



(11) **EP 4 109 486 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention  
of the grant of the patent:

**18.12.2024 Bulletin 2024/51**

(51) International Patent Classification (IPC):

**H01H 9/10** <sup>(2006.01)</sup> **H01H 33/666** <sup>(2006.01)</sup>  
**H01H 85/20** <sup>(2006.01)</sup> **H01H 85/54** <sup>(2006.01)</sup>  
**H01H 71/10** <sup>(2006.01)</sup>

(21) Application number: **21756447.5**

(52) Cooperative Patent Classification (CPC):

**H01H 9/10; H01H 85/20; H01H 33/666;**  
**H01H 2071/088; H01H 2085/2055; H01H 2300/03**

(22) Date of filing: **18.02.2021**

(86) International application number:

**PCT/ES2021/070119**

(87) International publication number:

**WO 2021/165561 (26.08.2021 Gazette 2021/34)**

(54) **SAFETY DEVICE AND THREE-POLE BASE**

SICHERHEITSVORRICHTUNG UND DREIPOLIGER SOCKEL

DISPOSITIF DE SÉCURITÉ ET BASE TRIPOLAIRE

(84) Designated Contracting States:

**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB**  
**GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO**  
**PL PT RO RS SE SI SK SM TR**

(74) Representative: **Curell Suñol S.L.P.**

**Muntaner 240, 4<sup>o</sup> 2<sup>a</sup>**  
**08021 Barcelona (ES)**

(30) Priority: **19.02.2020 ES 202030275 U**

(56) References cited:

**EP-A1- 0 387 635 EP-A2- 1 739 701**  
**WO-A1-2015/060016 WO-A1-2016/042290**  
**WO-A1-2019/025438 WO-A1-2020/109640**  
**CA-A- 1 074 372 CN-A- 112 768 317**  
**ES-U- 1 192 559 ES-U- 1 231 820**  
**ES-U- 1 231 820 US-A- 4 240 122**  
**US-A- 4 240 122 US-A- 5 594 610**  
**US-A- 5 594 610 US-A1- 2002 066 655**  
**US-A1- 2002 066 655 US-A1- 2006 028 073**

(43) Date of publication of application:  
**28.12.2022 Bulletin 2022/52**

(73) Proprietor: **TALLERES ELECTROMECÁNICOS L.**  
**PINAZO S.A.**  
**28110 Algete Madrid (ES)**

(72) Inventor: **PAUNERO QUIJADA, Pablo**  
**28028 Madrid (ES)**

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

**EP 4 109 486 B1**

## Description

### Field of the Invention

**[0001]** The invention is comprised in the field of electrical installations, particularly in the field of electric distribution panels comprising three-pole fuse bases.

**[0002]** More specifically, the invention relates to an electrical safety device configured for being installed in a three-pole fuse base, comprising two terminals between which there is defined an electrical branch, said branch being provided with a fuse configured for cutting off the passage of electric current in said branch in the case of blowing a fuse.

**[0003]** The invention also relates to a corresponding three-pole fuse base.

### State of the Art

**[0004]** In the field of electrical installations, the use of fuses intended for blowing when the intensity of the current exceeds a threshold, thereby cutting off the passage of current, is common. This blowing is generally not instantaneous, but rather requires said threshold to be exceeded for a given time window. Therefore, by selecting fuses with the appropriate characteristics, it is possible to create safety elements which impede the circulation of currents which are too high and could cause damage or accidents downstream. Particularly, in the field of low-voltage installations, three-pole fuse bases in which three of said fuses are inserted are used.

**[0005]** Devices of this type present an enhanced safety, given that they represent a physical cut-off in situations of excessive current. However, they have the drawback of having to replace the fuse, once blown, with a new one, which increases maintenance costs. Furthermore, in cases in which it is necessary to cut off the electrical power to perform operations with the lines, an operator must physically remove the fuse in order to thereby cut off the passage of current.

**[0006]** For these reasons, alternative solutions to fuses, for example breakers, have also emerged. These devices are calibrated to cut off the current under specific conditions, usually by means of bimetal strips. They have the advantage of allowing a resetting after a cut-off, generally by means of a manual actuator, or else by means of a motorized remote control, which largely reduces maintenance costs in comparison with fuses.

**[0007]** However, both devices based on fuses and devices based on breakers have the drawback of the difficulty in adapting the same device for different current cut-off situations. Furthermore, the usual breakers are not particularly suited to the voltage and current conditions in low-voltage installation distribution centers. Particularly, the safety level offered by said breakers can be lower than that offered by fuses.

**[0008]** Accordingly, an electrical safety device which allows a high safety level and which, at the same time,

lowers maintenance costs and provides flexibility in terms of the selection of the line cut-off criteria, is advisable.

**[0009]** WO 2016/042290 A1 discloses a current management device that includes a circuit breaker connected to a coupling assembly that connects terminals of a fuse unit to the circuit breaker. The coupling assembly includes a fuse, or connecting bar, which can be removably supported within the coupling assembly and provides an electrical path for current flow through the coupling assembly and circuit breaker. The circuit breaker is connected to a remote SCADA system which allows for remote operation of the device. As the switching device can be operated remotely, the current management device of the present invention therefore provides a remotely operated device that can be installed in the space of a conventional fuse. This reduces supply management time as it can be reset remotely. The provision of a fuse in series increases high current breaking capability. The current management device can be permanently installed or can be installed for a short period of time to assist in maintain supplies until a fault is located. Down time is minimised in a conventionally managed network and facilitates migration to a smart network, and there is increased operator safety through manually independent and/or remote switching. In addition, it can be installed on a selective basis in existing or new equipment. The document discloses all the features of the preamble of claim 1.

### Description of the Invention

**[0010]** The purpose of the invention is to provide an electrical safety device of the type indicated above, which allows the problems set forth above to be overcome.

**[0011]** This purpose is achieved by means of an electrical safety device according to claim 1. This electrical safety device is of the type indicated above and further comprises:

- a switch element, provided in said branch and connected in series with said fuse, said switch element having a closed state in which it allows the passage of electric current, and an open state in which it impedes the passage of electric current;
- a manual actuator configured for moving said switch element from said closed state to said open state and vice versa;
- measuring means configured for measuring at least one operational parameter of said safety device; and
- a control module configured for disabling in the event that said at least one operational parameter meets a predetermined condition, wherein said disabling comprises acting on said switch element in order to move said switch element from said closed state to said open state.

**[0012]** The switch element and the fuse are thereby connected in series. Therefore, the switch element acts

as a first cut-off line, whereas the fuse provides added safety: even if the switch should fail, if the current is excessive, the fuse will perform its function and cut off the line. In turn, disabling of the switch element is controlled by means of the control module, which allows one and the same device to be used for different predetermined conditions, for example, different current thresholds, temperature thresholds, etc. Said predetermined condition is based on an operational parameter measured in the device itself by the measuring means. Accordingly, under normal operation, the line is cut off by means of the switch element, based on a predetermined condition which can be adapted to each installation, thereby providing flexibility to the device. Given that in this normal operation there is no blowing of the fuse, it is not necessary to replace said fuse in the event of a cut-off, thereby minimizing maintenance costs. Nor is it necessary for an operator to remove the fuse in order to cut off the line, given that the manual actuator allows this operation by acting on the switch element.

**[0013]** Moreover, should any element, for example, the switch element or the control module, fail and the line is not cut off, the fuse provided in the device will blow. The safety level of the device is thereby equivalent to that of fuses used in the art, but with the incorporation of the technical advantages described above during normal operation.

**[0014]** Preferably, said control module is further configured for resetting, where said resetting comprises acting on said switch element in order to move said switch element from said open state to said closed state, which allows the possibility of resetting the device again without the need for an operator to physically go to the location where the device is used for resetting by operating said manual actuator.

**[0015]** Preferably, said control module is further configured for starting said resetting when a predetermined resetting time has elapsed since said disabling. This allows automatic resetting once a predetermined time has elapsed, providing the device with autonomy, allowing, in an autonomous manner, the device to be reset and allow the passage of current through the line without needing the intervention of an operator. This type of functionality is particularly advantageous in situations such as those in which current peaks, for example, due to lightning striking, take place.

**[0016]** Preferably, said control module is further configured for retrying at least once in the event that a disabling takes place immediately after said resetting, thereby increasing the autonomy of the device with respect to the resetting. Preferably, the total number of retries is limited to a predetermined value of retries, such that retries are not performed if the conditions triggering the line being cut off are maintained for a prolonged period, which generally implies that it is not an isolated problem.

**[0017]** Preferably, said operational parameters comprise an electric current measurement in said branch, and said predetermined condition comprises at least one

of the conditions where:

- said electric current measurement exceeds a threshold current; and
- said electric current measurement exceeds a threshold current for the duration of a threshold time.

**[0018]** The first condition is met when a current threshold value is exceeded, whereas the second condition requires a threshold current to be exceeded for a time window. Both threshold currents can be different. The device can thereby be disabled in the case of isolated current peaks and/or when there is a prolonged increase in current. Preferably, for the second condition, said threshold time depends on said threshold current, such that the higher the threshold current is, the lower the threshold time is.

**[0019]** Preferably, said measuring means comprise a first toroidal current transformer arranged surrounding an electrical conductor of said branch. This allows a current measurement to be taken on the current circulating through the branch through the current induced in said toroidal transformer. The measurement does not need any bypass circuit of the branch itself, nor does it require other elements to be placed in series. Furthermore, the current in the measuring circuit is isolated from the current circulating through the branch, which improves safety and particularly minimizes the risk of an excessive current being able to cause damage in the measuring means.

**[0020]** Preferably, said device further comprises a second toroidal current transformer configured for electrically powering said control module, such that external power supply for the device is not needed. Furthermore, similarly to case of the measurement through the first toroidal transformer, the supply circuit emerging from the second toroidal transformer to supply power to the device is electrically isolated from the main branch, thereby increasing device safety and robustness.

**[0021]** Preferably, said operational parameters further comprise at least one of:

- a temperature measurement;
- a current measurement; and
- a voltage measurement.

**[0022]** This allows said predetermined condition to be adapted to the physical and operating conditions in which the device can be found, which represents an increased safety and greater flexibility in determining when the device should be disabled, it even being possible for the predetermined condition to combine several of said measurements, which would be impossible in devices known in the art at present.

**[0023]** Preferably, said control module further comprises remote connection means configured for at least one of:

- sending said operational parameters; and
- receiving commands.

**[0024]** It is thereby possible to remotely monitor the operation of the device and/or to remotely send orders to the control module for said module to perform specific actions. This increases safety and facilitates equipment maintenance, potentially minimizing the cost of said maintenance or minimizing the time needed for maintenance operations.

**[0025]** Preferably, said commands comprise at least one of:

- an order for configuration;
- an order for starting said disabling; and
- an order for starting said resetting;

wherein said order for starting said resetting preferably comprises said predetermined value of retries. It is thereby possible to remotely configure the device and/or to remotely disable and/or to remotely reset after a disabling. Each of the aforementioned commands has different technical advantages. In that sense, the command for configuration allows the safety device to modify the operation thereof, for example, to modify the threshold current or time, or said predetermined condition. The order for disabling allows the device to be disconnected remotely if needed, for example, when technical actions must be performed in an area which require the absence of electric current for safety reasons. Lastly, the order for resetting allows the recovery of the device remotely, for example, after concluding the aforementioned technical actions. In any of the cases, the command is sent remotely, which facilitates centralizing the management of several devices, for example, in different geographical areas. This centralization has the additional advantage that, with a human team minimized in terms of the amount of personnel, a plurality of sites can be managed. Furthermore, this dedicated team can receive specialized training which would be very difficult to impart to the entire team of operators who generally act on equipment with fuse bases.

**[0026]** Preferably, said order for configuration comprises at least one of:

- an order for modifying said predetermined condition, which allows the conditions in which the device must be disabled automatically to be modified;
- an order for modifying said predetermined resetting time, which allows the automatic resetting to be re-programmed in order to increase or decrease the necessary time; and
- an order for modifying said predetermined value of resetting retries, which allows the device to be adapted to different conditions.

**[0027]** The orders for configuration furthermore allow the remote and preferably centralized modification of pa-

rameters such as those herein set forth. This has the additional advantage that should it be necessary to comply with different regulations over time, it is not necessary to physically act on or replace the device, but rather simply send the corresponding orders for remote configuration.

**[0028]** Said switch element comprises a vacuum interrupter of the type comprising:

- a bottle in which two electrical contacts are provided arranged in a vacuum medium;
- a first fixed terminal, attached to a first fixed rod, which communicates with the interior of said bottle and is attached to one of said electrical contacts;
- a second mobile terminal, attached to a second mobile rod, which communicates with the interior of said bottle and is attached to the other one of said electrical contacts;

wherein said second terminal is movable in a direction perpendicular to said bottle between a proximal position, in which said electrical contacts are in contact and said vacuum interrupter is in said closed state, and a distal position, in which said electrical contacts are separated and said vacuum interrupter is in said open state.

