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(54) ACCESSORY DEVICE FOR LOW-VOLTAGE ELECTRICAL INSTALLATIONS

(57) Accessory device for low-voltage installations, which is configured to be installed on a supporting structure together with and side by side a low-voltage protection device.

The accessory device comprises an insulating enclosure having a side portion facing said protection device, when said accessory device is installed on said supporting structure together with said protection device.

The accessory device further comprises a plurality of thermal sensors located at the side portion of said insulating enclosure and configured to detect temperatures at a plurality of thermal monitoring spots of said protection device, when said accessory device is installed on said supporting structure together with said protection device.

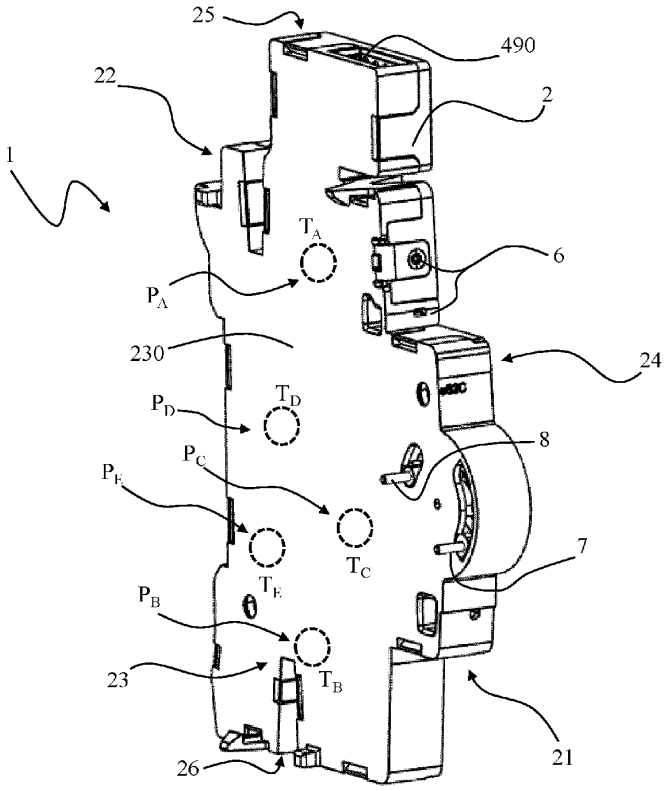


FIG. 1

EP 4 456 110 A1

Description

[0001] The present invention relates to the field of low-voltage electrical installations. More particularly, the present invention relates to an accessory device configured to be operatively coupled to a low-voltage protection device to provide monitoring functionalities of the operating conditions of said protection device.

[0002] Protection devices, such as MCBs, RCCBs, RCBOs and the like, are widely used in low-voltage electrical installations, such as electric power distribution grids or switchboards.

[0003] As is known, a protection device generally consists in a circuit breaker intended to be mounted on an electric line and typically configured to take two or three different operative states, namely a closed state, an open state and, possibly, a tripped state. In normal conditions of the electric line associated thereto, the protection device operates in a closed state, at which it enables a current flow along the conductors of the electric line. Instead, when it switches in a tripped state or in an open state, the protection device interrupts the current flowing along the conductors of the electric line.

[0004] In low-voltage installations, a protection device is often installed together with one or more accessory devices configured to provide signaling functionalities of the operating conditions of the protection device.

[0005] Some accessory devices are designed to signal whether the protection device operatively coupled thereto has carried out an opening manoeuvre.

[0006] Other accessory devices are configured to signal whether the protection device has carried out a tripping manoeuvre.

[0007] Currently available accessory devices of the state of the art do not ensure satisfactory monitoring services of the operating conditions of a protection device operatively coupled thereto.

[0008] Since they generally provide very basic signaling information, these accessory devices do not allow to carry out an effective diagnostics of the operating conditions of the protection device to identify possible incoming faults or possible installation or manufacturing errors in the protection device, while this latter is operating.

[0009] The main aim of the present invention is to provide an accessory device for low-voltage electrical installations, which allows overcoming or mitigating the mentioned technical problems of the state of the art.

[0010] Within the scope of this aim, an object of the present invention is to provide an accessory device, which is capable of providing improved monitoring services of the operating conditions of the protection device operatively coupled thereto.

[0011] Another object of the present invention is to provide an accessory device, which allows carrying out an effective diagnostics of the operating conditions of the protection device. Another object of the present invention is to provide an accessory device, which requires a relatively small space and relatively simple wiring operations for its installation.

[0012] Another object of the present invention is to provide an accessory device relatively easy to manufacture at industrial level, at competitive costs with respect to currently available devices of similar kind.

[0013] This aim, these objects and others that will become apparent hereinafter are achieved by an electronic protection device according to the following claim 1 and the related dependent claims.

[0014] The accessory device, according to the invention, is configured to be to be installed on a supporting structure together with and side by side a low-voltage protection device, for example a MCB, RCCB, RCBO, and the like.

[0015] The accessory device, according to the invention, is further configured to communicate with an outer electronic device, which may be, for example, a local control device.

[0016] According to the invention, the accessory device comprises an insulating enclosure having a side portion facing said protection device, when said accessory device is installed on said supporting structure together with said protection device.

[0017] According to the invention, the accessory device comprises a plurality of thermal sensors arranged at said side portion of the insulating enclosure and configured to detect temperatures at a plurality of thermal monitoring spots of said protection device, when said accessory device is installed on said supporting structure together with said protection device.

[0018] Said thermal sensors are arranged at selected positions, which are distributed along said side portion. The position of each thermal sensor conveniently corresponds to a desired thermal monitoring spot of the protection device, which is conveniently located in proximity of a given internal component of the protection device.

[0019] According to some embodiments of the invention, said thermal sensors have a thermal contact surface in thermal contact with said side portion of the insulating enclosure. Said side portion is, in turn, in thermal contact with said protection device, when said accessory device is installed on said supporting structure together with said protection device.

[0020] According to other embodiments of the invention, said thermal sensors have a thermal contact surface in thermal contact with said protection device, when said accessory device is installed on said supporting structure together with said protection device.

[0021] Preferably, the above-mentioned thermal sensors include two or more thermal sensors among:

- a first thermal sensor arranged at a first position along the above-mentioned side portion of said insulating enclosure. The position of said first thermal sensor corresponds to a first thermal monitoring spot of said protection device, which is located in proximity of a first electric terminal of said protection device;
- a second thermal sensor arranged at a second po-

sition along said side portion. The position of said second thermal sensor corresponds to a second thermal monitoring spot of said protection device, which is located in proximity of a second electric terminal of said protection device;

- a third thermal sensor arranged at a third position along said side portion. The position of said third thermal sensor corresponds to a third thermal monitoring spot of said protection device, which is located in proximity of a contact region of said protection device;
- a fourth thermal sensor arranged at a fourth position along said side portion. The position of said fourth thermal sensor corresponds to a fourth thermal monitoring spot of said protection device, which is located in proximity of tripping means of said protection device;
- a fifth thermal sensor arranged at a fifth position along said side portion. The position of said fifth thermal sensor corresponds to a fifth thermal monitoring spot of said protection device, which is located in proximity of a part of said protection device, which in operation is colder compared to other parts of said protection device.

[0022] According to the invention, the accessory device comprises a control module electrically connected to said thermal sensors. These latter are configured to transmit thermal detection signals to said control module, which are indicative of temperatures detected by said thermal sensors during operation of said protection device. Said control module is configured to receive and process said thermal detection signals and provide first detection information indicative of a thermal behaviour of said protection device based on said thermal detection signals.

[0023] Preferably, the above-mentioned thermal sensors are of the NTC type.

[0024] According to an aspect of the invention, the accessory device is configured to provide signaling services of an open state of said protection device.

[0025] The accessory device comprises a first lever protruding from said insulating enclosure and configured to be solidly coupled to a first mechanical component of said protection device. Said first mechanical component is configured to move during an opening manoeuvre of said protection device. Preferably, said first mechanical component is a handle of said protection device, which may be manually operated by a user or an actuator to carry out an opening manoeuvre of said protection device.

[0026] The above-mentioned first lever is configured to move from a first position to a second position, upon actuation by the first mechanical component of said protection device, when said protection device carries out an opening manoeuvre.

[0027] The accessory device further comprises a motion transmission mechanism mechanically coupled to said first lever and operatively coupled to a first switch circuit, which preferably includes a first microswitch mechanically coupled to said motion transmission mechanism in such a way to be actuatable by said motion transmission mechanism.

[0028] The motion transmission mechanism is configured to activate the switch circuit in response to a movement of said first lever from said first position to said second position (preferably by actuating the first microswitch).

[0029] Said first switch circuit is electrically connected to said control module and it is configured to provide a first state detection signal, which is indicative of an open state taken by said protection device during operation of said protection device, to said control module in response to the activation by said motion transmission mechanism (preferably in response to the actuation of said first microswitch by said motion transmission mechanism).

