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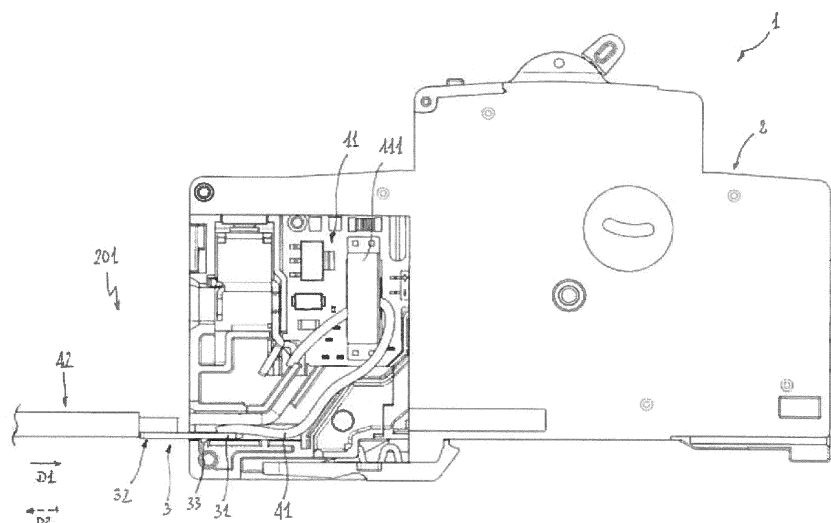
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(54) **A low voltage residual current device with solid neutral**

(57) A residual current device 1 comprising:  
a shaped casing 2; at least a couple of electric contacts comprising a moving contact and an fixed contact, which are adapted to be electrically connected to a phase conductor 101 of an electric line and which are adapted to be mutually coupled with or separated from one another; and residual current protection means 11 positioned in said shaped casing 2, which are preferably adapted to detect a residual current among the conductors 101, 102 of the electric line and generate a first tripping signal on

the basis of the trend of said residual current.

The residual current device comprises also a movable first connection element 3, which comprises a first connection portion 31, at which said first connection element is connectable to a first conductor 41 operatively coupled to said residual current protection means 11, and a second connection portion 32, at which said first connection element is connectable to a second connection element 42 adapted to be connected to the neutral conductor 102 of the electric line.



**FIG. 3**

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## Description

**[0001]** The present invention relates to the field of the residual current devices for low voltage electric lines.

**[0002]** More particularly, the present invention relates to a low voltage residual current device having solid (non-sectioned) neutral.

**[0003]** Within the framework of the present invention, the term "low voltage" relates to voltages lower than 1 kV AC and 1.5 kV DC.

**[0004]** Numerous examples of residual current devices, particularly for single-phase or three-phase low voltage electric lines, are available in the market.

**[0005]** As is known, a residual current device (RCD) is a circuit breaker, which is capable of interrupting an electric line connecting an electric power supply and an electric load when an on-board protection unit detects the presence of an unbalance current (residual current) among the conductors of the electric line.

**[0006]** Some RCDs are arranged to provide protection (overload protection) against over-currents flowing along the electric line.

**[0007]** To this aim, they may be provided with magneto-thermal tripping units that are capable of causing the interruption of the electric line as soon as the current exceeds a given threshold value.

**[0008]** As is known, a distinguishing feature of some RCDs consists in that they do not interrupt the neutral conductor when they intervene for some reasons, e.g. when residual currents and/or overload currents are detected.

**[0009]** In other words, when they trip, these devices operate the sectioning of the phase conductors of the electric line only whereas the neutral conductor is never sectioned (solid neutral).

**[0010]** A RCD with solid neutral is generally connected to a feeding portion of the neutral conductor (i.e. the portion of neutral conductor connected to the power supply) by means of a neutral connecting cable protruding from the casing of the RCD whereas the connection to a load portion of the neutral conductor (i.e. the portion of neutral conductor connected to the load) is normally arranged at a neutral terminal of the RCD.

**[0011]** In some RCDs with solid neutral, the neutral connecting cable is arranged during assembly operations, when the casing of the circuit breaker is still open.

**[0012]** Such a solution entails drawbacks in terms of flexibility of the product management process. In these RCDs, in fact, it is quite difficult to intervene on the neutral connecting cable (e.g. for customization purposes), once the casing has been finally assembled.

**[0013]** In the market, some available RCDs with solid neutral are available, in which a contact plate is solidly connected to the casing and protrudes from this latter.

**[0014]** Such a contact plate is adapted to be connected with the mentioned neutral connecting cable, when the casing of the RCD has already been assembled.

**[0015]** Even it has the advantage of making it possible

to easily and quickly customize the neutral connecting cable, according to the installation needs, such a solution still entails some drawbacks.

**[0016]** RCDs provided with an external contact plate are relatively cumbersome and their installation on a switchboard may be difficult, particularly when relatively small installation spaces are available, as it often occurs.

**[0017]** Further, complex and expensive insulation arrangements are needed to ensure proper levels of safety, since the electrical connection between the RCD and the neutral connecting cable is arranged externally to the casing of the RCD.

**[0018]** The main aim of the present invention is to provide a low voltage residual current device (RCD) with solid neutral that allows overcoming the above-described drawbacks.

**[0019]** Within the scope of this main aim, another object of the present invention is to provide a RCD that offers a considerable flexibility in the product management process, especially in relation to the customization of the electrical connections with the neutral conductor.

**[0020]** Another object of the present invention is to provide a RCD, which has a compact structure and which is quite easily to install on a switchboard, even when relatively small installation volumes are available.

**[0021]** Another object of the present invention is to provide a RCD, which ensures relatively high levels of safety.

**[0022]** Another object of the present invention is to provide a RCD, which is easy to manufacture on an industrial scale at competitive costs with respect to the devices of the state of the art.

**[0023]** The above main aim and objects, as well as other objects that will become apparent from the following description and attached drawings, are achieved according to the invention by a residual current device (RCD) for a low-voltage electric line according to the following claim 1 and the related dependent claims.

**[0024]** In a general definition, the RCD, according to the invention, comprises:

- a shaped casing;
- at least a couple of electric contacts comprising a moving contact and an fixed contact, which are adapted to be electrically connected to a phase conductor of an electric line and which are adapted to be mutually coupled with or separated from one another;
- residual current protection means positioned in said shaped casing, which are preferably adapted to detect a residual current among the conductors of the electric line and generate a first tripping signal on the basis of the trend of said residual current.

**[0025]** The RCD, according to the invention, comprises also a first connection element, which comprises a first connection portion, at which said first connection element is connectable to a first conductor operatively coupled to said residual current protection means, and a second

connection portion, at which said first connection element is connectable to a second connection element adapted to be connected to the neutral conductor of the electric line. According to the invention, said first connection element is movable, according to an insertion direction, between a first position, in which said second connection portion is positioned externally with respect to the casing of the RCD, and a second position, in which said second connection portion is positioned within the internal volume defined by said casing.

**[0026]** Preferably, the RCD, according to the invention, comprises blocking means, which are configured to block the movement of said first connection element, according to an extraction direction, opposite to said insertion direction, when said first connection element is in said first position or in said second position.

**[0027]** Preferably, said blocking means comprises first blocking means of said first connection element and second and third blocking means of said casing.

**[0028]** Said first and second blocking means mutually cooperate to block the movement of the first connection element, according to said extraction direction, when said first connection element is in said first position.

**[0029]** Said first and third blocking means mutually cooperate to block the movement of the first connection element, according to said extraction direction, when said first connection element is in said second position.

**[0030]** Preferably, the first connection element comprises a blocking portion protruding from a first surface of said first connection element.

