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(71) Applicant: **ABB Schweiz AG**
5400 Baden (CH)

(72) Inventor: **Iapichella, Rosario**
I-21050 Cairate (VA) (IT)

(74) Representative: **De Bortoli, Eros et al**
Zanoli & Giavarini S.p.A.
Via Melchiorre Gioia, 64
20125 Milano (IT)

(54) AN ELECTRICAL DEVICE FOR LOW-VOLTAGE ELECTRICAL SYSTEMS

(57) The present invention relates to an electrical device for low-voltage electrical systems.

The electrical device comprises an insulating housing having one or more terminal ports, each configured to allow a passage of first and second conductors into the internal volume of said electrical device.

The electrical device further comprises one or more electric terminals, each accommodated in the internal volume of said electrical device at a corresponding term-

inal port to connect electrically the electric conductors passing through said terminal port to an internal conductor of said electrical device.

Each electrical block is configured so that the wiring operations of a conductor can be carried out in an independent manner without influencing the coupling condition of the other conductor with the electric terminal or the wiring operation of the other conductor with the electric terminal.

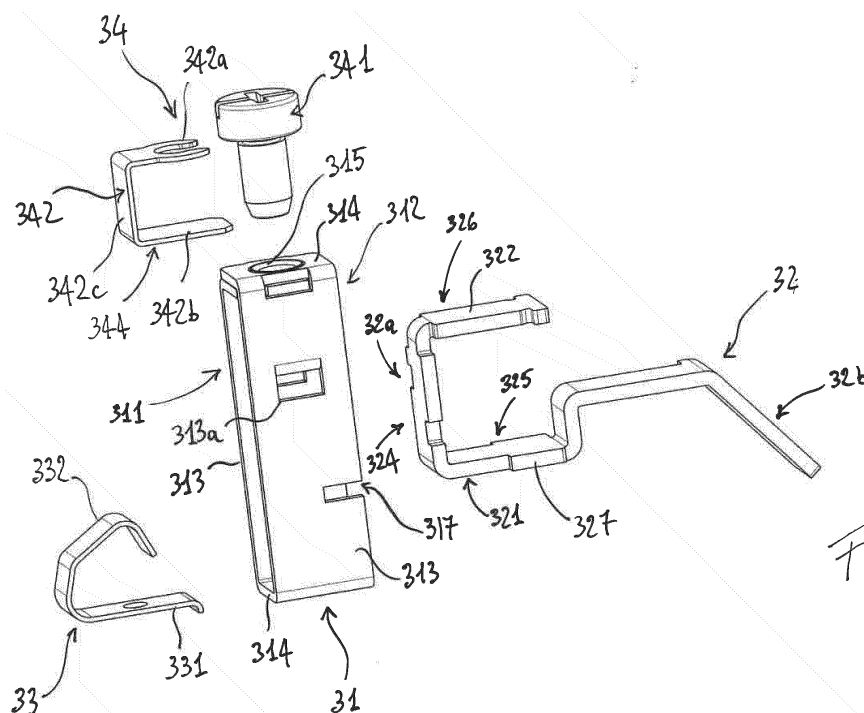


Fig. 2

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Description

[0001] The present invention relates to an electrical device for low-voltage electrical systems.

[0002] As is known, electrical devices for low-voltage electrical systems (e.g. circuit breakers, residual current devices, energy meters, or the like) normally include electric terminals for electrical and mechanical connection with the conductors of an electric line.

[0003] In certain applications, it is necessary to couple both a main conductor (e.g., a phase conductor or a neutral conductor) and an auxiliary conductor to some electric terminals of the electrical device. The main conductor may be a busbar electrically connecting the electrical device to an electric load while the auxiliary conductor may be a cable electrically connecting the electrical device to another circuit branch.

[0004] In these applications, electric terminals configured to connect electrically a pair of external electric conductors with an internal electric conductor of the electrical device are generally used.

[0005] Currently available electric terminals of this type have some aspects to improve.

[0006] Typically, these electric terminals are coupled to a main conductor through a screwless connection while they are coupled to an auxiliary conductor through a screw connection. The experience has however shown that wiring operations (in particular wire removal operations) of the auxiliary conductor may cause a loosening of the electrical connection between the electric terminal and the main conductor.

[0007] This circumstance may obviously lead to undesired electric effects (increase of the contact resistance of the main conductor) often accompanied by relevant heating phenomena.

[0008] The above-described issue is generally made more critical by the circumstance that the user may not realize that the electrical connection between the main conductor and the electric terminal has become loose in consequence of a wiring operation of the auxiliary conductor.

[0009] In the state of the art, there is a certain need for innovative solutions capable of overcoming or mitigating these criticalities as these latter may entail a risk of damaging the internal components of the electrical device and increase maintenance interventions.

[0010] In order to respond to this need, the present invention provides an electrical device according to the following claim 1 and the related dependent claims.

[0011] In a general definition, the electrical device of the invention comprises:

- an insulating housing defining an internal volume of said electrical device and having one or more terminal ports, each configured to allow a passage of first and second electric conductors into the internal volume of said electrical device;
- one or more electric terminals, each accommodated

in the internal volume of said electrical device at a corresponding terminal port to connect electrically the electric conductors passing through said terminal port to an internal electric conductor of said electrical device.

[0012] According to the invention, an electric terminal comprises:

- a support cage accommodated in the internal volume of said electrical device in proximity of a terminal port;
- an electrode element electrically connected to an internal conductor of said electrical device and at least partially accommodated in said support cage;
- a spring element and a pushing element coupled to said support cage and at least partially accommodated in said support cage.

[0013] The spring element and the pushing element are arranged at opposite sides of said support cage relative to said electrode element.

[0014] The spring element is configured to cooperate with said electrode element to clamp a first conductor passing through a terminal port of said insulating housing and inserted between said spring element and said electrode element.

[0015] The pushing element is configured to cooperate with said electrode element to clamp a second conductor passing through said terminal port and inserted between said pushing element and said electrode element.

[0016] The electrode element is coupled to said support cage in such a way to maintain a fixed position relative to said support cage during wiring operations of said first and second conductors.

[0017] According to some embodiments of the invention, the electrode element has one or more protrusions inserted into corresponding slits of said support cage to clamp said electrode element between opposite walls of said support cage and fix said electrode element to said support cage.

[0018] According to other embodiments of the invention, the electric terminal further comprises a holder element partially embracing said support cage. The electrode element has one or more protrusions passing through corresponding apertures of said support cage and inserted into corresponding holes of said holder element in such a way to clamp said electrode element between opposite portions of said holder element and fix said electrode element to said support cage.

[0019] According to an aspect of the invention, the support cage has a box-like structure including opposite first and second open sides. The first open side faces the terminal port of said insulating housing to receive the first and second conductors passing through said terminal port while the second open side faces the internal volume of said electrical device. The electrode element protrudes from said second open side to be electrically connected

to an internal conductor of said electrical device.

[0020] According to an aspect of the invention, the electrode element has a first coupling surface for coupling to the first conductor passing through said terminal port and a second coupling surface for coupling to the second conductor passing through said terminal port.

[0021] The electrode element has a coupling portion inserted in said support cage and including said first and second coupling surfaces and a connection portion protruding from said support cage for electrical connection with an internal conductor of said electrical device.

[0022] According to an aspect of the invention, the spring element is formed by a bent elastic lamina having a first end coupled to said support cage and a second free end arranged in proximity of said electrode element, more precisely in proximity or in contact with the first coupling surface of said electrode element.

[0023] The second free end of said elastic lamina has a third coupling surface for coupling to said first conductor passing through said terminal port. The first coupling surface of said electrode element and the third coupling surface of said elastic lamina are mutually opposite and define a passage for said first conductor.

[0024] According to an aspect of the invention, the pushing element includes a screw, which is inserted through a threaded hole of said support cage and movable along a translation axis (preferably directed transversally to said electrode element) and a pusher coupled to said screw in such a way to move together with said screw along said translation axis.

[0025] The pusher includes a fourth coupling surface for coupling to said second conductor.