[0030] According to an aspect of the invention, the accessory device is configured to provide signaling services of a tripping manoeuvre of said protection device.

[0031] The accessory device comprises a second lever protruding from said insulating enclosure and configured to be solidly coupled to a second mechanical component of said protection device. Said second mechanical component is configured to move during a tripping manoeuvre of said protection device. Preferably, said second mechanical component is a trip lever of said protection device, which trips during a tripping manoeuvre of said protection device.

[0032] The above-mentioned second lever is configured to move from a third position to a fourth position, upon actuation by the second mechanical component of said protection device, when said protection device carries out a tripping manoeuvre.

[0033] Said motion transmission mechanism is mechanically coupled to said second lever.

[0034] The accessory device comprises a second switch circuit, to which said motion transmission lever is operatively coupled. The second switch circuit preferably includes a second microswitch mechanically coupled to said motion transmission mechanism in such a way to be actuatable by said motion transmission mechanism.

[0035] Said motion transmission mechanism is configured to activate said second switch circuit in response to a movement of said second lever from said third position to said fourth position (preferably by actuating the second microswitch).

[0036] Said second switch circuit is electrically connected to said control module and it is configured to provide a second state detection signal to said control module in response to the activation of said second switch circuit by said motion transmission mechanism (preferably in response to the actuation of said second microswitch by said motion transmission mechanism).

[0037] Said second state detection signal is indicative of a tripping manoeuvre carried out by said protection device, during operation of said protection device.

[0038] Advantageously, the control module of said accessory device is configured to receive and process the above-mentioned first state detection signal, and possibly the above-mentioned second state detection signal.

[0039] Said control module is configured to provide second detection information indicative of an operating state taken by said protection device based on said first state detection signal, and possibly on said second state detection signal.

[0040] According to an aspect of the invention, the accessory device comprises a communication module electrically connected to said control module. Said communication module is configured to allow said control module to communicate with an electronic device by using a data packet communication mode.

[0041] According to an aspect of the invention, the accessory device comprises a power supply module electrically connected to one or more electronic components of said accessory device. Preferably, said power supply module is configured to receive a power supply voltage to feed said electronic components from said electronic device.

[0042] Preferably, said communication module and said power supply module are operatively coupled to a single cable interface configured to be connected to a bus cable, which is connectable to said electronic device.

[0043] According to an aspect of the invention, the accessory device comprises an interface module electrically connected to said control module. Said interface module includes signaling means driven by said control module and user interface means configured to allow a user to send data signals or command signals to said control module.

[0044] In a further aspect, the present invention relates to an electrical installation according to claim 13 and related independent claims.

[0045] In a further aspect, the present invention relates to a diagnostic method, according to claim 15. Further characteristics and advantages of the invention will become apparent from the detailed description of exemplary embodiments of the protection device, which is illustrated only by way of non-limitative examples in the accompanying drawings, wherein:

Figures 1-3 are some schematic view of the accessory device, according to the invention;

Figure 4 schematically shows a block diagram of the accessory device, according to the invention, when operatively coupled to a protection device and a local control device;

Figures 5 schematically shows a block diagram of the accessory device, according to the invention, when installed on a support, such as a DIN rail;

Figures 6 schematically shows a block diagram of a diagnostic method, in which detection data made available by the accessory device, according to the invention, are processed to check the operating conditions of a low-voltage protection device of an electrical installation.

[0046] With reference to the cited figures, the present invention relates to an accessory device 1 for low-voltage electrical installations.

[0047] For the purposes of the present application, the term "low voltage" (LV) relates to operating voltages lower than 1,5 kV AC and 2,0 kV DC.

[0048] The accessory device 1 is intended to be operatively associated to a low-voltage protection device 10, for example a MCB, RCCB, RCBO, and the like.

[0049] The protection device 10 is electrically connected to an electric line 101 and it is configured to allow or interrupt a current flow between different sections of said electric line.

[0050] In general terms, the protection device comprises an insulating enclosure 11 and a number of internal components 15, 16 accommodated in the internal volume defined by said insulating enclosure.

[0051] Conveniently, the protection device 10 may be arranged according to different configurations. In a possible configuration, the protection device 10 can take three different operative states, namely a closed state, a tripped state and an open state.

[0052] In another configuration, the protection device 10 can take two different operative states only, namely a closed state and an open state.

[0053] Normally, the protection device 10 operates in a closed state, at which it allows a current to flow along the electric line 101 between the upstream and downstream sections of this latter. When it switches in a tripped state or in an open state, the protection device 10 interrupts the current flow along the electric line 101, thereby electrically disconnecting the upstream and downstream portions of this latter.

[0054] The protection device 10 is configured to switch automatically from the closed state to a tripped state or to an open state (tripping manoeuvre) in case of fault conditions (e.g., for example, ground fault conditions, arc fault conditions, overvoltage conditions, short-circuit conditions, and the like) in the electric line or, in some cases, in the protection device itself. The protection device 10 is configured to switch from a closed state to an open state (opening manoeuvre) upon actuation by a user or by another driving device (e.g., an electro-mechanical actuator) operatively coupled thereto.

[0055] Preferably, the accessory device 1 is configured to communicate with an electronic device 90, which may be, for example, a local control device adapted to collect information from a number of installed field devices and manage the operation of protection devices and possibly, other electronic devices included in the electrical installation.

[0056] Preferably, the local control device 90 is, in turn, configured to communicate with remote computerized devices or platforms, for example via the Internet or a dedicated LAN.

[0057] In general terms, the protection device 10 and

the electronic device 90 may be industrially arranged according to solutions of known type. Therefore, in the following, they will be described only in relation to the aspects of interest of the invention, for the sake of brevity.

[0058] In use, the accessory device 1 is installed on a supporting structure 500 together with the protection device 10 and, possibly, the electronic device 90 (as shown in figure 5). The supporting structure 500 may be, for example, a DIN rail or a similar support arrangement. The accessory device 1 comprises an insulating enclosure 2 (preferably made of an electrically insulating material) adapted to be fixed to the supporting structure 500.

[0059] The insulating enclosure 2 of the switch pole is shaped as a contoured box with opposite front and rear walls 21, 22, opposite side walls 23, 24 and top and bottom walls 25, 26.

[0060] For the sake of clarity, it is specified that the relative terms used in this disclosure, e.g., "front", "rear", "lateral", "upper", "lower", "top" and "bottom" relate to the switch accessory 1 in its normal installation conditions, namely in the vertical installation shown in the cited figures. As shown in figure 2, the insulating enclosure 2 is preferably formed by a pair of half shells coupled one to another. In practice, a first half shell comprises a portion of the front wall 21, a first side wall 23, a portion of the rear wall 22, a portion of the top wall 25 and a portion of the bottom wall 26, while a second half shell comprises a further portion of the front wall 21, a second side wall 24, a further portion of the rear wall 22, a further portion of the top wall 25 and a further portion of the bottom wall 26.

[0061] When it is installed on the field, the accessory device 1 is placed side by side the protection device 10. The insulating enclosure 2 thus includes a side portion 230 facing the protection device 10, namely a corresponding side portion of the insulating enclosure of this latter. Preferably, the side portion 230 of the insulating enclosure 2 is put in thermal contact with the protection device 20, more particularly with the insulating enclosure 11 of this latter, when installed as described above.

[0062] For the sake of clarity, it is specified that the term "thermal contact" used in this disclosure refers to arrangements, in which two components or bodies are attached or put in proximity one to another in such a way that there can be a transmission of heat from a body to another.

[0063] In the embodiments shown in cited figures, the above-mentioned side portion 230 is part of a first side wall 23 of the insulating enclosure. According to other embodiments of the invention, however, the side portion of the insulating enclosure 2, which is intended to face the protection device 10, may be located at the opposite second side wall 24 of the insulating enclosure. The accessory device 1 comprises a control module 3 accommodated in the internal volume defined by the insulating enclosure 2. The control module 3 may include data processing resources, preferably of digital type, e.g., one or more microcontrollers capable of executing stored software instructions.

[0064] Basically, the control module 3 is configured to carry out control tasks to control the operation of the accessory device, data processing tasks for processing detection signals coming from suitable sensors or switches of the accessory device and, possibly, communication tasks with an outer electronic device.

[0065] As mentioned above, according to an aspect of the invention, the accessory device 1 is preferably configured to communicate at local level with an outer electronic device 90 operatively associated thereto.

[0066] Preferably, the accessory device 1 comprises a communication module 4 operatively connected (electrically connected) to the control module 3. Advantageously, the communication module 4 is configured to allow the control module 3 to communicate with the electronic device 90 according to a data packet communication mode.

[0067] According to the embodiment shown in the cited figures, the communication module 4 is configured to allow the control module 3 to communicate with the electronic device 90 in a wired mode. To this aim, the communication module 4 may include, for example, a communication port configured be electrically connected to a RS485 cable and communicate through a Modbus™ communication protocol.

