

(19)



(11)

EP 2 019 407 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
02.06.2010 Bulletin 2010/22

(51) Int Cl.:
H01H 83/22 (2006.01)

(21) Application number: **07425475.6**

(22) Date of filing: **26.07.2007**

(54) **Residual current device for an electric circuit breaker**

Differentialschutzblock für einen elektrischen Schalter

Bloc de protection différentielle pour un interrupteur électrique

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE
SI SK TR**

(43) Date of publication of application:
28.01.2009 Bulletin 2009/05

(73) Proprietor: **Bticino S.p.A.**
20154 Milano (IT)

(72) Inventors:
• **Re, Marcello**
21040 Venegono Superiore (Varese) (IT)

• **Vecchi, Cristian**
21056 Induno Olona (Varese) (IT)

(74) Representative: **Carangelo, Pierluigi et al**
Jacobacci & Partners S.p.A.
Via delle Quattro Fontane 15
00184 Roma (IT)

(56) References cited:
EP-A- 0 649 158 EP-B1- 0 806 784

EP 2 019 407 B1

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).

Description

[0001] The present invention relates to the technical field of equipment for distributing and controlling electric power and particularly relates to a residual current device that can be associated with an electric circuit-breaker.

[0002] As is known, residual current devices are a type of electric equipment comprising a totalizer transformer and a trip device that is electrically connected to the secondary of said transformer in order to mechanically causing an associable circuit-breaker to open in the event that the residual current device has triggered.

[0003] According to a practice that has been widely used for a long time, residual current devices and circuit-breakers are manufactured as separate modular units that are intended to be subsequently assembled, for example in the building site, before installation. This practice results to be profitable for manufacturers, who can thus avoid the assembly in the factory and deal with the production of a small number of item types. Similarly, this practice allows fitters to reduce the diversification of the pieces to be stocked. A residual current device and a circuit-breaker made as two distinct pieces and intended to be assembled to each other are, for example, described in the published French Patent Application No. FR 2373145.

[0004] In order to assemble a residual current device to a circuit-breaker, an electric interconnection is required to be provided between these two pieces of equipment, and a mechanical coupling also requires to be almost simultaneously provided, which involves an interpenetration of mechanical members of the one of the two pieces of equipment in the other of these pieces of equipment. Typically, the axial direction of interpenetration is perpendicular to the direction of connection of the electric terminals, and the available clearances are used to carry out the assembly. The assembly, however, is not easy and involves difficult handling.

[0005] To solve this drawback, several solutions have been already suggested in the art, such as for example that described in the European Patent No. EP 1 000 430 or that described in the European Patent No. EP 0 806 784.

[0006] The object of the present invention is to provide a residual current device that can be assembled to an associable electric circuit-breaker in a particularly comfortable and quick manner.

[0007] This object is achieved by means of a residual current device such as described in the first claim.

[0008] Other embodiments of the device according to the invention are as described in the subsequent claims.

[0009] Further characteristics and the advantages of the present invention will be better understood from the description given below of preferred though non-limiting embodiments thereof, wherein:

- Fig. 1 is a perspective view of a circuit-breaker unit with unassembled parts and comprising a multipole

circuit-breaker and a residual current device in accordance with a particularly preferred embodiment of the present invention;

- Fig. 2 is an almost front perspective view of the multipole circuit-breaker in Fig. 1;
- Fig. 3 is a plane front view of the circuit-breaker unit in Fig. 1;
- Fig. 4 is a perspective view of the circuit-breaker unit in Fig. 1, wherein the circuit-breaker unit is shown in a first assembly configuration;
- Fig. 5 is a plane view of the circuit-breaker unit in Fig. 1, wherein the circuit-breaker unit is shown in a second assembly configuration;
- Fig. 6 is a perspective view of the circuit-breaker unit in Fig. 1, wherein the circuit-breaker unit is shown in a third assembly configuration;
- Fig. 7 is a perspective view of a second embodiment of the residual current device;
- Fig. 8 shows an enlarged detail of the residual current device in Fig. 7;
- Fig. 9 is a perspective view of a circuit-breaker unit with unassembled parts comprising a circuit-breaker and a residual current device in accordance with a third embodiment of the present invention;
- Fig. 10 is a perspective view of the circuit-breaker unit in Fig. 9, wherein the circuit-breaker unit is shown in a first assembly configuration;
- Fig. 11 is a plane view of the circuit-breaker unit in Fig. 9, wherein the circuit-breaker unit is shown in a second assembly configuration; and
- Fig. 12 is a perspective view of the circuit-breaker unit in Fig. 9, wherein the circuit-breaker unit is shown in a third assembly configuration.

[0010] Equal or similar elements will be designated with the same numerals throughout the figures.

[0011] With reference to Fig. 1, a residual current device that can be associated with an electric circuit-breaker 1 has been generally designated with 2. Preferably, the circuit-breaker 1 is a multipole circuit-breaker that can be fixed to a DIN rail and is, in the example reported herein, in a non-limiting manner, a magneto-thermal quadrupole circuit-breaker, such as formed by juxtaposing four DIN unipolar modules. In a known manner, in the quadrupole circuit-breaker 1, the four DIN unipolar modules have kinematic actuators that are interconnected by mechanical coupling members.

[0012] The circuit-breaker 1 has an approximatively parallelepiped-shaped body. From a front face 3 of the circuit-breaker body 1, a pivoting drive lever 4 protrudes, which is provided to operate the circuit-breaker 1. In the example illustrated herein, the drive lever 4 is embodied by a C-shaped section bar engaging the four drive levers of the DIN unipolar modules, such as to allow simultaneously operating these levers.

[0013] The circuit-breaker 1 comprises two counterposed arrays of electric connection terminals for electrically connecting the circuit-breaker 1 to the line electric

circuit, i.e. the electric circuit upstream of the circuit-breaker, and to the load electric circuit, i.e. the electric circuit downstream of the circuit-breaker. For example, each of these connection terminals comprises a clamp. For this reason, as shown in Fig. 2, in the body of circuit-breaker 1 there are provided, in a known manner, on the upper 5 and lower 6 faces, corresponding series of openings 7 for access to the clamps, of which only the access openings 7 on the lower face 6 are shown in Fig. 2. As is also known, the clamps can be tightened by means of screws that can be accessed from front openings 8, 9 that are provided on the front face 3 of the body of circuit-breaker 1.

[0014] Furthermore, on the upper 5 and lower 6 faces of the body of circuit-breaker 1, some slots 10 are provided (only those provided on the lower face are shown in Fig. 2), which are such, by extending within the circuit-breaker body, as to be capable of receiving some blocking tabs therein, which prevent access to the screws tightening the clamps by closing the openings 8, 9.

[0015] On at least one of the two side faces 11, 12 of the body of circuit-breaker 1, and particularly on the side face 12 that is intended to be juxtaposed to a face of the associable residual current device 2, an access slot to the inner kinematic mechanism of circuit-breaker 1 is provided, which is suitable to be passed through by the release pin 15 of the residual current device 2. In the figures, only the slot 13 provided on the side face 11 is shown. An entirely similar slot is provided in the same position on the side face 12, even if it is not shown in the drawings.

[0016] Furthermore, on the side face 12 of the circuit-breaker 1, seats are provided (not shown in the drawings) which are suitable to co-operate with corresponding key pins 16 of the residual current device 2. In accordance to what has been disclosed by the teachings of the European Patent Application No. EP 0 626 711, the key pins 16 and corresponding seats operate as a key to allow the coupling between circuit-breakers 1 and residual current protection devices 2 with compatible electric capacity characteristics.

[0017] With reference to Fig. 1, the residual current device 2 comprises:

- interconnection electric terminals 22, or input terminals 22 suitable to establish an electric connection between the device 2 and the electric circuit-breaker 1 by co-operating with the respective electric terminals of the circuit-breaker 1 that are accessible through the lower face 6 thereof; and
- mechanical coupling means 15, 16 suitable to allow a mechanical interaction between the residual current device 2 and the circuit-breaker 1 through the side face 12 of the circuit-breaker 1 perpendicular to the lower face 6.

[0018] Advantageously, the residual current device 2 comprises a first part 20, 21 and a second part 24 that are pivotally hinged to each other and carrying the inter-

connection electric terminals 22, and the mechanical coupling means 15, 16, respectively.