**[0029]** Vacuum interrupters, sometimes called vacuum bottles, are elements that have frequently been used in medium- or high-voltage applications. However, their use in low-voltage applications with high current intensities, as in the case of the three-pole fuse bases, is unknown. Therefore, an object of the invention relates to the use of vacuum interrupters as a switch element for electrical safety devices configured for installation in three-pole bases. This type of switch has the advantage that the distance that the elements thereof must move for opening and closing the passage of current is very short in comparison with switches of another type, such as breakers based on bimetal strips. The reason is the high electric strength of the vacuum inside the bottle, which minimizes the occurrence of electric arcs. This short distance allows the resulting safety device to not require large mechanical movements either and the operating time of vacuum interrupters to be very rapid in comparison with other known alternatives. Other additional advantages of vacuum interrupters in comparison to other switches known for low-voltage environments consist of said interrupters having a lower weight and cost, requiring less maintenance, and having a longer service life.

**[0030]** Said device further comprises a controllable actuator configured for moving said second terminal from said proximal position to said distal position or vice versa; wherein said control module is configured for acting on said switch element by means of said controllable actuator. The vacuum interrupter requires mechanical action on its second mobile terminal to move same to the open or closed position. The use of a controllable actuator allows this mechanical action to be performed, whereas

the control electronics of the control module is in charge of determining when said action is necessary.

**[0031]** Said controllable actuator comprises:

- a rocker lever configured for rocking about a rocking shaft between a first rocking position and a second rocking position, said lever having a first segment on a first side of the shaft and a second segment on a second side of the shaft, opposite said first side;
- operating means configured for acting on said lever from said second segment for moving said lever between said first rocking position and said second rocking position and vice versa;
- securing means arranged in said first segment and configured for securing said lever to said second mobile terminal, such that in said first rocking position, said second terminal is in said proximal position, and in said second rocking position, said second terminal is in said distal position; and
- locking means configured for locking said second terminal in said proximal position when said lever is in said first rocking position.

**[0032]** The lever rocks about a shaft, and the operating means move said lever from one of the sides of the shaft. The skilled person will understand that the terms "first segment" and "second segment" are interchangeable in an equivalent manner. The same applies for "first side" and "second side". In that sense, when the operating means move the lever from a segment in one direction, said lever performs a see-saw movement about the shaft, moving the other segment of the lever in the opposite direction. The securing means secure the second mobile terminal, which allows the movement applied from the operating means to correspond to a movement of the second terminal from its proximal position to its distal position, or vice versa. It is thereby possible to cause the vacuum interrupter to move from the closed state to the open state, or vice versa. In the first rocking position, the second terminal is in the proximal position and the vacuum interrupter is in the closed state, whereas, in the second rocking position, the second terminal is in the distal position and the vacuum interrupter is in the open state. The arrangement by means of the rocker lever likewise allows the operating means to be arranged parallel to the bottle, which provides flexibility to the design of the device, particularly so that it can be used in three-pole fuse bases. Lastly, the function of the locking means is to impede the vacuum interrupter from unexpectedly opening, by means of locking the terminal in its proximal position. Indeed, in cases such as, for example, when there is an isolated current peak, a force that tends to separate the electrical contacts inside the bottle of the vacuum interrupter can be induced. If the separation is sufficiently rapid and the distance is large, the main effect is the disabling of the vacuum interrupter. However, in other cases, there can be overheating and said electrical contacts can even melt. These effects make it necessary

to later replace the damaged device and can even cause situations of risk. The locking means overcome these problems given that they impede the electrical connectors from moving away from one another as they impede movement of the second terminal.

**[0033]** Preferably, said operating means comprise at least one electromagnet. Each electromagnet is controlled by the control means to impart movement on one side of the lever. This solution does not need supplementary mobile parts such as gears, motors, etc., whereby the reliability and service life are high. Preferably, two electromagnets are arranged separated by an access space, which facilitates the assembly of the device. Particularly, the first terminal of the vacuum interrupter can be connected to one of the bars of a three-pole fuse base provided on the bottom of said base, which would make the assembly of the device on said base difficult were it not for said access space. Preferably, the lever is a planar part with a C-shaped side in which each end is operated by one of said electromagnets and the inner space leaves said access space free.

**[0034]** Preferably, each of said at least one electromagnet is further provided with a permanent magnet configured for maintaining the position of said rocker lever in the event of losing electrical power in said electromagnet. The electromagnet thereby only needs to be operated when the lever needs to be moved to one rocking position or the other. This lowers the power consumption of the device and prolongs its service life.

**[0035]** Preferably, said manual actuator comprises:

- an actuator rod arranged in a parallel direction with respect to said second mobile terminal of said vacuum interrupter and movable in said parallel direction, having a distal end relative to said vacuum interrupter and a proximal end relative to said vacuum interrupter;
- a push button secured to said actuator rod at said distal end;

said proximal end being assembled secured to said first segment of said rocker lever, such that a movement of said manual actuator moves said lever and vice versa. The manual actuator thereby benefits from the arrangement of the elements of the controllable actuator: both are interconnected and the actuation of one affects the other, or vice versa. The effect is that by means of both manual actuation and an actuation controlled by the control means, it is possible to open and close the switch. Preferably, said manual actuator also comprises a safe configured for impeding a movement of said manual actuator which involves a movement of said lever from said second rocking position to said first rocking position. This allows an operator to be able to use said safe for locking the device, for example, in the event that actions need to be performed on the installation: the operator moves the manual actuator, thereby moving the lever to its second rocking position and opening the switch, which cuts

off the supply in the corresponding electrical branch. Next, the operator uses the safe to lock the device in the open position, thereby ensuring that it cannot accidentally return to the closed position.

**[0036]** Preferably, said securing means comprise:

- a bushing integral with said rocker lever, provided with a central through hole which said second terminal goes through and with lateral holes; and
- a pin arranged going through said second terminal and extending perpendicular thereto and parallel to said rocking shaft, going through said lateral holes.

**[0037]** The central through hole is configured with sufficient clearance so as to allow the second terminal to pass therethrough both in the first rocking position and in the second rocking position. By way of preferred example, with a second cylindrical terminal, the central through hole has an oval shape with a minor axis parallel to the rocking shaft and a major axis perpendicular thereto. A similar consideration applies for the lateral holes and the pin. These configurations with the bushing and pin allow the rocking movement of the lever to be converted into a linear movement transmitted to the second terminal, which is needed for moving said terminal between its proximal and distal positions.

**[0038]** Preferably, said locking means comprise:

- a mobile part comprising a body provided with a catch on a first side of the body, said mobile part being arranged so as to be movable along a straight line which is perpendicular to said second terminal and to said rocking shaft, between a locking position and a release position, or vice versa;
- a spring attached to said mobile part on a second side of the body opposite said first side of the body; and
- a locking hole provided in said bushing and facing said catch in said first rocking position;

said locking means configured such that in said first rocking position, when said mobile part is in said locking position, said catch is introduced into said locking hole, and said spring is in a working position; and such that in said release position, said catch is removed from said locking hole, and said spring is in a standby position; wherein said body further comprises an upper pushing portion in the form of a ramp that ascends towards said second terminal, and wherein said rocker lever is provided with a lower pushing portion in the form of a ramp complementary to said upper pushing portion configured so that, in said second rocking position, said lower pushing portion is removed from said upper pushing portion and when said lever moves from said second rocking position to said first rocking position, said lower pushing portion pushes said upper pushing portion, driving said mobile part to said locking position.

**[0039]** Therefore, in the release position, the catch is

outside of the locking hole and the spring is in its standby position. In contrast, in the locking position, the spring is in a working position. In the context of the document, working position of the spring is understood to mean that position in which said spring is subjected to a force that elastically deforms said spring. By way of non-exclusive examples, in the case of a draught spring, the working position corresponds to an elongated position, whereas, in the case of a compression spring, the working position corresponds to a compressed position. Therefore, in said locking position, the spring tends to pull the mobile part in the direction corresponding to the standby position of the spring, which tends to move the catch away from the hole. This has the effect that if there is no element pushing the mobile part, the spring itself unlocks the locking means, whereby the second terminal tends to move towards its distal position to open the switch. On the other hand, when the lever moves from its second rocking position to its first position, the lower pushing portion is coupled to the upper pushing portion provided in the mobile part. The complementary ramp shape of both pushing portions has the effect of converting the rocking movement of the lever into a linear pushing of the part towards the second terminal. The pushing continues until, upon reaching the first rocking position, the catch is introduced in the locking hole, and the locking means impede the opening of the switch. In that sense, a linear pushing of the second terminal itself that tried to move said second terminal towards its distal position would be blocked by the catch and the locking hole. In contrast, a movement of the lever towards its second rocking position releases the force exerted by the lower pushing portion of the lever against the upper pushing portion of the mobile part, and the spring pulls said mobile part to release the catch from the locking hole. The result is an effective locking against undesired opening, but without the need to apply a large amount of energy for locking or unlocking. Accordingly, manual actuation is facilitated, and the energy requirements for the actuation controlled by the control module lessen.

**[0040]** Preferably, said mobile part further comprises:

- a spring rod having a first end attached to said body on said second side of the body, and a second end opposite said first end; and
- a flange attached to said spring rod at said second end;

said spring being arranged around said spring rod, between said flange and said body; said device further comprising guiding stops arranged for limiting the movement of said mobile part along said straight line; wherein in said working position, said spring is compressed between said flange and said guiding stops. The spring thereby works by compression: it is compressed in the working position and expands to its standby position when the mobile part moves from the locking position to the release position. Working by compression is advan-

tageous in relation to durability of the spring; furthermore, the movement is stable given that a core in the form of a rod goes through the spring. Moreover, the guiding stops facilitate the movement of the mobile part being in a straight line and minimize the risk of deviations occurring over time; furthermore, additional parts for compressing the spring in its working position are not needed given that the guiding stops themselves are used for such purpose.

**[0041]** Preferably, said vacuum interrupter is arranged vertically, such that said second mobile terminal is arranged so as to be movable in the vertical direction, and wherein said fuse is arranged above said vacuum interrupter. In the context of the document, and unless otherwise indicated, directions will be understood as being relative to the attached figures. Fuse bases generally have a limitation imposed on their dimensions, particularly in terms of the width of the fuses connected thereto. Usually, this limitation is imposed by the installation company, or a limitation is imposed by way of regulation. The location of the fuse on the switch element allows the use of relatively wide components which would not comply with said imposition if they were arranged laterally. It is thereby possible to replace current fuses in three-pole fuse bases with devices such as the device of the invention.

**[0042]** The invention also relates to a three-pole fuse base provided with at least one electrical safety device according to any of the forms described above.

**[0043]** The invention also comprises other detailed features illustrated in the detailed description of an embodiment of the invention and in the attached figures.

#### Brief Description of the Drawings

**[0044]** The advantages and features of the invention are apparent from the following description in which, in a non-limiting manner with respect to the scope of the main claim, preferred embodiments of the invention are disclosed in reference to the figures.

Figure 1 shows a perspective view of a three-pole fuse base provided with three safety devices according to an embodiment of the invention.

Figure 2 shows a safety device such as the one used in the fuse base of Figure 1 in an isolated manner.

Figure 3 is a detailed side view of the safety device of Figure 2, in which the external casing has been eliminated in order to see the internal elements.

Figure 4 is a perspective view corresponding to Figure 3.

Figure 5 is a detailed perspective view of the same device of Figure 4, in which the fuse has been eliminated.

Figure 6 is a detailed top view of the device of Figure 5, in which the connector emerging from the vacuum interrupter has furthermore been eliminated.

Figure 7 is a detailed side view of part of the safety device with the switch in the closed position and the rocker lever in the first rocking position. The walls of the vacuum interrupter have been eliminated to enable viewing the internal terminals.

Figure 8 is a side view equivalent to Figure 7 but with the switch in the open position and the rocker lever in the second rocking position.

Figure 9 and Figure 10 are detailed sides views of the safety device of the invention. Figure 9 shows the rocker lever in the first rocking position and the catch introduced in the locking hole, whereas Figure 10 shows the rocker lever in the second rocking position and the catch removed from the locking hole.

#### Detailed Description of Embodiments of the Invention

**[0045]** The figures show a first embodiment of the electrical safety device 1 of the invention, as well as of a corresponding three-pole fuse base 2.

**[0046]** Particularly, the device 1 of the invention is configured for being installed in a three-pole fuse base 2 such as the one in Figure 1, in which the base 2 is provided with three of said devices 1. Figure 2 shows the device 1 in an isolated manner. The device 1 comprises two electric terminals 101, 102 between which there is defined an electrical branch. In the embodiment shown in Figure 1 and Figure 2, the device comprises an external casing manufactured from an electrically insulating material. The device 1 comprises a control module 107 arranged in an area of the casing configured for accepting said control module 107. The functionality of the control module is described hereinbelow. Given that said external casing impedes viewing the rest of the internal components, for the sake of clarity, in the remaining Figures 3 to 10 said external casing has been eliminated. Likewise, the figures are simplified depictions of the device 1, so they do not show elements such as the internal wiring.