[0068] According to other embodiments of the invention (not shown), however, the communication module 4 may be configured to allow the control module 3 to communicate with the electronic device 90 in a wireless mode. To this aim, the communication module 4 may include, for example, a communication port configured to communicate at local level through a wireless communication protocol, such as Wi-Fi™, Bluetooth™, Zigbee™, and the like.

[0069] According to another aspect of the invention, the accessory device 1 comprises a power supply module 9 electrically connected to the internal electronic components (e.g., the control module 3) of the accessory device and configured to feed said electronic components.

[0070] The power supply module 9 includes suitable electronic circuits configured to draw electric power from an outer power source and provide suitable power supply voltages to the electronic components of the accessory device.

[0071] According to the embodiments shown in the cited figures, such a power supply source is advantageously the electronic device 90 communicating with the accessory device. In principle, however, it may be any suitable device or circuit adapted to provide an auxiliary power supply. According to the embodiments shown in the cited figures, the accessory device 1 is electrically connected to the electronic device 90 by means of a bus cable 110 (e.g., a flat cable) including a communication line 102 and a power supply line 103.

[0072] Preferably, the above-mentioned communication module 4 and power supply module 9 are operatively

coupled to a single cable interface 49 configured to be mechanically and electrically connected to the bus cable 110, which is in turn configured to be mechanically and electrically connected to the electronic device 90.

[0073] Conveniently, the cable interface 49 includes a connector 490 having first pins and second pins (not shown) configured to be electrically connected to the communication line 102 and the power supply line 103 of the bus cable 110, respectively.

[0074] The accessory device 1 can thus communicate in a wired manner with the electronic device 90 and, at the same time, be fed by this latter.

[0075] According to another aspect of the invention, the accessory device 1 comprises an interface module 6 electrically connected to the control module 3.

[0076] Preferably, the interface module 6 includes suitable signaling means driven by the control module 3. As an example, said signaling means may include one or more LEDs arranged on the front wall 21 of the insulating enclosure 3 and configured to emit light signals indicative of the operating conditions of the accessory device 1 or the protection device 10.

[0077] Preferably, the interface module 6 includes user interface means configured to allow a user to send data signals or command signals to the control module. As an example, said user interface means may include one or more buttons arranged on the front wall 21 of the insulating enclosure 3 and manually operable by the user to send data signals (e.g., configuration signals) or command signals (e.g., reset commands or configuration signals) to the control module 3.

[0078] In general terms, the communication module 4, the power supply module 9 and the interface module 6 may be industrially arranged according to solutions of known type. Therefore, in the following, they will be described only in relation to the aspects of interest of the invention, for the sake of brevity.

[0079] According to the invention, the accessory device 1 is configured to monitor the thermal behaviour of the protection device 10, while this latter is operating.

[0080] The accessory device 1 comprises a plurality of thermal sensors T_A, T_B, Tc, T_D, T_E arranged at the side portion 230 of the insulating enclosure 2.

[0081] During the operation of the accessory device, the thermal sensors T_A, T_B, Tc, T_D, T_E detect temperatures at a plurality of thermal monitoring spots Z_A, Z_B, Z_C, Z_D, Z_E of the protection device.

[0082] For the sake of clarity, it is specified that a "thermal monitoring spot" of the protection device is a region of the protection device selected in such a way to allow monitoring the temperature variations of a corresponding internal component of the protection device, while this latter is operating. In practice, the thermal monitoring spots Z_A, Z_B, Z_C, Z_D, Z_E of the protection device are regions of the insulating enclosure of the protection device, which are located in proximity of critical internal components of the protection device. Variations of temperatures at the thermal monitoring spots Z_A, Z_B, Z_C, Z_D, Z_E may thus be indicative of possible anomalous conditions of such internal components in the protection device 10.

[0083] The thermal sensors T_A, T_B, Tc, T_D, T_E are arranged at selected positions P_A, P_B, P_C, P_D, P_E that are distributed along the side portion 230 of the insulating enclosure 2. The position of each thermal sensors T_A, T_B, T_C, T_D, T_E corresponds to a thermal monitoring spot Z_A, Z_B, Z_C, Z_D, Z_E of the protection device 10. The detection of possible "hot spots" by the thermal sensors T_A, T_B, T_C, T_D, T_E may therefore indicate that anomalous conditions of such internal components in the protection device 10 are present.

[0084] Preferably, the above-mentioned thermal sensors comprise a first thermal sensor T_A and a second thermal sensor T_B arranged respectively at a first position P_A, which corresponds to a first thermal monitoring spot Z_A of the protection device, and at a second position P_B, which corresponds to a second thermal monitoring spot Z_B of the protection device. The first thermal monitoring spot Z_A and the second thermal monitoring spot Z_B are respectively located in proximity of a first electric terminal and of a second electric terminal of the protection device 10.

[0085] As it is apparent from the above, the thermal sensors T_A, T_B allow monitoring the thermal behaviour of the electric terminals of the protection device 10, at which this latter is electrically connected to the electric line 101. An anomalous temperature increase detected by the thermal sensor T_A or T_B may be indicative of loose electrical connections between the electric terminals of the protection device 10 and the corresponding conductor of the electric line 101. Preferably, the above-mentioned thermal sensors comprise a third thermal sensor Tc arranged respectively at a third position Pc, which corresponds to a third thermal monitoring spot Zc of the protection device. The third thermal monitoring spot Zc is located in proximity of the contact region of the protection device 10. The thermal sensor Tc allows monitoring the thermal behaviour of the separable arcing contacts of the protection device 10. An anomalous temperature increase detected by the thermal sensor Tc may be indicative of the presence of welding spots between the electric contacts or of an excessive erosion of these latter. Preferably, the above-mentioned thermal sensors comprise a fourth thermal sensor T_D arranged respectively at a fourth position P_D, which corresponds to a fourth thermal monitoring spot Z_D of the protection device. The fourth thermal monitoring spot Z_D is located in proximity of tripping means of the protection device 10. The thermal sensor T_D thus allows monitoring the thermal behaviour of the tripping means of the protection device 10, which are configured to cause a tripping manoeuvre of the protection device in case of overload or short-circuit events in the electric line 101. An anomalous temperature increase detected by the thermal sensor T_D may be indicative of an incoming fault at bi-metal actuator or trip coil actuator of the protection device.

[0086] Preferably, the above-mentioned thermal sen-

sors comprise a fifth thermal sensor T_E arranged respectively at a fifth position P_E, which corresponds to a fifth thermal monitoring spot Z_E of the protection device. The fifth thermal monitoring spot Z_E is located in proximity of a colder part of said protection device compared to other parts of said protection device. In practice, the fifth thermal monitoring spot Z_E is located in proximity of a part of the protection device, which does not warm up appreciably while this latter is operating. The fifth thermal monitoring spot Z_E is generally a "cold spot" of the protection device, the temperature of which is very close to the temperature of the environment, where the protection device is installed.

[0087] The arrangement of the thermal sensor T_E is particularly useful as it allows fixing a baseline temperature for the temperatures detected by other thermal sensors distributed along the side portion 230.

[0088] As it is evident from the above, monitoring the thermal behaviour of the thermal monitoring spots Z_A, Z_B, Z_C, Z_D, Z_E of the protection device 10 by the thermal sensors T_A, T_B, T_C, T_D, T_E allows collecting useful information to identify possible incoming faults or possible installation or manufacturing errors of critical internal components in the protection device 10. According to preferred embodiments of the invention, the accessory device 1 comprises all the thermal sensors T_A, T_B, T_C, T_D, T_E described above. According to other embodiments, however, the accessory device may include just some of the above-described thermal sensors. As it is evident to the skilled person, the accessory device 1 may also include additional thermal sensors with respect to those described above. Preferably, also these additional thermal sensors are distributed along the side portion 230 of the insulating enclosure 2 and are advantageously configured to detect temperatures at further thermal monitoring spots of the protection device.

[0089] According to the invention, the thermal sensors T_A, T_B, Tc, T_D, T_E of the accessory device are configured to transmit thermal detection signals D_A, D_B, D_C, D_D, D_E to the control module 3. Said thermal detection signals are indicative of the temperatures detected by said thermal sensors during the operation of the protection device 10.

[0090] The control module 3 is configured to receive and process the thermal detection signals D_A, D_B, D_C, D_D, D_E and, based on these latter, provide first detection information I_T indicative of a thermal behaviour of the protection device 10.

[0091] The first detection information I_T may advantageously include suitable detection data, such as temperature values detected by the thermal sensors T_A, T_B, Tc, T_D, T_E or other thermal values (e.g., temperature variation values, relative temperature values, and the like), which can be obtained by suitably processing the thermal detection signals D_A, D_B, Dc, D_D, D_E.