[0019] The mechanical coupling means 15, 16 comprise the release pin 15 and preferably the key pins 16. The release pin 15 projects from a slot 18 of the wall 19a to be inserted within a respective slot provided in the side wall 12 of the circuit-breaker thus ensuring the opening of the circuit-breaker 1 by the action of the residual current device.

[0020] In a particularly advantageous embodiment, the residual current device 2 comprises a receptacle 20, 21 that is approximatively L-shaped, and has:

- a first receptacle branch 20, substantially parallelepiped-shaped, which carries the interconnection electric terminals 22 in order to electrically connect the residual current device 2 to the circuit-breaker 1;
- a second receptacle branch 21, essentially parallelepiped-shaped, which is rigidly fixed to the first receptacle branch 20 and perpendicular thereto.

[0021] In this embodiment, the residual current device 2 further comprises a mechanical connection member 24 that is pivotally connected to the second receptacle branch 21 and carries the mechanical coupling means 15, 16 to mechanically connect the residual current device 2 to the circuit-breaker 1.

[0022] In the particular embodiment shown in Fig. 1, the mechanical connection member 24 has an essentially box-like shaped main body which has a corner that is hinged to a corner of the second receptacle branch 21 by means of a pin 26, which acts as the axis of rotation. In the particularly preferred embodiment as shown in Fig. 1, the corner of the mechanical connection member 24 that is hinged to the second receptacle branch 21, is a corner distal to the first receptacle branch 20 and proximal to the associable circuit-breaker 1.

[0023] The first receptacle branch 20 has an upper face 23 that is intended to be juxtaposed to the lower face 6 of the body of the associable circuit-breaker 1. From the upper face 23 the interconnection electric terminals 22 are provided, in a number of four in the example, each of which is preferably made in the form of a conductive bar (for example, of copper) which is intended to be received through the access openings 7 in a respective clamp of the circuit-breaker 1. Preferably, the first branch 20 further includes selection means, which are suitable to prevent the coupling between the residual current device 2 and a circuit-breaker that does not have a proper number of poles to be coupled to this device 2. Preferably, the selection means are embodied by tabs 25 provided on the face 23 of the first receptacle branch 20 to be capable of being received in respective seats that are opened on the lower face 6 of the circuit-breaker 1. Practically, the tabs 25 and respective seats operate as keys to allow the coupling between a differential device 2 with a determined number of poles to circuit-breakers 1 having the same number of poles.

[0024] Preferably, the electric terminals 22 are end portions of rigid conductors that run within the first receptacle branch 20 to the inside of the second receptacle branch 21 where a toroidal totalizer transformer (not shown in the drawings) that is run through by these conductors carries out the differential measurement.

[0025] The mechanical connection member 24 houses a trip device therein, for example a relay, which is operatively connected to the release pin 15 and electrically connected to the secondary of the totalizer transformer. The electric connection for example can be carried out by means of flexible and loose conductors such as to be capable of allowing the rotation of the member 24 relative to the second branch 21.

[0026] Preferably, the mechanical connection member 24 houses therein a mechanism for manually driving the trip device, not shown in the drawings, and that can be operated by means of a lever 27. The lever 27 has a projection 28 extending to the associable circuit-breaker 1 suitable to co-operate with the drive lever 4 of the circuit-breaker 1, such that when the residual current device 2 and the circuit-breaker 1 are mechanically and electrically coupled to each other, a movement of the drive lever 4 for closing the circuit-breaker 1 automatically causes the reset of the trip device of the residual current device 2.

[0027] The mechanical connection member 24 can be either shaped like a shell having a mouth facing the second receptacle branch 21 or like a substantially closed receptacle provided with an access opening facing the second branch 21 of the receptacle and provided for flexible conductors to pass therethrough for connection to the secondary of the totalizer transformer.

[0028] The residual current device 2 further comprises hooking means for locking the circuit-breaker 1 and the residual current device 2 in the configuration in which the two elements 1, 2 are electrically and mechanically coupled to each other, such that they form a compact magneto-thermal-differential circuit-breaker unit. In a particularly preferred embodiment, these hooking means include a hooking element 30 in the form of a bar that is slidably received within a suitable seat provided within the mechanical connection member 24. The bar 30 is preferably inclined relative to the side face 12 of the circuit-breaker 1 and is slidable relative to the circuit-breaker 1 between:

- a backward operative position, or release position, shown in Fig. 1, in which this bar is substantially non-interfering with the circuit-breaker 1; and
- a forward operative position, or hooked position, in which the bar 30 has an end portion, such as hook-shaped, which projects from the side face 19 of the pivoting member 24, by coming out of the opening 31, to be engaged within a respective retaining seat, not shown in the figures, which is provided on the side face 12 of the circuit-breaker 1. This retaining seat is preferably a channel opened onto the side face 12 and having an inclined extension direction

relative to the plane of said face 12.

[0029] In a particularly advantageous embodiment, the bar 30 has an end portion 32 that is provided with gripping means, such as, for example a notch 29, through which the bar can be brought, for example by means of a tool with a blade-like end, from the forward operative position to the backward operative position. These gripping means 19 can be foldaway-received within the seat of the bar 30 when the bar 30 is in the hooked position. Thereby, after the bar 30 has been brought to the hooked position, the bar cannot be extracted, such as to make substantially impossible to remove the circuit-breaker 1 from the residual current device 2.

[0030] In a particularly preferred embodiment, an end portion of the seat of the bar 30 within the member 24 has a wall portion 33 that is pre-fractured and removable. By removing this wall portion 33, the gripping means 29 of the bar 30 can be accessed when the latter is in the hooked position, and thus release the circuit-breaker 1 from the residual current device 2. It should be observed that, however, this removal is such as to leave a clear and irreversible evidence, in accordance with what is provided by the safety regulations in force.

[0031] With reference to Fig. 3, in a particularly preferred embodiment, the residual current device 2 includes locking means that are suitable to hold the mechanical connection member 24 in the angular position in which this is such as to be capable of establishing a mechanical coupling with the circuit-breaker 1, by preventing a rotation of this member after the latter has moved to the angular position of mechanical coupling with the circuit-breaker 1. With reference to Fig. 1, in this position, which will be referred to as the "mechanical connection position" herein below, the side wall 19a of the second branch 21 and the side wall 19b of the member 24 are substantially aligned with each other to form an individual wall 19a, 19b suitable to be juxtaposed to the side wall 12 of the circuit-breaker 1. For example, the locking means (shown in Fig. 3) comprise:

- a flexible tab having an end connected to the pivoting member 24 and an opposite end portion provided with a locking tooth 34;
- conjugated locking means 36 that are provided in the second receptacle branch 21.

[0032] For example, the conjugated locking means 36, comprise a channel 36, which is depicted with a dotted line in Fig. 3, having an opened end portion 35 defining a retaining seat for the tooth 34 in the locking position and having an opposite opened end portion suitable to receive a pointed tool to disengage the tooth 34 from the retaining seat thereof.

[0033] The residual current device 2 further includes interconnection electric terminals, or output terminals, to connect the residual current device 2 to a load circuit, i.e. to an electric circuit downstream of the residual current

device 2, such as for example a domestic electric network. Preferably, these output electric terminals are in the shaped of clamps. For this reason, as shown in Fig. 4, an array of access openings 40 to the clamps is provided, in a known manner, in the second receptacle branch 21. Also in a known manner, the clamps can be tightened by means of screws that are accessible through front openings 41 provided on the second receptacle branch 21.

[0034] In a particularly advantageous embodiment, the residual current device 2 comprises safety means suitable to at least partially prevent an access to the screws of the clamps of the output terminal of the residual current device 2 when the pivoting member 24 is oriented such as to move to an angular position other than the mechanical connection position. Preferably, these means include a sliding plate 42 housed within the second receptacle branch 21 and provided with an array of openings (two of which have been shown with a dotted line in Fig. 3 by way of example, and designated with numeral 44). The sliding plate 42 is preferably operatively coupled to the connection member 24, for example by means of a bracket 45, such that:

- when the mechanical connection member 24 is in the angular position of mechanical connection, the sliding plate 42 moves to a position such that each of the openings 44 thereof is axially aligned with a corresponding access opening 41; and
- when the mechanical connection member 24 moves to angular positions other than the mechanical connection position, the plate 42 moves to a position such that the openings 44 thereof are offset relative to the openings 41 and thus at least partially occlude the latter thereby preventing any access to the tightening screws of the clamps.