**[0031]** Preferably, the blocking portion is adapted to be inserted in a first and second slot obtained in said casing, when said first connection element is in said first and second position, respectively.

**[0032]** Preferably, the first blocking means comprise a first blocking surface of the blocking portion of said first connection element, the second blocking means comprise a second blocking surface of the first slot of said casing whereas the third blocking means comprise a third blocking surface of the second slot of said casing.

**[0033]** The first and second blocking surfaces are advantageously arranged so that said first blocking surface is positioned in contrast with said second blocking surface, when the blocking portion of said first connection element is inserted in the first slot of said casing.

**[0034]** The first and third blocking surfaces are advantageously arranged so that said first blocking surface is positioned in contrast with said third blocking surface, when the blocking portion of said first connection element is inserted in the second slot of said casing.

**[0035]** Preferably, the blocking portion of said first connection element comprises an inclined surface, which is arranged such that it allows the exit of said blocking portion from the first slot of said casing, when said first connection element is moved from said first position to said second position, according to the insertion direction.

**[0036]** Preferably, the RCD, according to the invention, comprises magneto-thermal protection means, posi-

tioned inside the casing, which are adapted to detect an over-current flowing along the phase conductors of the electric line and generating a second tripping signal on the basis of the trend of said over-current.

**[0037]** Preferably, the RCD, according to the invention, comprises actuating means positioned inside the casing, which are adapted to separate the moving contact from the fixed contact of the RCD, e.g. when they receive a tripping signal from said residual current protection means and/or from said magneto-thermal protection means.

**[0038]** In a further aspect, the present invention relates to a method for manufacturing a RCD.

**[0039]** The method, according to the invention comprises the following steps:

- providing a RCD in one of the embodiments described above, said RCD comprising at least:
  - a shaped casing, which defines an internal volume of said residual current device;
  - at least a couple of electric contacts comprising a moving contact and an fixed contact, which are adapted to be electrically connected to said phase conductor and which are adapted to be mutually coupled with or separated from one another;
  - residual current protection means positioned in said shaped casing;
  - a first connection element, which comprises a first connection portion, at which said first connection element is connectable to a first conductor operatively coupled to said residual current protection means, and a second connection portion, at which said first connection element is connectable to a second connection element adapted to be connected to said neutral conductor, said first connection element being movable, according to an insertion direction, between a first position, in which said second connection portion is positioned externally with respect to said shaped casing, and a second position, in which said second connection portion is positioned within the internal volume defined by said shaped casing;
  - connecting the first connection portion of said first connection element to said first conductor;
  - positioning said first connection element in said first position;
  - connecting the second connection portion of said first connection element to said second connection element, when said first connection element is in said first position;
  - moving said first connection element from said first position to said second position, according to the insertion direction, when the second connection portion of said first connection element is connected to said second connection ele-

ment.

**[0040]** Further features and advantages of the present invention will emerge more clearly from the description given below, referring to the attached figures, which are given as a non-limiting example, wherein:

- figure 1 schematically illustrates an overall view of RCD, according to the present invention; and
- figures 2-4 schematically illustrate some views of the RCD, according to the present invention, in different operative positions; and
- figures 5-6 schematically illustrate further views of the RCD, according to the present invention, in different operative positions; and
- figure 7 schematically illustrates a first connection element comprised in the RCD, according to the present invention;
- figure 8 schematically illustrates an example of electric line including the RCD, according to the present invention.

**[0041]** With reference to the above-mentioned figures, the present invention refers to a residual current device (RCD) 1 for a low voltage electric line 100.

**[0042]** The RCD 1 comprises a shaped casing 2 (e.g. made of a plastic material) that defines an internal volume of the RCD.

**[0043]** The electric line 100 electrically connects an electric power supply 200 with an electric load 300 and comprises at least a phase conductor 101 and a neutral conductor 102.

**[0044]** The electric line 100 is preferably of the three-phase or single phase type.

**[0045]** In the following, the RCD 1 will be described with reference to its employment in a single phase electric line for reasons of simplicity only, without intending to limit the scope of the present invention.

**[0046]** The phase conductor 101 comprises a phase feeding portion 1011, which is electrically connected to the power supply 200, and a phase load portion 1012, which is electrically connected to the load 300.

**[0047]** Preferably, the RCD 1 comprises a first phase terminal 151 and a second phase terminal 152. When the RCD 1 is operatively installed, the phase feeding portion 1011 is electrically connected to the first phase terminal 151 whereas the phase load portion 1012 is electrically connected to the second phase terminal 152.

**[0048]** The RCD 1 comprises at least an electric pole 14 comprising at least a moving contact and at least a fixed contact, which are advantageously electrically connected to the phase terminals 151, 152 of the RCD 1.

**[0049]** Such electric contacts are therefore adapted to be electrically connected to the phase conductor 101 through a phase conductive path extending through the phase terminals 151, 152.

**[0050]** The moving contact and the fixed contact of the electric pole 14 are adapted to be mutually coupled with

or separated from one another, so as to allow/interrupt the flow of current along the phase conductive path between the phase terminals 151, 152 and, consequently, along the phase conductor 101.

**[0051]** The number of electric poles comprised in the RCD 1 obviously depends on the number of phase conductors of the electric line 100.

**[0052]** The RCD 1 is provided with a solid neutral, i.e. with a neutral conductive path that is connectable to the neutral conductor 102 and that is never sectioned during the operation of the RCD 1.

**[0053]** The RCD 1 comprises a first connection element 3, a second connection element 42 and a first conductor 41, which form the neutral conductive path of the RCD 1.

**[0054]** The first connection element 3 comprises a first connection portion 31, at which it is connectable to the first conductor 41 that is in turn electrically connected to a neutral terminal 153 of the RCD 1.

**[0055]** The first connection element 3 comprises a second connection portion 31, at which it is connectable to the second connection element 42 that is adapted to be connected to the neutral conductor 102.

**[0056]** The RCD 1 is connected to the neutral conductor 102 through the neutral terminal 153 and the second connection element 42.

**[0057]** The neutral conductor 102 comprises a neutral feeding portion 1021, which is electrically connected to the power supply 200, and a neutral load portion 1022, which is electrically connected to the load 300.

**[0058]** Preferably, when the RCD 1 is installed, the neutral feeding portion 1021 is electrically connected with the second connection element 42, which protrudes from the casing 2, whereas the neutral load portion 1022 is electrically connected to the neutral terminal 153. The RCD 1 comprises residual current protection means 11 that are positioned inside the casing 2.

**[0059]** The residual current protection means 11 (which may be of known type) are advantageously capable to detect a residual current between the conductors 101, 102 of the electric line 100 and generate a first tripping signal T1 on the basis of the trend of said residual current. Preferably, the residual current protection means 11 comprise current sensing means 111 for detecting such a residual current, which preferably comprise at least one current transformer having a primary winding formed by the conductors 101, 102 (in particular by the phase conductive path and the neutral conductive path of the RCD 1).

**[0060]** Advantageously, the first conductor 41 of the RCD 1 is operatively coupled to the residual current protection means 11, in particular to the current transformer 111 to form a primary winding of this latter.

**[0061]** Preferably, the residual current protection means 11 comprise electronic means (e.g. including a microcontroller operatively connected to a filtering circuit), which receive an output signal coming from the current sensor 111 and generate the tripping signal T1 as a

function of the trend of the detected residual current.

**[0062]** Preferably, the RCD 1 is an electronic residual current device with overload protection.

**[0063]** In this case, the RCD 1 is provided with the residual current protection means 11 and with magneto-thermal protection means 12.

**[0064]** The magneto-thermal protection means 12 (which may be of known type) are configured to detect an over-current flowing along the phase conductor 101 and generate a second tripping signal T2 as a function of the trend of said over-current.