[0026] The second coupling surface of said electrode element and the fourth coupling surface of said pusher are mutually opposite and define a passage for said second conductor.

[0027] Advantageously, said screw is arranged coaxially with an access hole of the insulating housing configured to allow an access to said electric terminal.

[0028] Further characteristics and advantages of the invention will become apparent from the detailed description of exemplary embodiments, which are illustrated only by way of non-limitative examples in the accompanying drawings, wherein:

- Figure 1 schematically shows the electrical device, according to the invention;
- Figures 2-3 schematically show different views of an electric terminal in the electrical device, according to the invention;
- Figures 4-5 schematically show wiring operations of a pair of electric conductors to the electric terminal of figures 2-3;
- Figures 6-7 schematically show different views of a further electric terminal in the electrical device, according to the invention;
- Figures 8-9 schematically show wiring operations of a pair of electric conductors to the further electric

terminal of figures 6-7.

[0029] With reference to the cited figures, the present invention relates to an electrical device 1 for low-voltage electrical systems.

[0030] For the purposes of the present invention, the term "low-voltage" refers to operating voltage levels lower than 1,5 kV AC and 2.0 kV DC.

[0031] In principle, the electrical device 1 can be any electrical device electrically and mechanically connectable to the conductors of an electric line. However, according to preferred embodiments of the invention, an example of which is shown in the cited figures, the electrical device 1 is a switching device for low-voltage electrical systems, for example a circuit-breaker, a residual current device, or the like.

[0032] The electrical device 1 comprises an insulating housing 2 defining an internal volume.

[0033] The insulating housing 2 is conveniently made of an electrically insulating plastic material, for example thermosetting or thermoplastic material.

[0034] The insulating housing 2 has preferably a cuboid shape with pairs of opposite walls and it can be formed by a plurality of shells (e.g. a base shell and a cover shell) mutually joined by means of screw or snap-fit mechanical coupling arrangements.

[0035] For the sake of clarity, it is specified that the terms "coupling," "coupled" or "couplable" and other similar terms used in this disclosure relate to both an electrical and mechanical coupling of different parts unless otherwise specified or self-evident from the description or figures.

[0036] As shown in the cited figures, at one or more walls of the insulating housing 2, the electrical device 1 can include a number of manually operable user-interface arrangements that can be of known type, for example handles, buttons, micro-switches, or the like.

[0037] At further one or more walls, the insulating housing 2 can include further mechanical coupling arrangements with a support structure, for example to a DIN bar.

[0038] According to the invention, the insulating housing 2 comprises one or more terminal ports 20, each configured to allow the passage of first and second electric conductors 101, 102 into the internal volume of the electrical device.

[0039] Preferably, the terminal ports 20 are arranged at a lower wall 20a of the insulating housing (reference is made to a normal vertical installation position of the electrical device).

[0040] Preferably, the first electric conductor 101 is a main conductor, for example a phase conductor or a neutral conductor of an electric line, while the second conductor 102 is an auxiliary conductor 102, for example a phase conductor or a neutral conductor intended to connect electrically the electrical device 1 to a further circuit branch.

[0041] As shown in figures 4-5 and 8-9, the first con-

ductor 101 can be an electric busbar while the second conductor 102 can be an electric cable. The electric conductors 101, 102 can however be differently configured according to the needs.

[0042] In the embodiment of figure 1, the insulating housing includes a pair of terminal ports 20, each configured to allow the passage of a first conductor 101 (a main conductor) and a second conductor 102 (an auxiliary conductor). In principle, however, the number of terminal ports 20 can be different according to the needs.

[0043] The insulating housing 2 can also include terminal ports of different type compared to the terminal ports 20. As an example, it can include terminal ports configured to allow the passage of a single electric conductor (normally the conductor 101) into the internal volume of the electrical device.

[0044] Preferably, each terminal port 20 can include a pair of distinct pass-through holes 201, 202 (e.g. with a squared section) of the insulating housing, which are spaced apart one to another by an intermediate housing portion 203 as shown in figures 4-5 and 8-9. Each electric conductor 101, 102 is advantageously inserted through a corresponding pass-through hole 201, 202.

[0045] As an alternative, however, a terminal port 20 can include a single aperture of the insulating housing, through which both the electric conductors 101, 102 are inserted.

[0046] The electric conductors 101, 102 can be inserted through the corresponding terminal port 20 according to an insertion direction A perpendicular to said terminal port, more precisely to the the wall 20a of the insulating housing, at which said terminal port 20 is arranged.

[0047] According to the invention, the electrical device 1 comprises one or more electric terminals 3 accommodated in the internal volume defined by the insulating housing 2.

[0048] Each electric terminal 3 is arranged in proximity of a corresponding terminal port 20 of the insulating housing and it is configured to be electrically and mechanically connected with the first and second electric conductors 101, 102 inserted through the corresponding terminal port 20.

[0049] In principle, each electric terminal 3 can be coupled to only one between the first and second conductors 101, 102 (e.g., to the sole main conductor 101). This can occur in some specific operating conditions, for example when the auxiliary conductor 102 is removed or not present for any reasons. In most cases, however, each electric terminal 3 is coupled to both the first and second conductors 101, 102.

[0050] As it will be more apparent from the following, an electric terminal 3 can be differently configured depending on the type of the conductors 101, 102, to which is intended to be coupled.

[0051] If it is intended to be coupled to neutral conductors 101, 102 of an electric line, an electric terminal 3 is preferably configured according to the embodiment of

figures 2-5, whereas, if it is intended to be coupled to phase conductors 101, 102 of an electric line, an electric terminal 3 is preferably configured according to the embodiment of figures 6-9.

[0052] The electrical device can include electric terminals 3 having different configurations. For example, in the embodiment of figure 1, the electrical device 1 includes a pair of electric terminals (not shown in this figure) having different configurations. An electric terminal is configured to be coupled with a phase conductor of an electric line and a corresponding auxiliary conductor while another electric terminal is configured to be coupled to a neutral conductor of an electric line and a corresponding auxiliary conductor.

[0053] In general, however, the electrical device 1 can include any number or type of electric terminals 3, according to the needs.

[0054] The electrical device 1 can also include electric terminals of different type compared to the electric terminals 3. As an example, it can include electric terminals configured to be electrically and mechanically connected with a single electric conductor passing through a corresponding terminal port (normally a phase conductor or a neutral conductor of an electric line).

[0055] According to the invention, each electric terminal 3 comprises a support cage 31 to provide support to the other components of the electric terminal.

[0056] The support cage 31 is accommodated in a corresponding seat 23 of the internal volume of the electrical device defined by the insulating housing 2 (figures 4-5, 8-9).

[0057] Preferably, as shown in the cited figures, the support cage 31 is sandwiched between multiple walls of the insulating housing to be fixed in a suitable operating position. As an alternative, the support cage 31 can be fixed to the insulating housing 2 in a different manner, for example through suitable snap-fit coupling arrangements.

[0058] Preferably, the support cage 31 is made of a conductive material to favor electrical connection between the supported components.

[0059] Preferably, the support cage 31 has a box-like structure having opposite first and second open sides 311, 312 perpendicular to the insertion direction A of the electric conductors 101, 102 through the terminal port 20.

[0060] The first open side 311 of the support cage 31 faces the terminal port 20 of the insulating housing so that the support cage 31 can receive the first and second conductors 101, 102 passing through said terminal port.

[0061] The second open side 312 of the support cage 31 instead faces the internal volume of the electrical device and it is used for inserting other components of the electric terminal in the interior of the support cage 31.

[0062] Preferably, the support cage 31 includes first lateral walls 313, which are mutually opposite and perpendicular to the open sides 311, 312 of the support cage, and second lateral walls 314, which are mutually opposite and perpendicular to the open sides 311, 312 and to

the first lateral walls 313 of the support cage.

[0063] The first lateral walls 313 are conveniently provided with suitable apertures 313a, 319 aimed at favoring the mounting of the other components of the electric terminal on the support cage. According to the invention, each electric terminal 3 comprises an electrode element 32 (made of a conductive material) at least partially accommodated in the support cage 31.