[0035] In a particularly preferred embodiment, the residual current device 2 further includes a sliding screen 46 that can be coupled to the first receptacle branch 20 and including a comb of blocking tabs 47. The screen 46 is at least partially receivable within a suitable seat provided in the first branch 20 and is slidable relative to the latter between an extracted position and a forward position. In the latter position, each blocking tab is inserted within a respective slot 10 (shown in Fig. 2) of the circuit-breaker 1 to prevent access through the front openings 9 to the screws of the clamps that are intended to be connected to the interconnection terminals 22 of the residual current device 2. Preferably, anti-tampering signalling means are further provided, in order to prevent the sliding screen 46 from being extracted by unauthorized operators after it has been inserted. These means comprise, for example, a pair of holes 48, 49 which are provided within the first branch 20 and sliding screen 46, respectively, which are suitable to receive, in the forward position of the sliding screen 46, a wire seal.

[0036] With reference to Fig. 3 and 6, the assembly

operations between the circuit-breaker 1 and the residual current device 2 will be briefly described herein below.

[0037] Starting from the configuration with unassembled parts as shown in Fig. 3, by moving the circuit-breaker 1 towards the residual current device 2 in the way and direction indicated by the arrow IV, the interconnection terminals 22 of the device 2 are inserted within respective clamps of the circuit-breaker 1 to establish an electrical connection between the circuit-breaker 1 and the residual current device 2. It is thus obtained the configuration shown in Fig. 4. It should be observed that, in order to carry out this operation, the mechanical connection member 24 is required to be maintained in such an angular position that during the movement indicated by the arrow IV the mechanical connection means 15, 16 do not interfere with the side wall 12 of the circuit-breaker 1.

[0038] After the configuration in Fig. 4 has been attained, the mechanical connection member 24 is rotated about the pin 26 as indicated by the arrow VI until the angular position of mechanical connection has been reached. In this position:

- the release pin 15 passes through the side face 12 of the circuit-breaker and is operatively connected to the inner kinematic mechanism of the latter;
- the key pins 16 are inserted within the respective conjugated seats that are provided on the side face 12 of the circuit-breaker 1;
- the mechanical connection member 24 is locked in the angular position of mechanical connection because the tooth 34 is held within the seat 35.

[0039] The assembly configuration is thus obtained as shown in Fig. 5. As may be seen in this figure, in the mechanical connection position, the screws of the output terminals of the residual current device 2 can be accessed through the access openings 41 as the latter are no longer obstructed by the sliding plate 42 (shown in Fig. 4).

[0040] With reference to Fig. 5, a subsequent operation provides that the bar 30 is moved, which can be obtained by applying a pressure on the latter in the direction and way of the arrow VII until the locking position has been reached, in which the end portion of the bar 30 opposite the end portion 32 is engaged with the conjugated retaining means that are provided on the side face 12 of the circuit-breaker 1. Furthermore, with further reference to Fig. 5, a subsequent operation provides for tightening the screws of the circuit-breaker 1 which can be accessed via the openings 9, in order to make the electrical connection stable between the circuit-breaker 1 and the residual current device 2.

[0041] Finally, by sliding the screen 46 in the way of the arrow VIII, the assembled configuration is obtained as shown in Fig. 6, in which the access openings to the circuit-breaker 1 are obstructed by the blocking tabs 47. In this configuration, a wire seal (not shown) can be applied, which passes through the hole 49 and hole 48 (the

latter is shown in Fig. 5).

[0042] In Fig. 7 a first variant embodiment of residual current device 2 is shown, which essentially differs from the residual current device described above, in that it is provided with different locking means 54, 55 to hold the mechanical connection member 24 in the angular position of mechanical connection. In this embodiment, particularly, these locking means comprise a key 55 that is provided on the second branch 21, held in the forward position by a spring (not shown) and such as to be pushed to counter-act the action of this spring, and a shaped tab 54 projecting from the connection member 24. As may be better seen in Fig. 8, the shaped tab 54 is provided with a first cavity C1 that is shaped such as to be engaged with the key 55 when the latter is in the forward position thereof in order to hold the connection member 24 in the angular position of mechanical connection. The key 55 is shaped such that (for example, it has a notch or a discharge) it does not interfere with the shaped tab 54 when it is pressed in the forward position. Thereby, the connection member 24 can be unlocked from the angular position of mechanical connection.

[0043] As may be seen in Fig. 8, in a particularly preferred embodiment, the projecting tab 54 further has a second cavity C2 that is shaped such as to be engaged with the key 55 when the latter is in the forward position thereof in order to hold the connection member 24 in an angular position different from the position of mechanical connection and such that the mechanical coupling means 15, 16 of this member are substantially noninterfering with the face 12 of the circuit-breaker during a movement of the circuit-breaker 1 towards the device 2 in order to provide the electrical interconnection between the circuit-breaker 1 and the residual current device 2. By pressing the key 55, rotating the member 24 clockwise and releasing the key 55 at the first cavity C1, it is possible to pass from the angular position determined by the interference of the cavity C2 with the key 55 at the angular position of mechanical connection, which is determined by the interference of the cavity C1 with the key 55.

[0044] In the particular embodiment illustrated in Fig. 8 the projecting tab 54 is further provided with a thrust element 56 which is suitable to co-operate with the sliding plate 42 (Fig. 7) to cause the sliding of the latter during the rotation of the connection member 24.

[0045] In the Fig. 9-12, a kit of parts is illustrated, which comprises a circuit-breaker 1 that is entirely identical to the circuit-breaker described above with reference to the Fig. 1-6 and further comprising a residual current device 200 in accordance with a further embodiment of the present invention.

[0046] The residual current device 200 is different from the residual current device 2 described above essentially in that the second receptacle branch 221 is made as an individual block and has a corner that is pivotally connected to, for example hinged about the axis 226, an end portion of the first receptacle branch 220. As may be seen, in this embodiment the residual current device 200

also advantageously comprises a first part, i.e. the branch 220, and a second part, i.e. the branch 221, that are pivotally connected (for example pivoted) to each other, and carrying the interconnection electric terminals 22 and the mechanical coupling means 15, 16, respectively. In this case, to be capable of ensuring the electrical connection between the connection terminals 22 of the device 200 and the conductors passing through the totalizer transformer housed within the second branch 221, flexible electrical connection means can be provided, for example in the form of conductive plaits, at least proximate to the axis of rotation 226.

[0047] Similarly to what has been described above for the residual current device 2, in the residual current device 220 can be also provided locking means in the form of a sliding bar 30 and screen means 46 in the form of a sliding screen comprising a comb of blocking tabs 47. Furthermore, though not illustrated in the figures, even in this case a pre-fractured wall portion can be provided, which is suitable to make the gripping means of the bar 30 accessible after the latter has been inserted within the seat thereof.

[0048] To assemble the kit of parts in Fig. 9, the circuit-breaker 1 must be moved towards the residual current device 200 as indicated by the arrow IX, thereby establishing an electric connection between both pieces of equipment and obtaining the assembly configuration illustrated in Fig. 10. Subsequently, the second branch 221 must be rotated relative to the first branch 220 in the way indicated by the arrow X, in order to obtain the assembly configuration illustrated in Fig. 11. Starting from this configuration:

- by pushing the bar 30 as indicated by the arrow XI;
- by tightening the connecting screws of the circuit-breaker 1 to make the electrical connection between the residual current device 200 and the circuit-breaker 1 stable; and
- by sliding the sliding screen 46 (for clarity, only schematically illustrated in Fig. 9-12) the assembly configuration is obtained as illustrated in Fig. 12, in which the circuit-breaker 1 and the residual current device 200 are mechanically and electrically interconnected and are firmly locked to each other to form a magneto-thermal and residual current circuit-breaker unit.

[0049] As may be appreciated from what has been described above, a residual current device in accordance with the present invention allows achieving the pursued objectives, in that the assembly of the device together with a circuit-breaker requires particularly simple and rapid operations.

[0050] Those skilled in the art, in order to meet contingent and specific requirements, will be able to make a number of modifications and variations to the residual current devices described above, all being however contemplated within the scope of the invention as defined

by the following claims.