**[0047]** Figure 3 and Figure 4 show the main internal elements of the device 1 of the invention. Particularly, the figures show how the branch defined between the two terminals 101, 102 is provided with a fuse 103 intended for cutting off the passage of electric current in said branch in the case of blowing a fuse. In the case of the example, the fuse is a blade fuse with a rated current value of 400 A, although in other embodiments of the device 1, fuses of other current values, suited to the type of application for which the safety device 1 is intended, are used.

**[0048]** The device 1 further comprises a switch element 104 provided in the branch and connected in series

with the fuse 103. The switch element 104 of the example is a vacuum interrupter 150 with rated values of 400 A, 440 V, and 25 kA, effective for a 1-second short-circuit. The vacuum interrupter 150 has a closed state in which it allows the passage of electric current, and an open state in which it impedes the passage of electric current. Current thereby passes through the branch if both the fuse 103 and the vacuum interrupter 150 allow this passage. Vacuum interrupters 150 of this type are known, so only the most relevant elements are described so as to understand the invention. The vacuum interrupter 150 of the example comprises a cylindrical bottle 155 depicted vertically in the figures. Inside said bottle 155 there are two electrical contacts 151, 152 arranged in a vacuum medium. Two terminals 153 and 154 emerge from the upper and lower ends of the bottle 155, from the central axis of the bottle 155. A first terminal 153 is fixed, whereas the second terminal 154 is mobile and can be moved vertically in a direction which coincides with the axis of the bottle 155 and is perpendicular to an outer surface of said bottle 155; in the example of the figures, said surface outer is the upper surface of the bottle 155. Therefore, the second terminal 154 can be moved vertically between a proximal position, in which the electrical contacts 151, 152 of the interior of the bottle 155 are in electrical contact and the vacuum interrupter 150 is in the closed state, and a distal position, in which the electrical contacts 151, 152 are separated and said vacuum interrupter 150 is in said open state.

**[0049]** In the case of the first exemplary embodiment, the terminals 153 and 154 are provided with screws in order to attach them to busbars, although other equivalent forms of connection are possible, for example, a welded connection. The first terminal 153 is attached to an electric terminal 102 of the device 1, whereas the second terminal 154 is attached to the fuse 103 by means of a C-shaped conductive copper bar segment, conferring to it sufficient flexibility to absorb the vertical movements of the second terminal 154. As can be observed in Figures 3 and 4, the vacuum interrupter 150 is arranged vertically, such that the second mobile terminal 154 is arranged so as to be movable in the vertical direction, and the fuse 103 is arranged above said vacuum interrupter 150.

**[0050]** Figures 3 and 4 show how the safety device 1 also comprises measuring means, in this case, a first toroidal current transformer 106 arranged surrounding an electrical conductor of said branch emerging from the fuse 103 towards one of the electric terminals 101 of the device 1. This toroidal transformer 106 is configured for measuring at least one operational parameter of the safety device 1. In the case of the example, said parameter is a measurement of the current circulating through the branch. For the sake of clarity, the electrical connections between the toroidal transformer 106 and the control module 107 are not depicted in the figures. Said control module 107 is configured for disabling the device 1 in the event that the operational parameter, in this case the

current measurement, meets a predetermined condition. For the first embodiment, a selector provided in the device 1 allows an operator to be able to previously determine a threshold current value in the range of 160-400 A. In the particular case of the first embodiment, said selector is a potentiometer connected to the control module 107, although other equivalent forms can be provided. Therefore, the predetermined condition is for the electric current measurement to exceed said selected threshold current for the duration of a threshold time of 0.1 second. The disabling performed by the control module 107 comprises acting on the switch element 104, in this case the vacuum interrupter 150, in order to move said switch element 104 from the closed state to the open state.

**[0051]** Figure 5 shows the device 1 without the fuse 103 or the measuring means 106 such that other components can be observed more clearly. As shown in the figure, the device 1 further comprises a manual actuator 105 comprising an actuator rod 110 and a push button 111. The actuator rod 110 is arranged in a vertical direction, parallel to the second mobile terminal 154 of the vacuum interrupter 150 and movable in said direction. It has a distal end, away from the vacuum interrupter 150, and a proximal end, close to the vacuum interrupter 150. The push button 111 is secured to the actuator rod 110 at its distal end. The manual actuator 105 is configured for moving the switch element 104 from the closed state to the open state and vice versa. The manner in which this opening and closing of the switch element 104 is performed by the manual actuator 105 in the first embodiment is described below.

**[0052]** Figure 5 also shows that the device 1 further comprises a controllable actuator. Said controllable actuator is configured for moving the second mobile terminal 154 of the vacuum interrupter 150 corresponding to the switch element 104 from its proximal position to its distal position or vice versa. In turn, the control module 107 is configured for acting on the switch element 104 by means of said controllable actuator. The controllable actuator comprises a rocker lever 160 which, for the first embodiment, is a planar part with a C-shaped side. Figure 6 shows a detailed top view which shows the arrangement of the rocker lever 160, which is configured for rocking about a rocking shaft 161 between a first rocking position and a second rocking position. Figure 5 and Figure 6 depict said rocking shaft 161 as a discontinuous line superimposed on the figure. The lever 160 has a first segment 162 on a first side of the shaft 161 and a second segment 163 on a second side of the shaft 161, opposite said first side. The proximal end of the actuator rod 110 of the manual actuator 105 is assembled secured to the first segment 162 of the lever 160, such that a movement of said manual actuator 105 moves the lever 160 and vice versa. The controllable actuator also comprises operating means 170 configured for acting on said lever 160 from the second segment 163 for moving said lever 160 between the first rocking position and the second rocking position and vice versa. In the case of the em-

bodiment herein described the operating means 170 comprise two electromagnets 171 separated by an access space 172 which vertically coincides with the free space left by the C shape of the rocker lever 160. In that sense, each of the two ends of the second segment 163 of the lever 160 is operated by one of said electromagnets 171, leaving the access space 172 free, which allows accessing from above the anchoring point of the lower electric terminal 102 of the device 1. Each electromagnet 171 is further provided with a permanent magnet configured for maintaining the position of said rocker lever 160 in the event of losing electrical power in said electromagnet 171.

**[0053]** The controllable actuator also comprises securing means 180 arranged in the first segment 162 of the lever 160 and securing said lever 160 to the second mobile terminal 154 of the vacuum interrupter 150. Therefore, in the first rocking position, the second terminal 154 is in the proximal position, and in the second rocking position in which the vacuum interrupter 150 is closed, the second terminal 154 is in the distal position in which the vacuum interrupter 150 is open. In the embodiment of the figures, the securing means 180 comprise a bushing 181 integral with the rocker lever 160 and provided with a central through hole 182 that the second terminal 154 goes through. Figures 7, 8, 9, and 10 show how the bushing 181 has lateral holes 183 with an ellipsoid shape. A pin 184 is arranged going through the second terminal 154 and the bushing 181, to the lateral holes 183 thereof. Particularly, the pin 184 extends perpendicular to the second terminal 154 and parallel to the rocking shaft 161.

**[0054]** Figure 7 and Figure 8 are detailed side views of the device 1. To facilitate comprehension of the operation of the vacuum interrupter 150, the walls of said vacuum interrupter 150 and of the bottle 155 have been eliminated in said figures such that the internal elements are visible. Figure 7 corresponds to the device 1 with the rocker lever 160 in the first rocking position, whereby the second terminal 154 is in the proximal position, and the switch element 104 is closed. In contrast, in Figure 8 the rocker lever 160 is in the second rocking position, whereby the second terminal 154 is in the distal position, and the switch element 104 is open. The two electrical contacts 151 and 152 of the vacuum interrupter 150 can be seen in Figure 7 and 8, these contacts are actually arranged in a vacuum medium inside the bottle 155, but they are herein visible because said bottle 155 has been eliminated in these figures. The first fixed terminal 153 is attached to a first fixed rod which communicates with the interior of said bottle 155 and is attached to one of said electrical contacts 151. The second mobile terminal 154 is attached to a second mobile rod which communicates with the interior of said bottle 155 and is attached to the other one of said electrical contacts 152. Therefore, when the second terminal 154 is in the proximal position, like in Figure 7, the electrical contacts 151, 152 are in contact and the vacuum interrupter 150 is in the closed state, allowing the passage of electric current. In contrast,

when the second terminal 154 is in the distal position, like in Figure 8, the electrical contacts 151, 152 are separated and the vacuum interrupter 150 is in the open state, impeding the passage of electric current there-through.

**[0055]** Figure 9 and Figure 10 are detailed views of the attachment area between the second terminal 154 and the rocker lever 160. Figure 9 corresponds to the device 1 with the switch element 104 closed, whereas Figure 10 corresponds to the device 1 with the switch element open. It can be observed in said figures how the controllable actuator further comprises locking means which are configured for locking the second terminal 154 in the proximal position when the lever 160 is in the first rocking position, which corresponds to the situation shown in Figure 9. Particularly, said locking means comprise a mobile part 190 with a body 191 provided with a catch 192 on a first side of the body 191, which has been depicted on the right side in the figures. The mobile part 190 is assembled so as to be movable along a straight line which is perpendicular to the second terminal 154 and to the rocking shaft 161, and in the figures this straight line corresponds to a horizontal straight line. Figure 9 shows the mobile part 190 in a locking position, and Figure 10 shows it in a release position. The mobile part 190 is movable between both positions. Likewise, the mobile part 190 is attached to a spring 196 on a second side of the body 191 opposite the first side of the body, and in the figures this side corresponds to the left side. A locking hole 193 facing the catch 192 in the first rocking position shown in Figure 9 is provided in the bushing 181 of the securing means 180. In the situation shown in said figure, the catch 192 is introduced into the locking hole 193. Figure 9 depicts the tip of the catch 192 and the locking hole 193 by means of discontinuous lines, given that they would otherwise be concealed in the detailed side view. Likewise, in Figure 9 the spring 196 is in a working position which, for the case of the first embodiment, corresponds to a compressed position. In contrast, in the situation shown in Figure 10, in which the lever 160 is in the second rocking position and the mobile part 190 is in the release position, the catch 192 is removed from the locking hole 193, and the spring 196 is in a standby position.

**[0056]** Figures 9 and 10 show that the mobile part 190 further comprises a spring rod 198 and a flange 199. The spring rod 198 is attached to the body 191 at its first end, depicted on the right, and to the flange 199 at its second end, depicted on the left. Therefore, the spring 196 is arranged around the spring rod 198, between the flange 199 and the body 191 of the mobile part 190. Furthermore, for the first embodiment, the mobile part 190 is arranged inside a box-shaped guide structure 120. The walls of said guide structure 120 appear in as a cutaway section in Figures 9 and 10. Inside said guide structure 120 there are formed guiding stops 197 in the form of internal walls perpendicular to the direction of movement of the mobile part 190. These guiding stops 197 limit the movement of the mobile part 190 along the horizontal

straight line perpendicular to the second terminal 154, impeding lateral movements. The guiding stops 197 close to the spring 196 further serve to compress the spring 196 between said guiding stops 197 and the flange 199 when said spring 196 is in the working position shown in Figure 9.

**[0057]** It can be seen in Figures 9 and 10 that the body 191 of the mobile part 190 further comprises an upper pushing portion 194 in the form of a ramp that ascends towards said second terminal 154, on the right in the figures. Moreover, the rocker lever 160 is provided with a lower pushing portion 195 in the form of a ramp complementary to the upper pushing portion 194 of the mobile part. Figure 10 shows that in the second rocking position of the lever 160, the lower pushing portion 195 of the lever 160 is removed from the upper pushing portion 194 of the mobile part 190. In this situation, the spring 196 tends to expand to its standby position, driving the mobile part 190 and removing the catch 192 from the locking hole 193, as seen in Figure 10. When the lever 160 moves from the second rocking position shown in Figure 10 to the first rocking position shown in Figure 9, the lower pushing portion 195 contacts the upper pushing portion 194 and starts to push same. The shape of the ramps results in the presence of a horizontal component of the driving force going towards the second terminal 154, depicted on the right in the figures. The mobile part 190 is thereby driven to the locking position in which the catch 192 is introduced into the locking hole, as shown in Figure 9. When the device 1 is in this position, an eventual pushing of the second terminal 154 in the vertical direction will be blocked by the interaction of the catch 192 with the lower wall of the locking hole 193, thereby producing a secure closure. In contrast, a movement performed on the rocker lever 160, for example, due to the actuation of the electromagnets 171 or the manual actuator 105, separates the lower pushing portion 195 attached to the lever 160 from the upper pushing portion 194 of the mobile part, and the spring 196 itself pushes the mobile part 190 towards the position shown in Figure 10. Therefore, the locking only affects the movements initiated by the vertical movement of the second terminal.

**[0058]** Other embodiments of the safety device 1 which share many of the features of the first embodiment described above are described below. Therefore, only the different elements will be described hereinafter.

**[0059]** In a second embodiment not shown in the figures, the device 1 further comprises a second toroidal current transformer configured for electrically powering said control module 107 and said electromagnets 171.

