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(54) **Earthing switch device**

(57) The earthing switch device (1) comprises a frame (2) carrying, rotatably connected thereto, a knife (4) arranged to assume an operative position spaced from a fixed contact associable with a conductor, and a safety position connected between said fixed contact and

an earthing network. The knife (4) is connected to an automatic operating mechanism (8) arranged to move it from its operative position to its safety position when, during operation, a conductor connected to the fixed contact (6) assumes a dangerous voltage.

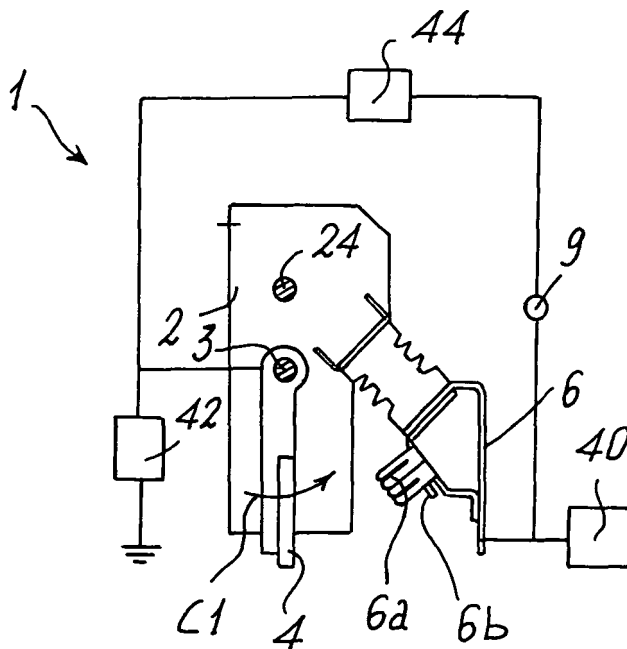


FIG. 2

EP 1 638 124 A1

Description

[0001] The present invention relates to an earthing switch device.

[0002] In particular, reference will be made hereinafter to switch devices of the type used in those places where, as the result of a fault or other problem, a conductor is able to assume voltages dangerous to man; in such cases the device is required to intervene to connect the conductor to an earthing system in order to limit risk to those persons who for work or other reasons lie in proximity to the conductor.

[0003] Such situations occur for example in the case of negative conductors of direct current installations, or of the neutral conductor of alternating current installations.

[0004] Devices for connecting a voltage-carrying conductor to the earthing system are currently of the "soule' switch" type, i.e. provided with a switch which at a predetermined voltage connects the conductor (negative or neutral) to the earthing system.

[0005] However this device presents the considerable drawback of not enabling the device to be reset to its operative configuration. Hence after the device has intervened to connect the conductor to earth, it remains closed and can be reset to its operative condition only by the action of an operator.

[0006] Moreover it is not possible to check visually that the "soule' switch" device has operated without endangering the safety of the operator.

[0007] Another type of device uses semiconductor elements to connect the conductor to earth.

[0008] This device can be reset to its operative configuration (if the installation is operating properly), but again it is not possible to see visually that the device has operated without endangering the safety of the operator. Another type of available device is the "Berlino" device, which however presents a very high intervention time and again cannot be visually seen to have operated.

[0009] Another type of available device uses varistors; however this presents low closure powers and again cannot be visually seen to have operated.

[0010] The technical aim of the present invention is therefore to provide an earthing switch device by which the stated drawbacks of the known art are eliminated.

[0011] Within the scope of this technical aim an object of the invention is to provide a device which can be reset to its operative configuration when the dangerous situation which has caused it to intervene has ceased.

[0012] In particular, the device of the invention can be automatically reset to its operative configuration.

[0013] Another object of the invention is to provide a device which can be seen visually to have operated (i.e. it enables the contact to be seen); this is very important to ensure operator safety.

[0014] Another object of the invention is to provide a device which presents intervention times compatible with the sector regulations; even this feature contribute to en-

sure operator safety.

[0015] A further object of the invention is to provide a device of very high closure power (up to the maximum short-circuiting values of known installations) and an opening power suitable for resetting the system even when stray currents of predetermined values are present.

[0016] The technical aim, together with these and further objects are attained according to the present invention by an earthing switch device in accordance with claim 1.

[0017] Other characteristics of the present invention are defined in the subsequent claims.

[0018] Advantageously, the device of the present invention presents an opening power suitable for systems of very different type and enables both the system closure and opening interventions to be adjusted; the device can also be provided with manual in addition to automatic control.

