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(74) Representative: **Giavarini, Francesco et al****Zanoli & Giavarini S.r.l.****Via Melchiorre Gioia, 64****20125 Milano (IT)**(54) **Automatic reset device for a low voltage circuit breaker**

(57) The present invention relates to an automatic reset device (1) for a low voltage circuit breaker (2). The device according to the present invention is particularly suitable for use with a residual current circuit breaker, but can also advantageously be used with circuit breakers of different type, for example, thermal magnetic circuit breakers. The reset device (1) essentially comprises a servomechanism (10), a control unit (20) of the servomechanism (10), a reset lever (30) associated with the servomechanism (10) and operatively connectable to a circuit breaker (2) to assume a first and a second operating

position respectively when the circuit breaker (2) assumes an open and closed configuration. The device (1) according to the invention also comprises position sensor means (7) to sense the position of the reset lever (30). The sensor means (7) generate a first position signal (101) when the reset lever (30) reaches the first operating position. The control unit (20) acquires said first input position signal (101) and generates an output close signal (111) that controls a first predetermined rotation by the servomechanism (10) to take the reset lever (30) from the first to the second operating position so that the circuit breaker (2) assumes the closed configuration.

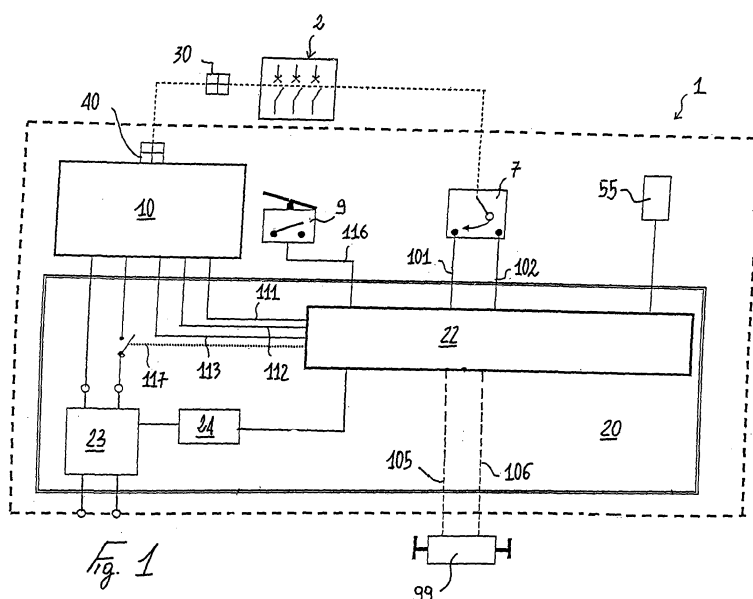
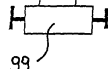


Fig. 1

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Description

[0001] The present invention relates to an automatic reset device for a low voltage circuit breaker. The device according to the present invention is particularly suitable for use with a residual current circuit breaker and reference will be made to this use without wishing to limit the use thereof in other fields, such as with thermal magnetic circuit breakers.

[0002] The use of residual current circuit breakers, i.e. electrical devices capable of breaking a circuit in the case of a fault to earth (leakage) or phase-earth fault, is known. These devices, normally called "residual current devices" are therefore protective devices and are commonly applied both to domestic and industrial networks.

[0003] It is also known that these devices can also act inopportunately, that is, in the absence of a persistent fault in the circuit. This situation can cause inconvenience for users, especially if the power supply of services connected to the circuit is interrupted for long periods subsequent to opening of the circuit.

[0004] To partly overcome this drawback, automatic reset devices have been developed which, acting on the kinematic chain of the residual current device, are capable of automatically restoring the operating conditions of the circuit without requiring human intervention.

[0005] For example, patent application EP 1487003 describes a reset device comprising a casing inside which there is arranged a mechanism for automatic actuation, operatively connectable to the lever to operate the residual current device in order to automatically reset said device a predetermined time after tripping. Inside the casing there is arranged a thermal actuator which acts on the operating mechanism after tripping of the residual current device, allowing the mechanism to perform resetting.

[0006] The solution described, just as others comparable thereto, has some drawbacks linked to the conformation of the reset device and to the operating principle thereof. The actuation mechanism used is in fact constituted by a considerable quantity of elements mutually interconnected to one another. The complex nature of the structure of the mechanism has a considerable influence on the production and assembly costs of the device, at the same time increasing the risk of faults.

[0007] Another drawback of the solution described above is linked to the operating principle of the reset device which is based on the use of a thermal actuator. The times required to reset the residual current device with this type of actuator are somewhat high and can even exceed one minute. In substance, the performance of the technical solution in question, and of others known in the sector, is poor and consequently the operating reliability of the device is also somewhat doubtful.

[0008] On the basis of these considerations, the main aim of the present invention is to provide an automatic reset device for a low voltage circuit breaker which makes it possible to overcome the drawbacks and the limits of

conventional devices.

[0009] In particular, an object of the present invention is to provide a reset device that allows correct and efficient resetting of a low voltage circuit breaker.

[0010] Another object of the present invention is to provide a reset device that is capable of resetting a low voltage circuit breaker in extremely short times.

[0011] A further object of the present invention is to provide a reset device the structure of which is produced with a small number of components easily assemblable with one another.

[0012] A further object of the present invention is to provide a device to reset a low voltage circuit breaker that is highly reliable, relatively easy to produce and at competitive costs.

[0013] The present invention relates to a reset device for a low voltage circuit breaker comprising:

- a servomechanism;
- a control unit of the servomechanism;
- a reset lever associated with the servomechanism and operatively connectable to the circuit breaker to assume a first and a second operating position respectively when the circuit breaker assumes an open and closed configuration.

[0014] The reset device according to the invention is characterized in that it comprises position sensor means to sense the position of the reset lever. The sensor means generate a first position signal when the reset lever reaches a first operating position. The control unit acquires the first input position signal, generating an output close signal that controls a first predetermined rotation by the servomechanism to take the reset lever from the first to the second operating position so that the circuit breaker assumes the closed configuration.

[0015] The use of a servomechanism as actuator of the reset lever constitutes one of the most evident advantages of the present invention as it gives the reset device reliable and repeatable performances by virtue of the simple and efficient operating principle thereof. The servomechanism functionally replaces the complex mechanisms used in conventional reset devices allowing an advantageous reduction in production and assembly costs.