**[0060]** In a third embodiment, the operational parameters comprise an electric current measurement in the branch, and the predetermined condition corresponds to the situation in which said electric current measurement exceeds a threshold current without taking into account the time by which said threshold is exceeded.

**[0061]** In a fourth embodiment, the operational parameter further comprises a temperature measurement.

**[0062]** In a fifth embodiment, said operational parameter further comprises a voltage measurement. Still other embodiments use an operational parameter comprising current, voltage, and temperature measurements.

**[0063]** In a sixth embodiment, the control module 107 is further configured for resetting, where said resetting comprises acting on said switch element 104 in order to move said switch element 104 from said open state to said closed state. The control module 107 starts the resetting when a predetermined resetting time has elapsed since said disabling, which is a value that can range between 5 and 180 seconds. Furthermore, the control module 107 is configured for carrying out up to 5 retries in the event that a disabling takes place immediately after said resetting.

**[0064]** In a seventh embodiment, the control module 107 further comprises a transmitter and a receiver configured for sending operational parameters and for receiving commands. The commands comprise orders for configuration, for starting the disabling, for starting the resetting. In some embodiments, the order for starting the resetting includes the predetermined values of retries. Some examples of orders for configuration are modification of the predetermined condition, modification of the predetermined resetting time, or modification of the number of retries.

## Claims

1. An electrical safety device (1) configured for being installed in a three-pole fuse base (2), comprising two terminals (101, 102) between which there is defined an electrical branch, said branch being provided with a fuse (103) configured for cutting off the passage of electric current in said branch in the case of blowing a fuse;

wherein said device (1) further comprises:

- a switch element (104) provided in said branch and connected in series with said fuse (103), said switch element (104) having a closed state in which it allows the passage of electric current, and an open state in which it impedes the passage of electric current;
- a manual actuator (105) configured for moving said switch element (104) from said closed state to said open state and vice versa;
- measuring means (106) configured for measuring at least one operational parameter of said safety device (1); and
- a control module (107) configured for disabling in the event that said at least one operational parameter meets a predetermined condition, wherein said disabling comprises

acting on said switch element (104) in order to move said switch element (104) from said closed state to said open state;

wherein said device (1) further comprises a controllable actuator, and said control module (107) is configured for acting on said switch element (104) by means of said controllable actuator; **characterized in that** said switch element (104) comprises a vacuum interrupter (150) of the type comprising:

- a bottle (155) in which two electrical contacts (151, 152) are provided arranged in a vacuum medium;
- a first fixed terminal (153), attached to a first fixed rod, which communicates with the interior of said bottle (155) and is attached to one of said electrical contacts (151, 152);
- a second mobile terminal (154), attached to a second mobile rod, which communicates with the interior of said bottle (155) and is attached to the other one of said electrical contacts (151, 152);

wherein said second terminal (154) is movable in a direction perpendicular to said bottle (155) between a proximal position, in which said electrical contacts (151, 152) are in contact and said vacuum interrupter (150) is in said closed state, and a distal position, in which said electrical contacts (151, 152) are separated and said vacuum interrupter (150) is in said open state; said controllable actuator configured for moving said second terminal (154) from said proximal position to said distal position or vice versa; said controllable actuator comprising:

- a rocker lever (160) configured for rocking about a rocking shaft (161) between a first rocking position and a second rocking position, said lever (160) having a first segment (162) on a first side of the shaft (161) and a second segment (163) on a second side of the shaft (161), opposite said first side;
- operating means (170) configured for acting on said lever (160) from said second segment (163) for moving said lever (160) between said first rocking position and said second rocking position and vice versa;
- securing means (180) arranged in said first segment (162) and configured for securing said lever (160) to said second mobile terminal (154), such that in said first rocking position, said second terminal (154) is in said proximal position, and in said second rocking position, said second terminal (154)

is in said distal position; and

- locking means configured for locking said second terminal (154) in said proximal position when said lever (160) is in said first rocking position.

2. The device (1) according to claim 1, **characterized in that** said control module (107) is further configured for resetting, where said resetting comprises acting on said switch element (104) in order to move said switch element (104) from said open state to said closed state; preferably, said control module (107) is further configured for starting said resetting when a predetermined resetting time has elapsed since said disabling.
3. The device (1) according to claim 2, **characterized in that** said control module (107) is further configured for retrying at least once in the event that a disabling takes place immediately after said resetting, the total number of retries preferably being limited to a predetermined value of retries.
4. The device (1) according to any one of claims 1 to 3, **characterized in that** said operational parameters comprise an electric current measurement in said branch, and said predetermined condition comprises at least one of the conditions where:
  - said electric current measurement exceeds a threshold current; and
  - said electric current measurement exceeds a threshold current for the duration of a threshold time;
 preferably, wherein said measuring means (106) comprise a first toroidal current transformer arranged surrounding an electrical conductor of said branch.
5. The device (1) according to any one of claims 1 to 4, **characterized in that** it further comprises a second toroidal current transformer configured for electrically powering said control module (107).
6. The device (1) according to any one of claims 1 to 5, **characterized in that** said operational parameters further comprise at least one of:
  - a temperature measurement;
  - a current measurement; and
  - a voltage measurement.
7. The device (1) according to any one of claims 1 to 6, **characterized in that** said control module (107) further comprises remote connection means configured for at least one of:

- sending said operational parameters; and  
 - receiving commands;  
 preferably, wherein said commands comprise at least one of:

- an order for configuration;
- an order for starting said disabling; and
- an order for starting said resetting;

wherein said order for starting said resetting preferably comprises said predetermined value of retries;  
 more preferably, wherein said order for configuration comprises at least one of:

- an order for modifying said predetermined condition;
- an order for modifying said predetermined resetting time; and
- an order for modifying said predetermined value of resetting retries.

8. The device (1) according to any one of claims 1 to 7, **characterized in that** said operating means (170) comprise at least one electromagnet (171), preferably two electromagnets (171) separated by an access space (172).

9. The device (1) according to claim 8, **characterized in that** each of said at least one electromagnet (171) is further provided with a permanent magnet configured for maintaining the position of said rocker lever (160) in the event of losing electrical power in said electromagnet (171).

10. The device (1) according to any one of claims 1 to 9, **characterized in that** said manual actuator (105) comprises:

- an actuator rod (110) arranged in a parallel direction with respect to said second mobile terminal (154) of said vacuum interrupter (150) and movable in said parallel direction, having a distal end relative to said vacuum interrupter (150) and a proximal end relative to said vacuum interrupter (150);
- a push button (111) secured to said actuator rod (110) at said distal end;

said proximal end being assembled secured to said first segment (162) of said rocker lever (160), such that a movement of said manual actuator (105) moves said lever (160) and vice versa.

11. The device (1) according to any one of claims 1 to 10, **characterized in that** said securing means (180) comprise:

- a bushing (181) integral with said rocker lever (160), provided with a central through hole (182) which said second terminal (154) goes through and with lateral holes (183); and
- a pin (184) arranged going through said second terminal (154) and extending perpendicular thereto and parallel to said rocking shaft (161), going through said lateral holes (183).

12. The device (1) according to claim 11, **characterized in that** said locking means comprise:

- a mobile part (190) comprising a body (191) provided with a catch (192) on a first side of the body, said mobile part (190) being arranged so as to be movable along a straight line which is perpendicular to said second terminal (154) and to said rocking shaft (161), between a locking position and a release position, or vice versa;
  - a spring (196) attached to said mobile part (190) on a second side of the body opposite said first side of the body; and
  - a locking hole (193) provided in said bushing (181) and facing said catch (192) in said first rocking position;
- said locking means configured such that in said first rocking position, when said mobile part (190) is in said locking position, said catch (192) is introduced into said locking hole (193), and said spring (196) is in a working position; and such that in said release position, said catch (192) is removed from said locking hole (193), and said spring (196) is in a standby position; wherein said body (191) further comprises an upper pushing portion (194) in the form of a ramp that ascends towards said second terminal (154), and wherein said rocker lever (160) is provided with a lower pushing portion (195) in the form of a ramp complementary to said upper pushing portion (194) configured so that, in said second rocking position, said lower pushing portion (195) is removed from said upper pushing portion (194) and when said lever (160) moves from said second rocking position to said first rocking position, said lower pushing portion (195) pushes said upper pushing portion (194), driving said mobile part (190) to said locking position.

13. The device (1) according to claim 12, **characterized in that** said mobile part (190) further comprises:

- a spring rod (198) having a first end attached to said body (191) on said second side of the body, and a second end opposite said first end; and
- a flange (199) attached to said spring rod (198) at said second end;

said spring (196) being arranged around said spring rod (198), between said flange (199) and said body (191);

said device (1) further comprising guiding stops (197) arranged for limiting the movement of said mobile part (190) along said straight line; where-  
in in said working position, said spring (196) is compressed between said flange and said guid-  
ing stops (197).

14. The device (1) according to any one of claims 1 to 13, **characterized in that** said vacuum interrupter (150) is arranged vertically, such that said second mobile terminal (154) is arranged so as to be movable in the vertical direction, and wherein said fuse (103) is arranged above said vacuum interrupter (150).

15. A three-pole fuse base (2) provided with at least one electrical safety device (1) according to any one of claims 1 to 14.

#### Patentansprüche

1. Sicherheitsvorrichtung (1), die konfiguriert ist, um in einem dreipoligen Sicherungssockel (2) installiert zu werden, die zwei Anschlüsse (101, 102) aufweist, zwischen denen ein elektrischer Zweig definiert ist, wobei der Zweig mit einer Sicherung (103) versehen ist, die konfiguriert ist, um den Durchgang von elektrischem Strom in diesem Zweig in dem Fall des Durchbrennens einer Sicherung zu unterbrechen;

wobei die Vorrichtung (1) ferner aufweist:

- ein Schaltelement (104), das in dem Zweig bereitgestellt ist und mit der Sicherung (103) in Reihe geschaltet ist, wobei das Schaltelement (104) einen geschlossenen Zustand, in dem es den Durchgang von elektrischem Strom zulässt, und einen offenen Zustand hat, in dem es den Durchgang von elektrischem Strom unterbindet, hat;
- einen manuellen Aktuator (105), der konfiguriert ist, um das Schaltelement (104) von dem geschlossenen Zustand in den offenen Zustand und umgekehrt zu bewegen;
- eine Messeinrichtung (106), die konfiguriert ist, um wenigstens einen Betriebsparameter der Sicherheitsvorrichtung (1) zu messen; und
- ein Steuermodul (107), das konfiguriert ist, um in dem Fall, dass der wenigstens eine Betriebsparameter eine vorbestimmte Bedingung erfüllt, zu deaktivieren, wobei das Deaktivieren das Einwirken auf das Schaltelement (104) bedeutet, um das Schalte-

lement (104) von dem geschlossenen Zustand in den offenen Zustand zu bewegen;

wobei die Vorrichtung (1) ferner einen steuerbaren Aktuator aufweist, und wobei das Steuermodul (107) konfiguriert ist, um mit Hilfe des steuerbaren Aktuators auf das Schaltelement (104) einzuwirken;

**dadurch gekennzeichnet, dass** das Schaltelement (104) einen Vakuumunterbrecher (150) der Art aufweist, der aufweist:

- eine Flasche (155), in der zwei elektrische Kontakte (151, 152), die in einem Vakuummedium angeordnet sind, bereitgestellt sind;
- einen ersten festen Anschluss (153), der an einem festen Stab befestigt ist, der mit dem Inneren der Flasche (155) in Verbindung steht und an einem der elektrischen Kontakte (151, 152) befestigt ist;
- einen zweiten beweglichen Anschluss (154), der an einem zweiten beweglichen Stab befestigt ist, der mit dem Inneren der Flasche (155) in Verbindung steht und an dem anderen der elektrischen Kontakte (151, 152) befestigt ist;

wobei der zweite Anschluss (154) in eine Richtung senkrecht zu der Flasche (155) beweglich ist zwischen einer proximalen Position, in der die elektrischen Kontakte (151, 152) in Kontakt sind und der Vakuumunterbrecher (150) in seinem geschlossenen Zustand ist, und einer distalen Position, in der die elektrischen Kontakte (151, 152) getrennt sind und der Vakuumunterbrecher (150) in seinem offenen Zustand ist; wobei der steuerbare Aktuator konfiguriert ist, um den zweiten Anschluss (154) von der proximalen Position in die distale Position oder umgekehrt zu bewegen; wobei der steuerbare Aktuator aufweist:

- einen Kipphebel (160), der derart konfiguriert ist, dass er um eine Kippwelle (161) zwischen einer ersten Kippposition und einer zweiten Kippposition kippt, wobei der Hebel (160) einen ersten Abschnitt (162) auf einer ersten Seite der Welle (161) und einen zweiten Abschnitt (163) auf einer zweiten Seite der Welle (161) entgegengesetzt zu der ersten Seite hat;
- eine Bedieneinrichtung (170), die konfiguriert ist, um von dem zweiten Abschnitt (163) auf den Hebel (160) einzuwirken, um den Hebel (160) zwischen der ersten Kippposition und der zweiten Kippposition und umgekehrt zu bewegen;

