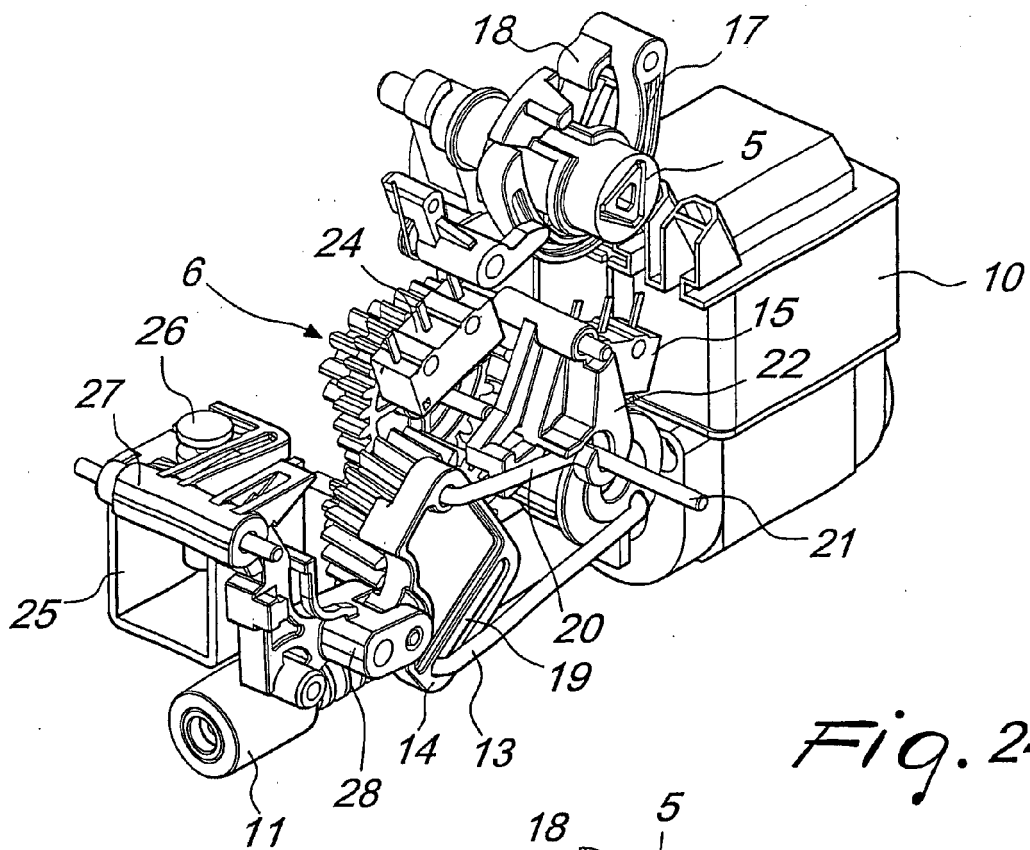


Fig. 21



REFERENCES CITED IN THE DESCRIPTION

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