Claims

1. A residual current device (2; 200) adapted to be associated to an electric circuit-breaker (1), the residual current device (2;200) comprising:

- interconnection electric terminals (22) suitable to establish, by co-operating with respective electric terminals of the circuit-breaker (1) that are accessible through a first face (6) of the latter, an electrical connection between the device (2;200) and the electric circuit-breaker (1); and
- mechanical coupling means (15,16) suitable to allow a mechanical interaction between the device (2;200) and the circuit-breaker (1) through a second face (12) perpendicular to said first face (6),

characterized in that

the device (2;200) comprises first (20,21;221) and second (24;220) parts that are pivotally connected to each other and carrying said interconnection electric terminals (22) and said mechanical coupling means (15,16), respectively.

2. The residual current device (2;200) according to claim 1, wherein the first (20,21;221) and second (24;220) parts of the device can be pivotally moved relative to each other to adopt a mutual position in which said connection electric terminals (22) of the device (2;200) can be connected to the respective electric terminals of the circuit-breaker by moving the circuit-breaker (1) towards said interconnection terminals (22) of the device (24;220) such that said mechanical coupling means (15,16) are noninterfering with said second face (12) of the circuit-breaker (1) during this movement.

3. The residual current device (2;200) according to claim 1 or 2, wherein the residual current device (2; 200) comprises a receptacle having:

- a first receptacle branch (20; 220) carrying said interconnection terminals (22) and having a face (23) that is intended to be juxtaposed to said first face (6); and
- a second receptacle branch (21, 221) carrying said mechanical coupling means (15,16) and having a face (19a, 19b) that is intended to be juxtaposed to said second face (12) of the circuit-breaker (1).

4. The residual current device (220) according to claim 3, wherein the first branch (220) has an end portion that is pivotally connected to said second branch

(221), the first (220) and second (221) branches being said first and said second parts that are pivotally connected, respectively.

5. The residual current device (2) according to claim 3, wherein the second branch (21) is rigidly connected to the first branch (20), and wherein said first part includes said first and said second branches, the second part including a mechanical connection member (24) that is pivotally connected to said second branch (21).

6. The residual current device (2) according to claim 5, wherein the mechanical connection member (24) is a box-like element having a corner that is hinged to a corner of said second branch (21).

7. The residual current device (2) according to claim 6, wherein said corner is a corner distal from said second branch (21) and proximal to said circuit-breaker (1).

8. The residual current device (2;200) according to any preceding claim, wherein said mechanical coupling means comprise a release pin (15) suitable to co-operate with an inner kinematic mechanism of said circuit-breaker (1) .

9. The residual current device (2;200) according to any preceding claim, further comprising hooking means (30) to lock the circuit-breaker (1) and the residual current device (2) in an assembly configuration in which they (1, 2) are electrically and mechanically coupled to each other to form a compact circuit-breaker unit.

10. The residual current device (2;200) according to claim 9, wherein said hooking means comprise a bar (30) that is slidably housed within a seat provided in said device (2;200) to be capable of being moved between a backward position and a forward position by sliding in an inclined direction relative to the laying plane of said second face (12) of the circuit-breaker (1).

11. The residual current device (2) according to claim. 5, further comprising locking means (34,35;54,55) suitable to hold the mechanical connection member (24) in a first angular position in which the latter is such as to be capable of allowing said mechanical interaction with the circuit-breaker (1), thereby preventing this member to rotate after the latter has moved to said first angular position.

12. The residual current device (2) according to claim 11, wherein said locking means are further suitable to hold the mechanical connection member (24) locked in a second angular position different from

said first angular position, said locking means being further such as to be released to allow a rotation of said connection member between said first and said second angular positions, and vice versa.

13. The residual current device (2) according to claim 5, wherein the device further includes output electric terminals to connect the residual current device (2) to a load circuit, the output electric terminals being in the form of clamps that can be tightened by means of screws accessible through front openings (41) that are provided on the second receptacle branch (21), the residual current device (2) further comprising safety means suitable to at least partially prevent an access to said screws when the mechanical interconnection member (24) is oriented such as to move to an angular position other than an angular position suitable to allow said mechanical interaction.
14. The residual current device (2) according to claim 13, wherein the safety means include a plate (42) being slidably housed within said second receptacle branch (21) and operatively coupled to said mechanical connection member (24).
15. The residual current device (2) according to claim 3, further comprising a sliding screen (46) couplable to the first receptacle branch (20) and including a comb of blocking tabs (47), each blocking tab (47) being insertable within a respective slot (10) of the circuit-breaker (1) to prevent the access to screws of clamps of the circuit-breaker (1) that are intended to be connected to said interconnection terminals (22) of the residual current device (2).
16. A circuit-breaker unit comprising a circuit-breaker (1) and a residual current device according to any claim 1 to 15.

Patentansprüche

1. Differenzstromvorrichtung (2, 200), die mit einem elektrischen Stromkreisunterbrecher (1) verbunden werden kann, wobei die Differenzstromvorrichtung (2, 200) umfasst:

elektrische Zwischenverbindungsanschlüsse (22), die geeignet sind, durch Zusammenwirken mit entsprechenden elektrischen Anschlüssen des Stromkreisunterbrechers (1), die durch eine erste Fläche (6) des letzteren zugänglich sind, eine elektrische Verbindung zwischen der Vorrichtung (2, 200) und dem elektrischen Stromkreisunterbrecher (1) herzustellen, und mechanische Kopplungsmittel (15, 16), die geeignet sind, eine mechanische Interaktion zwischen der Vorrichtung (2, 200) und dem Strom-

kreisunterbrecher (1) durch eine zur ersten Fläche (6) senkrechte zweite Fläche (12) zu gestatten,

- 5 **dadurch gekennzeichnet, dass**
die Vorrichtung (2, 200) ein erstes (20, 21, 221) und ein zweites (24, 220) Teil umfasst, die schwenkbar miteinander verbunden sind, und die elektrischen Zwischenverbindungsanschlüsse (22) und die mechanischen Kopplungsmittel (15, 16) entsprechend tragen.
- 10 2. Differenzstromvorrichtung (2, 200) gemäß Anspruch 1, bei der das erste (20, 21, 221) und das zweite (24, 220) Teil der Vorrichtung schwenkbar relativ zueinander bewegt werden können, um eine wechselseitige Position anzunehmen, in der die elektrische Verbindungsanschlüsse (22) der Vorrichtung (2, 200) mit den entsprechenden elektrischen Anschlüssen des Stromkreisunterbrechers mittels Bewegens des Stromkreisunterbrechers (1) in Richtung der Zwischenverbindungsanschlüsse (22) der Vorrichtung (24, 220) derart verbunden werden können, dass die mechanischen Kopplungsmittel (15, 16) während dieser Bewegung nicht mit der zweiten Fläche (12) des Stromkreisunterbrechers (1) interferieren.
- 15 25 3. Differenzstromvorrichtung (2, 200) gemäß Anspruch 1 oder 2, bei der die Differenzstromvorrichtung (2, 200) eine Buchse umfasst, mit:

- einem ersten Buchsenarm (20, 220), der die Zwischenverbindungsanschlüsse (22) trägt und eine Fläche (23) aufweist, die dazu gedacht ist, dass sie benachbart zur ersten Fläche (6) ist, und
- einem zweiten Buchsenarm (21, 221), der die mechanischen Kopplungsmittel (15, 16) trägt und eine Fläche (19a, 19b) aufweist, die dazu gedacht ist, dass sie benachbart zur zweiten Fläche (12) des Stromkreisunterbrechers (1) ist.
- 30 35 40 4. Differenzstromvorrichtung (220) gemäß Anspruch 3, bei welcher der erste Arm (220) einen Endabschnitt aufweist, der mit dem zweiten Arm (221) schwenkbar verbunden ist, wobei der erste (220) und der zweite (221) Arm das erste und zweite Teil sind, die entsprechend schwenkbar verbunden sind.
- 45 50 5. Differenzstromvorrichtung (2) gemäß Anspruch 3, bei welcher der zweite Arm (21) starr mit dem ersten Arm (20) verbunden ist, und bei welcher der erste Teil den ersten und zweiten Arm umfasst, wobei das zweite Teil ein mechanisches Verbindungsbauteil (24) umfasst, das schwenkbar mit dem zweiten Arm (21) verbunden ist.
- 55 6. Differenzstromvorrichtung (2) gemäß Anspruch (5),

bei der das mechanische Verbindungsbauteil (24) ein schachtelähnliches Element mit einer Ecke ist, die an einer Ecke des zweiten Arms (21) eingehängt ist.