**[0065]** Preferably, the RCD 1 comprises actuating means 13 (which may be of known type) for separating the moving contact from the fixed contact of the electric pole 14, e.g. when they receive the first tripping signals T1 and/or T2 from the protection means 11 and/or 12, respectively.

**[0066]** Preferably, the first connection element 3 of the RCD 1 is formed by a shaped plate of conductive material (e.g. steel covered by a layer of copper), which may be obtained by means of a known industrial manufacturing process (moulding, punching, or the like).

**[0067]** Preferably, the first conductor 41 of the RCD 1 is formed by a first cable, which may be of known type. As an alternative, it may be formed by a conductive bar or a similar arrangement. The connection between the first connection element 3 and the first conductor 41 is preferably obtained by soldering, punching or other similar techniques. As an alternative, such a connection may be movable, such a plug-socket connection.

**[0068]** Preferably, the second connection element 42 is formed by a second conductor, advantageously by a second cable, which may be of known type.

**[0069]** The connection between the first connection element 3 and the second connection element 42 is preferably obtained by soldering, punching or other similar techniques. As an alternative, it may be a plug-socket connection or another connection of movable type.

**[0070]** According to the invention, the first connection element 3 is movable, according to an insertion direction D1, between a first position 201, in which the second connection portion 32 is positioned externally with respect to the casing 2, and a second position 202, in which the second connection portion 32 is positioned within the internal volume defined by the casing 2.

**[0071]** Advantageously, as it is better described in the following, the second connection portion 32 is electrically connected to the second connection element 42, when the first connection element 3 is in the first position 201.

**[0072]** When the first connection element 3 is in the first position 201, the second connection portion 32 advantageously protrudes from the casing 2.

**[0073]** Conveniently, the first connection element 3 is moved from the first position 201 to the second position 202, when the second connection portion 32 is finally connected to the second connection element 42.

**[0074]** When the first connection element 3 is in the second position 202, the second connection portion 32

(and preferably any further portion of the connection element 3) is fully accommodated within the volume defined by the casing 2 and it does not protrude from the casing 2 anymore.

**[0075]** Preferably, the second connection element 42 protrudes from the casing 2, when the first connection element 3 is in the second position 202.

**[0076]** In this way, the second connection element 42 can be easily connected to the neutral conductor 102 (e.g. by means of known connection techniques).

**[0077]** Preferably, the RCD 1 comprises blocking means 331, 221, 231, which are configured to block the movement of the first connection element 3, according to an extraction direction D2, opposite to the insertion direction D1, when the first connection element 3 is in the first position 201 or in the second position 202.

**[0078]** Advantageously, the blocking means 331, 221, 231 are configured to allow the movement of the connection element 3, according to the insertion direction D1 only, in particular when the connection element 3 is in the first position 201.

**[0079]** The blocking means of the RCD 1 comprise first blocking means 331 of the first connection element 3, which are preferably formed by a first blocking surface 331 of this latter.

**[0080]** The blocking means of the RCD 1 comprise also second blocking means 221 and third blocking means 231 of the casing 2, which are preferably formed by a second blocking surface 221 and a third blocking surface 231 of the casing 2, respectively.

**[0081]** The first blocking means 331 and the second blocking means 221 mutually cooperate to block the movement of the first connection element 3, according to the extraction direction D2, when the connection element 3 is in the first position 201.

**[0082]** The first blocking means 331 and the third blocking means 231 mutually cooperate to block the movement of the first connection element 3, according to the extraction direction D2, when the connection element 3 is in the second position 202.

**[0083]** Preferably, the first connection element 3 comprises a first surface 34, which is opposite to a second surface 35, at which the connection element 3 is connectable with the first conductor 41 and the second connection element 42.

**[0084]** Preferably, the first surface 34 lays on a guiding surface 21 of the casing 2, when the connection element 3 is positioned in or moves between the operative positions 201, 202. Advantageously, the guiding surface 21 may be obtained from an internal shaped rib or edge of the casing 2.

**[0085]** Preferably, the first connection element 3 comprises a blocking portion 33 protruding from the first surface 34.

**[0086]** Preferably, the blocking portion 33 comprises the first blocking surface 331 forming the mentioned first blocking means.

**[0087]** Preferably, the blocking portion 33 of the con-

nection element 3 is inserted in a first slot 22 and in a second slot 23 of the casing 2, when the connection element 3 is in the operative position 201 and 202, respectively.

**[0088]** Advantageously, the first and second slots 22, 23 are obtained in the guiding surface 21 of the casing 2.

**[0089]** Preferably, the first slot 22 comprises the second blocking surface 221 forming the mentioned second blocking means whereas the second slot 23 comprises the third blocking surface 231 (forming the mentioned third blocking means).

**[0090]** Advantageously, the first blocking surface 331 and the second blocking surface 221 are arranged, such that the first blocking surface 331 is faced opposite with the second blocking surface 221, when the blocking portion 33 is inserted in the first slot 22 (i.e. when the first connection element 3 is in the first position 201).

**[0091]** In this way, the first blocking surface 331 is positioned in contrast with the second blocking surface 221, when the blocking portion 33 is inserted in the first slot 22.

**[0092]** The mutually opposing surfaces 331, 221 are thus capable to block the movement of the connection element 3 according to the extraction direction D2.

**[0093]** Advantageously, the first blocking surface 331 and the third blocking surface 231 are arranged, such that the first blocking surface 331 is faced opposite with the third blocking surface 231, when the blocking portion 33 is inserted in the second slot 23 (i.e. when the first connection element 3 is in the second position 202).

**[0094]** In this way, the first blocking surface 331 is positioned in contrast with the third blocking surface 231, when the blocking portion 33 is inserted in the second slot 23.

**[0095]** The mutually opposing surfaces 331, 231 are thus capable to block the movement of the first connection element 3 according to the extraction direction D2.

**[0096]** Preferably, the first blocking surface 331 is oriented perpendicularly with respect to the first surface 34 of the first connection element 3 and the second and third blocking surfaces 221, 231 are oriented perpendicularly with respect to the guiding surface 21 of the casing 2.

**[0097]** In this way, undercut couplings between the opposing surfaces 331, 221 and the opposing surfaces 331, 231 are advantageously obtained, when the blocking portion 33 is inserted in the first slot 22 and in the second slot 23, respectively.

**[0098]** It is apparent that any movement of the connection element 3, according to the extraction direction D2, is blocked by the mutual contrast between the opposing surfaces 331, 221 and the opposing surfaces 331, 231, when the first connection element 3 is in the first position 201 and in the second position 202, respectively.

**[0099]** Preferably, the blocking portion 33 of the connection element 3 is shaped like a reverse-wedge and it comprises a shaped inclined surface 332, which extends from an edge 331A of the first blocking surface 331 (in distal position with respect to the first surface 34 of the first connection element 3) towards the first surface 34.

**[0100]** Preferably, the inclined surface 332 is oriented so as to allow the exit of the blocking portion 33 from the first slot 22, when the first connection element 3 is moved from the first position 201 to the second position 202.

**[0101]** The inclined surface 332 advantageously forms an angle less than 90° with the first surface 34 of the first connection element 3 (in a distal position from the edge 331A of the blocking portion 33).

**[0102]** In this way, when the connection element 3 is moved towards the insertion direction D1, the inclined surface 332 slides on an edge 222 of the first slot 22, which is positioned opposite with respect to the blocking surface 221 of the slot 22.

**[0103]** In this way, the movement of the connection element 3, according to the insertion direction D1, is not blocked.

**[0104]** In a further aspect, the present invention related to a method for assembling an RCD.

**[0105]** The method comprises a step of providing the RCD 1, in one of the embodiments described above.

**[0106]** The method of the invention comprises a step of connecting the first connection portion 31 of the first connection element 3 to the first conductor 41.