[0019] Further characteristics and advantages of the invention will be apparent from the description of a preferred but non-exclusive embodiment of the earthing switch device of the invention, illustrated by way of non-limiting example in the accompanying drawings, in which:

Figures 1 and 2 are respectively a schematic front and side view of the device of the invention, with the knife, connectable to the conductor to be maintained under control, shown in an operative position (i.e. separated from the respective fixed contact);

Figure 3 is an enlarged section taken on the line III-III of Figure 1, this section showing a manipulator unit in its operative configuration;

Figure 4 is an enlarged section taken on the line IV-IV of Figure 1, this section showing a control unit in its operative configuration;

Figures 5 and 6 are respectively a schematic front and side view of the device with the knife in a safety position (i.e. with the knife associated with the fixed contact);

Figure 7 is an enlarged section taken on the line VII-VII of Figure 5, this section showing a manipulator unit in its safety configuration;

Figure 8 is an enlarged section taken on the line VI-II-VIII of Figure 5, this section showing a control unit in its safety configuration.

[0020] Said figures show an earthing switch device indicated overall by the reference numeral 1.

[0021] The device 1 comprises a frame 2 carrying, rotatably connected thereto, a shaft 3 with which a knife 4 is rigid (in other embodiments of the invention the knives can be of a different number, for example two knives can be provided).

[0022] The knife 4 is movable and is intended to assume an operative position (shown in Figures 1-4) in which it is spaced from a fixed contact 6 (associated with a negative or neutral conductor, when the device is in-

stalled), and a safety position (shown in Figures 5-8) connected to the fixed contact 6 and to the earthing network.

[0023] The fixed contact 6 is of such shape and dimensions as to withstand high closure powers and is provided with a contact spring 6a and a damper 6b of elastic material to damp the closure blow, in order to protect the more fragile parts from breakage.

[0024] The knife 4 is connected to an automatic operating mechanism 8 (Figures 1 and 5), arranged to move it from its operative position (Figure 2) to its safety position (Figure 6) when a conductor 9 connected to the fixed contact 6 assumes a dangerous voltage during operation.

[0025] In particular, the operating mechanism 8 comprises a manipulator unit 11 connected to a release unit 12.

[0026] The manipulator unit 11 comprises an elastic element 14 (Figure 7) arranged to accumulate energy and to release it when commanded by the release unit 12.

[0027] The elastic element 14 stores (via the manipulator unit 11) energy during the operation of the outer shaft 24 rigid with the lever 23 which, by way of the coupling lever 21 pivoted on the pin 22, acts on the pin 20 fixed to the lever 18 which is pivoted on the shaft 3. The elastic element 14 is compressed between the fixed pin 17a and the movable pin 17b, this latter rigid with the lever 33 which, when in its final position (Figure 3), is retained by the coupling lever 31 pivoted on the pin 32.

[0028] The reaction of the elastic element 14 is therefore restrained by the coupling lever 31.

[0029] Figure 7 shows the initial movement position, in which the outer shaft 24 commences to rotate in the direction indicated by the arrow M1 and, by way of the lever 23 and lever 21, acts on the pin 20 to cause the lever 18 to rotate in the direction of the arrow M3.

[0030] The stroke of the lever 18 terminates when, by means of a return spring, the coupling lever 31 lies as a strut for the lever 33, so that when the elastic element 14 has been loaded, it cannot discharge its energy even by further rotating the lever 23 and hence removing the lever 21 from its position of thrust on the pin 20.

[0031] The final position is shown in Figure 3 in which the lever 33 can be seen maintained in position by the coupling lever 31, the elastic element 14 being shown with its energy stored and the lever 21, having terminated its loading task, no longer engaging the pin 20.

[0032] The release unit 12 (Figures 4 and 8) is formed as a coil with movable armature 38 which, when power ceases, rotates the lever 35 in the direction of the arrow F1 by means of a return spring.

[0033] Alternatively, the release unit 12 can also be formed as a coil with movable armature 38a which, when powered, rotates the lever 35 in the same direction as the arrow F1.

[0034] In Figure 4 the lever 36 rests against the lever 35 by means of a return spring. When the coil with movable armature 38 (or 38a) is activated, the lever 35 rotates in the direction of the arrow F1 to hence enable the lever

36 to rotate and during its travel drag the lever 34a rigid with the pin 32 which is rigid with the coupling lever 31. Hence activation of the coil with movable armature 38 (or 38a) releases the energy of the elastic element 14 which, no longer retained by the coupling lever 31, is able to rotate the shaft 3 rigid with the knife 4, which can hence engage the contact spring 6a and electrically connect the fixed contact to earth at 6.