7. Differenzstromvorrichtung (2) gemäß Anspruch 6, bei der die Ecke eine Ecke ist, die entfernt vom zweiten Arm (21) und nahe zum Stromkreisunterbrecher (1) ist. 5
8. Differenzstromvorrichtung (2, 200) gemäß einem der vorangegangenen Ansprüche, bei der die mechanischen Kopplungsmittel einen Freigabestift (15) umfassen, der geeignet ist, mit einem inneren Kinetikmechanismus des Stromkreisunterbrechers (1) zusammenzuwirken. 10
9. Differenzstromvorrichtung (2, 200) gemäß einem der vorangegangenen Ansprüche, weiter umfassend: Einhakmittel (30), um den Stromkreisunterbrecher (1) und die Differenzstromvorrichtung (2) in einem Anordnungsaufbau zu verriegeln, indem sie (1, 2) elektrisch und mechanisch miteinander gekoppelt sind, um eine kompakte Stromkreisunterbrechereinheit auszubilden. 15
10. Differenzstromvorrichtung (2, 200) gemäß Anspruch 9, bei der die Einhakmittel eine Stange (30) umfassen, die gleitbar innerhalb eines in der Vorrichtung (2, 200) vorgesehenen Sitzes aufgenommen ist, damit sie zwischen einer hinteren Position und einer vorderen Position durch Gleiten in einer geneigten Richtung relativ zur Lageebene der zweiten Fläche (12) des Stromkreisunterbrechers (1) bewegt werden kann. 20
11. Differenzstromvorrichtung (2) gemäß Anspruch 5, weiter umfassend: Verriegelungsmittel (34, 35, 54, 55), die geeignet sind, ein mechanisches Verbindungsbauteil (24) in einer ersten Winkelposition zu halten, in der Letzteres derart vorgesehen ist, dass es eine mechanische Interaktion mit dem Stromkreisunterbrecher (1) gestatten kann, wodurch dieses Bauteil daran gehindert wird, sich zu drehen, nachdem sich das Letztere zur ersten Winkelposition bewegt hat. 25
12. Differenzstromvorrichtung (2) gemäß Anspruch 11, bei der die Verriegelungsmittel weiter geeignet sind, das mechanische Verbindungsbauteil (24) in einer von der ersten Winkelposition verschiedenen zweiten Winkelposition verriegelt zu halten, wobei das Verriegelungsmittel weiter derart ist, dass es freigegeben wird, um eine Drehung des Verbindungsbauteils zwischen der ersten und der zweiten Winkelposition, und umgekehrt, zu gestatten. 30
13. Differenzstromvorrichtung (2) gemäß Anspruch 5, 35

bei der die Vorrichtung weiter umfasst: elektrische Ausgabeanschlüsse, um die Differenzstromvorrichtung (2) mit einem Lastkreis zu verbinden, wobei die elektrischen Ausgabeanschlüsse in der Gestalt von Klammern sind, die mittels Schrauben anziehbar sind, welche durch am zweiten Buchsenarm (21) vorgesehene Vorderöffnungen (41) zugänglich sind, wobei die Differenzstromvorrichtung (2) weitere Sicherheitsmittel umfasst, die geeignet sind, zumindest teilweise einen Zugang zu den Schrauben zu verhindern, wenn das mechanische Zwischenverbindungsbauteil (24) so orientiert ist, dass es sich zu einer anderen Winkelposition bewegt als einer Winkelposition, die geeignet ist, die mechanische Interaktion zu gestatten.

14. Differenzstromvorrichtung (2) gemäß Anspruch 13, bei der die Sicherheitsmittel eine Platte (42) aufweisen, die gleitbar innerhalb des zweiten Buchsenarms (21) aufgenommen ist und wirksam mit dem mechanischen Verbindungsbauteil (24) gekoppelt ist. 40
15. Differenzstromvorrichtung (2) gemäß Anspruch 3, weiter umfassend: einen gleitenden Schirm (46), der mit dem ersten Buchsenarm (20) koppelbar ist, und eine Wabe aus Blockierstreifen (47) umfasst, wobei jeder Blockierstreifen (47) innerhalb eines entsprechenden Schlitzes (10) des Stromkreisunterbrechers (1) einführbar ist, um den Zugang zu Schrauben der Klemmen des Stromkreisunterbrechers (1) zu verhindern, die dazu gedacht sind, dass sie mit den Zwischenverbindungsanschlüssen (22) der Differenzstromvorrichtung (2) verbunden werden. 45
16. Stromkreisunterbrechereinheit, umfassend einen Stromkreisunterbrecher (1) und eine Differenzstromvorrichtung gemäß einem der Ansprüche 1 bis 15. 50

Revendications

1. Dispositif de protection différentielle (2; 200) adapté pour être associé avec un disjoncteur électrique (1), le dispositif de protection différentielle (2; 200) comprenant : 45
 - des bornes électriques d'interconnexion (22) appropriées pour l'établissement d'une connexion électrique entre le dispositif (2; 200) et le disjoncteur électrique (1) en coopérant avec des bornes électriques respectives du disjoncteur (1) qui sont accessibles par une première face de ce dernier ; et
 - des moyens d'accouplement mécanique (15, 16) appropriés pour permettre une interaction mécanique entre le dispositif (2; 200) et le dis-

joncteur (1) à travers une deuxième face (12) perpendiculaire à ladite première face (6),

caractérisé en ce que

- le dispositif (2; 200) comprend une première (20, 21; 221) et une deuxième (24; 220) parties qui sont raccordées en pivotement l'une à l'autre et portant respectivement lesdites bornes électriques d'interconnexion (22) et lesdits moyens d'accouplement mécanique (15, 16). 5
2. Dispositif de protection différentielle (2; 200) selon la revendication 1, dans lequel la première (20, 21; 221) et la deuxième (24; 220) parties du dispositif peuvent être montées en pivotement l'une par rapport à l'autre afin d'adopter une position réciproque dans laquelle lesdites bornes électriques de connexion (22) du dispositif (2; 200) peuvent être connectées aux bornes électriques respectives du disjoncteur en déplaçant le disjoncteur (1) vers lesdites bornes d'interconnexion (22) du dispositif (24; 220) de sorte que lesdits moyens d'accouplement mécanique (15, 16) n'entravent pas ladite deuxième face (12) du disjoncteur (1) pendant ce mouvement. 10
3. Dispositif de protection différentielle (2; 200) selon la revendication 1 ou 2, dans lequel le dispositif de protection différentielle (2; 200) comprend une prise ayant : 15
- une première branche de prise (20; 200) portant lesdites bornes d'interconnexion (22) et ayant une face (23) qui est destinée à être juxtaposée à ladite première face (6) ; et
 - une deuxième branche de prise (21, 221) portant lesdits moyens d'accouplement mécanique (15, 16) et ayant une face (19a, 19b) qui est destinée à être juxtaposée à ladite deuxième face (12) du disjoncteur (1). 20
4. Dispositif de protection différentielle (220) selon la revendication 3, dans lequel la première branche (220) possède une partie extrême qui est raccordée en pivotement à ladite deuxième branche (221), la première (220) et la deuxième (221) branches étant ladite première et ladite deuxième parties qui sont raccordées en pivotement, respectivement. 25
5. Dispositif de protection différentielle (2) selon la revendication 3, dans lequel la deuxième branche (21) est raccordée rigidement à la première branche (20), et dans lequel ladite première partie comporte ladite première et ladite deuxième branches, la deuxième partie comportant un élément de raccordement mécanique (24) qui est raccordé en pivotement à ladite deuxième branche (21). 30
6. Dispositif de protection différentielle (2) selon la revendication 5, dans lequel l'élément de raccordement mécanique (24) est un élément en forme de boîte ayant un coin qui est articulé à un coin de ladite deuxième branche (21). 35
7. Dispositif de protection différentielle (2) selon la revendication 6, dans lequel ledit coin est un coin distal par rapport à ladite deuxième branche (21) et proximal par rapport audit disjoncteur (1). 40
8. Dispositif de protection différentielle (2; 200) selon l'une quelconque des revendications précédentes, dans lequel lesdits moyens de raccordement mécanique comprennent une broche de libération (15) appropriée pour coopérer avec un mécanisme cinématique interne dudit disjoncteur (1). 45
9. Dispositif de protection différentielle (2; 200) selon l'une quelconque des revendications précédentes, comprenant en outre des moyens d'accrochage (30) pour verrouiller le disjoncteur (1) et le dispositif de protection différentielle (2) dans une configuration d'assemblage dans laquelle ils (1, 2) sont électriquement et mécaniquement couplés entre eux pour former une unité de disjoncteur compacte. 50
10. Dispositif de protection différentielle (2; 200) selon la revendication 9, dans lequel lesdits moyens d'accrochage comprennent une barre (30) qui est logée en coulissement dans un siège prévu dans ledit dispositif (2; 200) pour être déplaçable entre une position vers l'arrière et une position vers l'avant par coulissement dans une direction inclinée par rapport au plan dans lequel s'étale ladite deuxième face (12) du disjoncteur (1). 55
11. Dispositif de protection différentielle (2) selon la revendication 5, comprenant en outre des moyens de verrouillage (34, 35; 54, 55) appropriés pour le maintien de l'élément de raccordement mécanique (24) dans une première position angulaire dans laquelle ce dernier est apte à permettre ladite interaction mécanique avec le disjoncteur (1), empêchant ainsi cet élément de tourner après déplacement de ce dernier vers ladite première position angulaire.
12. Dispositif de protection différentielle (2) selon la revendication 11, dans lequel lesdits moyens de verrouillage sont en outre appropriés pour le maintien de l'élément de raccordement mécanique (24) verrouillé dans une deuxième position angulaire différente de ladite première position angulaire, lesdits moyens de verrouillage étant en outre tels qu'ils sont libérés afin de permettre une rotation dudit élément de raccordement entre ladite première et ladite deuxième positions angulaires, et vice versa.
13. Dispositif de protection différentielle (2) selon la re-