**[0107]** Advantageously, this step is carried out during the assembly of the casing 2 of the RCD 1, when the casing 2 is still open.

**[0108]** Preferably the first conductor 41 is connected to the neutral terminal 153 and is coupled to the residual current protection means 11, before being connected to the first connection element 3.

**[0109]** The method of the invention comprises a step of positioning the first connection element 3 in the first position 201.

**[0110]** Also this step is advantageously carried out during the assembly stage of the casing 2 of the RCD, when the casing 2 is still open.

**[0111]** According to the method of the invention, once the assembly of the casing 2 is completed, the first connection element 3 is positioned in the first position 201.

**[0112]** When the connection element 3 is the first position 201, any movement according to the extraction direction D2, is blocked by the mutual interaction between the first and second blocking means 331, 221.

**[0113]** The method of the invention comprises a step of connecting the second connection portion 32 of the first connection element 3 to the second connection element 42, when said first connection element is in such a first position 201.

**[0114]** The method of the invention comprises the step of moving the first connection element 3 from the first position 201 to the second position 202, when the second connection portion 32 is finally connected to the second connection element 42.

**[0115]** When the connection element 3 is the second position 202, any movement according to the extraction direction D2, is blocked by the mutual interaction between the first and third blocking means 331, 231.

**[0116]** Further, when the connection element 3 is the

second position 202, the second connection element 42 protrudes from the casing 2.

[0117] The RCD 1 is now ready to be operatively installed on the field, by connecting the terminals 151, 152, 153 and the connection element 42 respectively to the phase conductor 101 and the neutral conductor 102, as described above.

[0118] It has been shown in practice that the residual current device 1, according to the invention, provides remarkable advantages with available solutions of the state of the art.

[0119] The connection element 42 with the neutral conductor of the electric line can be customized according to the needs, without intervening on the casing 2, which remarkably simplifies the manufacturing process, ensuring at the same time a high level of flexibility in the customization of the connection arrangements with the neutral conductor.

[0120] On the other hand, when it has been finally configured (the connection element 3 is moved into the position 102), the RCD 1 offers a very compact structure and is therefore quite easy to install on a switchboard.

[0121] Being the connection element 3 finally inserted (movement D1) inside the casing 2, an optimal insulation of the electrical connections between the first and second connection elements 3, 42 can be obtained, thereby ensuring appropriate levels of safety.

[0122] The RCD 1 has proven to be relatively easy to manufacture at industrial level, at competitive costs with respect to the devices of the state of the art.

## Claims

1. A residual current device (1) for a low voltage electric line (100) comprising at least a phase conductor (101) and a neutral conductor (102), said residual current device comprising:

- a shaped casing (2), which defines an internal volume of said residual current device;
  - at least a moving contact and an fixed contact, which are adapted to be electrically connected to said phase conductor and which are adapted to be mutually coupled with or separated from one another;
  - residual current protection means (11) positioned in said shaped casing (2);
  - a first connection element (3), which comprises a first connection portion (31), at which said first connection element is connectable to a first conductor (41) operatively coupled to said residual current protection means, and a second connection portion (32), at which said first connection element is connectable to a second connection element (42) adapted to be connected to said neutral conductor;
- characterised in that** said first connection ele-

ment (3) is movable, according to an insertion direction (D1), between a first position (201), in which said second connection portion (32) is positioned externally with respect to said shaped casing (2), and a second position (202), in which said second connection portion (32) is positioned within the internal volume defined by said shaped casing (2).

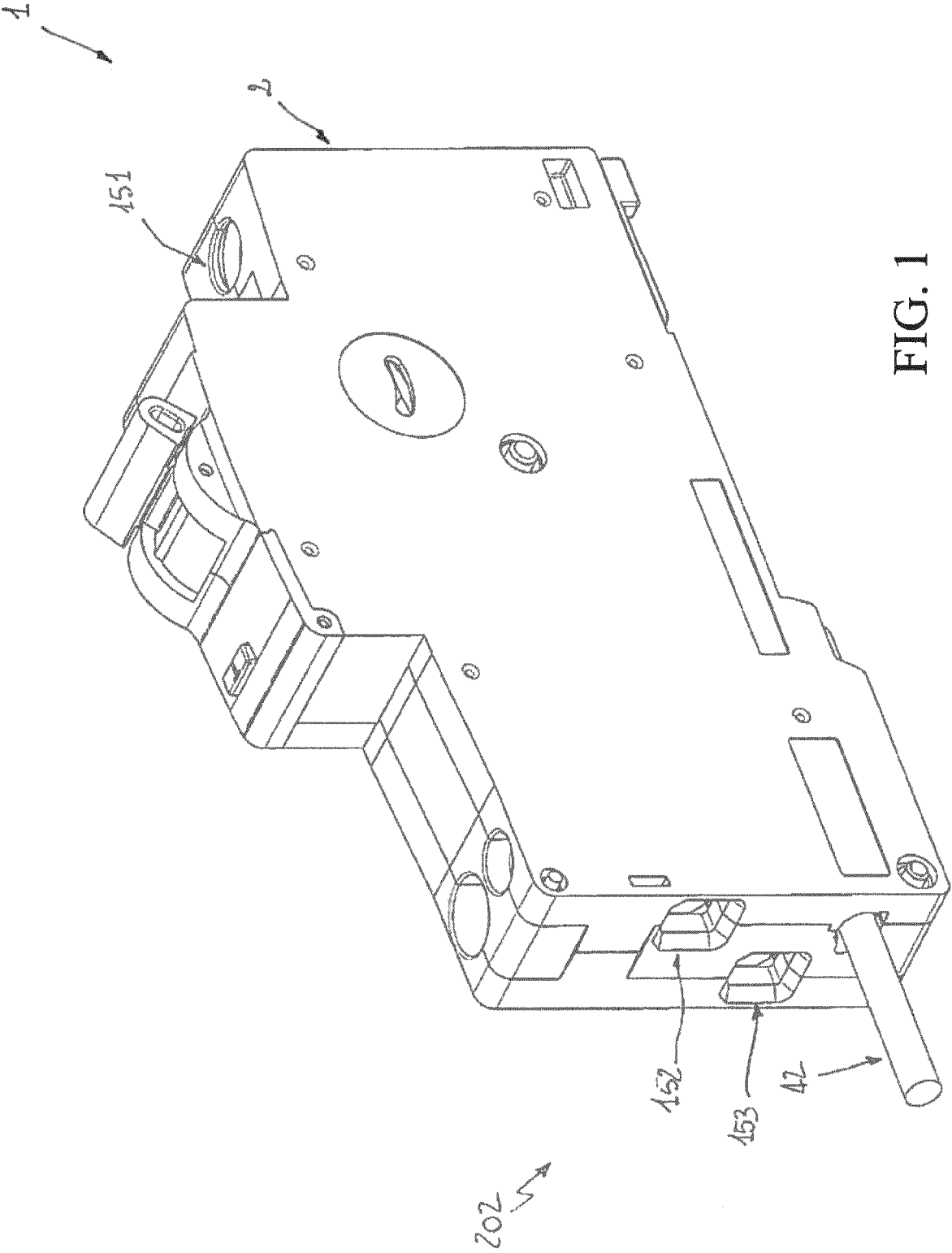
2. A residual current device, according to claim 1, **characterised in that** it comprises blocking means (331, 221, 231), which are configured to block the movement of said first connection element (3), according to an extraction direction (D2), opposite to said insertion direction, when said first connection element is in said first position (201) or in said second position (202).
3. A residual current device, according to claim 2, **characterised in that** said blocking means comprises first blocking means (331) of said first connection element (3) and second and third blocking means (221, 231) of said casing (2), said first and second blocking means mutually cooperating to block the movement of said first connection element (3), according to said extraction direction (D2), when said first connection element is in said first position (201), said first and third blocking means mutually cooperating to block the movement of said first connection element (3), according to said extraction direction (D2), when said first connection element is in said second position (202).
4. A residual current device, according to one or more of the previous claims, **characterised in that** said first connection element (3) comprises a blocking portion (33) protruding from a first surface (34) of said first connection element, said blocking portion (33) being adapted to be inserted in a first slot (22) obtained in said shaped casing (2), when said first connection element (3) is in said first position (201), and to be inserted in a second slot (23) obtained in said shaped casing (2), when said first connection element (3) is in said second position (202).
5. A residual current device, according to claims 3 and 4, **characterised in that** said first blocking means comprise a first blocking surface (331) of said third blocking portion (33), said second blocking means comprise a second blocking surface (221) of said first slot (22) and said third blocking means comprise a third blocking surface (231) of said second slot (23).
6. A residual current device, according to claim 5, **characterised in that** said first, second and third blocking surfaces are arranged such that said first blocking surface (331) is positioned in contrast with said second blocking surface (221), when said blocking por-