[0016] Further characteristics and advantages of the invention will be more evident from the description of preferred, but not exclusive, embodiments of the reset device according to the invention, shown by way of a non-limiting example in the accompanying drawings, wherein:

- Figure 1 is a block diagram relative to a reset device according to the invention;
- Figure 2 is a block diagram relative to a servomechanism of a reset device according to the invention;
- Figures 3 and 4 are perspective views relative to a possible embodiment of a reset device according to the invention;

- Figures 5 and 6 are perspective views of the reset device in Figures 3 and 4 in a lockout state;
- Figures 7 and 8 are further perspective views of the reset device in Figures 3 and 4;
- Figures 9 and 10 are views relative to sensor means, in a first operating condition, applied to a reset lever of a device according to the present invention;
- Figures 11 and 12 are views relative to the sensor means in Figures 9 and 10 in a second operating condition;
- Figure 13 is relative to a low voltage circuit breaker unit comprising a reset device according to the present invention.

[0017] With reference to the cited figures, the automatic reset device 1 according to the invention essentially comprises a servomechanism 10, a control unit 20 and a reset lever 30 mechanically connected to the servomechanism 10 and arranged to be connected to a low voltage circuit breaker 2 to which the reset device 1 is applied (see Figure 12). Throughout the description reference will be made in particular to use for a residual current circuit breaker 2 without however in any way wishing to limit the possible scopes of application of the reset device 1 which can be used, for example, also to reset thermal magnetic circuit breakers.

[0018] The reset lever 30 can advantageously be associated with the operating lever of the circuit breaker 2 to follow the movement thereof so as to assume a first and a second operating position respectively when the circuit breaker 2 assumes an open and closed configuration. The reset device 1 is characterized in that it comprises position sensor means 7 to sense the position of the reset lever 30 and to generate a first position signal 101 when the reset lever 30 reaches the first position, i.e. due to a fault in the system that triggers the residual current device 2 to assume the open configuration. This first signal 101 is acquired by the control unit 20 which generates an output close signal 111 that controls a predetermined rotation by the servomechanism 10 to take the reset lever 30 from the first to the second operating position so that the residual current device 2 is reset, i.e. assumes the closed configuration.

[0019] Figure 1 is a schematic block diagram of the main components of the reset device 1 according to the invention. The control unit 20 preferably comprises a microprocessor 22 operatively communicating with the position sensor means 7 and with the servomechanism 10 that controls the reset lever 30. Between these two last parts there are interposed disengaging means 40 which have the function of releasing the reset lever 30 from the servomechanism 10 when this lever reaches the second operating position, or when the residual current device 2 assumes the closed configuration. In this regard, from an operative point of view, the sensor means 7 generate a second position signal 102 when the reset lever 30 reaches the second operating position. The second input position signal 102 is acquired by the control unit 20, in

particular by the microprocessor 22, which generates the output disengage signal 112 that controls activation of the disengaging means 40 by the servomechanism 10. In other words, the disengage signal 112 releases the reset lever 30 from the servomechanism 10 allowing triggering of the residual current device 2 to assume an open configuration if, for example, the fault condition in the system persists.

[0020] Again with reference to Figure 1, the microprocessor 22 acquires at least a first control signal 105 coming from a remote source 99, which can, for example, be a transmitter, a remote control or any functionally equivalent apparatus. After reception of the first control signal 105, the microprocessor 22 generates an open signal 113 which controls a second predetermined rotation by the servomechanism 10 to take the reset lever 30 from the second to the first operating position in which the residual current device 2 assumes the open configuration.

[0021] According to a preferred embodiment of the invention, the microprocessor 22 advantageously also acquires a second control signal 106, again coming from a remote source 99, following which the microprocessor 22 generates the aforesaid close signal 111 for the servomechanism 10. From what has just been indicated, it is understood that the automatic reset device 1 also performs the function of motorized control for the residual current device 2. In fact, through this a user can act on a remote control 99 to remotely control opening or closing of the residual current device 2 according to service needs.

[0022] If the control to open the residual current device 2, i.e. the signal 105, is sent remotely, at the end of the opening movement the microprocessor 22 generates an electrical lockout signal 117 for the servomechanism 10 which in substance inhibits the reset operation performed thereby. The microprocessor 22 suspends the electrical lockout signal 117 when it acquires the second remote control signal 106 or when it acquires a status signal 116 generated by a microswitch 9 actuated according to methods described hereunder.

[0023] Again with reference to Figure 1, the servomechanism 10 and the control unit 20 are supplied with power through a power supply 23, i.e. at 6 volt, preferably integrated with self powering means 24, operation of which is monitored by the microprocessor 22. According to a preferred embodiment of the invention, the self-powering means 24 comprise one or two capacitors which act as power storage devices for the servomechanism 10 in order to allow it to perform the opening movement of the residual current device 2 when there is a failure in power to the power supply 23 and when the opening or closing movement is already in progress. After a power failure or when the power supply is restored, the microprocessor 22 remains inactive for a predetermined time, i.e. a few seconds, inhibiting any possible action of the servomechanism 10. After this predetermined time, given to allow the capacitors to recharge, the device regains

its full self-closing capacity. Moreover, the microprocessor 22 responds to one of the control signals 105 or 106 sent remotely, opening or reclosing the residual current device 2 as required.

[0024] Figure 2 shows a second schematic diagram relative to the servomechanism 10 of the reset device 1 according to the invention. The servomechanism 10 comprises a control unit 12 that controls an electric motor 11 mechanically connected to the reset lever 30 and suitable to perform the first and the second rotation to respectively close and open the residual current device. The servomechanism 10 also comprises transducer means 13 suitable to provide the control unit 12 with a signal indicating the angular distance covered by the electric motor 11. These transducer means 13, for example constituted by a potentiometer connected to the shaft of the electric motor 11, allow the control unit 12 proportional control of the motor. In fact, the control unit 12 supplies the electric motor 11 with a power proportional to the angular distance that must be covered thereby to complete said first or said second rotation.

[0025] The use of transducer means 13 also allows proportional control of the rpm of the electric motor 11. In fact, this motor can advantageously rotate at a greater/lesser speed in relation to the greater/lesser angular distance to be covered to complete the first or the second rotation.

[0026] According to a preferred embodiment of the invention, the control unit 12 of the servomechanism 10 is configured to acquire pulsed input signals sent by the control unit 20 of the reset device 1. In other words, the close signal 111, the disengage signal 112 and the open signal 113 are pulsed signals which have the same frequency but a different time duration of the pulses.

[0027] The control unit 12 of the servomechanism 10 decodes these pulsed input signals recognizing the different time duration and consequently controlling the first and the second rotation, or activation of the disengaging means 40, by the electric motor 11.