[0064] The electrode element 32 is intended to be electrically connected to an internal conductor (not shown) of the electrical device. Such an internal conductor can be a pole contact member of the electrical device.

[0065] The electrical connection between the electrode element 32 and the internal conductor of the electrical device can be realized, for example, through a flexible braid conductor (not shown). Preferably, the electrode element 32 has a first coupling surface 321 for coupling to the first conductor 101, when this latter is inserted through the terminal port 20, and a second coupling surface 322 for coupling to the second conductor 102, when this latter is inserted through the terminal port 20.

[0066] Advantageously, the first and second coupling surfaces 321, 322 are arranged at opposite sides of the electrode element 32 (along a direction perpendicular to the second lateral walls 314 of the support cage) and are spaced one from another.

[0067] Preferably, the electrode element 32 includes a coupling portion 32a inserted in the support cage 31. The coupling portion 32a conveniently includes the above-mentioned first and second coupling surfaces 321, 322 of the electrode element for coupling to the first and second conductors 101, 102.

[0068] Preferably, the electrode element 32 includes a connection portion 32b for electrical connection with an internal conductor of the electrical device.

[0069] Advantageously, the connection portion 32b protrudes from the support cage 31 at the second open side 112 of this latter to make easier the electrical connection with the internal conductor of the electrical device.

[0070] When the electric terminal 3 is intended to be electrically connected to neutral conductors 101, 102 of an electric line, the electrode element 32 is realized according to the configuration of figures 2-5. In this case, the coupling portion 32a of the electrode element has a hook or ring shape and it includes first and second rectilinear sub-portions 325, 326 arranged in parallel.

[0071] The first and second sub-portions 325, 326 of the electrode element are oriented according to directions parallel to an insertion direction A of the electric conductors 101, 102 through the terminal port 20.

[0072] The first and second sub-portions 325, 326 of the electrode element are spaced one from another by an intermediate sub-portion 324, which can be oriented perpendicularly to the above-mentioned first and second sub-portions.

[0073] The intermediate sub-portion 324 can slightly protrude from the first open side 311 of the support cage as shown in figures 2-5.

[0074] Preferably, the first and second rectilinear sub-portions 325, 326 of the electrode element include respectively the first and second coupling surfaces 321, 322 of the electrode element for coupling to the first and second conductors 101, 102. In this way, the first and second coupling surfaces 321, 322 are arranged at opposite sides of the electrode element and spaced one from another.

[0075] When the electric terminal 3 is intended to be electrically connected to phase conductors 101, 102 of an electric line, the electrode element 32 is realized according to the configuration of figures 6-9.

[0076] In this case, the coupling portion 32a of the electrode element has a rectilinear shape and it is oriented according to a direction parallel to an insertion direction A of the electric conductors 101, 102.

[0077] The coupling portion 32a can slightly protrude from the first open side 311 of the support cage as shown in figures 6-9.

[0078] According to the invention, the electric terminal 3 further comprises a spring element 33 and a pushing element 34 at least partially accommodated in the support cage 31 and coupled to this latter.

[0079] The spring element 33 and the pushing element 34 are coupled to the support cage 31 and arranged at opposite sides of this latter relative to said electrode element 32. Advantageously, the spring element 33 and the pushing element 34 are coupled to the opposite second lateral walls 314 of the support cage 31.

[0080] The spring element 33 is configured in such a way to cooperate with the electrode element 32 to clamp a first conductor 101 passing through the terminal port 20 of the insulating housing and inserted between said spring element and said electrode element. By virtue of the spring element 33, the electric terminal 3 can be coupled to the first conductor 101 (main conductor) through a coupling of the screwless type.

[0081] Preferably, the spring element 33 is formed by a bent elastic lamina having a first end 331 coupled to the support cage 31, at a second lateral wall 314 of this latter, and a second free end 332 arranged in proximity of the electrode element 32, more particularly in proximity or in contact with the first coupling surface 321 of the coupling portion 32a of the electrode element. Preferably, the spring element 33 is arranged in such a way that the first end 331 is simply kept into a fixed position relative to the second lateral wall 314 of the support cage by elastic force exerted by of the spring element. To this aim, the spring element is advantageously precompressed when it is accommodated in the support cage 31. When the conductor 101 is inserted, the spring element is subject to an additional compression between the second lateral wall 314 and the conductor 101.

[0082] Preferably, the spring element 33 is coupled to the support cage through a shape-coupling between the

first end 331 and the second lateral wall 314.

[0083] At the second free end 332, the elastic lamina 33 has a third coupling surface 333 for coupling to the first conductor 101. Conveniently, the first coupling surface 321 of the electrode element 32 and the third coupling surface 333 of the elastic lamina 33 are arranged mutually opposite and define a passage 101a for the first conductor 101.

[0084] The electrode element 32 and the elastic lamina 33 are mutually positioned so that when the first conductor 101 is inserted between the first coupling surface 321 of the electrode element 32 and the third coupling surface 333 of the elastic lamina 33, the elastic lamina 32 is bent and stores elastic energy. The spring element 32 can thus exert a retaining force on the first conductor 101 in cooperation with the electrode element 32 by clamping the first conductor 101 against the electrode element 32.

[0085] The pushing element 34 is configured in such a way to cooperate with the electrode element 32 to clamp a second conductor 102 passing through the terminal port 20 of the insulating housing and inserted between said pushing element and the electrode element 32. By virtue of the pushing element 34, the electric terminal 3 can be coupled to the second conductor 102 (auxiliary conductor) through a screw coupling.

[0086] Preferably, the pushing element 34 includes a screw 341 inserted through a threaded hole 315 of the support cage 31. The threaded hole 315 is arranged at a second lateral wall 314 of the support cage 31, which is opposite to the second lateral wall at which the spring element 32 is located.

[0087] The screw 341 is arranged in such a way to cross the lateral wall 314 of the support cage at the threaded hole 315. The screw 341 has thus a head portion located out of the support cage 31 and a threaded portion that can be inserted in or extracted from the interior of the support cage 31.

[0088] The screw 341 is movable along a translation axis B perpendicular to the lateral walls 314. The translation axis B is perpendicular to the electrode element, more particularly to the second coupling surface 322 of the coupling portion 32a of the electrode element (figures 4 and 8). The screw 341 is arranged coaxially (along the translation axis B) with a corresponding access hole 25 of the insulating housing configured to allow an access to the electric terminal 3.

[0089] The access hole 25 is configured to allow an operator to insert a mechanical tool (e.g. a screwdriver) to rotate the screw 341 and move this latter along the translation axis B. Advantageously, the access hole 25 is arranged at a wall 20b of the insulating housing (the front wall with reference to a normal vertical installation position of the electrical device), which is perpendicular to the wall 20a at which the terminal port 20 is arranged (figure 1).

[0090] Preferably, the pushing element 34 includes a pusher 342 coupled to the screw 341 in such a way to move together with this latter along the translation axis B.

[0091] As shown in the cited figures, the pusher 342 can be formed by a C-shaped bracket having a central portion 342c and a pair of parallel legs 342a, 342b.

[0092] The central portion 342c is preferably arranged in parallel to the first open side 311 or the second open side 312 of the support cage.

[0093] A first leg 342a of the pusher is arranged out of the support cage 31 in parallel with the lateral wall 314 and perpendicularly to the open sides 311, 312 of the support cage.

[0094] The first leg 342a of the pusher is coupled to a collar region of the screw 341 between the head portion and the threaded portion of the screw 341 in such a way to be always interposed between the head portion of the screw 341 and the lateral wall 314 of the support cage.

[0095] A second leg 342b of the pusher is inserted in the support cage 31 between the lateral wall 314 and the electrode element 32, preferably in proximity of this latter.

[0096] At the second leg 342b, the pusher 342 has a fourth coupling surface 344 for coupling to the second conductor 102. Conveniently, the second coupling surface 322 of the electrode element 32 and the fourth coupling surface 344 of the pusher are mutually opposite and define a passage 102b for said second conductor 102.