tion (33) is inserted in said first slot (22), and is positioned in contrast with said third blocking surface (231), when said blocking portion is inserted in said second slot (23).

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7. A residual current device, according to one or more of the claims from 4 to 6, **characterised in that** said blocking portion (33) comprises an inclined surface (332), which is arranged such that it allows the exit of said blocking portion from said first slot (22), when said first connection element (3) is moved from said first position (201) to said second position (202), according to said insertion direction (D1). 10
8. A residual current device, according to one or more of the previous claims, **characterised in that** it comprises: 15
  - said residual current protection means (11), which are adapted to detect a residual current among the conductors of said electric line and generate a first tripping signal (T1) based on the trend of said residual current; 20
  - a magneto-thermal protection means (12), positioned inside said shaped casing, which are adapted to detect an over-current flowing along said phase conductor and generate a second tripping signal (T2) based on the trend of said over-current; 25
  - actuating means (13) positioned inside said shaped casing, which are adapted to separate said moving contact from said fixed contact. 30
9. A method for assembling a residual current device, **characterised in that** it comprises the steps of: 35
  - providing a residual current device (1), according to one or more of the previous claims;
  - connecting the first connection portion (31) of said first connection element (3) to said first conductor (41); 40
  - positioning said first connection element (3) in said first position (201);
  - connecting the second connection portion (32) of said first connection element (3) to said second connection element (42), when said first connection element is in said first position (201); 45
  - moving said first connection element (3) from said first position (201) to said second position (202), according to said insertion direction (D1), when the second connection portion (32) of said first connection element (3) is connected to said second connection element (42). 50

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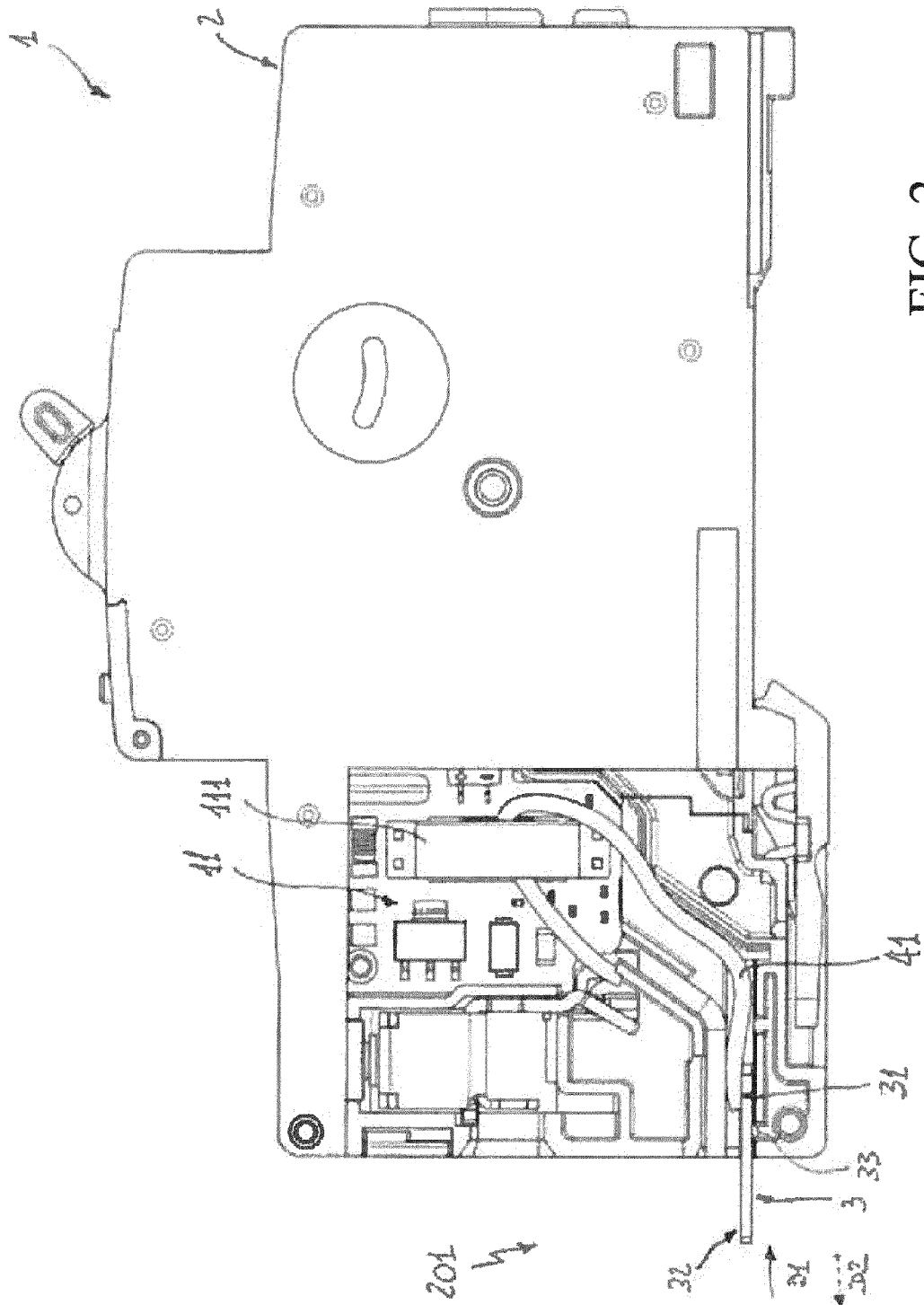