[0035] Figure 3 shows the coupling of the lever 31 to the lever 33, while Figure 8 shows the effected release of the release unit 12.

[0036] The release operation can also be effected manually without activating the coil with movable armature 38 (or 38a). This is achieved by rotating the outer shaft 24 to rotate the lever 23 which, at the end of the slot 25, moves the pin 28 rigid with the lever 29 which in its turn acts on the coupling lever 31 via the pin 30.

[0037] The device for opening under load is in the form of the knife 4 which, when in its safety position, engages the contact spring (of the fixed contact 6) to connect to earth the conductor fixed to the fixed contact 6. Electrically connected to the knife 4 there is also a spring mechanism (not shown) which during the slow opening operation by the motor 41, or by manual action, remains mechanically engaged with the fixed contact 6 until the knife 4 is almost completely opened. Said spring mechanism is released at this point from its mechanical coupling position and returns to its rest position parallel to the contact spring 6a (of the fixed contact 6) to hence interrupt electrical connection and return the device to its operative configuration.

[0038] Advantageously, the device 1 comprises a first sensor 40 (Figures 4 and 8) to sense a dangerous situation and consequently activate the release unit 11; the first sensor 40 preferably comprises a voltage relay arranged to sense dangerous voltages and emit a closure signal for the device 1 (via the electromagnet 38 or 38a).

[0039] The device also comprises a motor 41 connected to the manipulator unit 11 for its operation.

[0040] The device also comprises a second sensor 42 arranged to sense that the dangerous situation has ceased and to cause the motor 41 to return the knife 4 from the safety position to the operative position; the second sensor 42 comprises a current relay.

[0041] In addition, in a preferred embodiment the device 1 also comprises a semiconductor element or varistor 44 connected in parallel with the device 1, to limit the voltage peaks to non-dangerous values until the device 1 is closed.

[0042] The operation of the earthing switch device 1 of the invention is apparent from that described and illustrated and is substantially as follows.

[0043] During the operation of the electrical system the device 1 is in the configuration shown in Figure 2, i.e. the device is open and the conductor 9 (neutral or negative respectively) is isolated from earth.

[0044] When a dangerous situation occurs and the conductor 9 (neutral or negative) under control assumes

a dangerous voltage, the voltage relay 40 generates a signal which causes interruption of power to the electromagnet 38.

[0045] This causes the spring to pull one end of the lever 35 which rotates as indicated by the arrow F1; the lever 36, the end of which has been freed from the obstacle caused by the lever 35, also rotates as indicated by the arrow F2.

[0046] This also causes the lever 34a and hence the coupling lever 31 to also rotate, as indicated by the arrow F3.

[0047] The end 33 of the lever 18 is hence freed and the lever 18 can rotate as indicated by the arrows F4 to enable the spring 14 to rapidly release the stored energy; this causes rapid rotation of the shaft 3 and hence rapid closure of the knife 4 which moves into contact with the fixed contact 6, to put the neutral or negative conductor on which the anomaly has been detected into a safety state.

[0048] The rotation of the lever 23 also causes the lever 21 to rotate into the position indicated in Figure 3.

[0049] Subsequently when the current relay 42 senses that the anomaly is no longer present, it operates the motor 41 to again separate the knife 4 from the fixed contact 6 of the device 1 and return this latter into its operative configuration.

[0050] The device 1 can also be returned from its safety position to its operative position manually by acting on the shaft 24 (for example by means of a crank).

[0051] The described device requires a certain time to pass from the operative position to the safety position. In the case of faults with very high voltages this time could be insufficient to ensure human safety.

[0052] Consequently it is an advantage to connect in parallel with the device 1 one or more semiconductors, or one or more varistors, or one or more voltage dischargers, i.e. means which, when determined dangerous voltages appear, maintain the circuit in a safety state for the time necessary for the device to close.

[0053] The earthing switch device conceived in this manner is susceptible to numerous modifications and variants, all falling within the scope of the inventive concept; moreover all details can be replaced by technically equivalent elements.

[0054] In practice the materials used, and dimensions, can be chosen at will according to requirements and to the state of the art.