[0028] Figures 3 and 4 are perspective views of a reset device 1 according to the invention which comprises a casing 90 suitable to house the servomechanism 10 and the control unit 20. In the solution shown, the casing 90 comprises at least a first lower surface 91, a second 92 and a third 93 side surface substantially opposite each other. The casing 90 is completed by a fourth 94 and a fifth 95 side surface that extend on opposite sides and according to planes substantially perpendicular to said first lower surface 91 and to said second 92 and third 93 side surfaces. A sixth upper surface 96 closes the casing 90 at the top extending in a position substantially opposite that of said first surface 91.

[0029] Naturally, the description is only an example of an embodiment of the casing 90 and must not be considered in any way limiting. In other words, alternative embodiments to the one shown also fall within the scope of the inventive concept.

[0030] As is evident in particular in Figure 3, the casing

90 comprises means 88 for connecting the reset device 1 to a relative residual current circuit breaker 2 so as to produce a circuit breaker unit 3 like the one shown by way of example in Figure 10. The connection means 88 shown comprise a plurality of fastening teeth arranged on the fourth 94 and on the fifth 95 side surface. It must be understood that these means could be replaced with others functionally equivalent but with different forms and arrangements.

[0031] Figures 5 and 6 are other views of the reset device 1 already shown in Figures 3 and 4 which show further technical solutions distinguishing said device. In particular, the device comprises a movable slider 69 suitable to activate/deactivate a microswitch 9 (see Figure 1) operatively connected to the microprocessor 22 of the control unit 20. When activated, the microswitch 9 generates a status signal 116 following which the microprocessor 22 generates an electrical lockout signal 117 for the servomechanism 10.

[0032] If deactivated, the microswitch 9 suspends the status signal 116 and consequently the control unit 20 suspends the lockout signal 117 for the servomechanism 10. In other words, the movement of the movable slider 69 determines an electrical lockout of the device 1 that inhibits operation of the servomechanism 10 or inhibits the reset function performed by said servomechanism. In the same way, lockout also inhibits response to the controls sent remotely and described above. As is evident, for example, from Figure 5, the electrical lockout of the reset device 1 can also be integrated by a mechanical lockout defined, for example, by a perforated eyelet 67 projecting from the casing 90. This mechanical lockout can only be activated when the residual current device 2 is open and the device 1 is in electrical lockout state. In these conditions a padlock, for example, can be applied to the perforated eyelet 67, suitable to lock the movable slider 69 in the position in which the microswitch 9 is activated.

[0033] According to a preferred embodiment of the invention, the control unit 20 generates the lockout signal 117 of the device 1 also when the number of consecutive closings performed by the device 1 exceeds a predetermined value. This function is implemented by counting means connected to the control unit 20 or integrated therein as in the case of the microprocessor 22 indicated above. Counting of the number of closings is extremely useful as it consist in using the reset device 1 correctly, which is maintained in electrical lockout state only if the fault sensed by the residual current device 2 persists.

[0034] Again with reference to Figure 1, to indicate the electrical lockout state the reset device 1 advantageously also comprises visual indicating means 55 which can be, for example, bi-color LEDs. Naturally, any other equivalent means can be used for the same purpose, i.e. to indicate the normal operating state and the lockout state of the reset device 1.

[0035] Figures 7 and 8 are respectively a perspective view and a sectional view of the device 1 in Figures 3

and 4 and allow the reciprocal arrangement of the components of the reset device 1 to be observed. As shown, the control unit 20 and the servomechanism 10 are placed inside the casing 90, while the reset lever 30 extends outside said casing in a direction substantially orthogonal to the second side surface 92.

[0036] The reset device 1 comprises suitable transmission means suitable to transfer motion from the servomechanism 10 to the reset lever 30. As shown in particular in Figure 8, these transmission means essentially comprise a first 121 and a second 122 toothed wheel associated respectively with the shaft of the servomechanism 10 and with a second shaft 125 substantially orthogonal to the axis of rotation 61 of said servomechanism 10. The second shaft 125 is pivoted at the ends in a first and in a second seat produced respectively in the second 92 and in the third side surface 93.

[0037] Rotation of the reset lever 30 advantageously takes place about an axis of rotation that coincides with the axis of rotation of the aforesaid second shaft 125. According to a preferred embodiment, the reset lever 30 comprises a first 131 and a second 132 wing each provided with a suitable seat to house the second shaft 125. This solution in substance defines two kinematic pairs which allow the reset lever 30 to rotate freely with respect to the second shaft 125. As is again evident from Figure 8, the second toothed wheel 122 is also free to rotate with respect to the second shaft 125 and advantageously comprises a portion 122A which is placed between the two wings 131 and 132 of the reset lever 30 in order to increase the structural rigidity in the area of transmission of the movement. The second wheel 122 transmits the movement to the reset lever 30 engaging with the first wing 131 of said lever. This coupling is mediated by the disengaging means 40 (Figure 7) which in substance allow the first wing 131 to be released when controlled by the second toothed wheel 122.

[0038] In the solution shown, the disengaging means 40 are constituted by two shaped parts which engage with/disengage from each other. In particular, a first shaped portion 151 is operatively connected to the second toothed wheel 122, while a second shaped portion 152 is connected to the first wing 131 of the reset lever 30. Advantageously, the first shaped portion 151 can be constituted in a single piece with the second toothed wheel 122, while the second shaped portion 152 can be produced directly on the first wing 131, or can be constituted in a single piece with the second toothed wheel 122. Alternatively, the portions 151 and 152 can be produced separately and only subsequently connected to the components for which they are designed.

[0039] Figures from 9 to 12 show a possible embodiment of the sensor means 7 according to the present invention. In particular, the sensor means 7 comprise a dual Hall-effect sensor capable of generating the first 101 and the second position signal 102 when the reset lever 30 reaches the aforesaid operating positions. Naturally, the possibility of using other functionally equivalent sen-

sor means 7 besides those indicated below also falls within the scope of the inventive concept.

[0040] Figures 9 and 10 respectively show the control unit 20, the sensor means 7 and the reset lever 30 in the second operating position, i.e. when the residual current device 1 assumes a closed configuration. The dual Hall-effect sensor comprises a magnet 8 associated with a shaped end 135 of the first wing 131 of the reset lever 30. The sensor also comprises a first 144 and a second 145 transducer associated with the control unit 20 which are activated by the magnet 8 when the lever reaches the first and the second operating position respectively. In other words, when the magnet 8 is positioned over one of the two transducers it activates said transducer to generate one of the position signals 101 and 102.

[0041] In the conditions shown in Figures 9 and 10, the magnet 8 activates the second transducer 145 which generates the second position signal 102 to indicate to the control unit 20 that the second operating position has been reached.