- eine Befestigungseinrichtung (180), die in dem ersten Abschnitt (162) eingerichtet und konfiguriert ist, um den Hebel (160) derart an dem zweiten beweglichen Anschluss (154) zu befestigen, dass der zweite Anschluss (154) in der ersten Kippposition in der proximalen Position ist und der zweite Anschluss (154) in der zweiten Kippposition in der distalen Position ist; und
- eine Verriegelungseinrichtung, die konfiguriert ist, um den zweiten Anschluss (154) in der proximalen Position zu verriegeln, wenn der Hebel (160) in der ersten Kippposition ist.
2. Vorrichtung (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** das Steuermodul (107) ferner für Zurücksetzen konfiguriert ist, wobei das Zurücksetzen das Einwirken auf das Schaltelement (104) aufweist, um das Schaltelement (104) von dem offenen Zustand in den geschlossenen Zustand zu bewegen; wobei das Steuermodul (107) ferner vorzugsweise konfiguriert ist, um das Zurücksetzen zu beginnen, wenn seit der Deaktivierung eine vorbestimmte Rücksetzzeit vergangen ist.
3. Vorrichtung (1) nach Anspruch 2, **dadurch gekennzeichnet, dass** das Steuermodul (107) ferner konfiguriert ist, um in dem Fall, dass eine Deaktivierung stattfindet, unmittelbar nach dem Zurücksetzen wenigstens einmal einen erneuten Versuch durchzuführen, wobei die Gesamtanzahl von erneuten Versuchen vorzugsweise auf einen vorbestimmten Wert von erneuten Versuchen beschränkt ist.
4. Vorrichtung (1) nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** die Betriebsparameter eine elektrische Strommessung in dem Zweig aufweisen und dass die vorbestimmte Bedingung wenigstens eine der Bedingungen aufweist, wobei:
- die elektrische Strommessung einen Schwellstrom überschreitet; und
  - die elektrische Strommessung einen Schwellstrom die Dauer einer Schwellzeit überschreitet;
- wobei die Messeinrichtung (106) vorzugsweise einen ersten Ringstrom-Transformator aufweist, der einen elektrischen Leiter des Zweigs umgebend angeordnet ist.
5. Vorrichtung (1) nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** sie ferner einen zweiten Ringstrom-Transformator aufweist, der konfiguriert ist, um das Steuermodul (107) elektrisch zu betreiben.
6. Vorrichtung (1) nach einem der Ansprüche 1 bis 5,
- dadurch gekennzeichnet, dass** die Betriebsparameter ferner wenigstens eine der folgenden aufweisen:
- eine Temperaturmessung;
  - eine Strommessung; und
  - eine Spannungsmessung.
7. Vorrichtung (1) nach einem der Ansprüche 1 bis 6, **dadurch gekennzeichnet, dass** das Steuermodul (107) ferner eine Fernverbindungseinrichtung aufweist, die für wenigstens eines der folgenden konfiguriert sind:
- Senden der Betriebsparameter; und
  - Empfangen von Befehlen;
- wobei die Befehle vorzugsweise wenigstens eines der folgenden aufweisen:
- eine Reihenfolge für die Konfiguration;
  - eine Reihenfolge für das Beginnen der Deaktivierung; und
  - eine Reihenfolge für das Beginnen des Zurücksetzens;
- wobei die Reihenfolge für das Beginnen des Zurücksetzens vorzugsweise den vorbestimmten Wert für die erneuten Versuche aufweist;
- wobei die Reihenfolge für die Konfiguration noch besser wenigstens eine der folgenden aufweist:
- eine Reihenfolge für das Modifizieren der vorbestimmten Bedingung;
  - eine Reihenfolge für das Modifizieren der vorbestimmten Zeit für das Zurücksetzen;
  - eine Reihenfolge für das Modifizieren des vorbestimmten Werts für die erneuten Versuche zum Zurücksetzen.
8. Vorrichtung (1) nach einem der Ansprüche 1 bis 7, **dadurch gekennzeichnet, dass** die Bedieneinrichtung (170) wenigstens einen Elektromagneten (171), vorzugsweise zwei Elektromagnete (171), die durch einen Zugangsraum (172) getrennt sind, aufweist.
9. Vorrichtung (1) nach Anspruch 8, **dadurch gekennzeichnet, dass** jeder des wenigstens einen Elektromagneten (171) ferner mit einem Permanentmagnet versehen ist, der konfiguriert ist, um die Position des Kipphelbs (160) in dem Fall beizubehalten, in dem die elektrische Leistung in dem Elektromagnet (171) verloren geht.

10. Vorrichtung (1) nach einem der Ansprüche 1 bis 9, **dadurch gekennzeichnet, dass** der manuelle Aktuator (105) aufweist:

- einen Aktuatorstab (110), der in Bezug auf den zweiten beweglichen Anschluss (154) des Vakuumunterbrechers (150) parallel angeordnet ist und in der Parallelrichtung beweglich ist, der ein distales Ende relativ zu dem Vakuumunterbrecher (150) und ein proximales Ende relativ zu dem Vakuumunterbrecher (150) hat;  
- einen Druckknopf (111), der an dem distalen Ende an dem Aktuatorstab (110) befestigt ist;

wobei das proximale Ende an dem ersten Abschnitt (162) des Kipphebels (160) befestigt montiert ist, so dass eine Bewegung des manuellen Aktuators (105) den Hebel (160) bewegt und umgekehrt.

11. Vorrichtung (1) nach einem der Ansprüche 1 bis 10, **dadurch gekennzeichnet, dass** die Befestigungseinrichtung (180) aufweist:

- eine Hülse (181), die integral mit dem Kipphebel (160) ist, die mit einem mittleren Durchgangsloch (182), durch welches der zweite Anschluss (154) geht, und mit seitlichen Löchern (183) versehen ist; und  
- einen Stift (184), der durch den zweiten Anschluss (154) gehend angeordnet ist und sich senkrecht dazu und parallel zu dem Kipphebel (181), durch die seitlichen Löcher (183) gehend erstreckt.

12. Vorrichtung (1) nach Anspruch 11, **dadurch gekennzeichnet, dass** die Verriegelungseinrichtung aufweist:

- einen beweglichen Teil (190), der einen Körper (191) aufweist, der auf einer ersten Seite des Körpers mit einem Riegel (192) versehen ist, wobei der bewegliche Teil (190) derart angeordnet ist, dass er entlang einer geraden Linie, die senkrecht zu dem zweiten Anschluss (154) und zu der Kippwelle (161) ist, zwischen einer Verriegelungsposition und einer Löseposition oder umgekehrt beweglich ist;  
- eine Feder (196), die auf einer zweiten Seite des Körpers entgegengesetzt zu der ersten Seite des Körpers an dem beweglichen Teil (190) befestigt ist; und  
- ein Verriegelungsloch (193), das in der Hülse (181) bereitgestellt ist und dem Riegel (192) in der ersten Kippposition zugewandt ist; wobei die Verriegelungseinrichtung derart konfiguriert ist, dass der Hebel (192) in der ersten Kippposition, wenn der bewegliche Teil (190) in der Verriegelungsposition ist, in das Verriegelungsloch (193) eingeführt wird und die Feder (196) in einer Arbeitsposition ist; und so dass der Riegel (192) in der Löseposition aus dem Verriegelungsloch (193) entfernt wird, und die Feder (196) in einer Bereitschaftsposition ist; wobei der Körper (191) ferner einen oberen Druckabschnitt (194) in der Form einer Rampe, die in Richtung des zweiten Anschlusses (154) ansteigt, aufweist, und wobei der Kipphebel (160) mit einem unteren Druckabschnitt (195) in der Form einer Rampe versehen ist, die zu dem oberen Druckabschnitt (194) komplementär ist, der derart konfiguriert ist, dass der untere Druckabschnitt (195) in der zweiten Kippposition von dem oberen Druckabschnitt (194) entfernt wird, und wobei der untere Druckabschnitt (195), wenn der Hebel (160) sich von der zweiten Kippposition zu der ersten Kippposition bewegt, den oberen Druckabschnitt (194) drückt, wobei der bewegliche Teil (190) in die Verriegelungsposition getrieben wird.

13. Vorrichtung (1) nach Anspruch 12, **dadurch gekennzeichnet, dass** der bewegliche Teil (190) ferner aufweist:

- einen Federstab (198) mit einem ersten Ende, das auf der zweiten Seite des Körpers an dem Körper (191) befestigt ist, und einem zu dem ersten Ende entgegengesetzten zweiten Ende; und  
- einen Flansch (199), der an dem zweiten Ende an dem Federstab (198) befestigt ist; wobei die Feder (196) zwischen dem Flansch (199) und dem Körper (191) um den Federstab (198) herum angeordnet ist; wobei die Vorrichtung (1) ferner Führungsanschlüsse (197) aufweist, die eingerichtet sind, um die Bewegung des beweglichen Teils (190) entlang der geraden Linie zu führen; wobei die Feder (196) in der Arbeitsposition zwischen dem Flansch und den Führungsanschlüssen (197) zusammengedrückt wird.

14. Vorrichtung (1) nach einem der Ansprüche 1 bis 13, **dadurch gekennzeichnet, dass** der Vakuumunterbrecher (150) vertikal angeordnet ist, so dass der zweite bewegliche Anschluss (154) derart angeordnet ist, dass er in der Vertikalrichtung beweglich ist, und wobei die Sicherung (103) oberhalb des Vakuumunterbrechers (150) angeordnet ist.

15. Dreipoliger Sicherungssockel (2), der mit wenigstens einer elektrischen Sicherheitsvorrichtung (1) nach einem der Ansprüche 1 bis 14 versehen ist.

## Revendications

1. Dispositif de sécurité électrique (1) configuré pour être installé dans un socle à fusibles tripolaire (2), comprenant deux bornes (101, 102) entre lesquelles est définie une branche électrique, ladite branche étant pourvue d'un fusible (103) configuré pour couper le passage du courant électrique dans ladite branche en cas de claquage d'un fusible;

dans lequel ledit dispositif (1) comprend:

- un élément de commutation (104) prévu dans ladite branche et connecté en série avec ledit fusible (103), ledit élément de commutation (104) ayant un état fermé qui permet le passage du courant électrique, et un état ouvert qui empêche le passage du courant électrique;
- un actionneur manuel (105) configuré pour déplacer ledit élément de commutation (104) dudit état fermé vers ledit état ouvert et vice versa;
- un moyen de mesure (106) configuré pour mesurer au moins un paramètre de fonctionnement dudit dispositif de sécurité (1); et
- un module de commande (107) configuré pour se désactiver dans le cas où ledit au moins un paramètre opérationnel satisfait une condition prédéterminée, ladite désactivation comprenant une action sur ledit élément de commutation (104) afin de déplacer ledit élément de commutation (104) dudit état fermé vers ledit état ouvert;

dans lequel ledit dispositif (1) comprend en outre un actionneur commandable, et ledit module de commande (107) est configuré pour agir sur ledit élément de commutation (104) au moyen dudit actionneur commandable;

**caractérisé en ce que** ledit élément de commutation (104) comprend un interrupteur à vide (150) du type comprenant:

- une bouteille (155) dans laquelle sont prévus deux contacts électriques (151, 152) disposés dans un milieu sous vide ;
- une première borne fixe (153), fixée à une première tige fixe, qui communique avec l'intérieur de ladite bouteille (155) et est fixée à l'un desdits contacts électriques (151, 152) ;
- une seconde borne mobile (154), fixée à une seconde tige mobile, qui communique avec l'intérieur de ladite bouteille (155) et est fixée à l'autre desdits contacts électriques (151, 152);

dans lequel ladite seconde borne (154) est mobile dans une direction perpendiculaire à ladite bouteille (155) entre une position proximale, dans laquelle lesdits contacts électriques (151, 152) sont en contact et ledit interrupteur à vide (150) est dans ledit état fermé, et une position distale, dans laquelle lesdits contacts électriques (151, 152) sont séparés et ledit interrupteur à vide (150) est dans ledit état ouvert; ledit actionneur commandable étant configuré pour déplacer ladite seconde borne (154) de ladite position proximale à ladite position distale ou vice versa; ledit actionneur commandable comprenant:

- un bras de levier (160) configuré pour basculer autour d'un axe pivot (161) entre une première position de basculement et une seconde position de basculement, ledit levier (160) comportant un premier segment (162) sur un premier côté de l'arbre (161) et un second segment (163) sur un second côté de l'arbre (161), opposé audit premier côté;
- un moyen d'actionnement (170) configuré pour agir sur ledit levier (160) à partir dudit second segment (163) pour déplacer ledit levier (160) entre ladite première position de basculement et ladite seconde position de basculement et vice versa;
- un moyen de fixation (180) disposé dans ledit premier segment (162) et configuré pour fixer ledit levier (160) à ladite seconde borne mobile (154), de telle sorte que dans ladite première position de basculement, ladite seconde borne (154) soit dans ladite position proximale, et dans ladite seconde position de basculement, ladite seconde borne (154) soit dans ladite position distale; et
- un moyen de verrouillage configuré pour verrouiller ladite seconde borne (154) dans ladite position proximale lorsque ledit levier (160) est dans ladite première position de basculement.