Claims

1. An earthing switch device (1), **characterised by** comprising a frame (2) carrying, rotatably connected thereto, at least one knife (4) arranged to assume an operative position in which it is spaced from a fixed contact (6) associable with a conductor, and a safety position in which the knife (4) is connected between said fixed contact (6) and an earthing net-

work, said knife (4) being connected to an automatic operating mechanism (8) arranged to move it from said operative position to said safety position when, during operation, a conductor (9) connected to said fixed contact (6) assumes a dangerous voltage.

2. A device (1) as claimed in claim 1, **characterised in that** said automatic operating mechanism (8) comprises a manipulator unit (11) connected to a release unit (12).

3. A device (1) as claimed in one or more of the preceding claims, **characterised in that** said manipulator unit (11) comprises at least one elastic element (14) arranged to store energy and to release it when commanded by said release unit (12).

4. A device (1) as claimed in one or more of the preceding claims, **characterised in that** said manipulator unit (11) is arranged to load said elastic element (14) in order to store energy, when said at least one knife (4) is moved from said safety position to said operative position.

5. A device (1) as claimed in one or more of the preceding claims, **characterised in that** said elastic element (14) comprises a torsion spring or traction spring or compression spring.

6. A device (1) as claimed in one or more of the preceding claims, **characterised by** comprising an electromechanical element (38, 38a) driving said lever (35).

7. A device (1) as claimed in one or more of the preceding claims, **characterised by** comprising a first sensor (40) arranged to sense a dangerous situation and to activate said release unit (12).

8. A device (1) as claimed in one or more of the preceding claims, **characterised in that** said first sensor (40) comprises a voltage relay arranged to sense dangerous voltages and to emit a closure signal for said device (1).

9. A device (1) as claimed in one or more of the preceding claims, **characterised by** comprising a motor (41) connected to said at least one knife (4), for its manipulation.

10. A device (1) as claimed in one or more of the preceding claims, **characterised by** comprising a second sensor (42) arranged to sense that the dangerous situation has ceased and to cause said motor (41) to return said knife (4) from said safety position to said operative position.

11. A device (1) as claimed in one or more of the pre-

ceding claims, **characterised in that** said sensor (42) comprises a current relay.

- 12.** A device (1) as claimed in one or more of the preceding claims, **characterised by** comprising a semiconductor element or varistor (44) connected in parallel with said device to limit the voltage peaks to non-dangerous values until the closure of said device.

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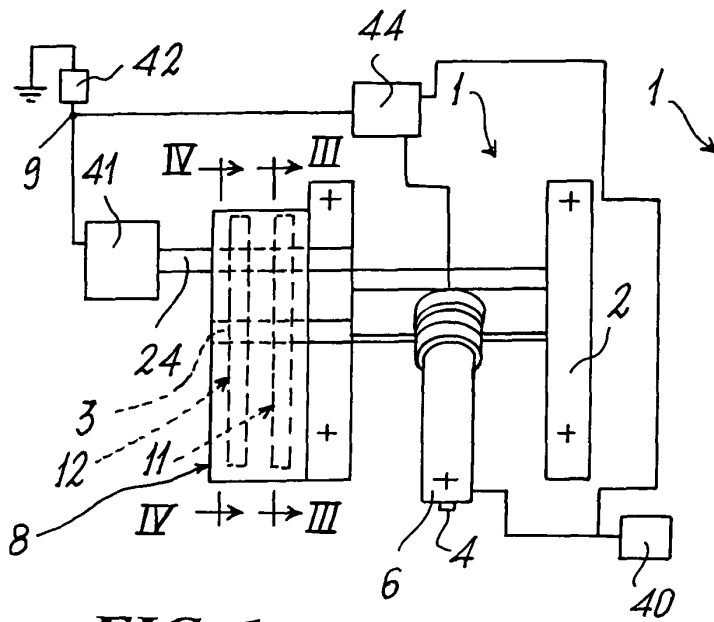