vendication 5, dans lequel le dispositif comporte en outre des bornes électriques de sortie pour connecter le dispositif de protection différentielle (2) à un circuit de charge, les bornes électriques de sortie étant sous la forme de griffes qui peuvent être serrées au moyen de vis accessibles à travers des ouvertures frontales (41) qui sont prévues sur la deuxième branche de prise (21), le dispositif de protection différentielle (2) comprenant en outre des moyens de sécurité appropriés pour empêcher au moins en partie un accès aux dites vis lorsque l'élément de raccordement mécanique (24) est orienté de sorte à se déplacer vers une position angulaire autre qu'une position angulaire appropriée pour permettre ladite interaction mécanique.

14. Dispositif de protection différentielle (2) selon la revendication 13, dans lequel les moyens de sécurité comportent une plaque (42) qui est logée en coulissement dans ladite deuxième branche de prise (21) et opérationnellement couplée audit élément de raccordement mécanique (24).
15. Dispositif de protection différentielle (2) selon la revendication 3, comprenant en outre un blindage coulissant (46) que l'on peut coupler à la première branche de prise (20) et comportant un peigne de languettes de blocage (47), chaque languette de blocage (47) pouvant être insérée dans une fente respective (10) du disjoncteur (1) pour empêcher l'accès à des vis de griffes du disjoncteur (1) qui sont destinées à être connectées aux dites bornes d'interconnexion (22) du dispositif de protection différentielle (2).
16. Unité de disjoncteur comprenant un disjoncteur (1) et un dispositif de protection différentielle selon l'une quelconque des revendications 1 à 15.