[0097] When the second conductor 102 is inserted between the second coupling surface 322 of the electrode element 32 and the fourth coupling surface 344 of the pusher 342, the pushing element 34 can exert a retaining force on the second conductor 102 in cooperation with the electrode element 32 when said pushing element is tightened, more precisely when the screw 341 is tightened and exerts a pressure force on the pusher 342, which in turn clamps the second conductor 102 against the electrode element 32.

[0098] An important aspect of the invention consists in that the electrode element 32 is arranged in such a way not to be free to move relative to the support cage 31. In other words, the electrode element 32 is coupled to the support cage 31 in such a way to maintain always a fixed position relative to this latter.

[0099] This solution is quite advantageous as the electrode element 32 can maintain a fixed position in any operating conditions, in particular during the wiring operations of the electric conductors 101, 102.

[0100] As an example, differently from the electric terminals of the state of the art, if the second conductor 102 is removed for any reasons when the first conductor 101 is still clamped between the spring element 32 and the electrode element 32, the electrode element 32 does not move relative to the support cage 31 even if it is subject to a pressure exerted by the spring element 32 (through the first conductor 101) and the pushing element 34 is loosened to allow the removal of the second conductor 102.

[0101] As a further example, if the second conductor 102 is inserted between the electrode element 32 and the pushing element 34 for any reasons when the first con-

ductor 101 is not present, the electrode element 32 does not move relative to the support cage 31 even if it is subject to a pressure exerted by the pushing element 34 (through the second conductor 102) when the pushing element 34 is tightened to clamp the second conductor 102 against the electrode element 32.

[0102] The circumstance that the electrode element 32 is fixed to the support cage 31 ensures the wiring operations of the second conductor 102 have substantially no influence on the electrical and mechanical coupling between the first conductor 101 and the electric terminal.

[0103] On the one hand, the removal of the auxiliary conductor 102 causes no undesired loosening of the screwless coupling between the first conductor 101 and the electric terminal. On the other hand, the insertion of the auxiliary conductor 102 before the first conductor 101 does not make more difficult the subsequent coupling of the first conductor 101 and the electric terminal 3 due to a possible displacement of the passage between the spring element 33 and the electrode element 32.

[0104] The way in which the electrode element 32 is fixed to the support cage 31 can vary depending on the type of the conductors 101, 102, to which the electric terminal 3 is intended to be coupled.

[0105] If it is intended to be coupled to neutral conductors 101, 102 of an electric line, the electric terminal 3 is preferably configured according to the embodiment of figures 2-5.

[0106] In this case, the electrode element 32 has one or more protrusions 327 inserted into corresponding slits 317 of the opposite walls 313 of the support cage 31 in such a way that the electrode element 32 is clamped between the opposite walls 313 of the support cage and is fixed to said support cage.

[0107] Preferably, the coupling portion 32a of the electrode element includes a pair of opposite protrusions 327 at the first rectilinear sub-portion 325. The protrusions 327 extend laterally (preferably perpendicularly) relative to the main longitudinal axis of the electrode element.

[0108] Preferably, the opposite first lateral walls 313 of the support cage includes a pair of slits 317 in proximity of the second open side 312. In this way, the protrusions 327 can be easily inserted in a slidable manner into the corresponding slits 317 of the support cage 31 when the electrode element 32 is inserted in the interior of the support cage through the second open side 312. The electrode element 32 can thus be fixed to the support cage 31 without the need of screws or other coupling means of similar type, which remarkably simplifies the assembling process of the electric terminal 3 at industrial level.

[0109] If it is intended to be coupled to phase conductors 101, 102 of an electric line, the electric terminal 3 is preferably configured according to the embodiment of figures 6-9.

[0110] In this case, the electric terminal 3 comprises a holder element 35 partially embracing the support cage 31. The electrode element 32 has one or more protrusions

328 passing through corresponding apertures 319 of the support cage 31 and inserted into corresponding holes 355 of the holder element 35 in such a way that said electrode element 32 is clamped between opposite portions 354 of the holder element and is fixed to the support cage.

[0111] Preferably, the holder element 35 is formed by a C-shaped bracket having a central section 353 arranged in parallel to the second lateral wall 314 of the support cage, on which the spring element 32 is fixed, and a pair of opposite legs 354 extending in parallel to the opposite first lateral walls 313 of the support cage. The opposite legs 354 of the holder element have holes 355 coaxially arranged with the apertures 319 of the lateral walls 313 of the support cage. Preferably, the coupling portion 32a of the electrode element includes a pair of opposite protrusions 328 extending laterally (preferably perpendicularly) relative to the main longitudinal axis of the electrode element.

[0112] When the electrode element 32 is inserted in the interior of the support cage through the second open side 312, the opposite protrusions 328 pass through the apertures 319 of the first lateral walls 313 of the support cage and are inserted into the corresponding holes 355 of the legs 354 of the holder element in such a way that the electrode element 32 is clamped between the opposite legs 354 of the holder element and is fixed to the support cage.

[0113] Also in this case, the electrode element 32 can be fixed to the support cage 31 without the need of screws or other coupling means of similar type.

[0114] Figures 4-5 and 8-9 show how the wiring operations of the first and second conductors 101, 102 are carried out.

Insertion and removal of the first conductor 101

[0115] The first conductor 101 is inserted through the terminal port 20 (for example through the first passing hole 201) and the passage 101a defined by the electrode element 32 and the spring element 33.

[0116] When the first conductor 101 is inserted between the first coupling surface 321 of the electrode element 32 and the third coupling surface 333 of the spring element 33, the spring element is compressed (the elastic lamina is bent) and exerts a pressure on first conductor 101 that is clamped against the electrode element 32.

[0117] The spring element 33 thus cooperates with the electrode element 32 to exert a retaining force on the first conductor 101 that is thus held in electrical and mechanical contact with the electrode element 32.

[0118] The removal of the first conductor 101 can be simply carried out by extracting this latter through the terminal port 20.

Insertion and removal of the second conductor 102

[0119] The pushing element 34 is initially supposed to be in a loose condition.

[0120] The second conductor 102 is inserted through the terminal port 20 (for example through the first passing hole 201) and the passage 102a defined by the electrode element 32 and the pusher 342 of the pushing element 34.

[0121] Once the second conductor 102 is inserted between the second coupling surface 322 of the electrode element 32 and the fourth coupling surface 344 of the pusher 342, the screw 341 of the pusher element is tightened by actuating with a suitable tool (e.g., a screwdriver) inserted through the access hole 25 of the insulating housing.

[0122] The screw 341 moves the pusher 342 towards the electrode element 32. The pusher 342 thus exerts a pressure on the second conductor 102 that is clamped against the electrode element 32.

[0123] The pushing element 34 thus cooperates with the electrode element 32 to exert a retaining force on the second conductor 102 that is thus held in electrical and mechanical contact with the electrode element 32.

[0124] The pushing element 34 is now supposed to be in a tightened condition, at which it clamps the second conductor against the electrode element 32.

[0125] In order to remove the second conductor 102, the screw 341 of the pusher element is loosened by actuating it with a suitable tool (e.g., a screwdriver) inserted through the access hole 25 of the insulating housing.

[0126] Once the pushing element 34 is in a loose condition, the removal of the second conductor 102 can be simply carried out by extracting this latter through the terminal port 20.

[0127] The electrical device, according to the invention, provides relevant advantages over the solutions of the state of the art.

[0128] In the electrical device of the invention, each electrical block is configured so that the wiring operations of a conductor can be carried out in an independent manner without influencing the coupling condition of the other conductor with the electric terminal or the wiring operation of the other conductor with the electric terminal.

[0129] As an example, wire removal operations of an electric conductor (in particular of the auxiliary conductor) from an electric terminal does not influence in any way the quality of the electrical and mechanical connection of the other electric conductor (in particular of the main conductor) with the electric terminal.