[0092] Preferably, the control module 3 sends the first detection information I_T to the electronic device 90, which may process it for diagnostic purposes, as described in the following.

[0093] According to some embodiments of the invention, the control module 3 may be configured to carry out some diagnostic functionalities at local level. In this case, the first detection information I_T conveniently include also diagnostic data and, possibly, alarm messages to be further processed by the electronic device 90.

[0094] In an industrial implementation of the accessory device, the thermal sensors T_A, T_B, Tc, T_D, T_E may be arranged together with most of the other internal electronic components of the accessory device (e.g., the electronic modules 3, 4, 6, 9 described above) on a suitable circuit support member 29 (for example a printed circuit board) accommodated in the internal volume defined by the insulating enclosure.

[0095] According to some embodiments of the invention (shown in the cited figures), the thermal sensors T_A, T_B, Tc, T_D, T_E have a thermal contact surface in thermal contact (attached or in proximity) with the side portion 230 of the insulating enclosure 2. The side portion 230 is, in turn, in thermal contact (attached or in proximity) with the protection device, preferably with an insulating enclosure of this latter, when the accessory device is installed on the supporting structure 500 together with the protection device.

[0096] According to these embodiments of the invention, the thermal sensors T_A, T_B, Tc, T_D, T_E may be arranged on the circuit member 29 in such a way to be located just behind the side portion 230 of the insulating enclosure. The thermal sensors T_A, T_B, Tc, T_D, T_E may have their thermal contact surfaces thermally bonded to the internal surface of the side portion of the insulating enclosure. To this aim. a thermally conductive bonding material, such as thermally conductive silicone, may be used.

[0097] According to other embodiments of the invention (not shown), the thermal sensors T_A, T_B, Tc, T_D, T_E have their thermal contact surfaces in thermal contact (attached or in proximity) with the protection device 10, preferably with an insulating enclosure of this latter when the accessory device is installed on the supporting structure 500 together with the protection device. According to these embodiments of the invention, the insulating enclosure 2 conveniently comprises a plurality of ports at the side portion 230, each located at a corresponding position P_A, P_B, P_C, P_D, P_E selected for a thermal sensor T_A, T_B, Tc, T_D, T_E. Conveniently, each thermal sensor T_A, T_B, Tc, T_D, T_E is arranged at a corresponding port of the insulating enclosure in such a way to have a thermal contact surface substantially flush or slightly or slightly recessed relative to an outer surface of the side portion 230.

[0098] Preferably, when the accessory device 1 is installed side by side the protection device 10, the thermal sensors T_A, T_B, Tc, T_D, T_E have their thermal contact surfaces thermally bonded to the insulating enclosure of the protection device 10. Also in this case, a thermally conductive bonding material may be suitably used.

[0099] Preferably, the thermal sensor T_A, T_B, Tc, T_D, T_E are of the NTC type. However, other kinds of thermal sensors may be conveniently used, according to the needs.

[0100] According to an aspect of the invention, the accessory device 1 is configured to monitor whether the protection device 10 takes an open state in operation.

[0101] Preferably, the accessory device 1 comprises a first lever 7 protruding from the insulating enclosure 2 of the accessory device, a motion transmission mechanism 5 mechanically coupled to said first lever and operatively coupled to a first switch circuit 51 electrically connected to the control module 3.

[0102] Preferably, the first switch circuit 51 includes a first microswitch W_A mechanically coupled to said motion transmission mechanism in such a way that it can be actuated by this latter.

[0103] When said accessory device is installed on the supporting structure 500 together with the protection device 10, the first lever 7 is solidly coupled to a first mechanical component 15 of the protection device 10, which moves from a corresponding closing position to an opening position, when the protection device 10 carries out an opening manoeuvre or a tripping manoeuvre.

[0104] Preferably, the first mechanical component 15 is the handle of the protection device 10 or another mechanical component solidly coupled with said handle in such a way to move together with this latter.

[0105] When the protection device 10 carries out an opening manoeuvre or a tripping manoeuvre, the first lever 7 moves from a first position to a second position, upon actuation by the first mechanical component 15 of the protection device.

[0106] In response to such a movement of the first lever 7, the motion transmission mechanism 5 activates the switch circuit 51. This latter provides a first state detection signal S_A to the control module 3 in response to the activation by the motion transmission mechanism. The first state detection signal S_A is indicative of an open state taken by the protection device.

[0107] Preferably, the motion transmission mechanism 5 actuates the first microswitch W_A of the first switch circuit 51 in response to the movement of the first lever 7 and the switch circuit 51 provides the first state detection signal S_A in response to the actuation of the first microswitch. According to other embodiments, however, the switch circuit 51 may include a different device (for example a magnetic device, a hall sensor, a photocell, a photoelectric sensor, and the like) activated in response to a motion of the motion transmission mechanism.

[0108] According to a further aspect of the invention, the accessory device 1 may be also configured to monitor whether the protection device 10 carries out a tripping manoeuvre in operation.

[0109] In this case, the accessory device 1 comprises a second lever 8 protruding from the insulating enclosure 2 of the accessory device and a second switch circuit 52, to which the motion transmission mechanism 5 is operatively coupled.

[0110] Preferably, the second switch circuit 52 includes a second microswitch W_B mechanically coupled to the motion transmission mechanism 5.

[0111] The second switch circuit 52 is electrically connected to the control module 3.

[0112] When the accessory device is installed on the supporting structure 500 together with the protection device 10, the second lever 8 is solidly coupled to a second mechanical component 16 of the protection device 10, which moves from a corresponding closing position to a tripping position, when the protection device 10 carries out a tripping manoeuvre.

[0113] Preferably, the second mechanical component 16 is a trip lever of the protection device 10 or another mechanical component solidly coupled with said trip lever in such a way to move together with this latter.

[0114] When the protection device 10 carries out a tripping manoeuvre, the second lever 8 moves from a third position to a fourth position, upon actuation by the second mechanical component 16 of the protection device.

[0115] In response to such a movement of the second lever 8, the motion transmission mechanism 5 activates the switch circuit 52. This latter provides a second state detection signal S_B to the control module 3 in response to the activation by the motion transmission mechanism. The second state detection signal S_B is indicative of a tripping manoeuvre carried out by the protection device.

[0116] Preferably, the motion transmission mechanism 5 actuates the second microswitch W_B of the second switch circuit 52 in response to the movement of the second lever 8 and the switch circuit 52 provides the second state detection signal S_B in response to the actuation of the second microswitch.

[0117] According to other embodiments, however, the switch circuit 52 may include a different device (for example a magnetic device, a hall sensor, a photocell, a photoelectric sensor, and the like) activated in response to a motion of the motion transmission mechanism.

[0118] The control module 3 is configured to receive and process the first state detection signal S_A provided by the first switch circuit 51, and possibly the second state detection signal S_B provided by the second switch circuit 52.

[0119] Based on the first state detection signal S_A, and possibly on the second state detection signal S_B, the control module 3 provides second detection information Is indicative of an operating state taken the protection device 10.

[0120] The second detection information I_T may advantageously include suitable logic values indicative of the operating state taken by the protection device 10, which can be obtained by suitably processing the state detection signals S_A, S_B.

[0121] Preferably, the control module 3 sends the second detection information Is to the electronic device 90, which is conveniently configured to process said information for signaling purposes.

[0122] In an industrial implementation of the accessory device, the first and second levers 7, 8 may be formed by suitable pins protruding from the insulating enclosure 2, the first and second switch circuit 51, 52 may be arranged on the circuit support member 29 while the motion transmission mechanism 5 may be accommodated in a suitable portion of the internal volume defined by the insulating enclosure 2.

[0123] In general terms, the levers 7, 8, the motion transmission mechanism 5 and the switch circuits 51, 52 may be industrially arranged according to solutions of known type. Therefore, in the following, they will be described only in relation to the aspects of interest of the invention, for the sake of brevity.

[0124] Figure 5 shows a typical low-voltage electrical installation including the accessory device, according to the invention. Such an electrical installation comprises:

- the protection device 10 installed on the supporting structure 500 (e.g., a DIN rail) and electrically connected to an electric line 101;
- the accessory device 1 installed on the supporting structure 500 together with and side by side the protection device 10;
- the electronic device 90 installed on the supporting structure 500 and in communication with the accessory device 1.

[0125] The electronic device 90 is electrically connected to the accessory device 1 through a flat cable 110, which includes a communication line 102 and a power supply line 103. The electronic device 90 and the accessory device can thus communicate in a wired manner and the accessory device 1 is electrically fed by the electronic device 90.

[0126] The electronic device 90 is advantageously configured to receive and process first detection information I_T indicative of a thermal behaviour of the protection device 10, which is provided by the accessory device 1.

[0127] Preferably, the electronic device 90 is also configured to receive and process the second detection information Is indicative of an operating state taken by the protection device 10, which is provided by the accessory device 1.