[0042] Instead, in the condition shown in Figures 11 and 12 the magnet activates the first transducer 144 which generates the first position signal 101 to indicate to the control unit 20 that the reset lever 30 has reached the first operating position, i.e. that the residual current device 1 is open. Consequently, the control unit 20 controls the servomechanism 10 according to the description above. In Figure 10* the broken line shows the reset lever 30 in the position already shown in Figure 8 to allow the movement of the magnet 8 from the second to the first operating position and vice versa to be better understood.

[0043] With reference to Figure 13, the present invention also relates to a low voltage circuit breaker unit 3 comprising a residual current circuit breaker 2 to which an automatic reset device 1 according to the present invention is operatively connected.

[0044] The technical solutions adopted for the reset device make it possible to fully achieve the aims and objects set. In particular, the movement of the reset lever is obtained through the use of a servomechanism that advantageously results in a noteworthy reduction in the number of components and in the final production costs. The use of sensor means and of a control unit for the servomechanism 10 also makes it possible to obtain a device which is very efficient as regards operation and which is also very reliable.

[0045] The reset device thus conceived is susceptible to numerous modifications and variants, all falling within the scope of the inventive concept; moreover, all details can be replaced by other technically equivalent elements.

Claims

1. Automatic reset device (1) for a low voltage circuit breaker (2), said device (1) comprising:

- a servomechanism (10);

- a control unit (20) of said servomechanism (10);
- a reset lever (30) associated with said servomechanism (10) and operatively connectable to said circuit breaker (2) to assume a first and a second operating position respectively when said circuit breaker (2) assumes an open and closed configuration,

characterized in that it comprises position sensor means (7) to sense the position of said reset lever (30), said sensor means (7) generating a first position signal (101) when said reset lever (30) reaches said first operating position, said control unit (20) acquiring said first input position signal (101) and generating an output close signal (111) that controls a first predetermined rotation by said servomechanism (10) to take said reset lever (30) from said first to said second operating position so that said circuit breaker (2) assumes said closed configuration.

2. Device (1) as claimed in claim 1, **characterized in that** it comprises disengaging means (40) suitable to release said reset lever (30) from said servomechanism (10), said sensor means (7) generating a second position signal (102) when said reset lever (30) reaches said second operating position, said control unit (20) acquiring said input position signal (102) and generating an output disengage signal (112) that controls activation of said disengaging means (40) by said servomechanism (10).
3. Device (1) as claimed in claim 1 or 2, **characterized in that** said control unit (20) acquires at least a first control signal (105) sent from a remote control (99), said control unit (20) generating, after reception of said control signal (105), an open signal (113) which controls a second predetermined rotation by said servomechanism (10) to take said reset lever (30) from said second to said first operating position so that said residual current device (2) assumes said open configuration.
4. Device (1) as claimed in claim 3, **characterized in that** said control unit (20) acquires at least a second control signal (106) sent from said remote control (99), said control unit (20) generating said close signal (111) after reception of said second control signal (106).
5. Device (1) as claimed in one or more of claims 1 to 4, **characterized in that** it comprises a power supply (23) to supply said servomechanism (10) and said control unit (20), said power supply (23) being integrated with self-powering means (24).
6. Device as claimed in one or more of claims 1 to 5, **characterized in that** said servomechanism (10)

comprises an electric motor (11), a control unit (12) of said electric motor (11), transducer means (13) of the angular distance covered by said electric motor (11), said electric motor (11) being connected to said reset lever (30) and performing said predetermined rotations.

7. Device (1) as claimed in claim 6, **characterized in that** said control unit (12), following input coding of said close signal (111), controls said first predetermined rotation by said electric motor (11) and, following input coding of said disengage signal (112), controls activation of said disengaging means (40), said control unit (12) controlling said second predetermined rotation by said electric motor (11) following input coding of said open signal (113).
8. Device (1) as claimed in claims 6 or 7, **characterized in that** said control unit (12) applies to said electric motor (11) a power proportional to the angular distance that must be covered thereby to complete said predetermined rotation.
9. Device (1) as claimed in one or more of claims 6 to 8, **characterized in that** said electric motor (11) rotates with a speed proportional to the angular distance that must be covered thereby to complete said predetermined rotation.
10. Device (1) as claimed in one or more of claims 3 to 9, **characterized in that** said close signal (111), said disengage signal (112) and said open signal (113) are pulsed signals having the same frequency and a different time duration of the pulses.
11. Device (1) as claimed in one or more of claims 1 to 10, **characterized in that** said reset lever (30) rotates about an axis substantially orthogonal to the axis of rotation (61) of said servomechanism (10).
12. Device (1) as claimed in one or more of claims 1 to 11, **characterized in that** it comprises a movable slider (69) suitable to activate/deactivate a microswitch (9) operatively connected to said control unit (20), said microswitch (9) generating, if activated, a status signal (116) following which said control unit (20) generates a lockout signal (117) for said servomechanism (10).
13. Device (1) as claimed in claim 12, **characterized in that** it comprises a mechanical lock suitable to maintain said movable slider (69) in a position in which said microswitch (9) is activated.
14. Device (1) as claimed in one or more of claims 11 to 13, **characterized in that** it comprises transmission means suitable to transfer motion from said electric motor (11) to said reset lever (30), said transmission

means comprising a first toothed wheel (121) meshing with a second toothed wheel (122), said first toothed wheel (121) being associated with the shaft of said servomechanism (10), said second wheel (122) being associated with a second shaft (125) substantially orthogonal to the axis of said first toothed wheel (121), said second shaft (125) being pivoted in two seats produced in a casing (90) for housing said servomechanism (11) and said control unit (20).

15. Device (1) as claimed in claim 14, **characterized in that** said reset lever (30) comprises a first (131) and a second (132) wing each provided with a seat for housing said second shaft (125), said second toothed wheel (122) being provided with a portion (122A) which is placed between said first (131) and said second (132) wing, said disengaging means (40) being operatively positioned between said second toothed wheel (122) and said first wing (131) of said reset lever (30), said disengaging means comprising a first shaped portion (151) operatively connected to said second toothed wheel (122) and a second shaped portion (151) connected to said first wing (131).
16. Device as claimed in one or more of claims 1 to 15, **characterized in that** said sensor means (7) comprise a dual Hall-effect sensor comprising a magnet (8) associated with one end (135) of said first wing (131) of said reset lever (30), said dual sensor comprising a first (144) and a second (145) transducer operatively connected to said control unit (20), said magnet (8) activating said first transducer (144) when said reset lever (30) assumes said first operating position and activating said second transducer (145) when said reset lever (30) assumes said second operating position.
17. Low voltage circuit breaker unit (3) comprising a circuit breaker (2), **characterized in that** it comprises an automatic reset device (1) as claimed in one or more of claims 1 to 16, said reset device (1) being operatively connected to said circuit breaker (2) to allow automatic reset thereof.