[0130] Conversely, wire insertion operations of an electric conductor (in particular of the auxiliary conductor) into the electric terminal does not make more difficult a subsequent insertion of the other electric conductor (in particular of the main conductor 101) with the electric terminal. By virtue of the above-mentioned technical capabilities, the reliability in operation of the electrical

device is greatly increased in comparison to the traditional electrical devices of the state of the art. In particular, unforeseen loosening of the coupling between the main conductors and the electrical device are prevented or greatly limited.

[0131] Thanks to the particular configuration of the electric terminals, the electrical device of the invention can provide the above-mentioned advantages without any increase of the overall size compared to the traditional devices available on the market.

[0132] The electrical device of the invention has proven to be easy to manufacture industrially, at competitive costs compared to currently available electrical devices of the state of the art.

Claims

1. An electrical device (1) for low-voltage electrical systems, said electrical device comprising:

- an insulating housing (2) defining an internal volume of said electrical device and having one or more terminal ports (20), each configured to allow a passage of first and second conductors (101, 102) into the internal volume of said electrical device;
- one or more electric terminals (3), each accommodated in the internal volume of said electrical device at a corresponding terminal port (20) to connect electrically the electric conductors passing through said terminal port to an internal conductor of said electrical device;

characterised in that an electric terminal (3) comprises:

- a support cage (31) accommodated in the internal volume of said electrical device in proximity of a terminal port (20);
- an electrode element (32) electrically connected to an internal conductor of said electrical device and at least partially accommodated in said support cage;
- a spring element (33) and a pushing element (34) coupled to said support cage (31) and at least partially accommodated in said support cage,

wherein said spring element and said pushing element are arranged at opposite sides of said support cage relative to said electrode element (32),
wherein said spring element cooperates with said electrode element

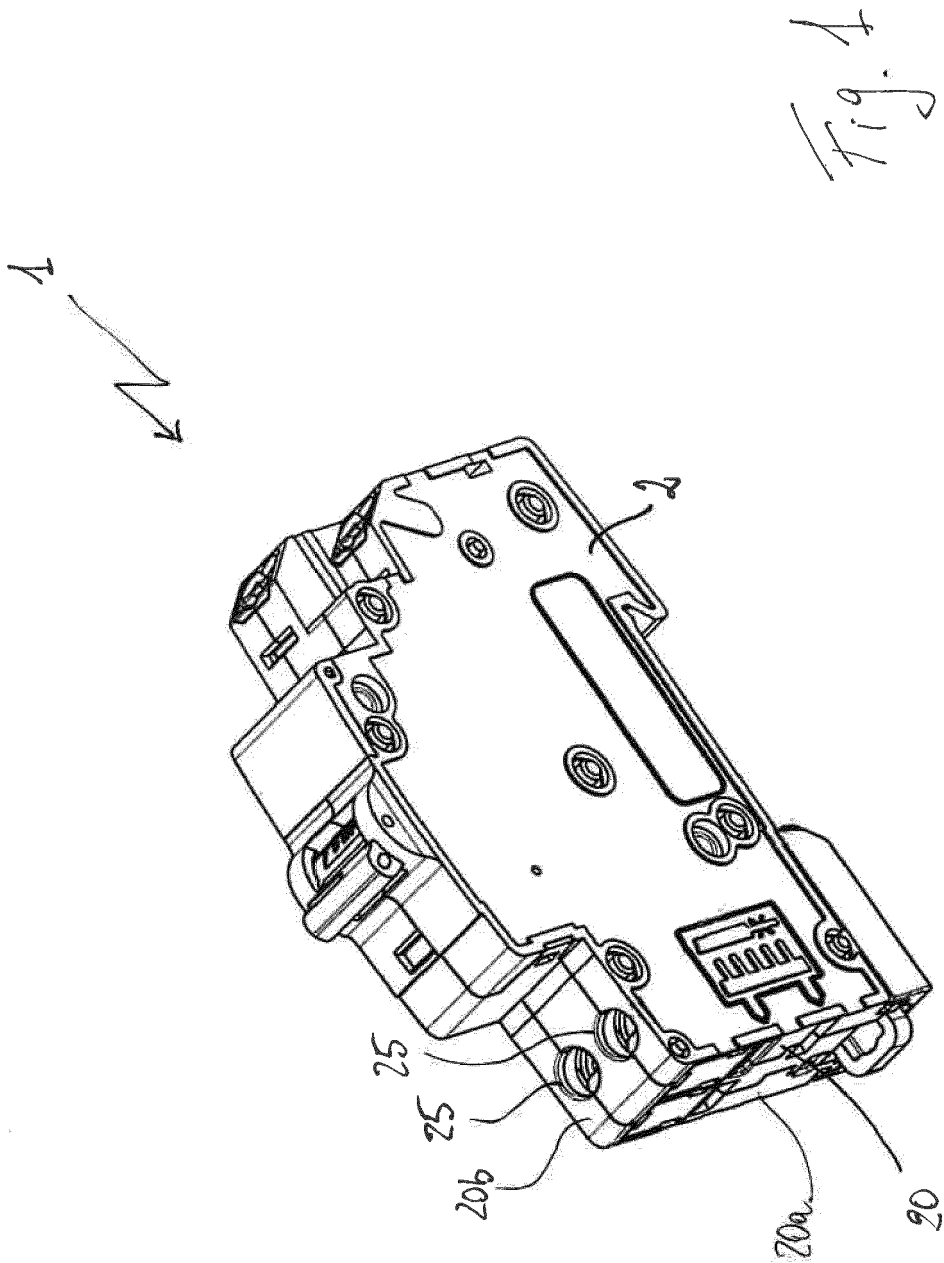
(32) to clamp a first conductor (101) passing through a terminal port (20) of said insulating housing and inserted between said spring element and said electrode element, wherein said pushing element cooperates with said electrode element (32) to clamp a second conductor (102) passing through said terminal port (20) and inserted between said pushing element and said electrode element;

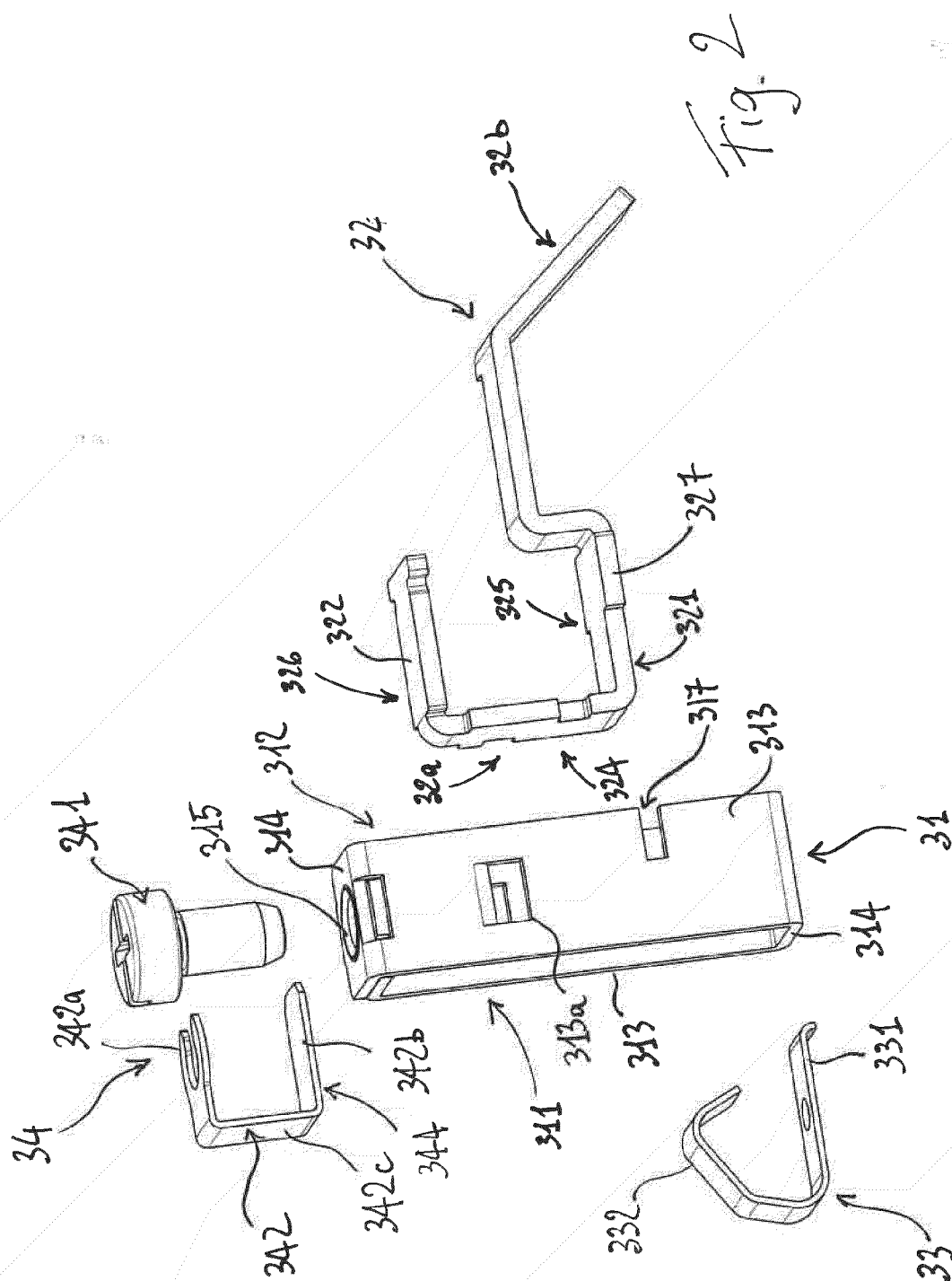
wherein said electrode element (32) is coupled to said support cage (31) in such a way to maintain a fixed position relative to said support cage during wiring operations of said first and second conductors (101, 102).