[0128] As the skilled person will certainly understand, the above-mentioned installation may be arranged to solutions of different type.

[0129] As an example, also the electronic device 90 may be installed side by side the protection device (on an opposite side relative to the accessory device) or side by side the accessory device (on an opposite side relative to the protection device).

[0130] As a further example, the electronic device 90 may be installed on a different supporting structure compared to the support structure 500, on which the protection device 10 and the accessory device 1 are installed.

[0131] As a further example, when the accessory device 1 is configured to communicate wirelessly at local level, the electronic device 90 may be installed at a certain distance from the protection device 10 and the accessory device 1.

[0132] As mentioned above, the information provided by the thermal sensors T_A, T_B, Tc, T_D, T_E of the accessory device may be conveniently processed for carrying out diagnostic procedures directed to check the thermal behaviour of the protection device 10.

[0133] In a further aspect, the present invention is related to a diagnostic method 1000 for checking a thermal behaviour of a protection device 10, to which the accessory device 10 is operatively coupled as described above.

[0134] Preferably, the diagnostic method 1000 is carried out by the electronic device 90 based on detection data D_T included in the first diagnostic information I_T provided by the accessory device.

[0135] According to other embodiments of the invention, however, the diagnostic method 1000 might be carried by the control module 3 of the accessory device itself based on detection data D_T directly calculated by said control module. In this case, the first diagnostic information I_T provided to the electronic device 90 will include diagnostic data and, possibly, alarm messages to be further processed by the electronic device 90.

[0136] The diagnostic method 1000 comprises a step 1001 of acquiring detection data D_T indicative of the thermal behaviour of the protection device 10.

[0137] Conveniently, the detection data D_T are calculated by the accessory device 1 by suitably processing the thermal detection signals D_A, D_B, Dc, D_D, D_E provided by the thermal sensors T_A, T_B, Tc, T_D, T_E. They may advantageously include temperature values detected by the above-mentioned thermal sensors or other thermal values calculated by processing the above-mentioned temperature values.

[0138] In the embodiments, in which the diagnostic method 1000 is carried out by the electronic module 90, the detection data D_T will be part of the first detection information I_T sent by the accessory device 1 to the electronic device 90.

[0139] In the embodiments in which the diagnostic method 1000 is carried out by the accessory device, the detection data D_T will be immediately available to the control module 3 upon processing the thermal detection signals provided by the thermal sensors.

[0140] The diagnostic method 1000 then comprises a step 1002 of calculating first diagnostic data M_T indicative of a thermal condition of the protection device 10 based on the acquired detection data D_T. The first diagnostic data M_T conveniently includes a thermal map of the protection device 10.

[0141] The diagnostic method 1000 comprises a step 1003 of comparing the calculated first diagnostic data M_T with predefined second diagnostic data Mo indicative of a reference thermal condition of the protection device. The second diagnostic data Mo are conveniently stored

in a memory and they may be selected depending on additional detection information related to operating conditions of said protection device 10. For example, such additional detection information may include data related to operating currents and voltages of the protection device as detected by suitable sensors of the electrical installation, data indicative of the operating age of the protection device, and the like.

[0142] In the embodiments, in which the diagnostic method 1000 is carried out by the electronic module 90, the above-mentioned additional detection information may be provided to the electronic device by the accessory device itself or by suitable sensors or additional electronic devices communicating with the electronic device 90.

[0143] In the embodiments in which the diagnostic method 1000 is carried out by the accessory device, the above-mentioned additional detection information may be provided to the control module 3 of the accessory device by electronic device 90.

[0144] The diagnostic method 1000 comprises a step 1004 of providing an alarm message A_L, if the first diagnostic data M_T do not match with the second diagnostic data Mo. In this case, in fact, the comparison between the first and second diagnostic data M_T, Mo has allowed to identify anomalies in the thermal behaviour of the protection device, which may be indicative of possible incoming faults or possible installation or manufacturing errors in the protection device.

[0145] In the embodiments, in which the diagnostic method 1000 is carried out by the electronic module 90, the above-mentioned alarm messages may be sent to remote computerized devices or platforms directly by the electronic device 90.

[0146] In the embodiments in which the diagnostic method 1000 is carried out by the accessory device, the above-mentioned alarm messages may be sent to the electronic device 90 by the accessory device. The electronic device 90, in turn, may send these alarm messages to remote computerized devices or platforms.

[0147] Conveniently, the diagnostic method 1000 is executed cyclically by the electronic device 90 or by the control module 3 of the accessory device. At each processing cycle, the first diagnostic data M_T (thermal map) of the protection device 10 will be updated based on newly acquired detection data D_T made available by the accessory device by processing the thermal detection signals provided by the thermal sensors.

[0148] It has been found in practice that the accessory device, according to the invention, fully achieves the intended aim and objects.

[0149] The accessory device 1, according to the invention, provides improved monitoring services of the operating conditions of the protection device operatively coupled thereto. In particular, in addition to the most traditional signaling services related to the operating state of the protection device, the accessory device is capable of providing relevant detection data related to the thermal behaviour of the protection device, which may be conveniently exploited for carrying out an effective diagnostics directed to identify possible incoming faults or possible installation or manufacturing errors in the protection device.

[0150] These capabilities can be suitably exploited to plan on-time and tailored maintenance interventions in such a way to prevent malfunctions of the electric line and ensure a continuity of service.

[0151] The accessory device 1 has a compact structure and it requires a relatively small place for its installation on the field. Wiring operations between the accessory device 1 and the electronic device 90 are relatively simple as these latter devices are at most connected by a suitable bus cable.

[0152] The accessory device 1 has proven to be easy to industrially manufacture, at competitive costs with respect to currently available protection devices.

Claims

1. Accessory device (1) for low-voltage installations,

wherein said accessory device is configured to be installed on a supporting structure (500) together with and side by side a low-voltage protection device (10),
wherein said accessory device comprises an insulating enclosure (2) having a side portion (230) facing said protection device (10), when said accessory device is installed on said supporting structure together with said protection device,
characterised in that it comprises:

- a plurality of thermal sensors (T_A, T_B, Tc, T_D, T_E) arranged at said side portion (230) of the insulating enclosure (2) and configured to detect temperatures at a plurality of thermal monitoring spots (Z_A, Z_B, Z_C, Z_D, Z_E) of said protection device, when said accessory device is installed on said supporting structure together with said protection device,
wherein said thermal sensors are arranged at selected positions (P_A, P_B, P_C, P_D, P_E) distributed along said side portion (230), the position of each thermal sensor corresponding to a thermal monitoring spot (Z_A, Z_B, Z_C, Z_D, Z_E) of said protection device;
- a control module (3) including digital data processing resources and electrically connected to said thermal sensors (T_A, T_B, Tc, T_D, T_E);

wherein said thermal sensors (T_A, T_B, Tc, T_D, T_E) are configured to transmit thermal detection signals (D_A, D_B, Dc, D_D, D_E) to said control mod-

ule (3), said thermal detection signals being indicative of temperatures detected by said thermal sensors during operation of said protection device,
wherein said control module (3) is configured to receive and process said thermal detection signals (D_A, D_B, Dc, D_D, D_E) and provide first detection information (I_T) indicative of a thermal behaviour of said protection device based on said thermal detection signals.

2. Accessory device, according to claim 1, **characterised in that** said thermal sensors (T_A, T_B, Tc, T_D, T_E) have a thermal contact surface in thermal contact with said side portion (230) of the insulating enclosure (2), said side portion being in thermal contact with said protection device, when said accessory device is installed on said supporting structure together with said protection device.

3. Accessory device, according to claim 1, **characterised in that** said thermal sensors (T_A, T_B, Tc, T_D, T_E) have a thermal contact surface in thermal contact with said protection device, when said accessory device is installed on said supporting structure together with said protection device.

4. Accessory device, according to one of the preceding claims, **characterised in that** said thermal sensors (T_A, T_B, Tc, T_D, T_E) are of the NTC type.

5. Accessory device, according to one of the preceding claims, **characterised in that** said thermal sensors include two or more thermal sensors among:

- a first thermal sensor (T_A) arranged at a first position (P_A) along said side portion (230), the position of said first thermal sensor corresponding to a first thermal monitoring spot (Z_A) of said protection device in proximity of a first electric terminal of said protection device;
- a second thermal sensor (T_B) arranged at a second position (P_B) along said side portion (230), the position of said second thermal sensor corresponding to a second thermal monitoring spot (Z_B) of said protection device in proximity of a second electric terminal of said protection device;
- a third thermal sensor (Tc) arranged at a third position (Pc) along said side portion (230), the position of said third thermal sensor corresponding to a third thermal monitoring spot (Zc) of said protection device in proximity of a contact region of said protection device;
- a fourth thermal sensor (T_D) arranged at a fourth position (P_D) along said side portion (230), the position of said fourth thermal sensor corresponding to a fourth thermal monitoring spot (Z_D) of said protection device in proximity of tripping means of said protection device;
- a fifth thermal sensor (T_E) arranged at a fifth position (P_E) along said side portion (230), the position of said fifth thermal sensor corresponding to a fifth thermal monitoring spot (Z_E) of said protection device in proximity of a colder part of said protection device compared to other parts of said protection device.