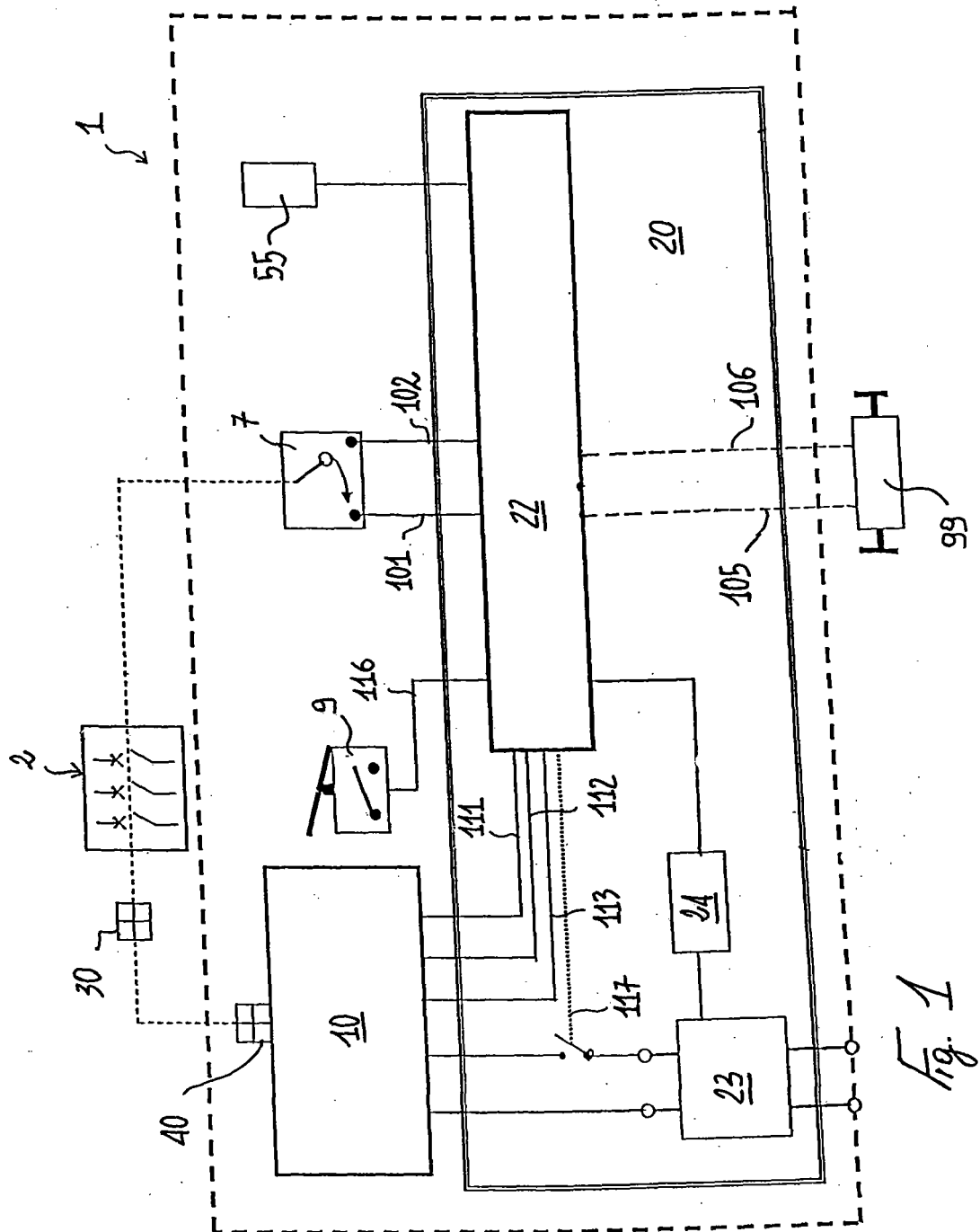


Fig. 1

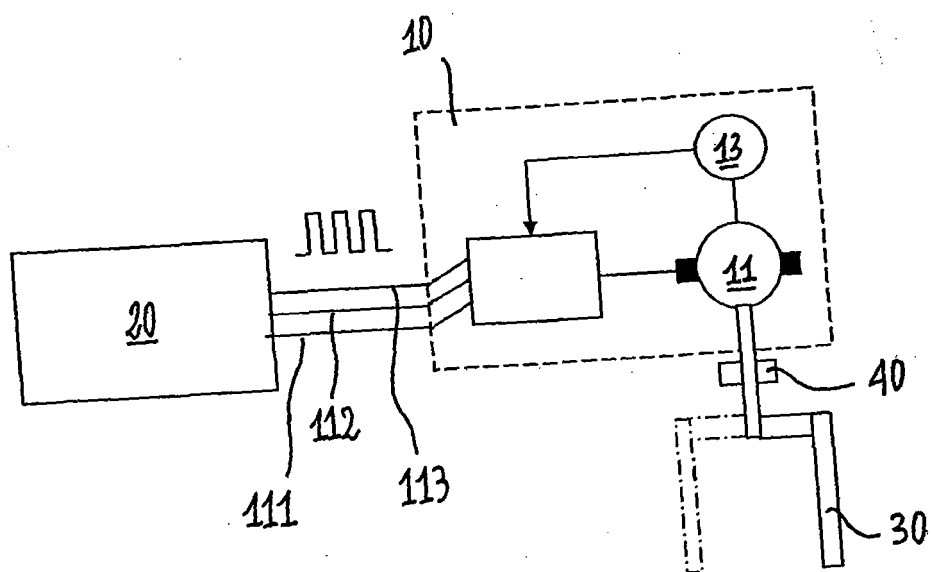
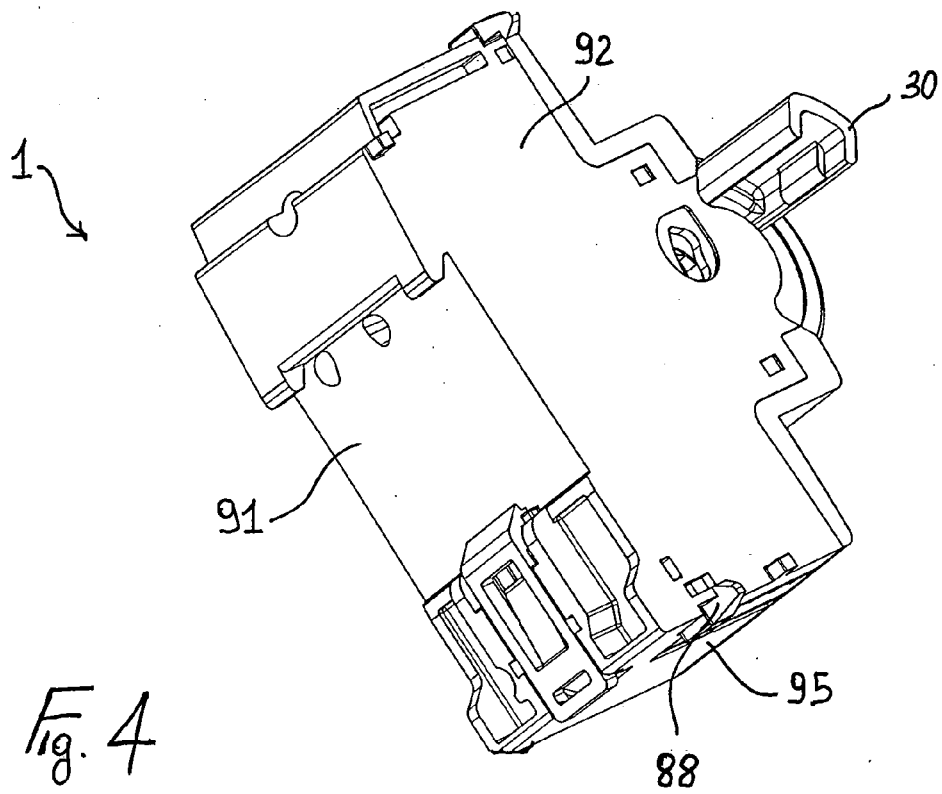