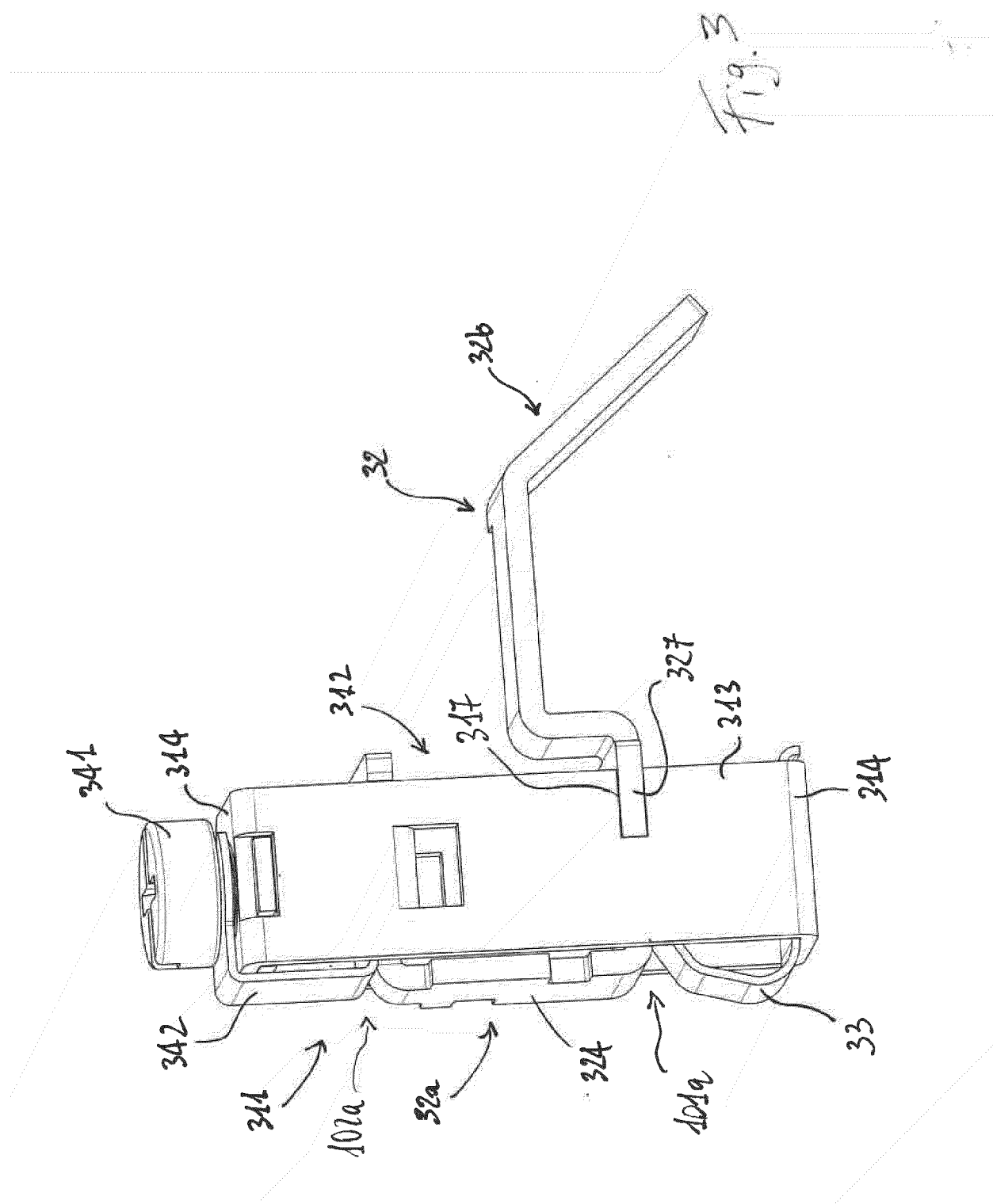
2. Electrical device, according to claim 1, **characterised in that** said electrode element (32) has one or more protrusions (327) inserted into corresponding slits (317) of said support cage (31) in such a way that said electrode element is clamped between opposite walls (313) of said support cage and is fixed to said support cage.
3. Electrical device, according to claim 1, **characterised in that** said electric terminal (3) comprises a holder element (35) outwardly embracing said support cage (31), wherein said electrode element (32) has one or more protrusions (328) passing through corresponding apertures (319) of said support cage and inserted into corresponding holes (355) of said holder element (35) in such a way that said electrode element (32) is clamped between opposite portions (354) of said holder element and is fixed to said support cage.
4. Electrical device, according to one of the previous claims, **characterised in that** said support cage (31) has a box-like structure including opposite first and second open sides (311, 312), said first open side (311) facing the terminal port (20) of said insulating housing to receive said first and second conductors (101, 102), said second open side (312) facing the internal volume of said electrical device, wherein said electrode element (32) protrudes from said second open side (312) to be electrically connected to an internal conductor of said electrical device.
5. Electrical device, according to one of the previous claims, **characterised in that** said electrode element (32) has a first coupling surface (321) for coupling to said first conductor (101) and a second coupling surface (322) for coupling to said second