6. Accessory device, according to one of the preceding claims, **characterised in that** it comprises:

- a first lever (7) protruding from said first insulating enclosure (2) and configured to be solidly coupled to a first mechanical component (15) of said protection device, said first mechanical component being configured to move during an opening manoeuvre of said protection device;
- a motion transmission mechanism (5) mechanically coupled to said first lever (7);
- a first switch circuit (51) operatively coupled to said motion transmission mechanism and electrically connected to said control module (3);
wherein said first lever (7) is configured to move from a first position to a second position, upon actuation by the first mechanical component (15) of said protection device, when said protection device carries out an opening manoeuvre,
wherein said motion transmission mechanism (5) is configured to activate said first switch circuit (51) in response to a movement of said first lever (7) from said first position to said second position;
wherein said first switch circuit (51) is configured to provide a first state detection signal (S_A) to said control module (3) in response to activation by said motion transmission mechanism, said first state detection signal (S_A) being indicative of an open state taken by said protection device.

7. Accessory device, according to claim 6, **characterised in that** it comprises:

- a second lever (8) protruding from said first insulating enclosure (2) and configured to be solidly coupled to a second mechanical component (16) of said protection device, said second mechanical component being configured to move during a tripping manoeuvre of said protection device, said motion transmission mechanism (5) being mechanically coupled to said second lever (8);
- a second switch circuit (52) operatively coupled to said motion transmission mechanism and electrically connected to said control module (3);
wherein said second lever (8) is configured to move from a third position to a fourth position,

upon actuation by the second mechanical component (16) of said protection device, when said protection device carries out a tripping manoeuvre,
wherein said motion transmission mechanism (5) is configured to activate said second switch circuit (52) in response to a movement of said second lever (8) from said third position to said fourth position;
wherein said second switch circuit (52) is configured to provide a second state detection signal (S_B) to said control module (3) in response to the activation by said motion transmission mechanism, said second state detection signal (S_B) being indicative of a tripping manoeuvre carried out by said protection device.

8. Accessory device, according to one of the claims from 6 to 7, **characterised in that** said control module (3) is configured to receive and process said first state detection signal (S_A), and possibly said second state detection signal (S_B), and provide second detection information (Is) indicative of an operating state taken by said protection device based on said first state detection signal, and possibly on said second state detection signal.

9. Accessory device, according to one of the preceding claims, **characterised in that** it comprises a communication module (4) electrically connected to said control module (3), said communication module being configured to allow said control module to communicate with an electronic device (90) by using a data packet communication mode.

10. Accessory device, according to one of the preceding claims, **characterised in that** it comprises a power supply module (9) electrically connected to one or more electronic components (3, 6, 51, 52) of said accessory device.

11. Accessory device, according to claims 9 and 10, **characterised in that** said communication module (4) and said power supply module (9) are operatively coupled to a single cable interface (49) configured to be connected to a bus cable (110) connectable to said electronic device (90).

12. Accessory device, according to one of the preceding claims, **characterised in that** it comprises an interface module (6) electrically connected to said control module (3), said interface module including signaling means driven by said control module and user interface means configured to allow a user to send data signals or command signals to said control module.

13. A low-voltage electrical installation (100) **characterised in that** it comprises an accessory device (1), according to one of the previous claims.

14. Electrical installation (100), according to claim 13, comprising:

- a low-voltage protection device (10) installed on a supporting structure (500) and electrically connected to an electric line (101);
- said accessory device (1) installed on said supporting structure (500) together with and side by side said protection device;
- a control unit (90) installed on said supporting structure (500) and in communication with said accessory device (1), said control unit being configured to receive and process first detection information (I_T) indicative of a thermal behaviour of said protection device, and possibly second detection information (Is) indicative of an operating state taken by said protection device, provided by said accessory device (1).

15. A diagnostic method (1000) for checking a thermal behaviour of a protection device (10) of a low-voltage electrical installation, said diagnostic method including the following steps:

- acquiring (1001) first detection data (D_T) indicative of a thermal behaviour of said protection device (10), said detection data being calculated and provided by an accessory device (1), according to one of the claims from 1 to 12, operatively coupled to said protection device (10);
- calculating (1002) first diagnostic data (M_T) indicative of a thermal condition of said protection device (10) based on said detection data (D_T);
- comparing (1003) the calculated first diagnostic data (M_T) with predefined second diagnostic data (Mo) indicative of a thermal condition of said protection device;
- providing (1004) an alarm message (A_L), if said first diagnostic data (M_T) do not match with said second diagnostic data (Mo).