2. Dispositif (1) selon la revendication 1, **caractérisé en ce que** ledit module de commande (107) est en outre configuré pour effectuer une réinitialisation, ladite réinitialisation comprenant une action sur ledit élément de commutation (104) afin de déplacer ledit élément de commutation (104) dudit état ouvert vers ledit état fermé; de préférence, ledit module de commande (107) est en outre configuré pour démarrer ladite réinitialisation lorsqu'un temps de réinitialisation prédéterminé s'est écoulé depuis ladite désactivation.

3. Dispositif (1) selon la revendication 2, **caractérisé en ce que** ledit module de commande (107) est en outre configuré pour effectuer une nouvelle tentative au moins une fois dans le cas où une désactivation a lieu immédiatement après ladite réinitialisation, le nombre total de nouvelle tentatives étant de préférence limité à une valeur prédéterminée de nouvelle tentatives. 5
4. Dispositif (1) selon l'une des revendications 1 à 3, **caractérisé en ce que** lesdits paramètres opérationnels comprennent une mesure de courant électrique dans ladite branche, et ladite condition prédéterminée comprend au moins l'une des conditions où: 10
- ladite mesure de courant électrique dépasse un courant seuil; et
  - ladite mesure de courant électrique dépasse un courant seuil pendant la durée d'un temps seuil; 20
- de préférence, dans lequel ledit moyen de mesure (106) comprend un premier transformateur de courant toroïdal disposé autour d'un conducteur électrique de ladite branche. 25
5. Dispositif (1) selon l'une des revendications 1 à 4, **caractérisé en ce qu'il** comprend en outre un deuxième transformateur de courant toroïdal configuré pour alimenter électriquement ledit module de commande (107). 30
6. Dispositif (1) selon l'une des revendications 1 à 5, **caractérisé en ce que** lesdits paramètres opérationnels comprennent en outre au moins une mesure parmi : 35
- une mesure de température;
  - une mesure de courant; et
  - une mesure de tension. 40
7. Dispositif (1) selon l'une des revendications 1 à 6, **caractérisé en ce que** ledit module de commande (107) comprend en outre un moyen de connexion à distance configuré pour au moins l'une des opérations suivantes: 45
- envoyer lesdits paramètres opérationnels; et
  - recevoir des commandes; 50
- de préférence, lesdites commandes comprenant au moins l'une des opérations suivantes:
- un ordre de configuration;
  - un ordre de démarrage de ladite désactivation; et
  - un ordre de démarrage de ladite réinitialisation; 55
- ledit ordre de démarrage de ladite réinitialisation comprenant de préférence ladite valeur prédéterminée de nouvelle tentatives; de manière encore plus préférable, ledit ordre de configuration comprenant au moins l'une des opérations suivantes:
- un ordre de modification de ladite condition prédéterminée;
  - un ordre de modification dudit temps de réinitialisation prédéterminé; et
  - un ordre de modification de ladite valeur prédéterminée de nouvelle tentatives de réinitialisation.
8. Dispositif (1) selon l'une des revendications 1 à 7, **caractérisé en ce que** ledit moyen d'actionnement (170) comprend au moins un électroaimant (171), de préférence deux électroaimants (171) séparés par un espace d'accès (172).
9. Dispositif (1) selon la revendication 8, **caractérisé en ce que** chacun desdits au moins un électroaimant (171) est en outre pourvu d'un aimant permanent configuré pour maintenir la position dudit levier à bascule (160) en cas de perte de puissance électrique dans ledit électroaimant (171).
10. Dispositif (1) selon l'une des revendications 1 à 9, **caractérisé en ce que** ledit actionneur manuel (105) comprend:
- une tige d'actionneur (110) disposée dans une direction parallèle par rapport à ladite seconde borne mobile (154) dudit interrupteur à vide (150) et mobile dans ladite direction parallèle, ayant une extrémité distale par rapport audit interrupteur à vide (150) et une extrémité proximale par rapport audit interrupteur à vide (150);
  - un bouton poussoir (111) fixé à ladite tige d'actionneur (110) à ladite extrémité distale;
- ladite extrémité proximale étant assemblée de manière fixe audit premier segment (162) dudit bras de levier (160), de telle sorte qu'un mouvement dudit actionneur manuel (105) déplace ledit levier (160) et vice versa.
11. Dispositif (1) selon l'une des revendications 1 à 10, **caractérisé en ce que** ledit moyen de fixation (180) comprend:
- une douille (181) solidaire dudit bras de levier (160), munie d'un trou traversant central (182) traversé par ladite seconde borne (154) et de trous latéraux (183); et
  - une goupille (184) disposée traversant ladite seconde borne (154) et s'étendant perpendicu-

lairement à celle-ci et parallèlement audit axe basculant (161), traversant lesdits trous latéraux (183).

**12. Dispositif (1) selon la revendication 11, caractérisé en ce que** ledit moyen de verrouillage comprend :

- une partie mobile (190) comprenant un corps (191) pourvu d'un pêne (192) sur un premier côté du corps, ladite partie mobile (190) étant agencée de manière à être mobile le long d'une droite perpendiculaire à ladite seconde borne (154) et audit axe pivot (161), entre une position de verrouillage et une position de libération, ou inversement;
- un ressort (196) fixé à ladite partie mobile (190) sur un second côté du corps opposé audit premier côté du corps; et
- un trou de verrouillage (193) prévu dans ladite douille (181) et faisant face audit pêne (192) dans ladite première position basculante; ledit moyen de verrouillage étant configuré de telle sorte que dans ladite première position basculante, lorsque ladite partie mobile (190) est dans ladite position de verrouillage, ledit pêne (192) est introduit dans ledit trou de verrouillage (193), et ledit ressort (196) est dans une position de travail; et de telle sorte que dans ladite position de libération, ledit pêne (192) soit retiré dudit trou de verrouillage (193), et ledit ressort (196) soit dans une position d'attente; dans lequel ledit corps (191) comprend en outre une partie de poussée supérieure (194) sous la forme d'une rampe qui monte vers ladite seconde borne (154), et dans lequel ledit bras de levier (160) est pourvu d'une partie de poussée inférieure (195) sous la forme d'une rampe complémentaire à ladite partie de poussée supérieure (194) configurée de telle sorte que, dans ladite seconde position basculante, ladite partie de poussée inférieure (195) soit retirée de ladite partie de poussée supérieure (194) et lorsque ledit levier (160) se déplace de ladite seconde position basculante à ladite première position basculante, ladite partie de poussée inférieure (195) pousse ladite partie de poussée supérieure (194), entraînant ladite partie mobile (190) vers ladite position de verrouillage.

**13. Dispositif (1) selon la revendication 12, caractérisé en ce que** ladite partie mobile (190) comprend en outre :

- une tige à ressort (198) ayant une première extrémité fixée audit corps (191) sur ledit second côté du corps, et une seconde extrémité opposée à ladite première extrémité; et
- une bride (199) fixée à ladite tige à ressort (198)

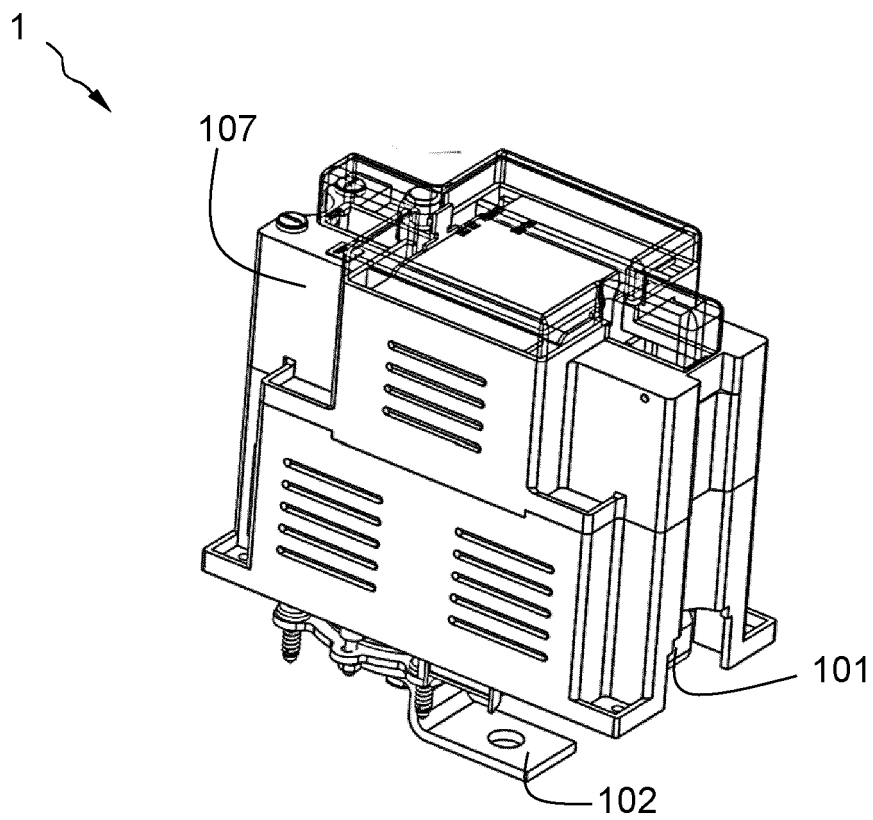
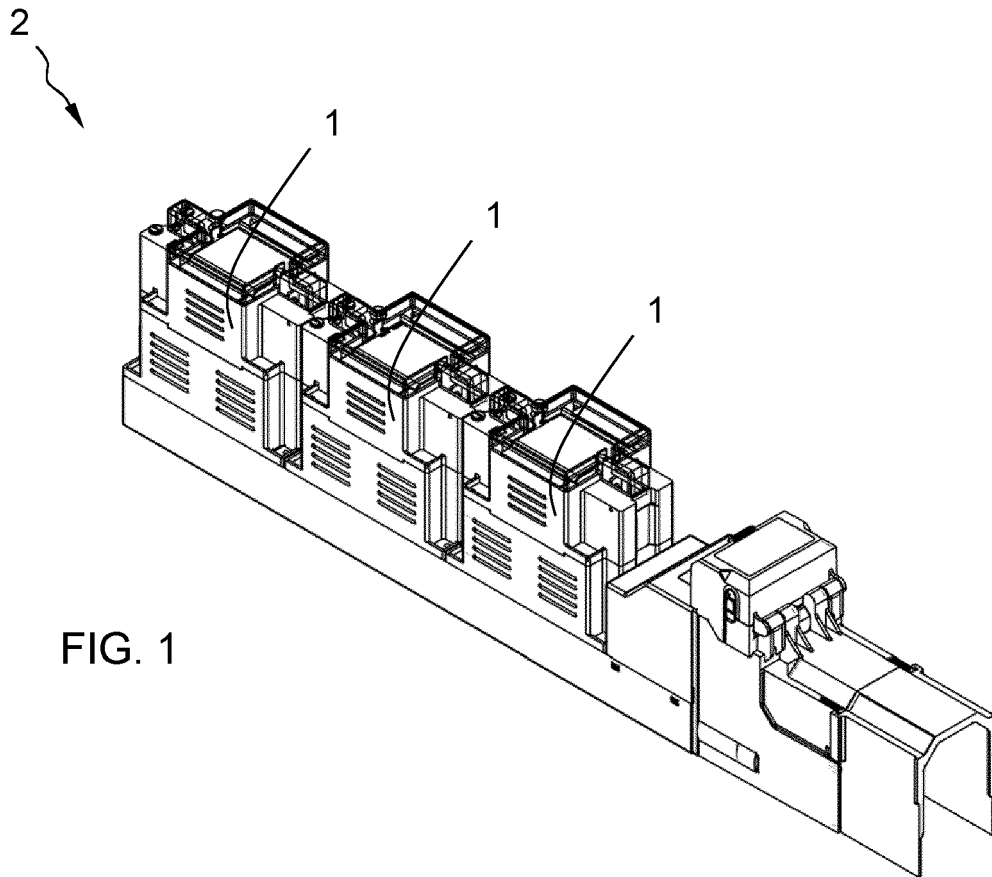
à ladite seconde extrémité;

ledit ressort (196) étant disposé autour de ladite tige à ressort (198), entre ladite bride (199) et ledit corps (191);

ledit dispositif (1) comprenant en outre des butées de guidage (197) agencées pour limiter le mouvement de ladite partie mobile (190) le long de ladite ligne droite; dans ladite position de travail, ledit ressort (196) est comprimé entre ladite bride et lesdites butées de guidage (197).

**14. Dispositif (1) selon l'une des revendications 1 à 13, caractérisé en ce que** ledit interrupteur à vide (150) est disposé verticalement, de telle sorte que ladite seconde borne mobile (154) est disposée de manière à pouvoir se déplacer dans la direction verticale, et dans lequel ledit fusible (103) est disposé au-dessus dudit interrupteur à vide (150).