40

45

50

55

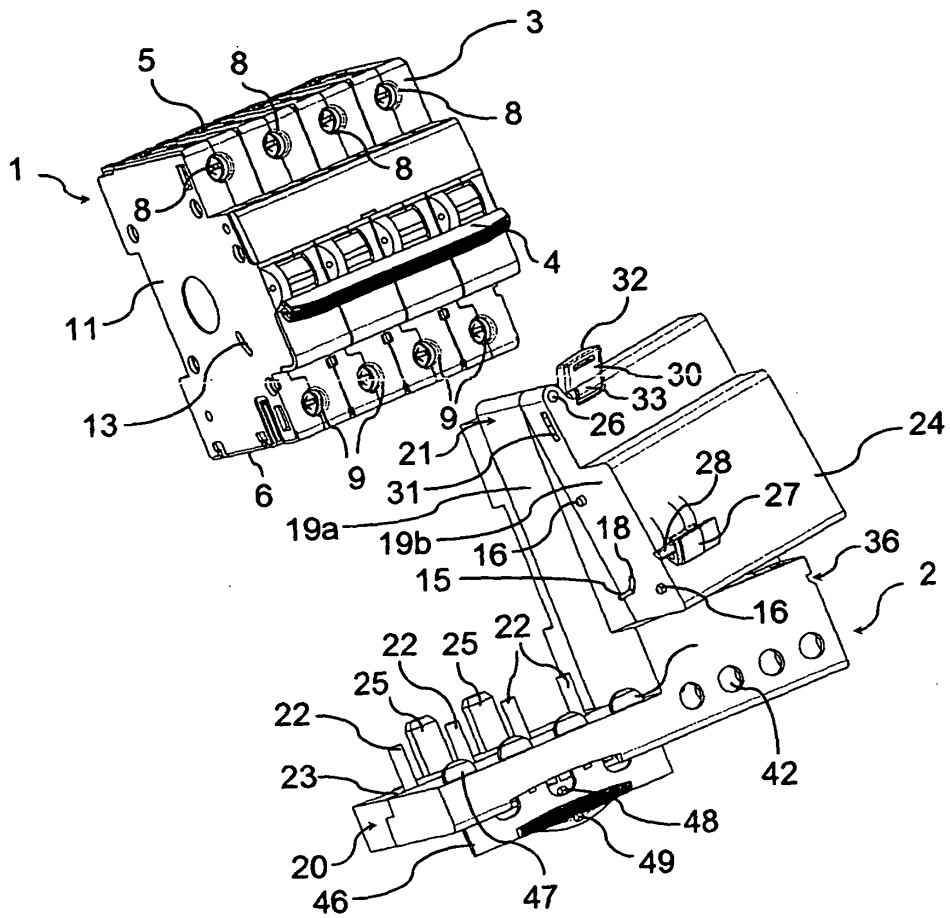


FIG 1

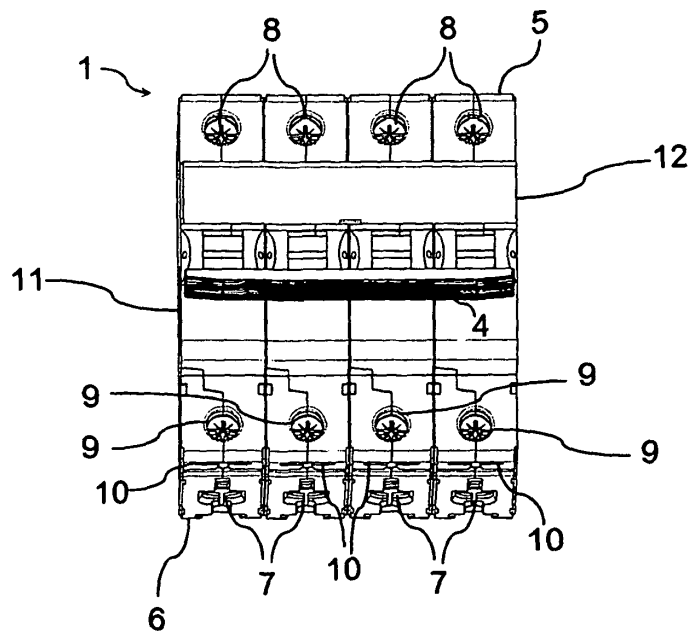


FIG 2

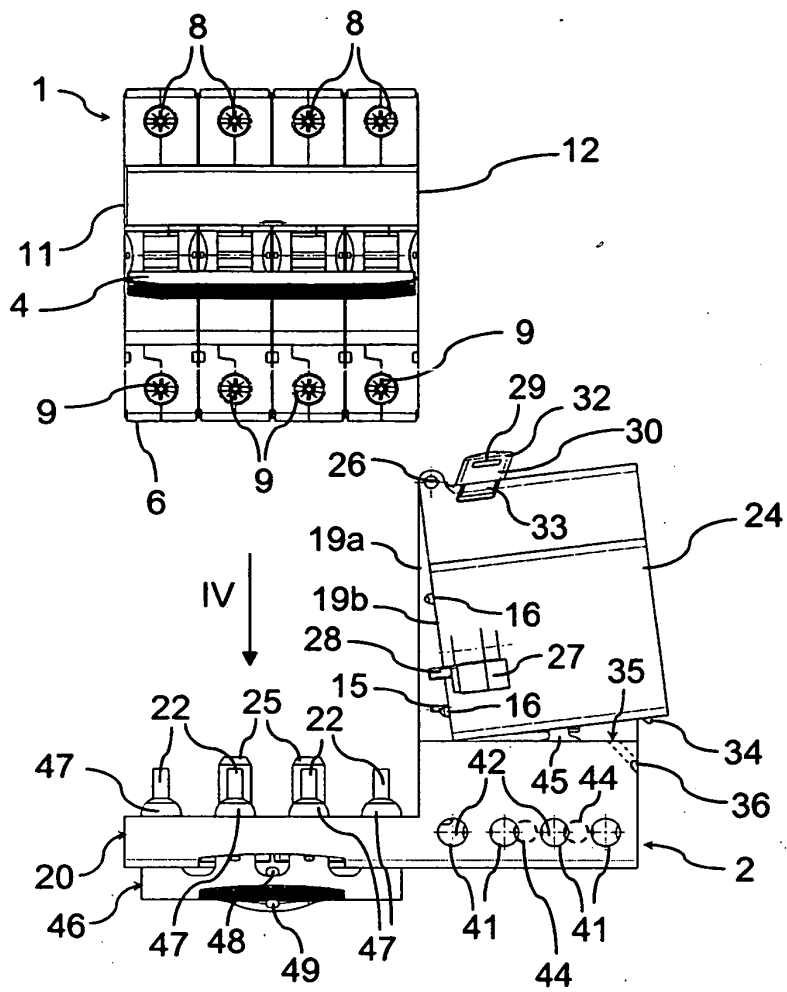


FIG 3

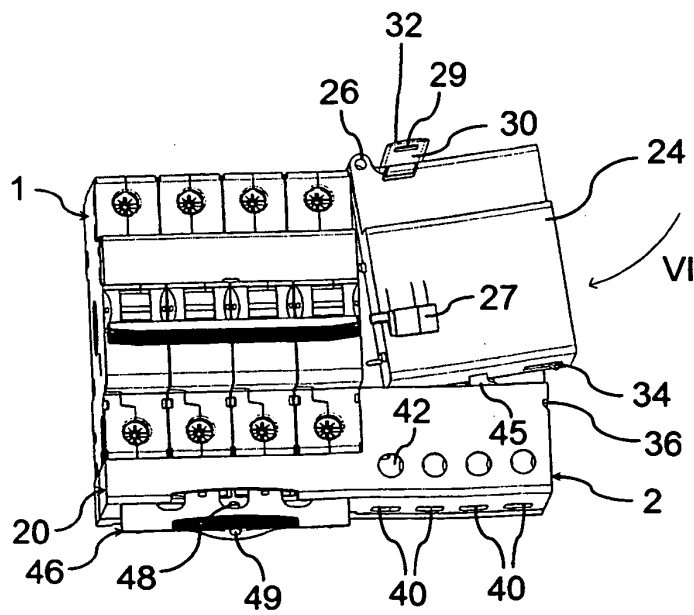
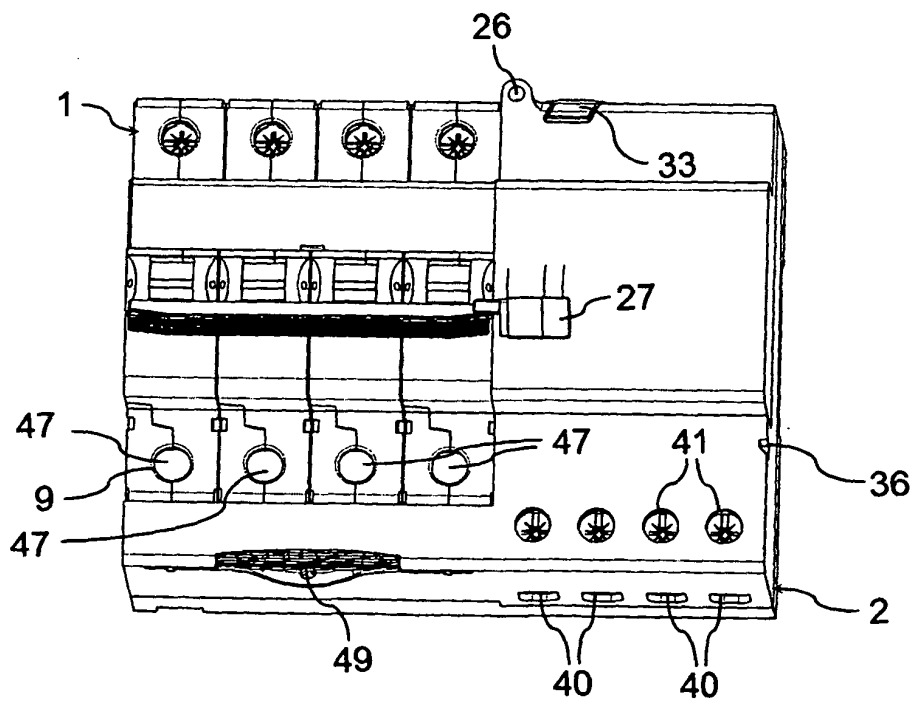
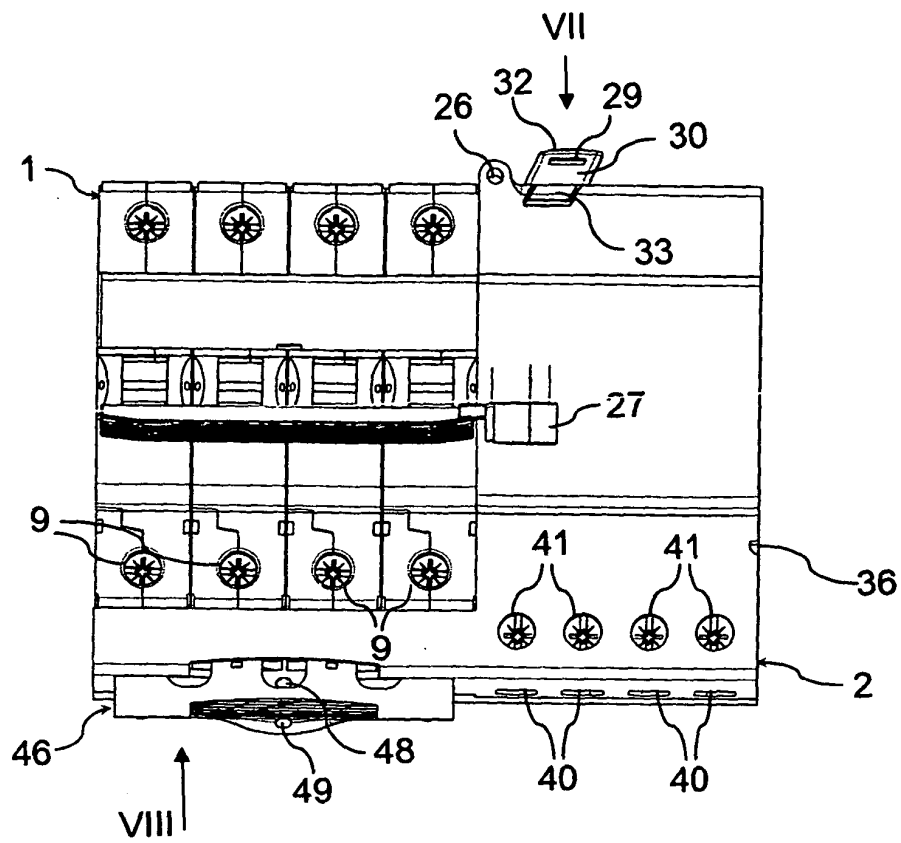