FIG. 1

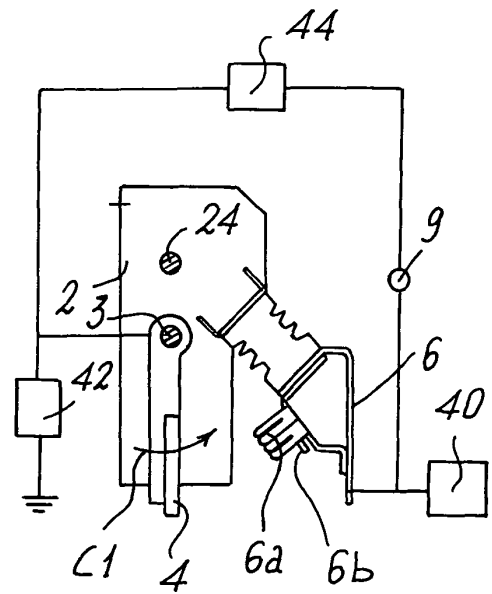


FIG. 2

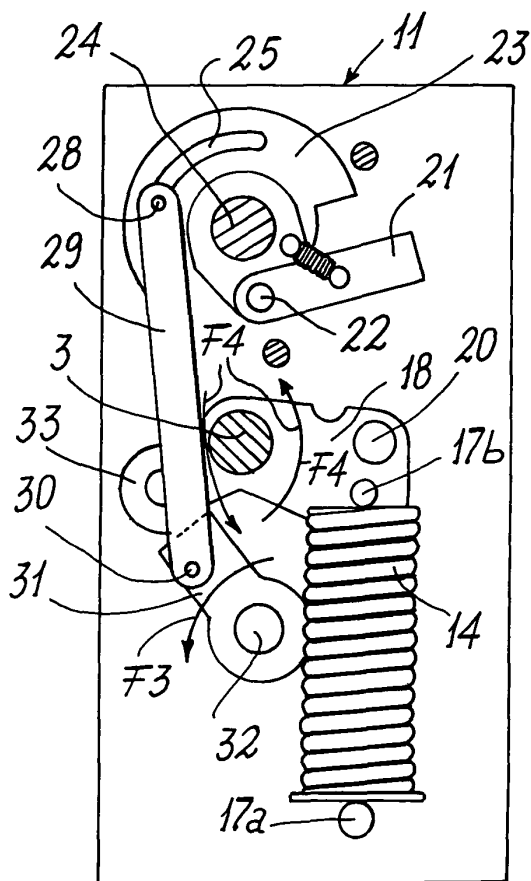


FIG. 3

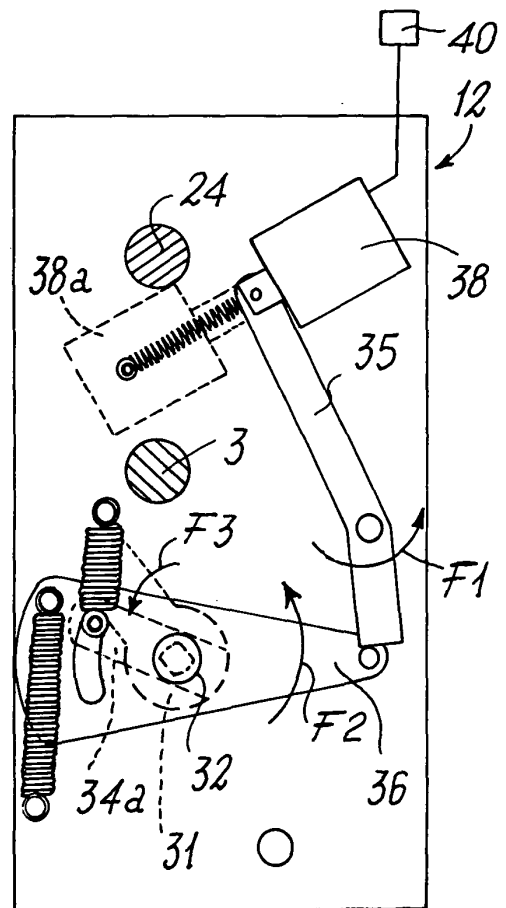


FIG. 4

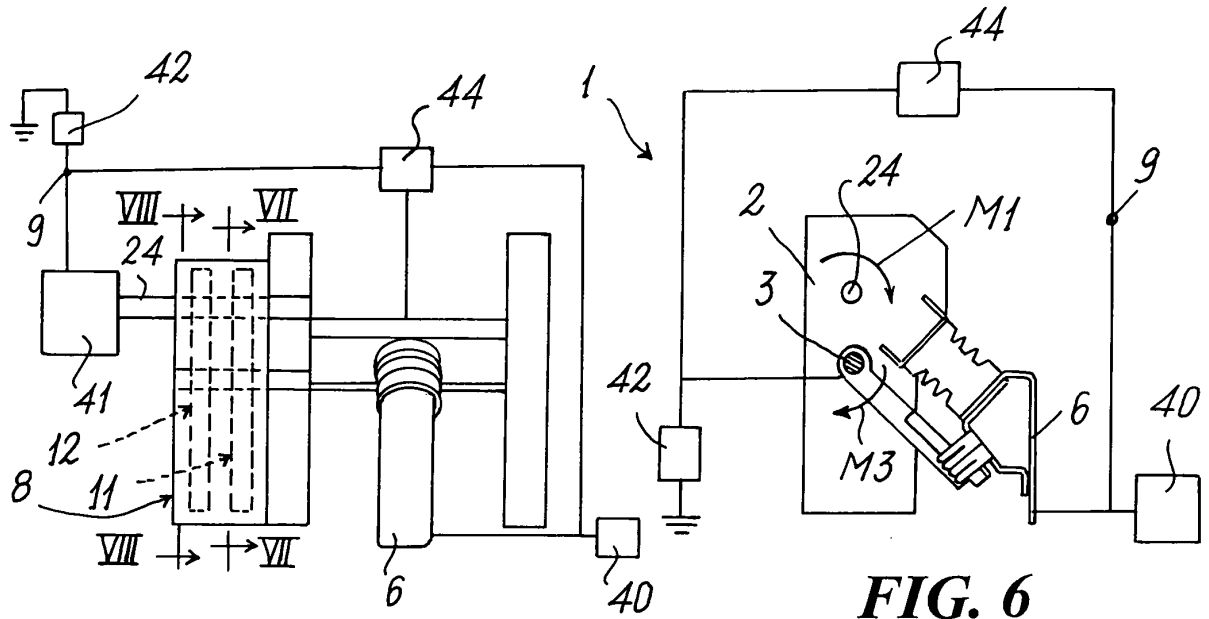


FIG. 5

FIG. 6

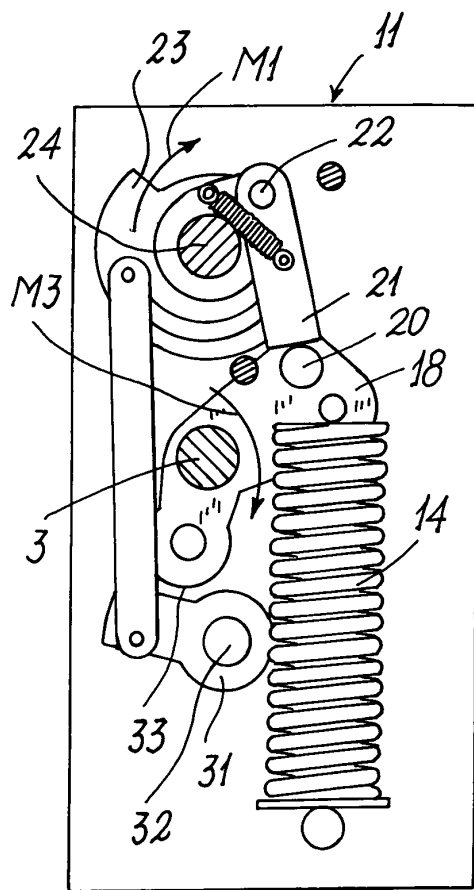


FIG. 7

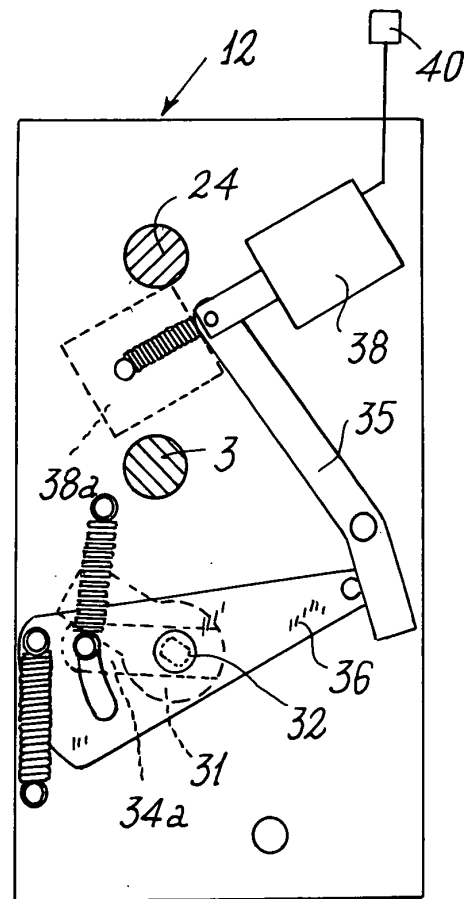


FIG. 8



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EUROPEAN SEARCH REPORT

Application Number
EP 04 02 2004

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			H01H
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 18 January 2005	Examiner Simonini, S
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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