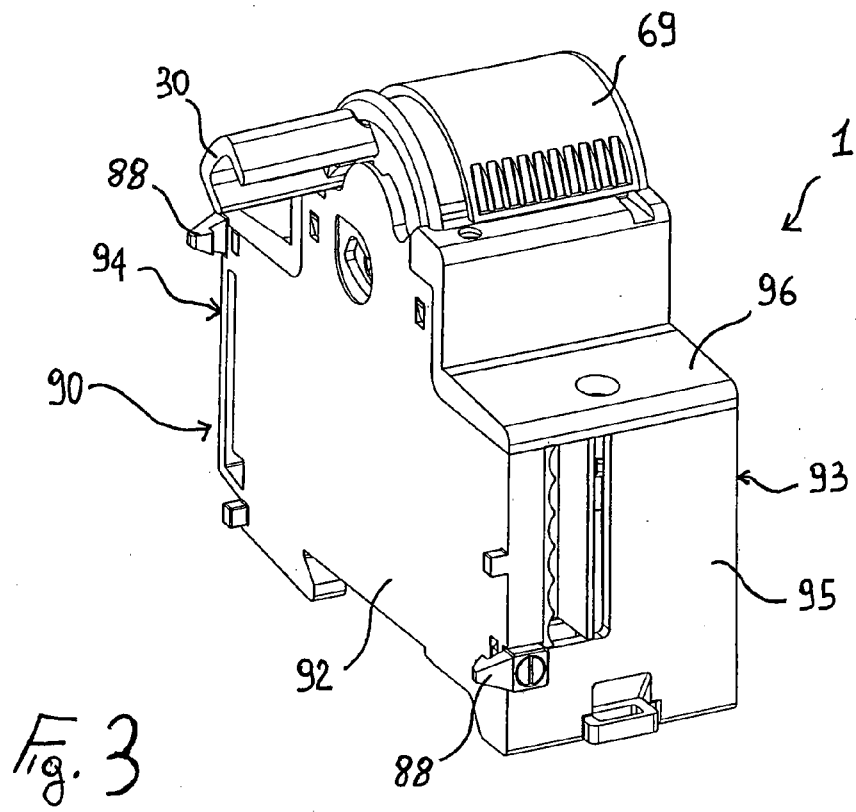
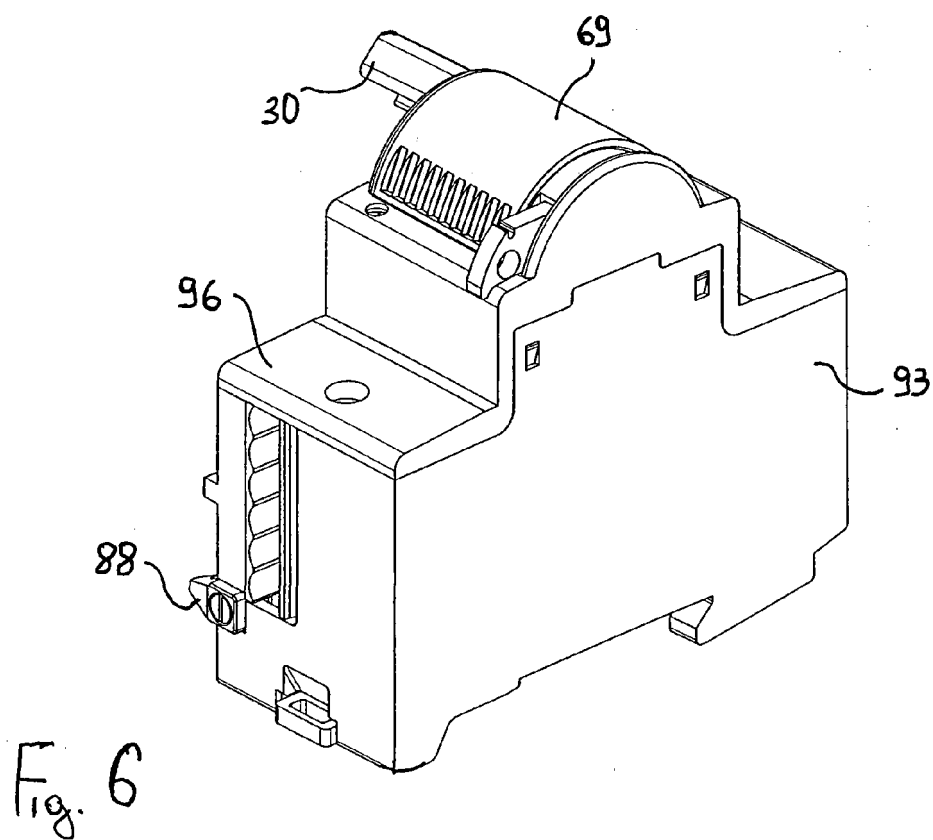
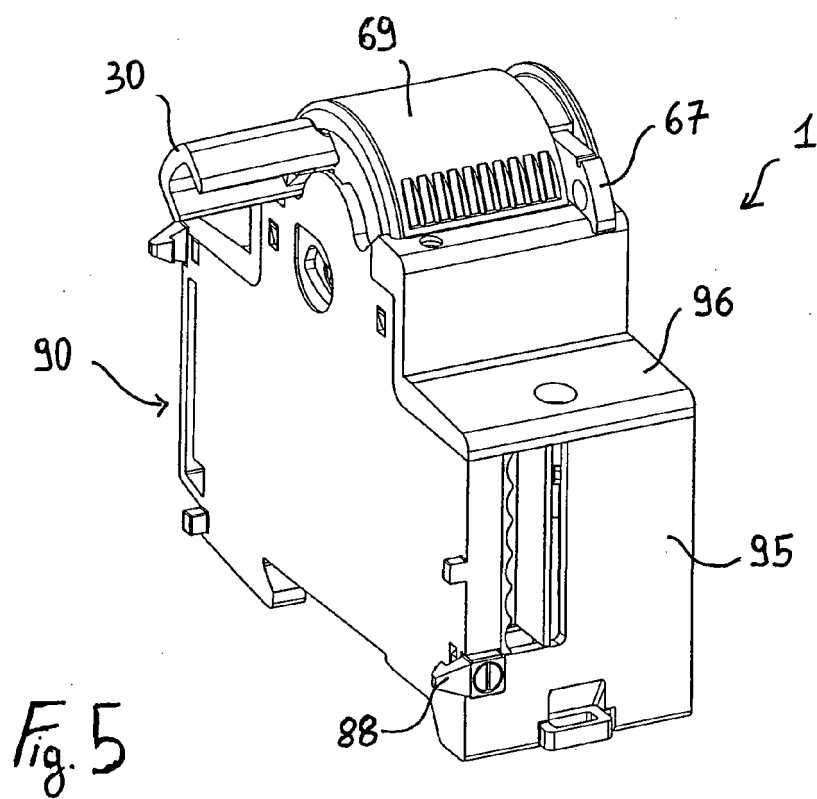