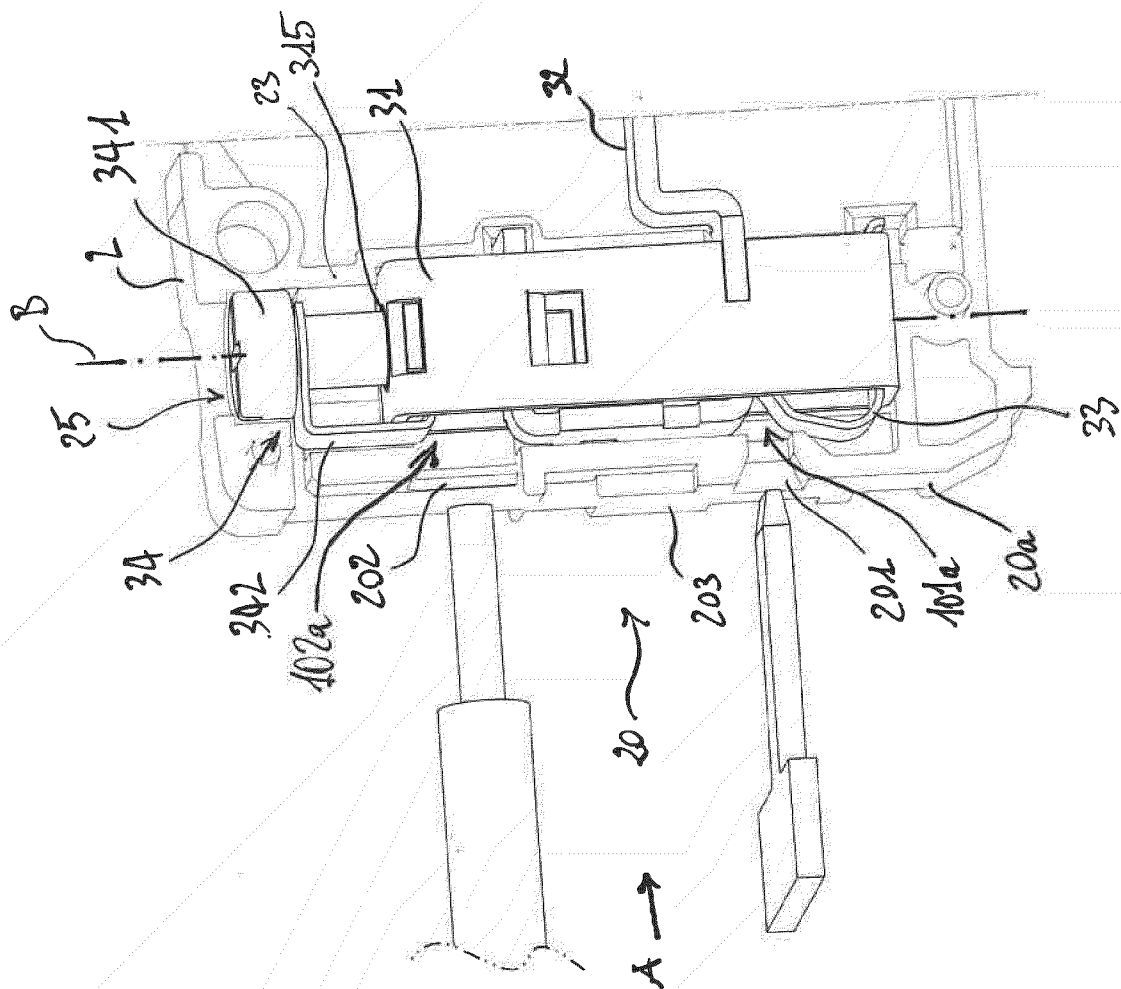
conductor (102).

6. Electrical device, according to claim 5, **characterised in that** said electrode element (32) has a coupling portion (32a) inserted in said support cage (31) and including said first and second coupling surfaces (321, 322) and a connection portion (32b) protruding from said support cage (31) for electrical connection with the internal conductor of said electrical device.
7. Electrical device, according to one of the previous claims, **characterised in that** said spring element (33) is formed by a bent elastic lamina having a first end (331) coupled to said support cage (31) and a second free end (332) arranged in proximity of said electrode element (32).
8. Electrical device, according to claims 5 and 7, **characterised in that** the second free end (332) of said elastic lamina (33) has a third coupling surface (333) for coupling to said first conductor (101), wherein the first coupling surface (321) of said electrode element (32) and the third coupling surface (333) of said elastic lamina (33) are mutually opposite and define a passage (101a) for said first conductor (101).
9. Electrical device, according to one of the previous claims, **characterised in that** said pushing element (34) includes:
 - a screw (341) inserted through a threaded hole (315) of said support cage (31) and movable along a translation axis (B);
 - a pusher (342) coupled to said screw (341) in such a way to move together with said screw (34) along said translation axis (B).
10. Electrical device, according to claims 5 and 9, **characterised in that** said pusher (342) includes a fourth coupling surface (344) for coupling to said second conductor (102), wherein the second coupling surface (322) of said electrode element (32) and the fourth coupling surface (344) of said pusher (34) are mutually opposite and define a passage (102a) for said second conductor (102).
11. Electrical device, according to one of the claims from 9 to 10, **characterised in that** said screw (341) is arranged coaxially with an access hole (25) of said insulating housing, wherein said access hole is configured to allow an access to said electric terminal (3).
12. Electrical device, according to one of the previous claims, **characterised in that** it is a switching device or a metering device for low-voltage electrical systems.









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Fig.