FIG 4



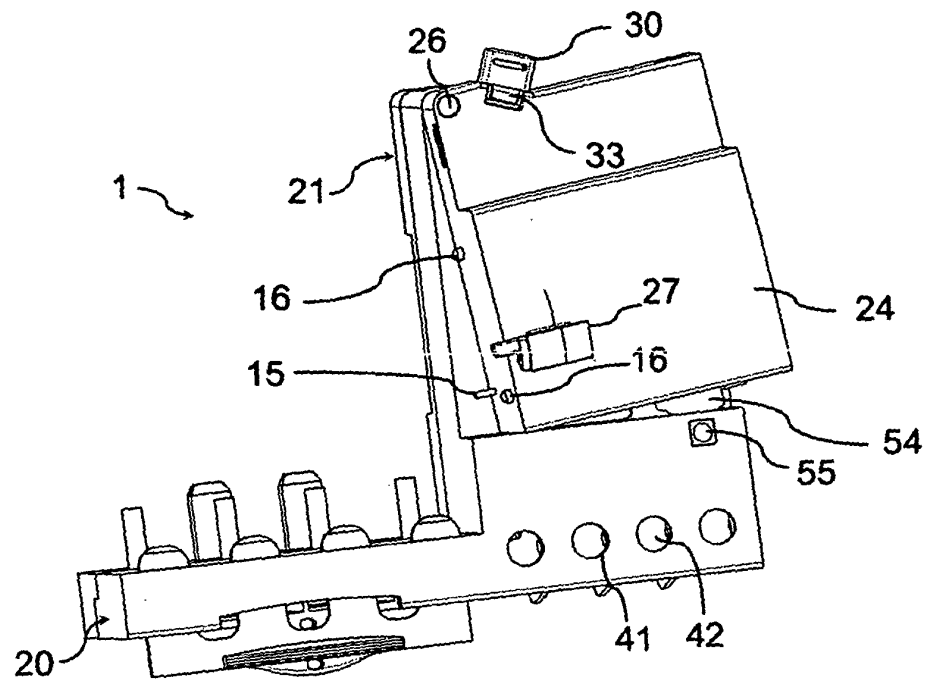


FIG 7

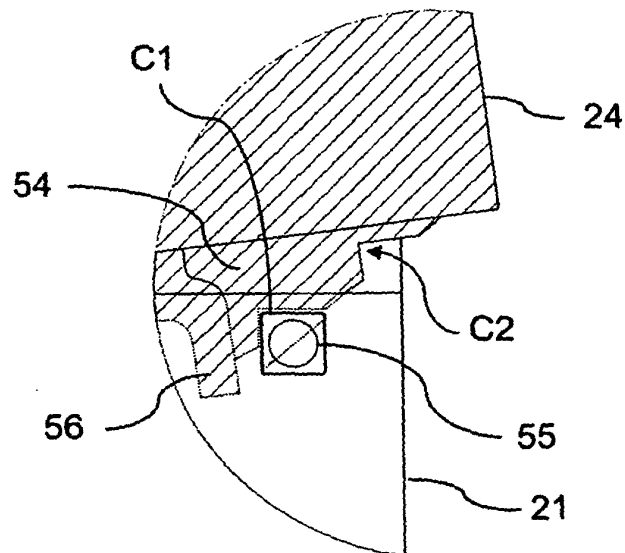


FIG 8

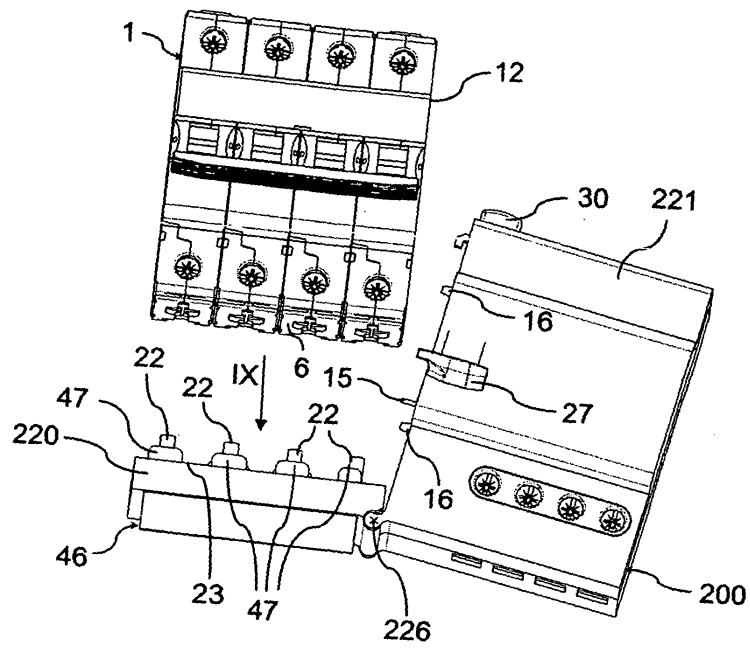


FIG 9

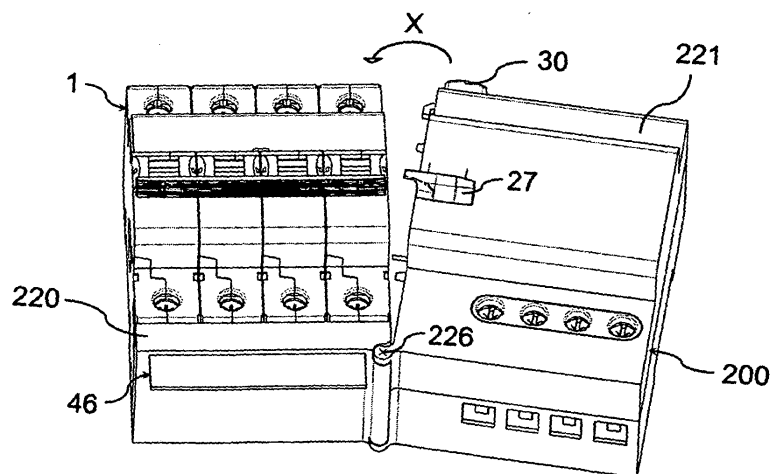
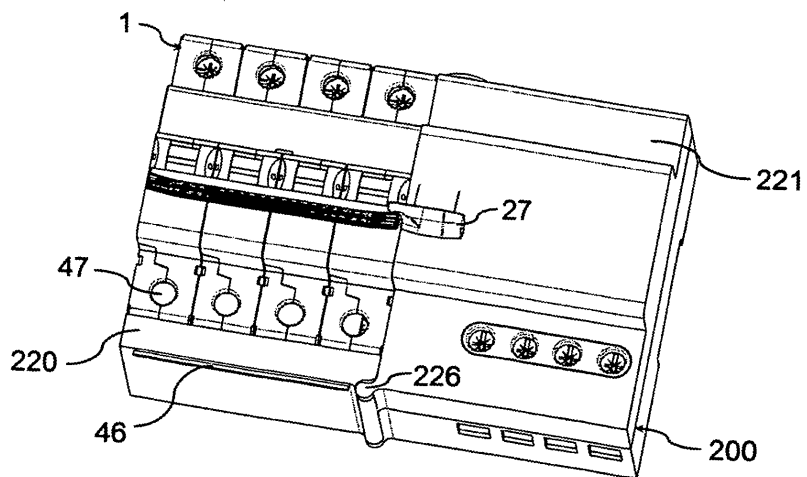
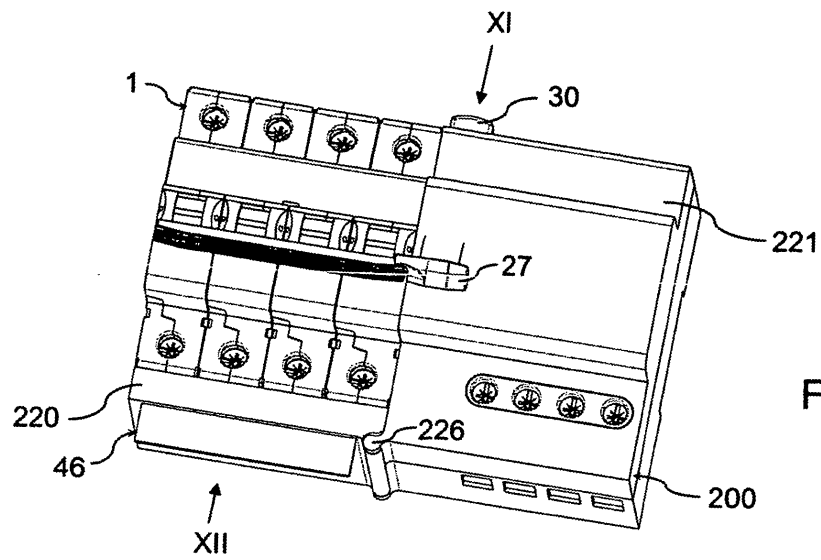


FIG 10



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

- FR 2373145 [0003]
- EP 1000430 A [0005]
- EP 0806784 A [0005]
- EP 0626711 A [0016]