**15. Socle à fusibles tripolaire (2) munie d'au moins un dispositif de sécurité électrique (1) selon l'une des revendications 1 à 14.**



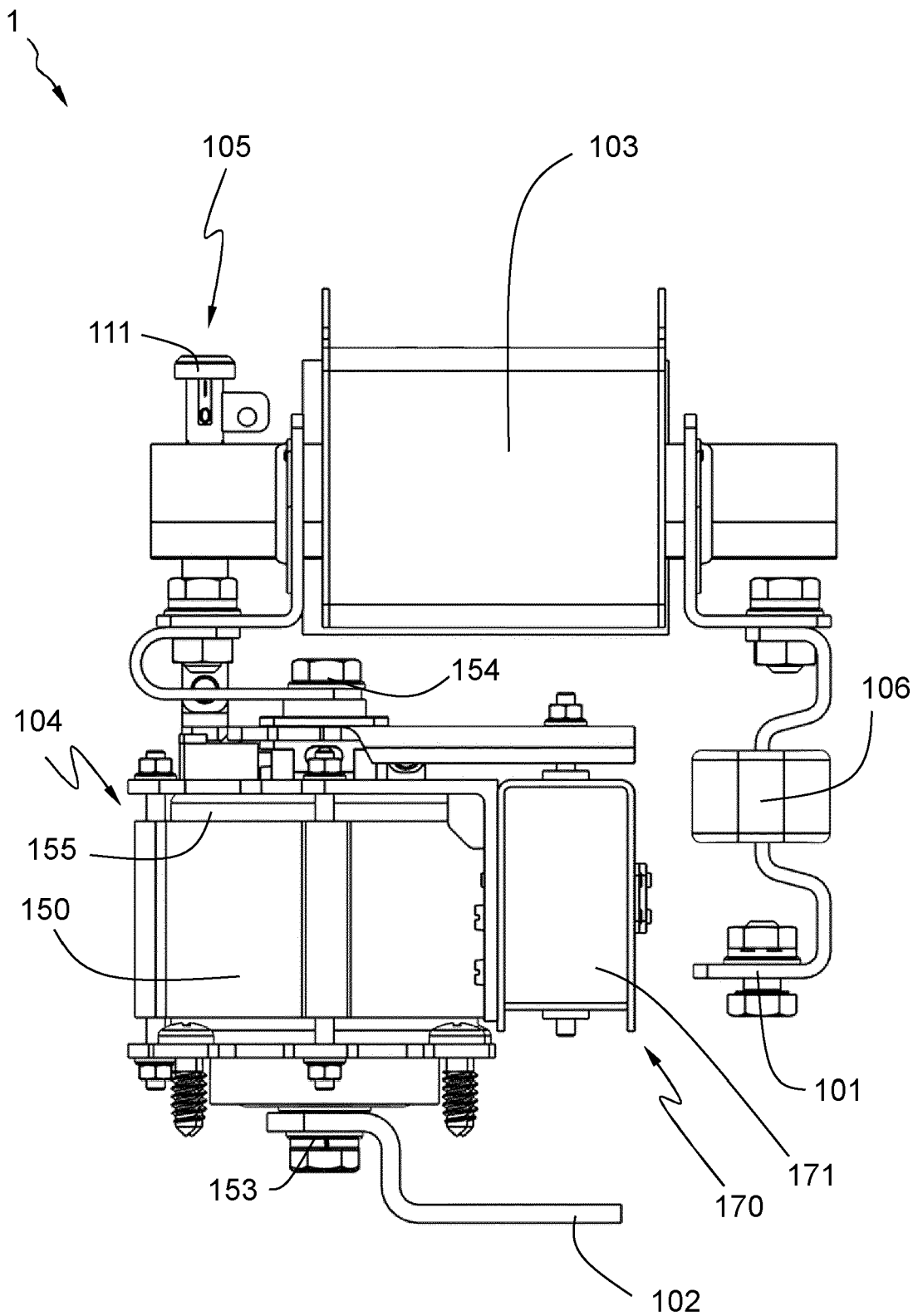


FIG. 3

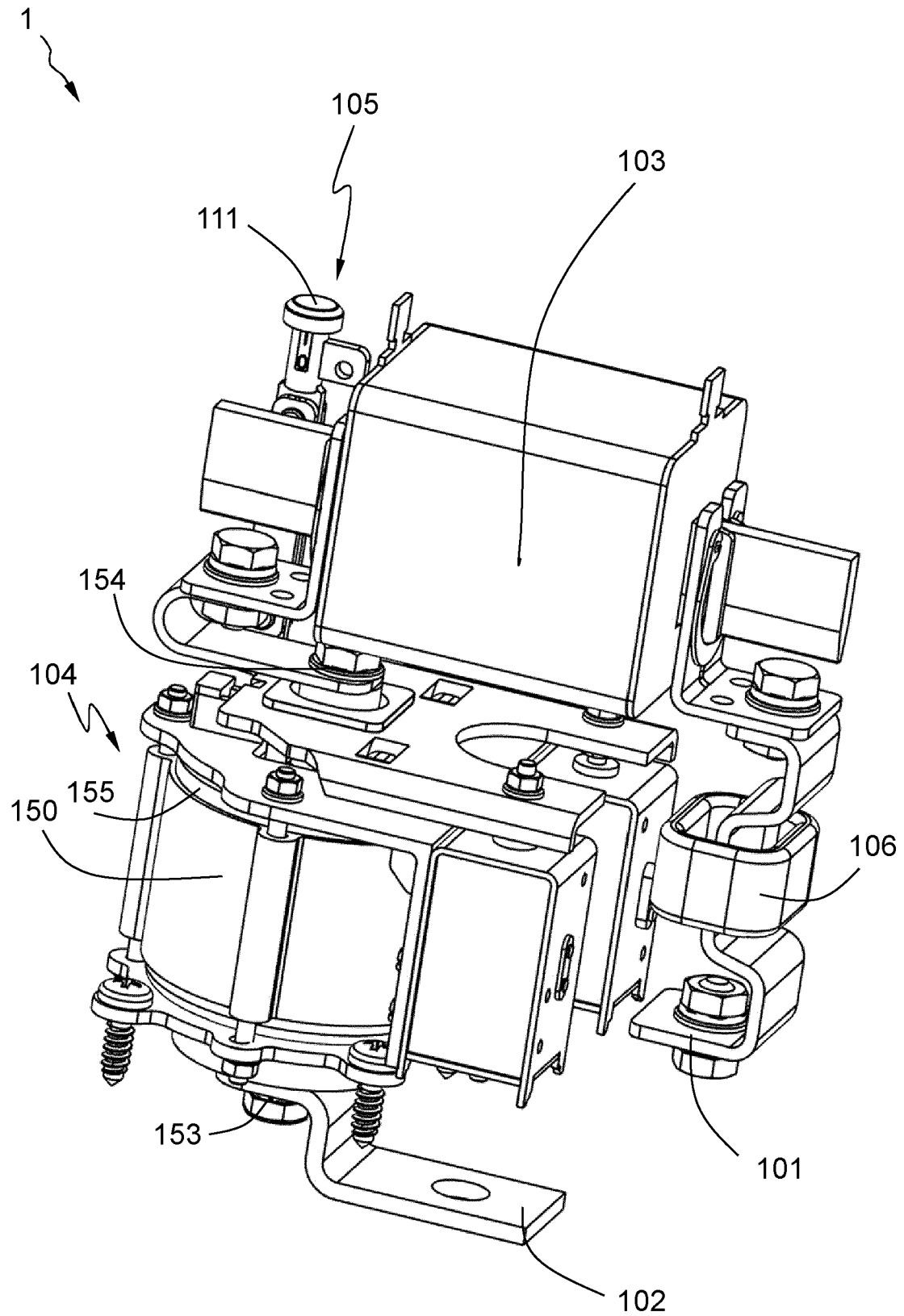


FIG. 4

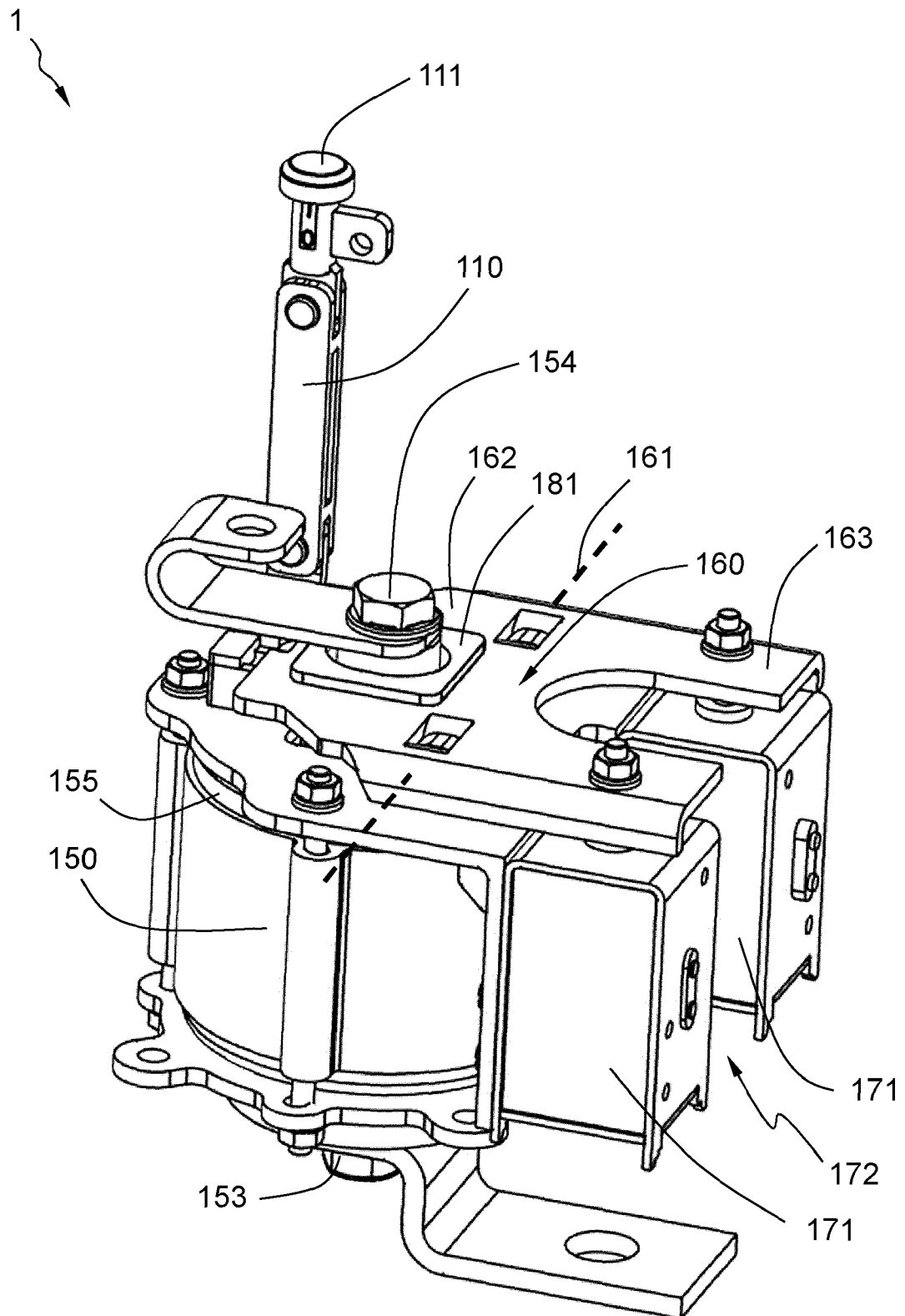


FIG. 5

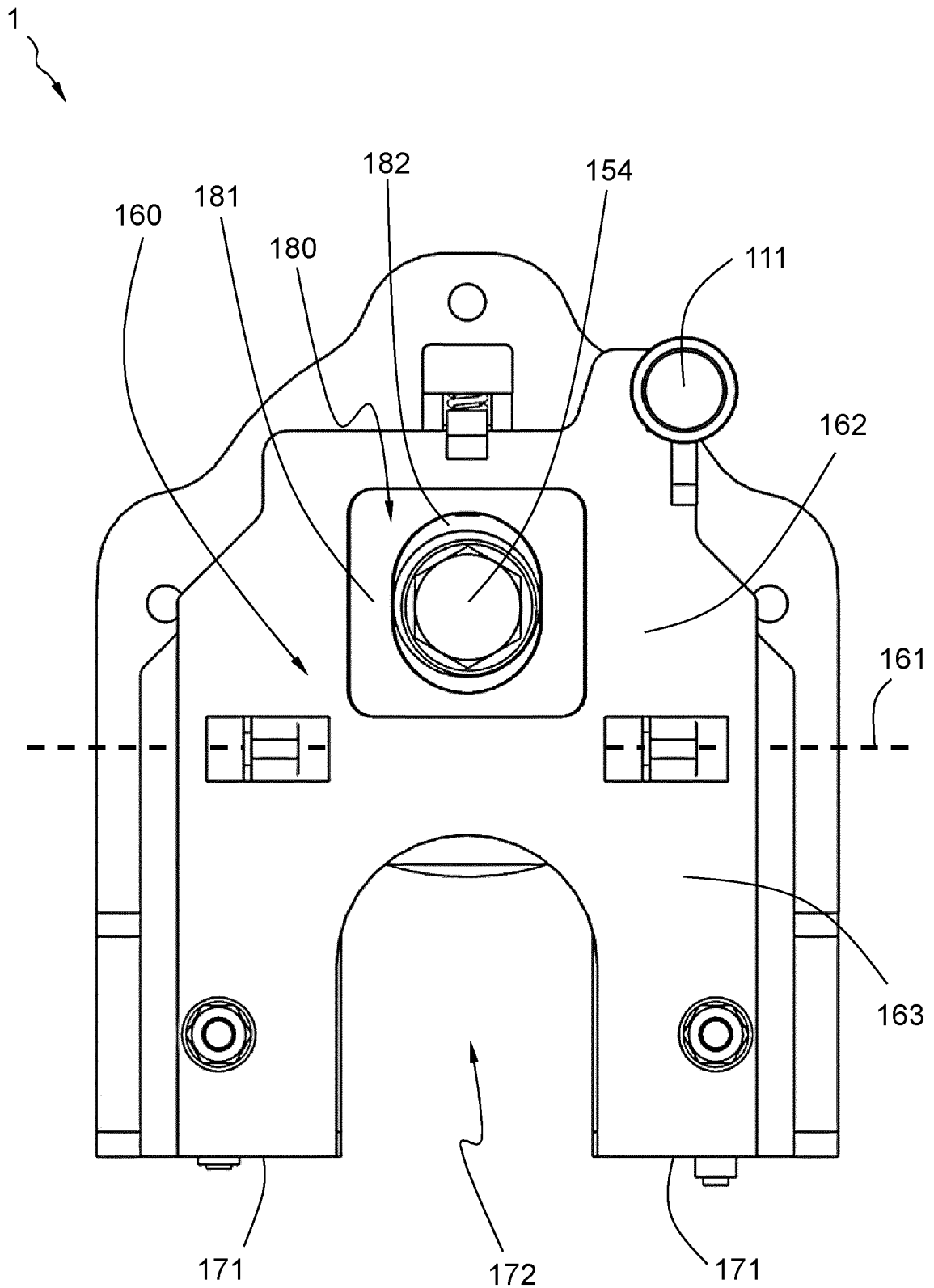


FIG. 6