FIG. 1

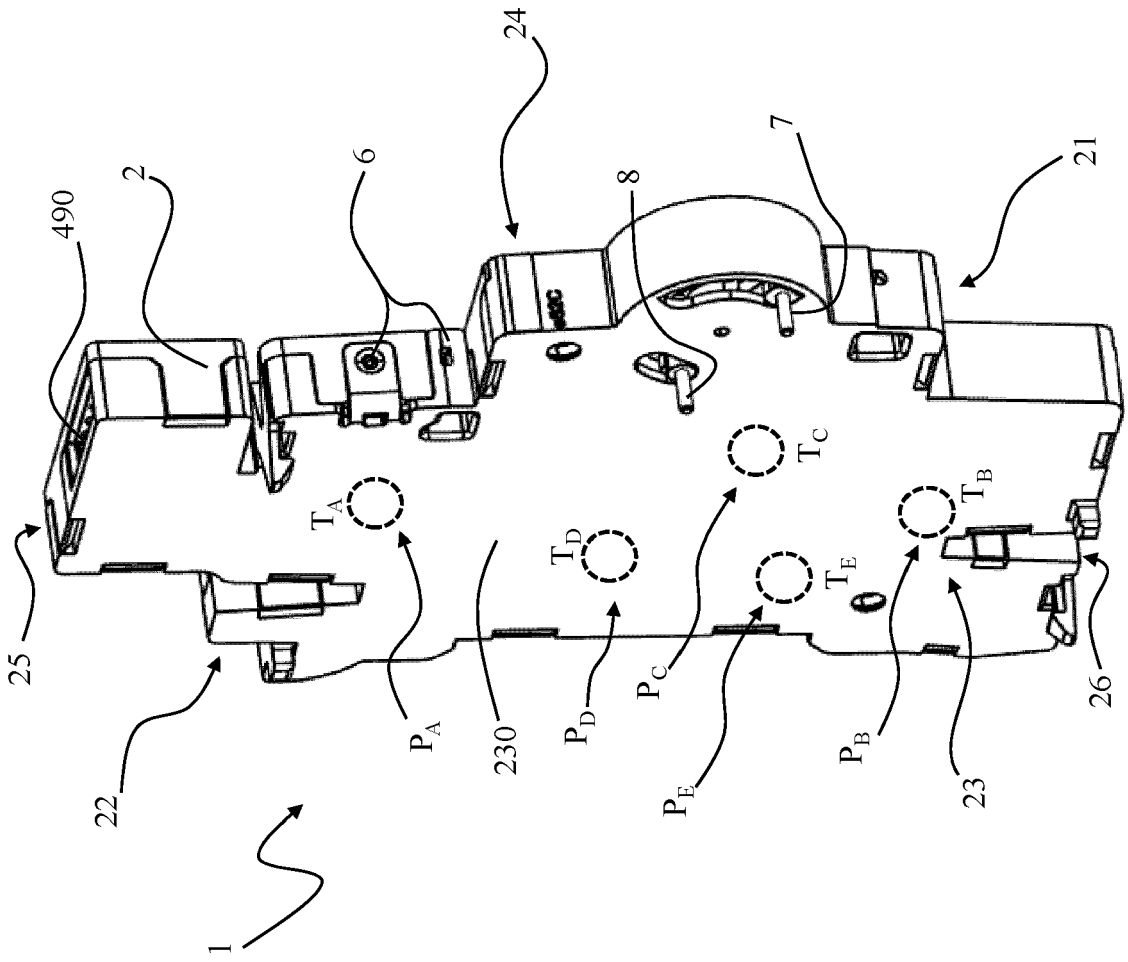


FIG. 2

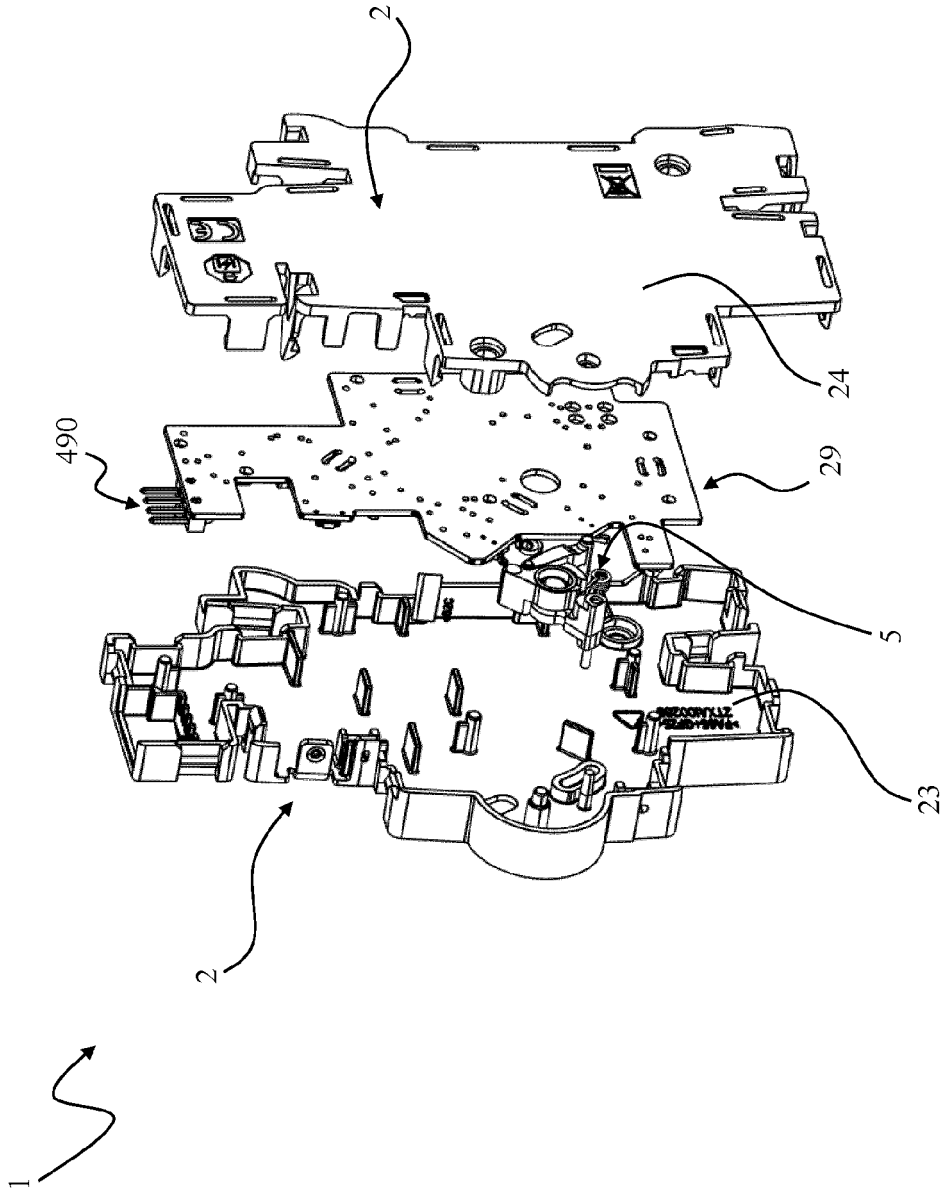


FIG. 3

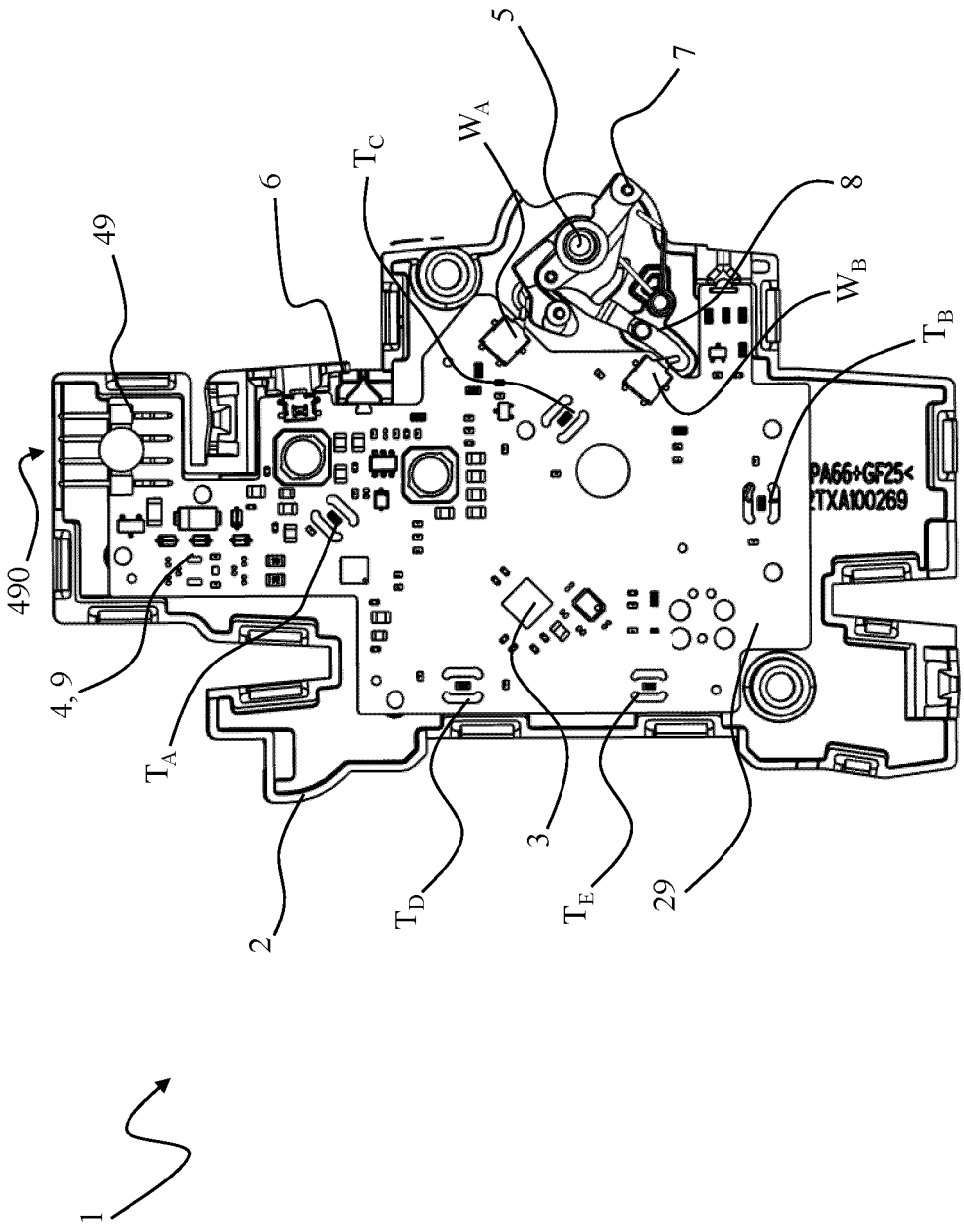


FIG. 4

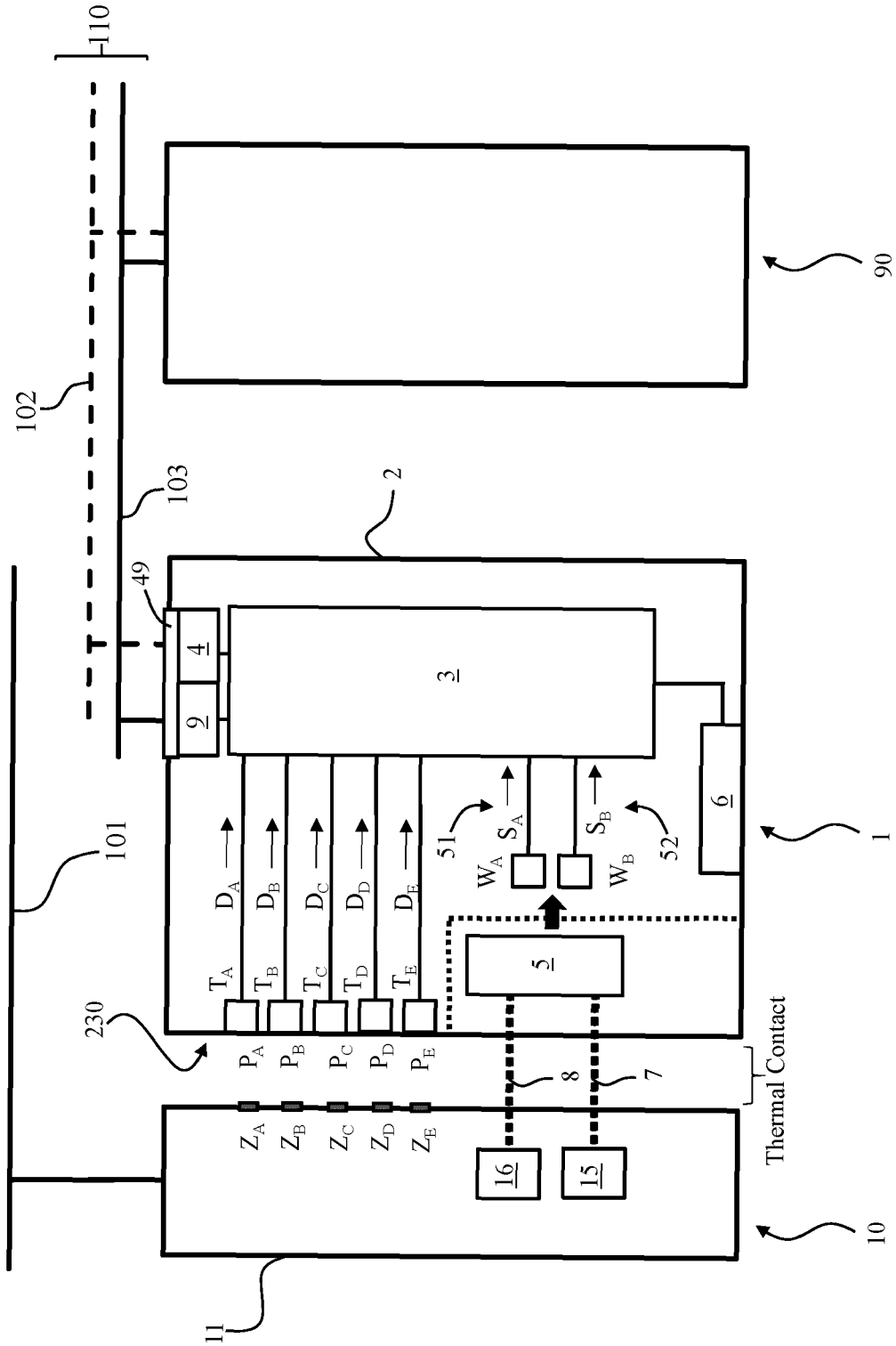

110
102
103
2
49
4
9
3
6
90
1
101
230
T_A T_B T_C T_D T_E
D_A D_B D_C D_D D_E
P_A P_B P_C P_D P_E
51
W_A S_A
S_B W_B
52
5
8
7
Thermal Contact
Z_A Z_B Z_C Z_D Z_E
16
15
10
11

FIG. 5

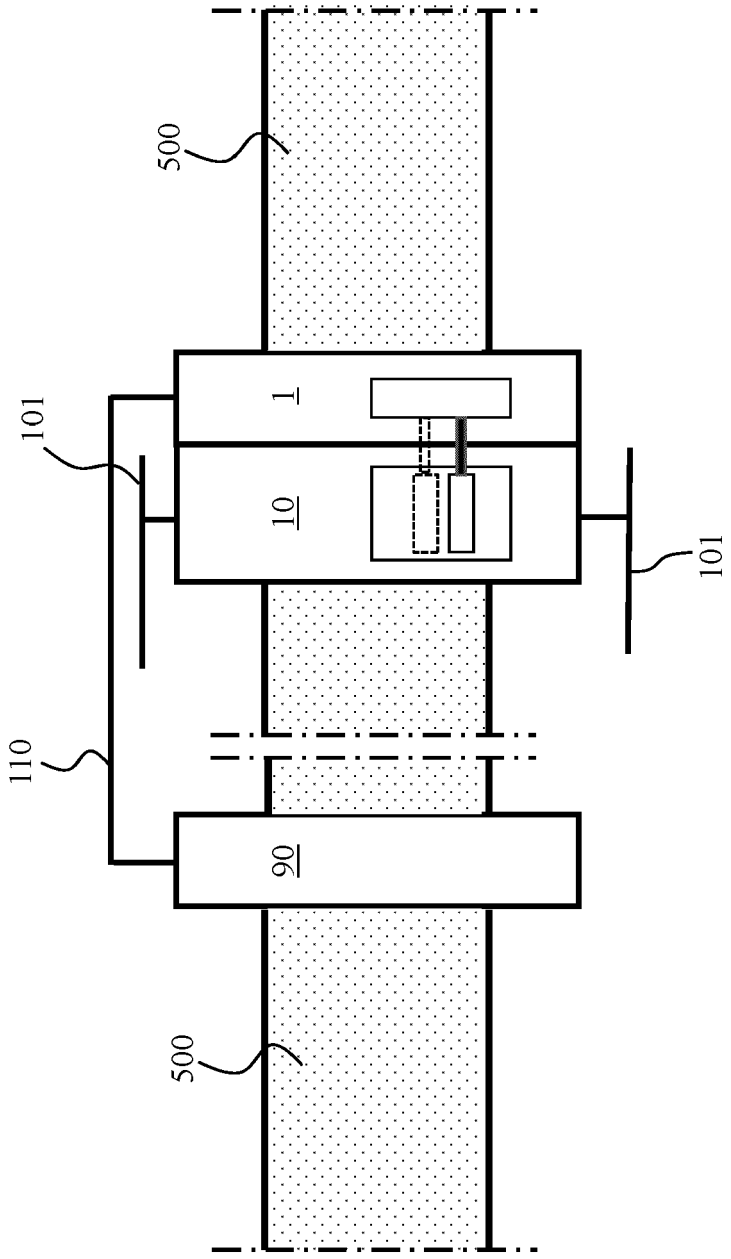
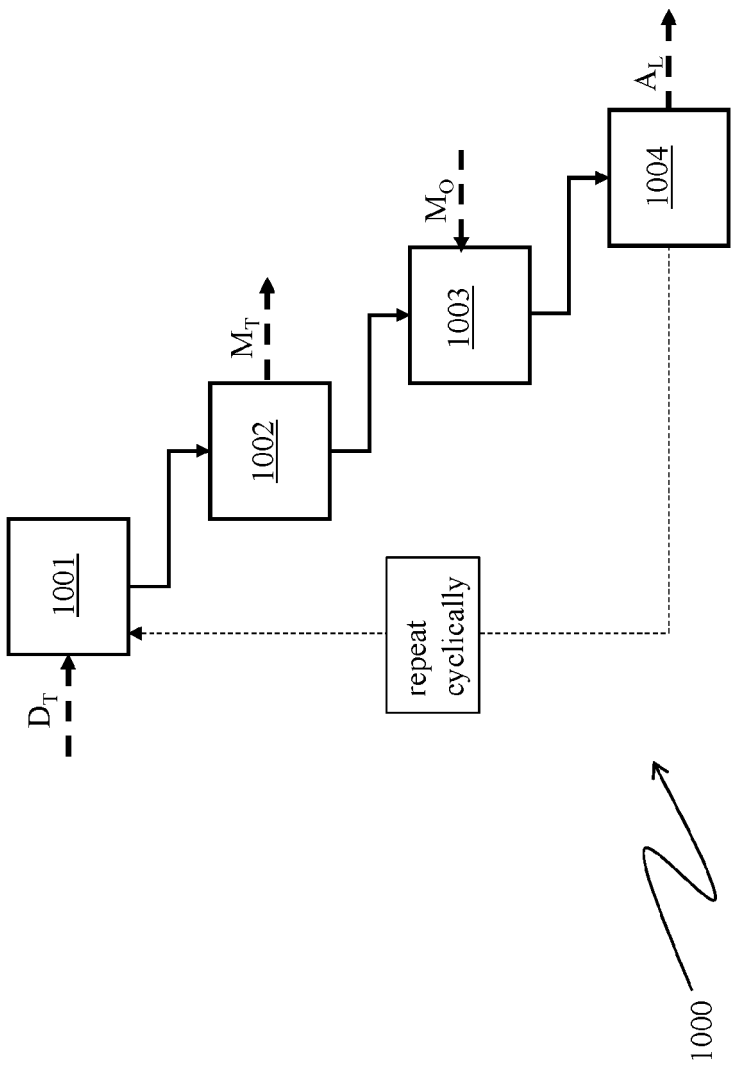


FIG. 6



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EUROPEAN SEARCH REPORT

Application Number
EP 23 17 0276

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 3 863 037 A1 (SIEMENS AG [DE]) 11 August 2021 (2021-08-11) * paragraphs [0054], [0060], [0061], [0068], [0065], [0066]; figures 2,3 *	1-15	INV. H01H71/04
A	US 2017/047184 A1 (ASHTEKAR KOUSTUBH DNYANDEO [US] ET AL) 16 February 2017 (2017-02-16) * abstract; figure 3 *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	12 September 2023	Simonini, Stefano

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12-09-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 3863037 A1	11-08-2021	CN 113257630 A	13-08-2021
		EP 3863037 A1	11-08-2021
US 2017047184 A1	16-02-2017	CN 106449297 A	22-02-2017
		US 2017047184 A1	16-02-2017

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82