FIG. 2

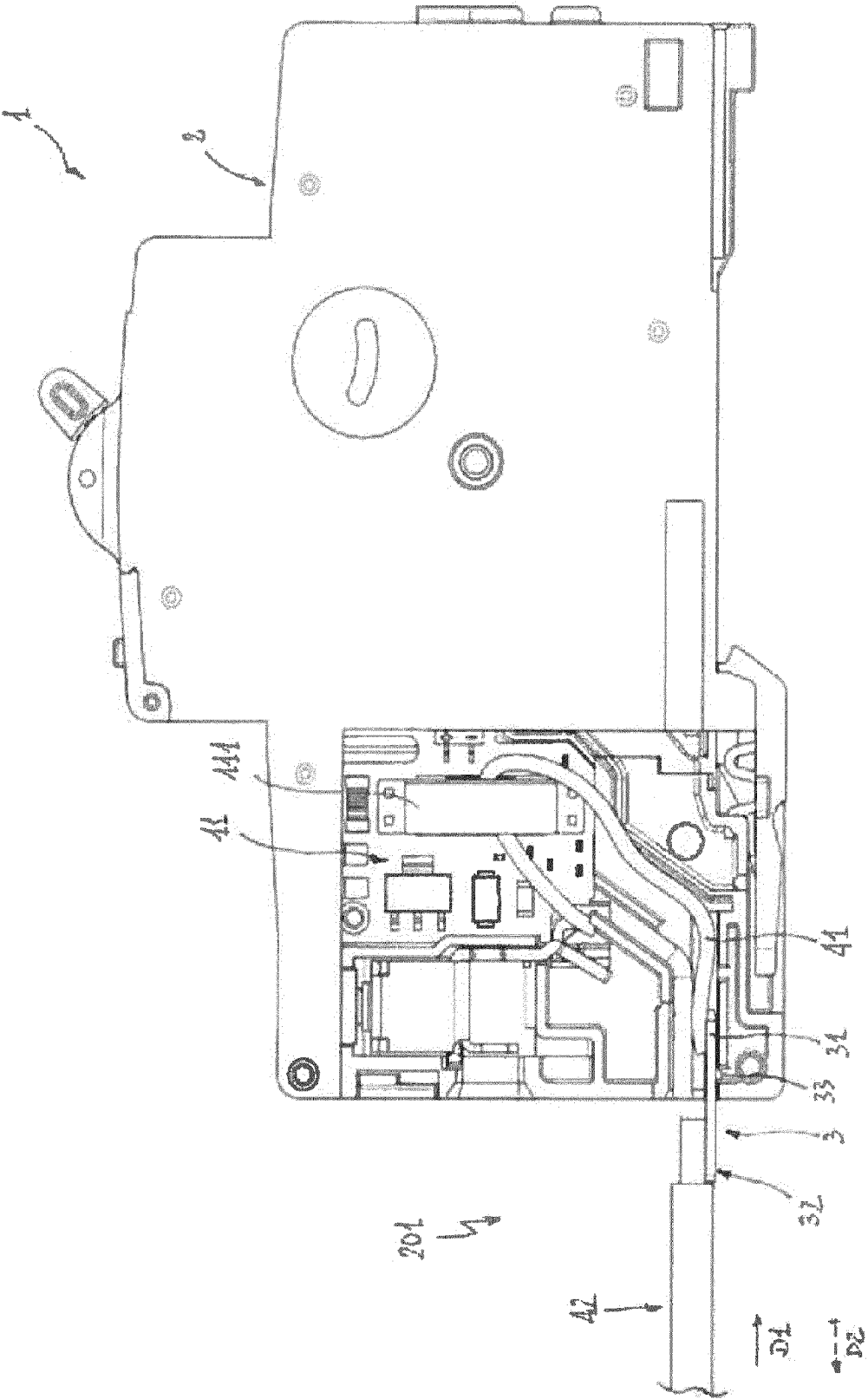


FIG. 3

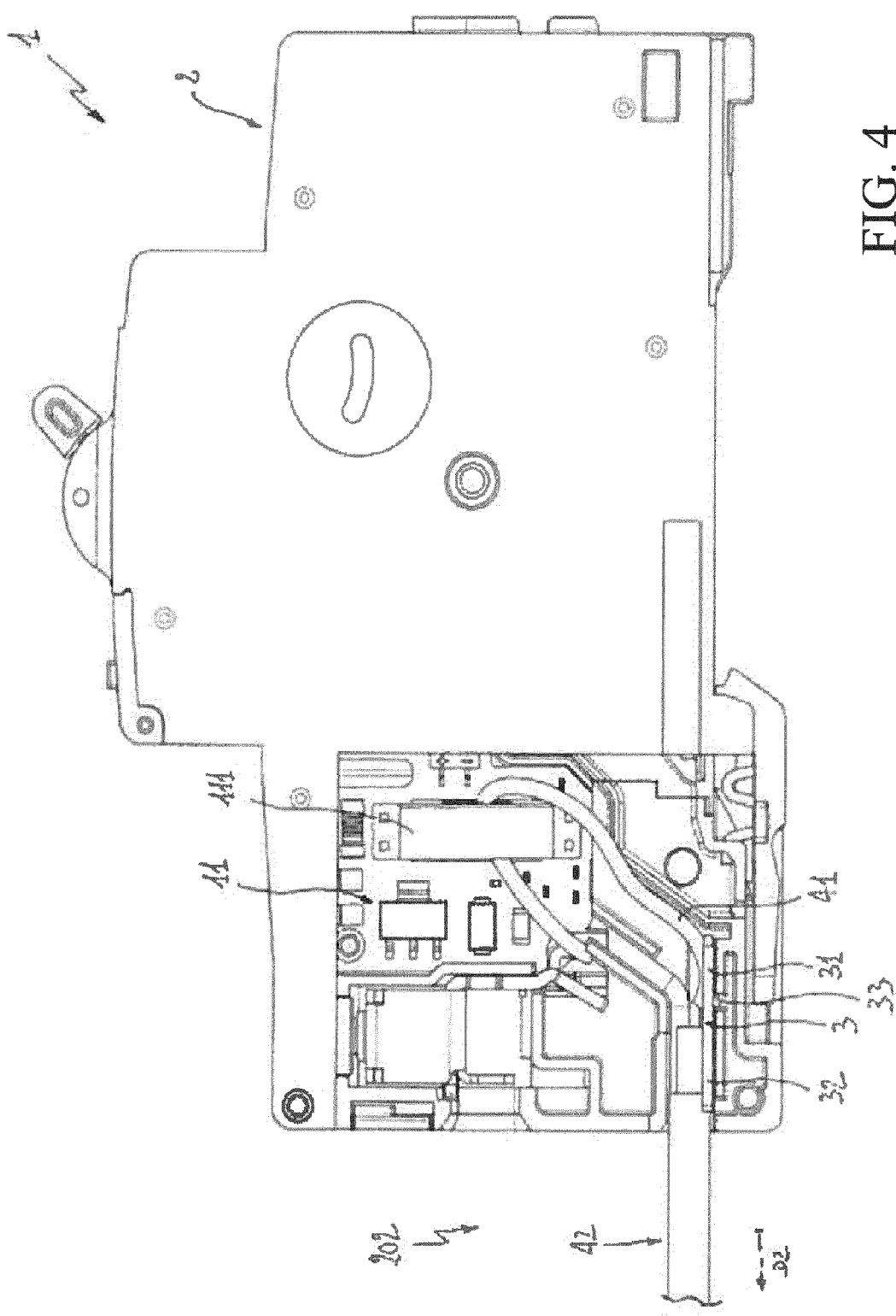
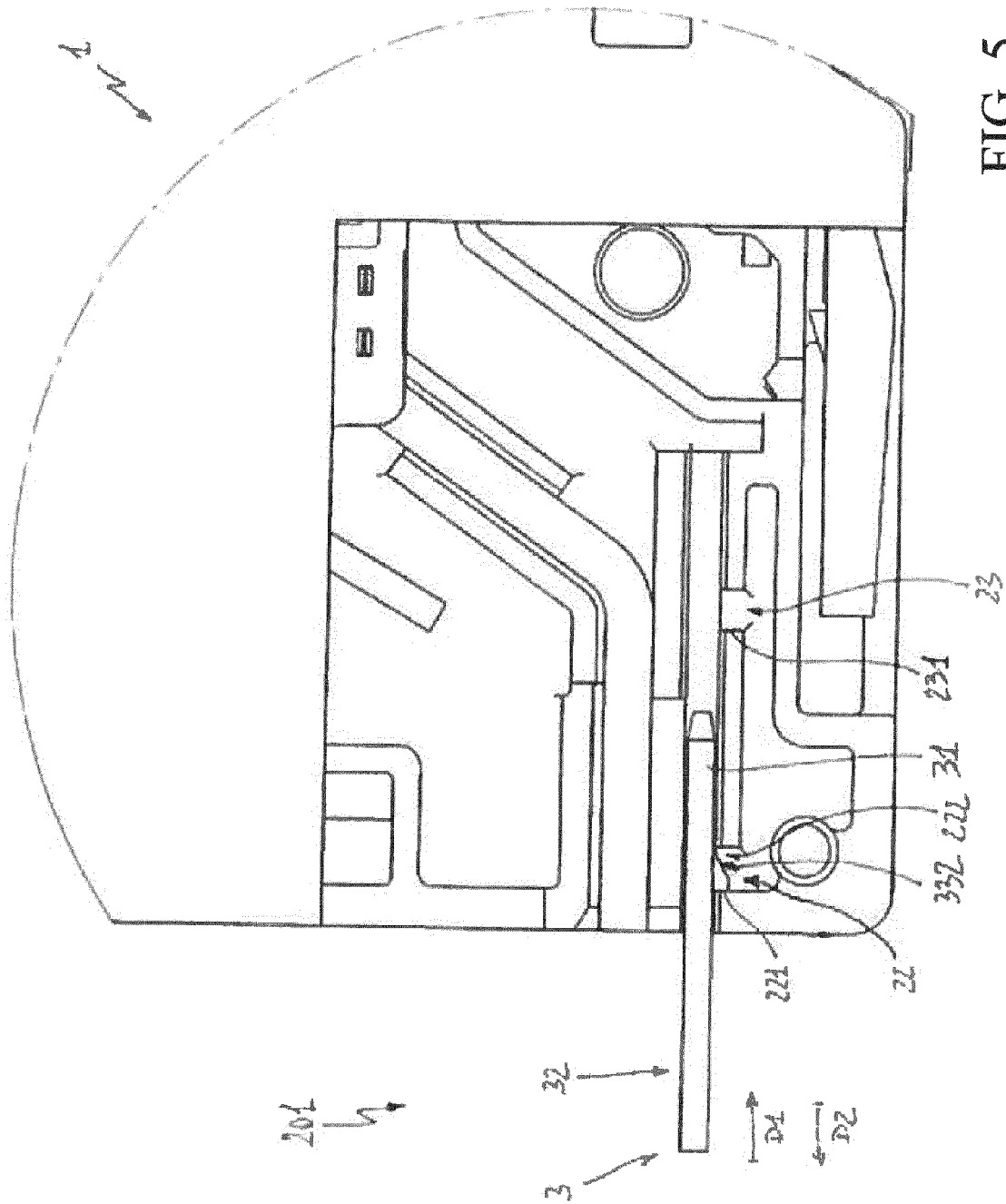