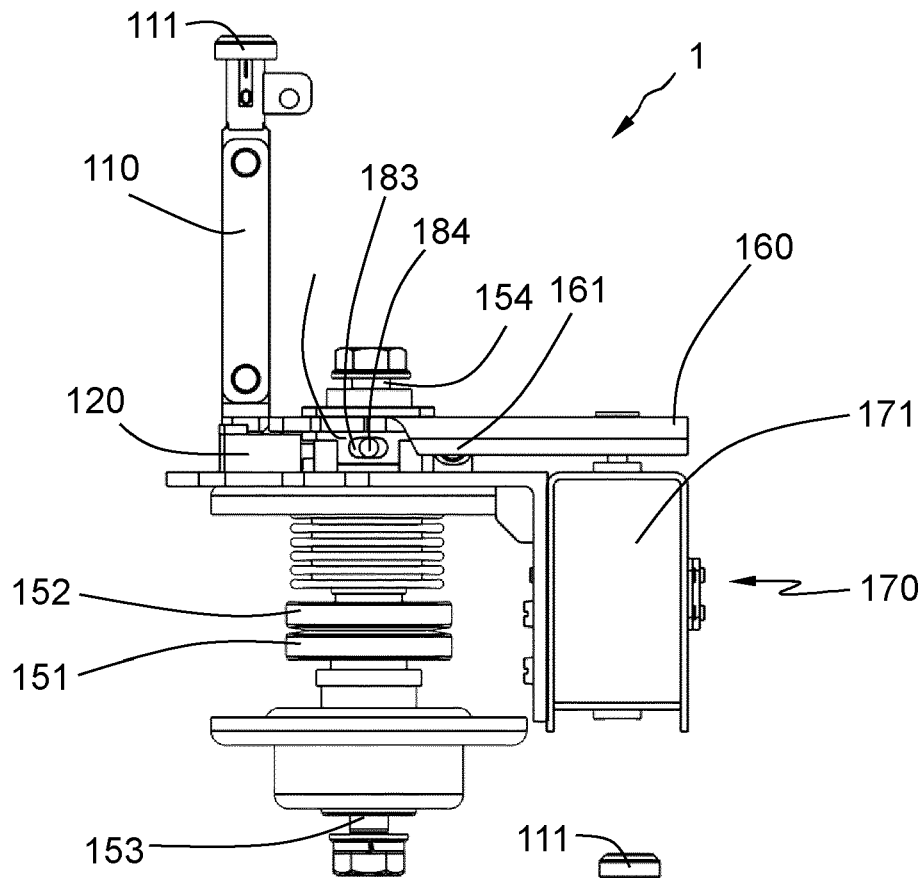


FIG. 7

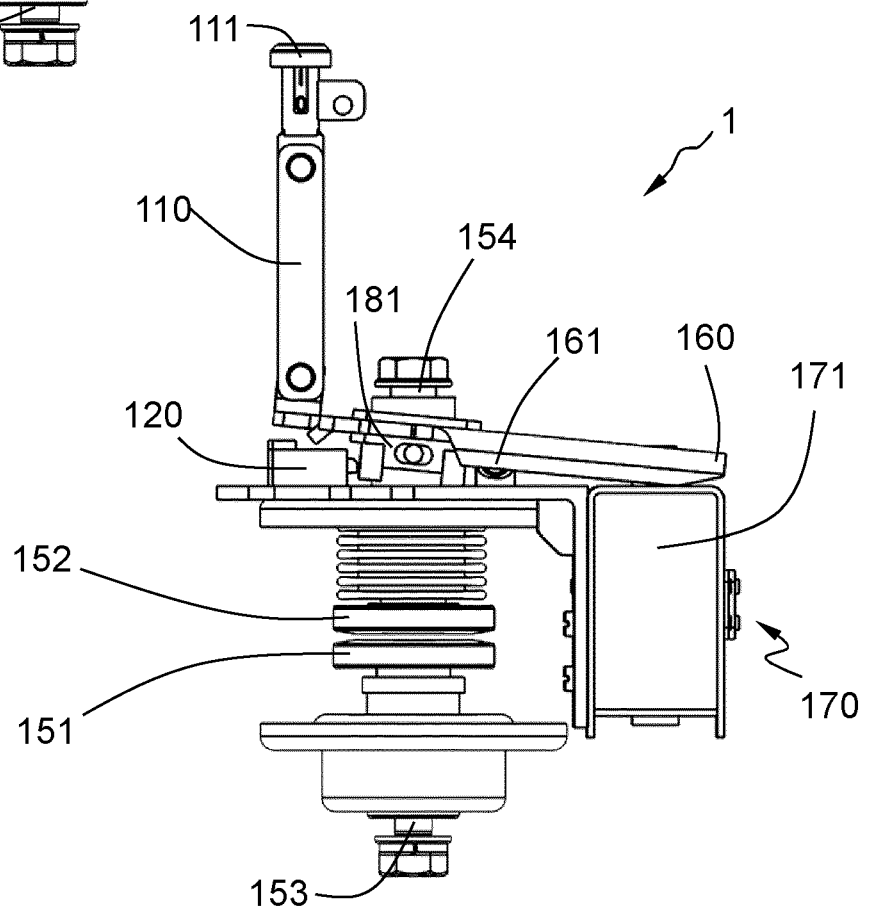


FIG. 8

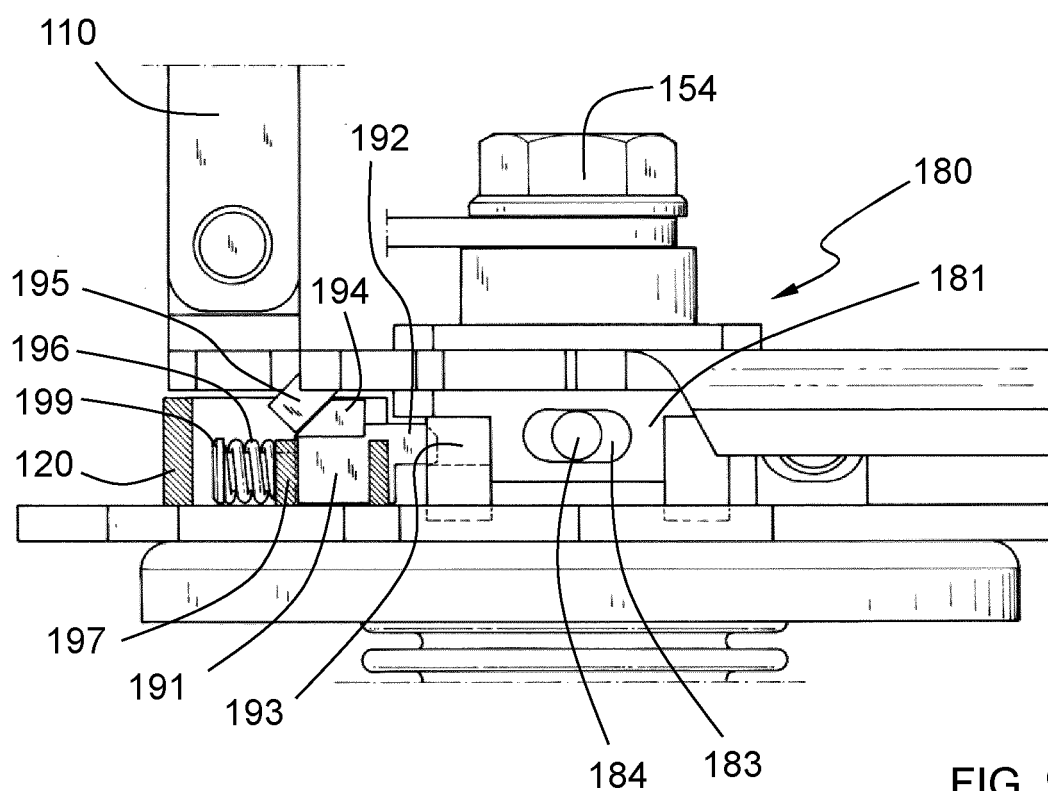


FIG. 9

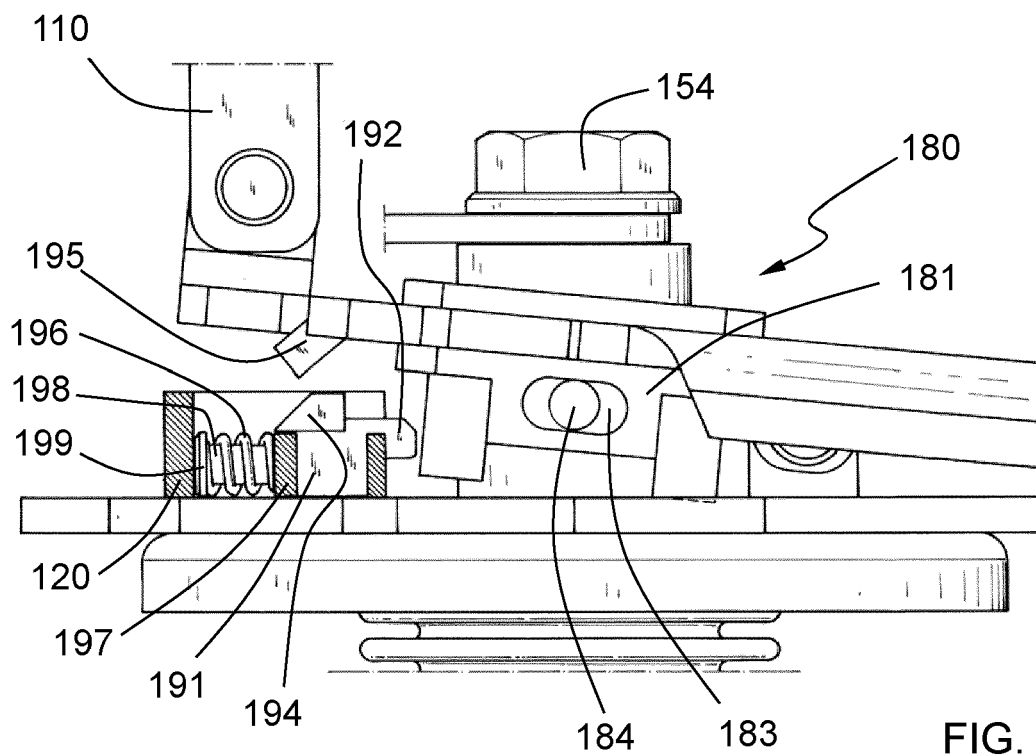


FIG. 10

**REFERENCES CITED IN THE DESCRIPTION**

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

**Patent documents cited in the description**

- WO 2016042290 A1 [0009]