Fig. 2





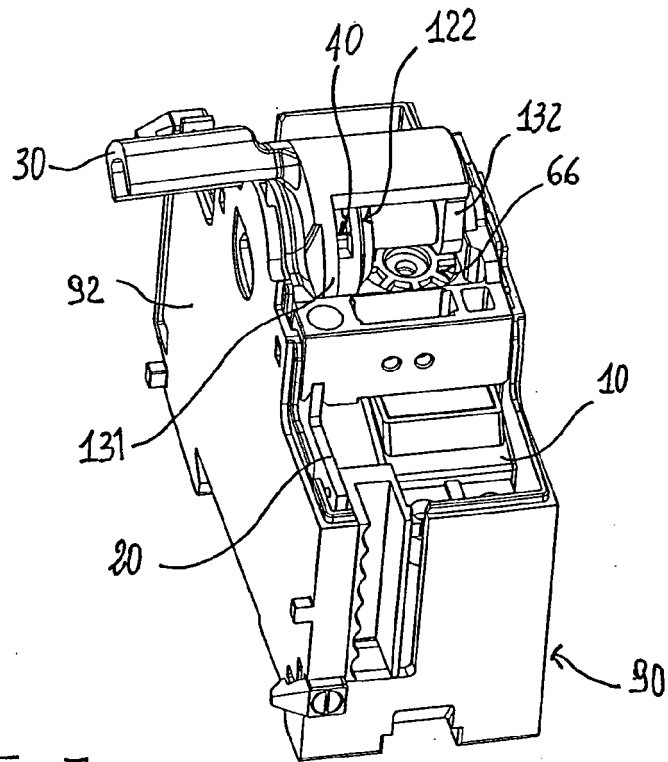


Fig. 7

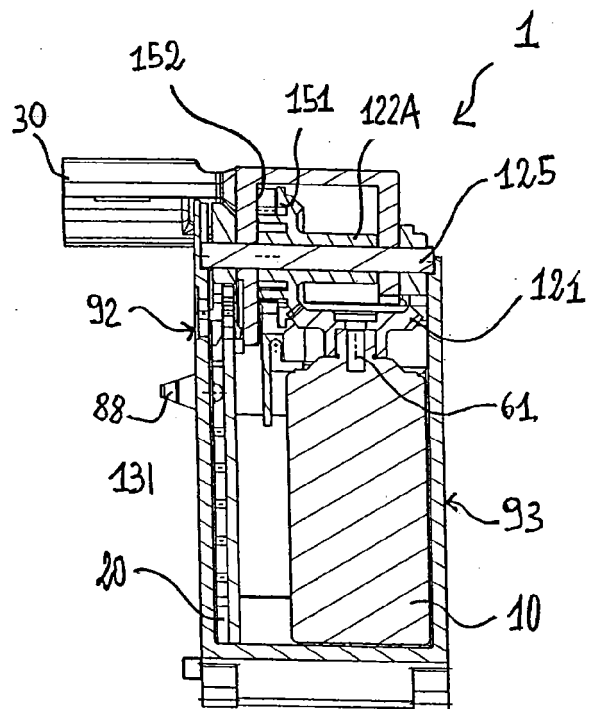


Fig. 8

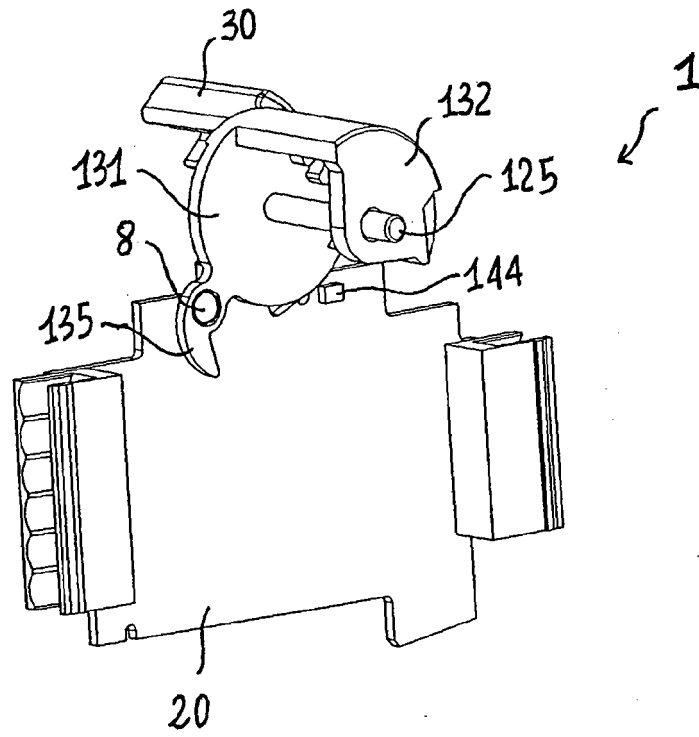


Fig. 9

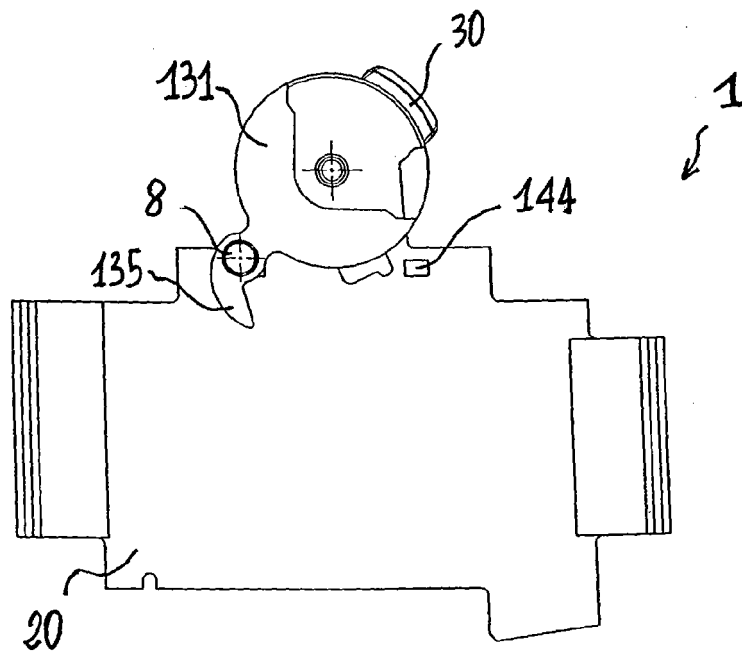


Fig. 10

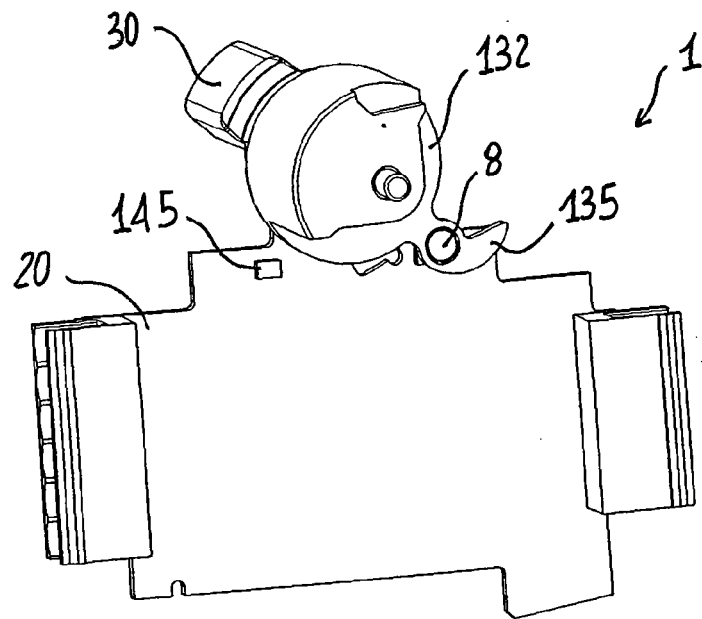


Fig. 11

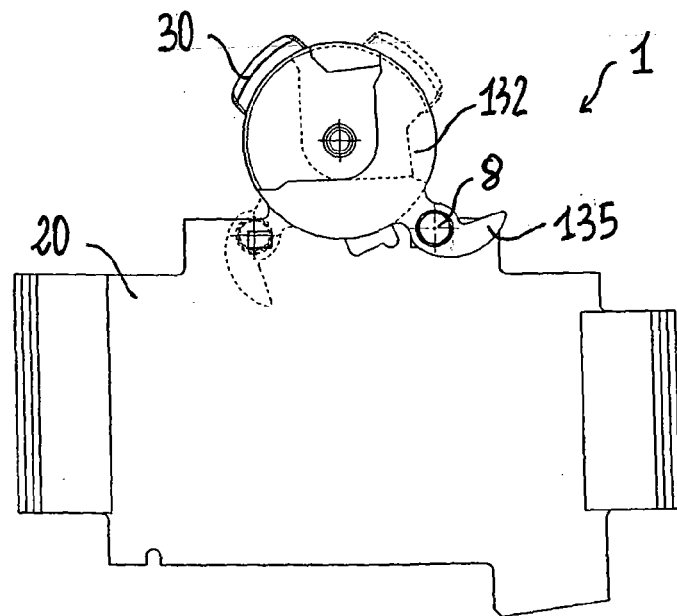


Fig. 12



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 07 10 8610

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 6 522 227 B1 (MODY HEMANT KUMAR [US] ET AL) 18 February 2003 (2003-02-18) * paragraph [0020]; figure 5 *	1,3,4, 11,14, 15,17	INV. H01H71/70
Y	----- US 2005/001700 A1 (LEWIS BLAIN [US]) 6 January 2005 (2005-01-06) * paragraph [0026] *	5,16	
Y	----- US 2005/001700 A1 (LEWIS BLAIN [US]) 6 January 2005 (2005-01-06) * paragraph [0026] *	5	
A	----- FR 2 731 107 A1 (ESTANG DU RUSQUEC GILLES DE L [FR]) 30 August 1996 (1996-08-30) * abstract; figure 6 *	2	
X	----- FR 2 731 107 A1 (ESTANG DU RUSQUEC GILLES DE L [FR]) 30 August 1996 (1996-08-30) * abstract; figure 6 *	1	
Y	----- EP 1 670 014 A (EATON CORP [US]) 14 June 2006 (2006-06-14) * the whole document *	16	
			TECHNICAL FIELDS SEARCHED (IPC)
			H01H
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		3 July 2007	Simonini, Stefano
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

- ☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

- ☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.
- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
- ☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1-5, 11, 14-17



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**LACK OF UNITY OF INVENTION
SHEET B**

Application Number
EP 07 10 8610

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-5,11,14-17

Invention 1 relates to constructive details of a power reset mechanism.

2. claims: 6-10

Invention 2 relates to details of the control system of the device.

3. claims: 12,13

Invention 3 relates to a lockout mechanism.

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 07 10 8610

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

03-07-2007

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6522227	B1	18-02-2003	DE 10244231 A1 10-04-2003
			JP 2003178664 A 27-06-2003
			US 2003058068 A1 27-03-2003
			US 2003090349 A1 15-05-2003
US 2005001700	A1	06-01-2005	NONE
FR 2731107	A1	30-08-1996	NONE
EP 1670014	A	14-06-2006	US 2006125582 A1 15-06-2006

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1487003 A [0005]