FIG. 4



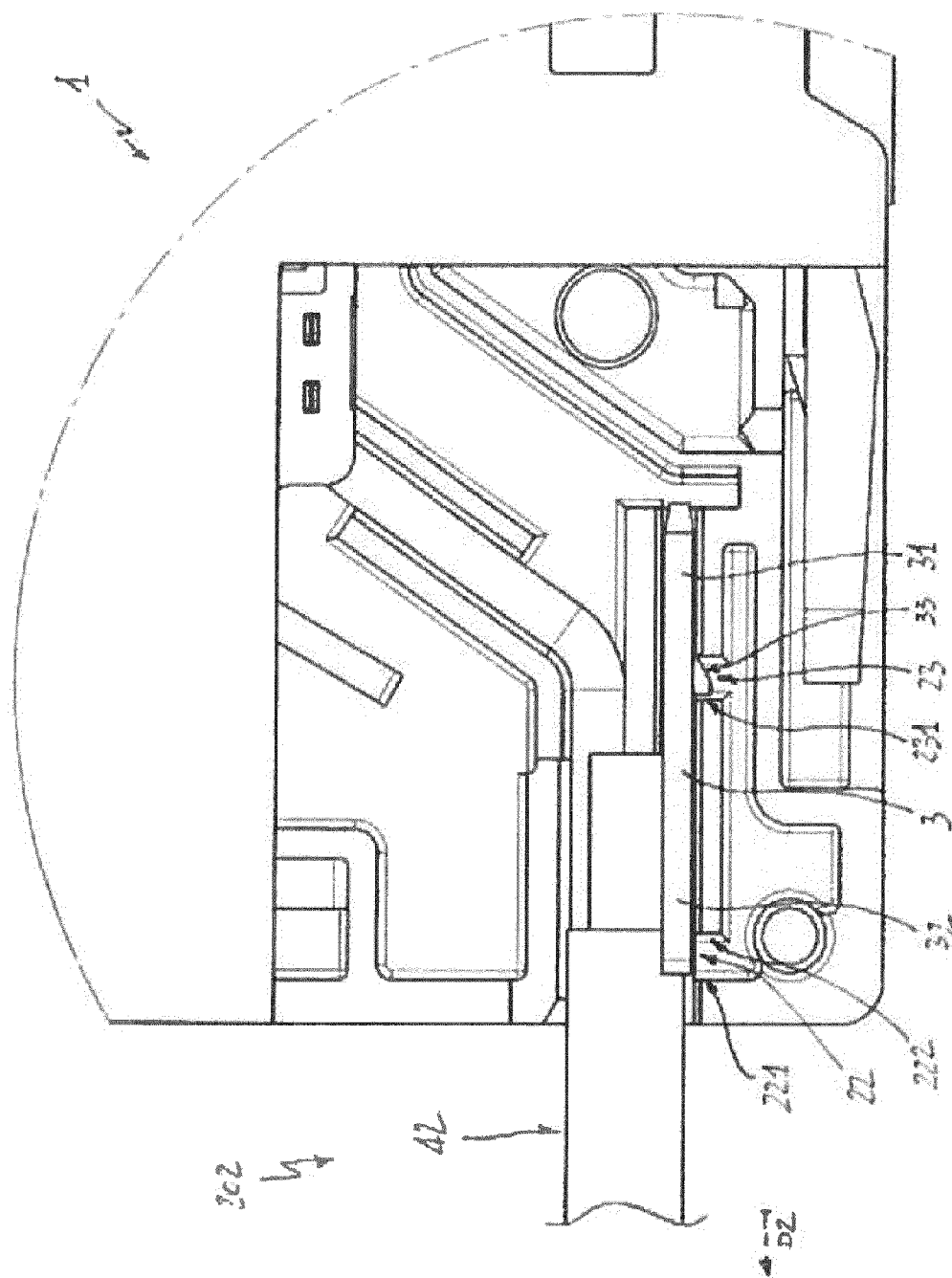


FIG. 6

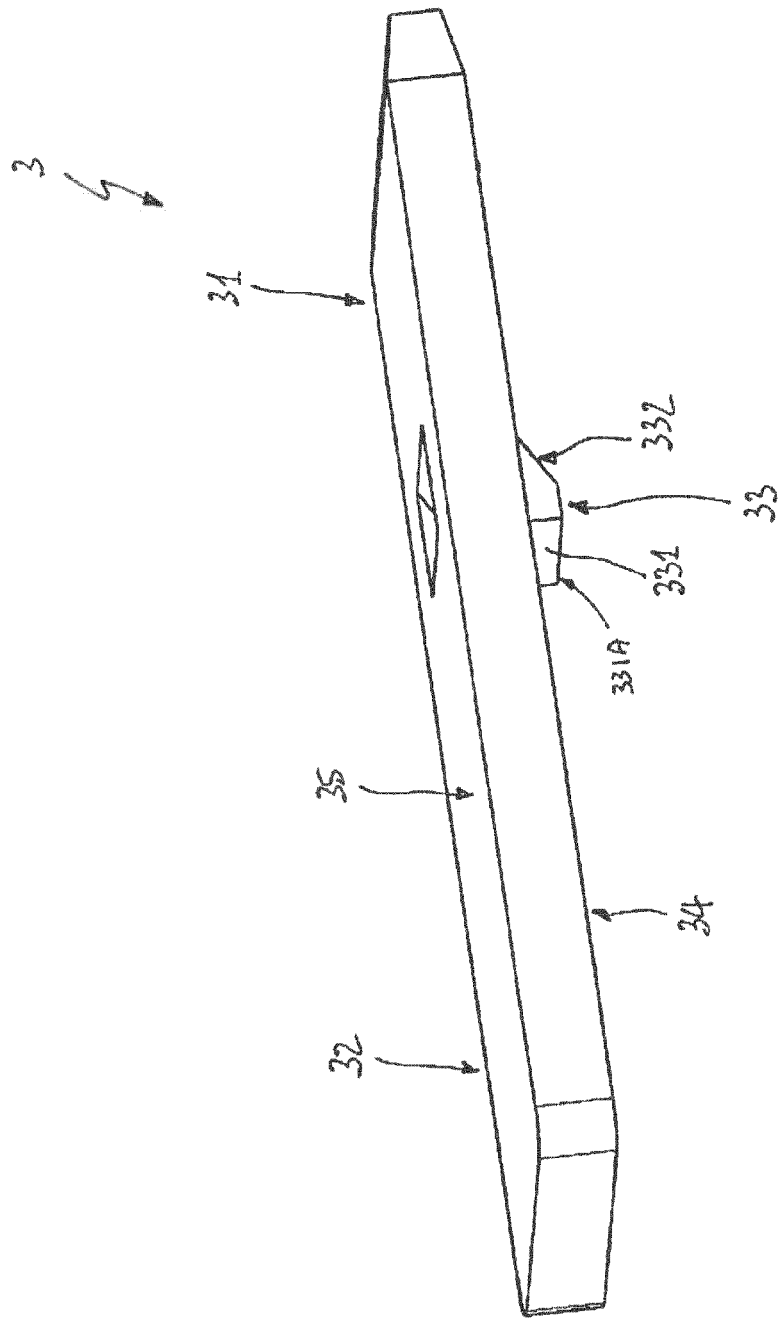


FIG. 7

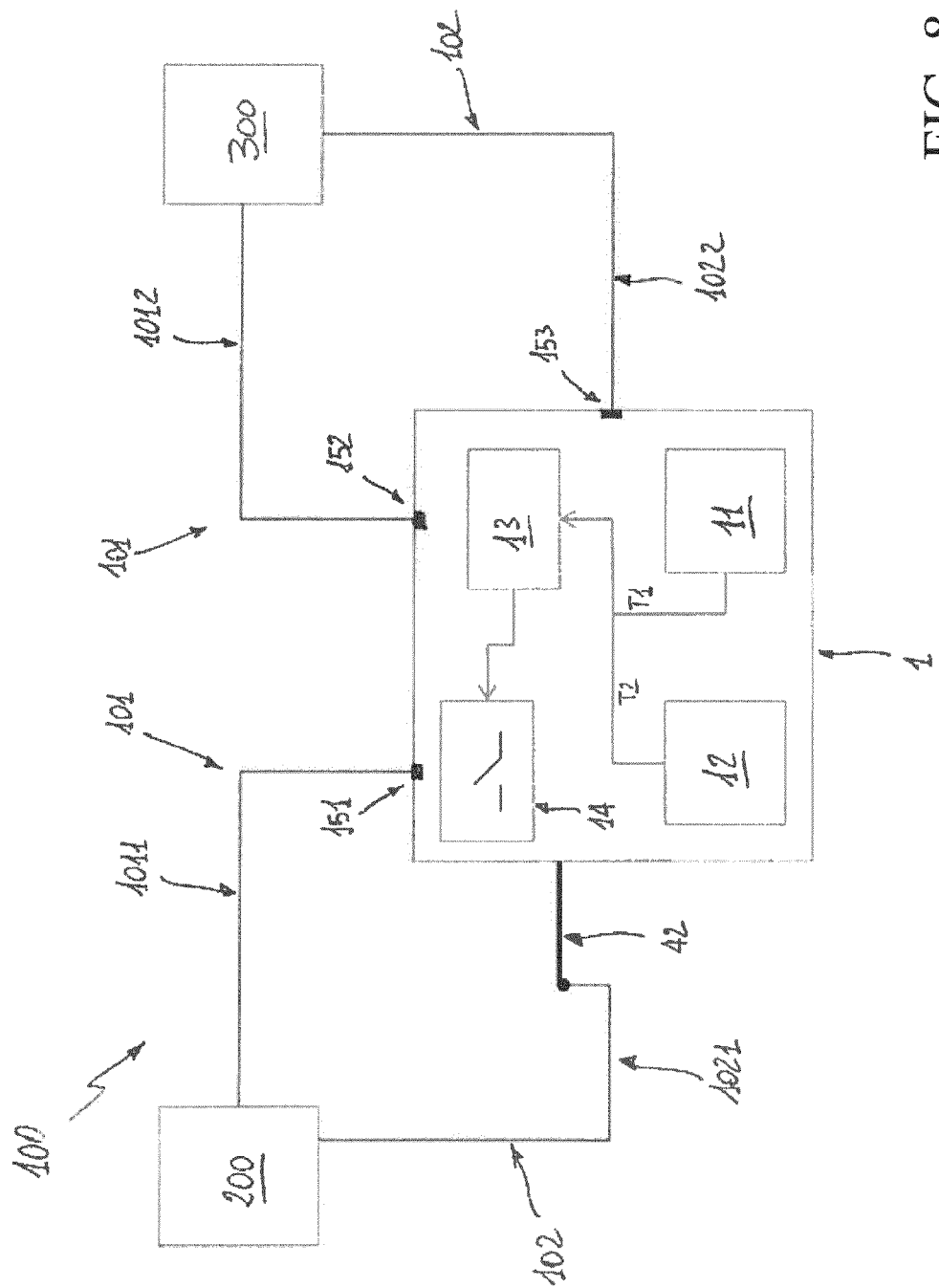


FIG. 8



## EUROPEAN SEARCH REPORT

Application Number  
EP 13 17 8663

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                           |                                                      |                                             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|---------------------------------------------|
| Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Citation of document with indication, where appropriate, of relevant passages                                                             | Relevant to claim                                    | CLASSIFICATION OF THE APPLICATION (IPC)     |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | US 6 442 006 B1 (BAERTSCH RICHARD DUDLEY [US] ET AL) 27 August 2002 (2002-08-27)<br>* column 3, line 62 - column 4, line 8;<br>figure 2 * | 1-9                                                  | INV.<br>H01H71/08<br>H01H83/14<br>H01H71/02 |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | US 6 255 923 B1 (MASON JR HENRY H [US] ET AL) 3 July 2001 (2001-07-03)<br>* column 3, lines 40-59; figures 1-3 *                          | 1-9                                                  |                                             |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | US 5 414 395 A (GARNTO CHARLES D [US] ET AL) 9 May 1995 (1995-05-09)<br>* figures 1-6 *                                                   | 1-9                                                  |                                             |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                           |                                                      | TECHNICAL FIELDS SEARCHED (IPC)             |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                           |                                                      | H01H<br>H01R                                |
| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                           |                                                      |                                             |
| Place of search<br>Munich                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                           | Date of completion of the search<br>11 December 2013 | Examiner<br>Glaman, C                       |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document<br>T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                                                                                                                           |                                                      |                                             |

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EPO FORM 1503 03.82 (P04C01)

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

EP 13 17 8663

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11-12-2013

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