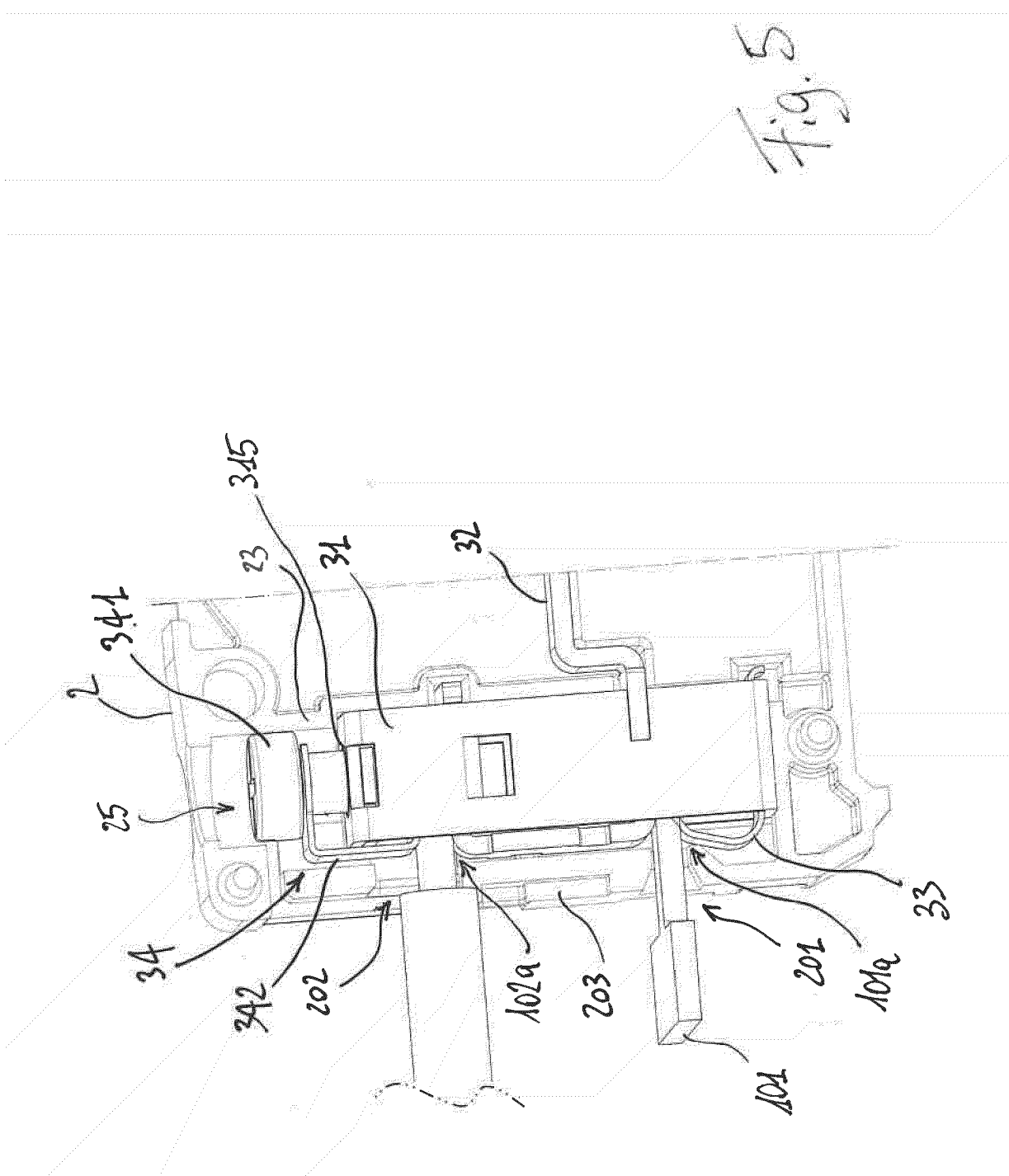
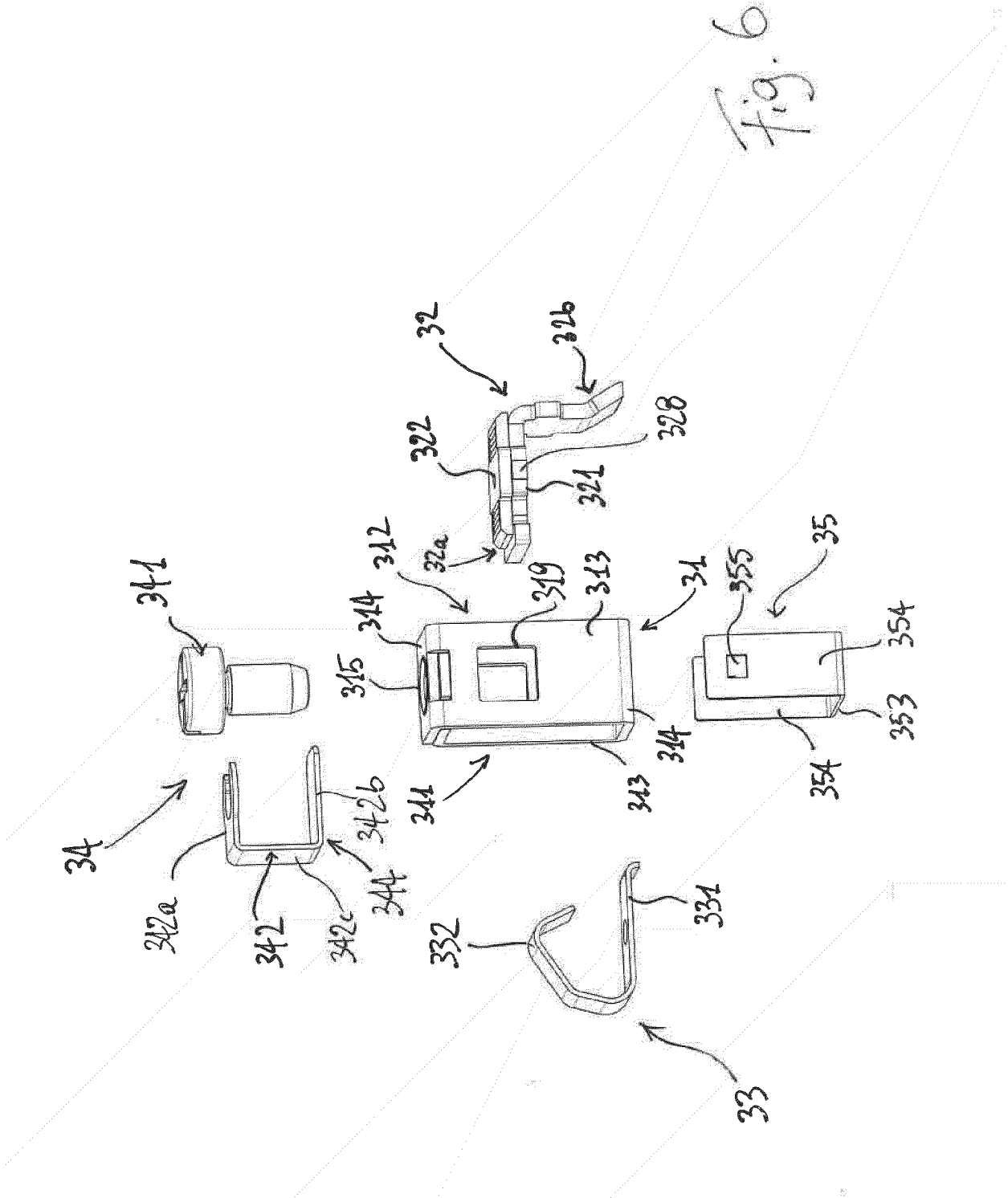
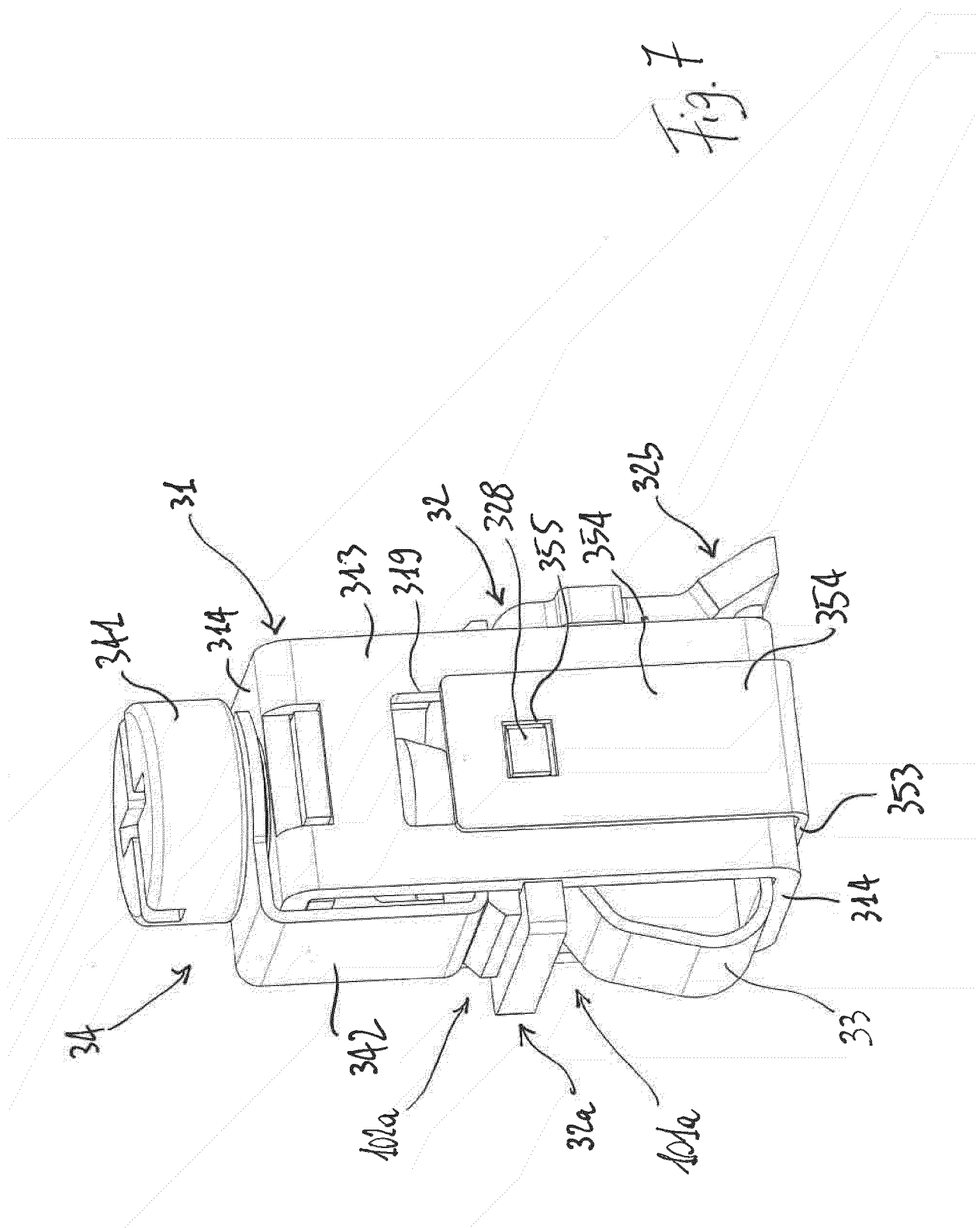


Fig. 5





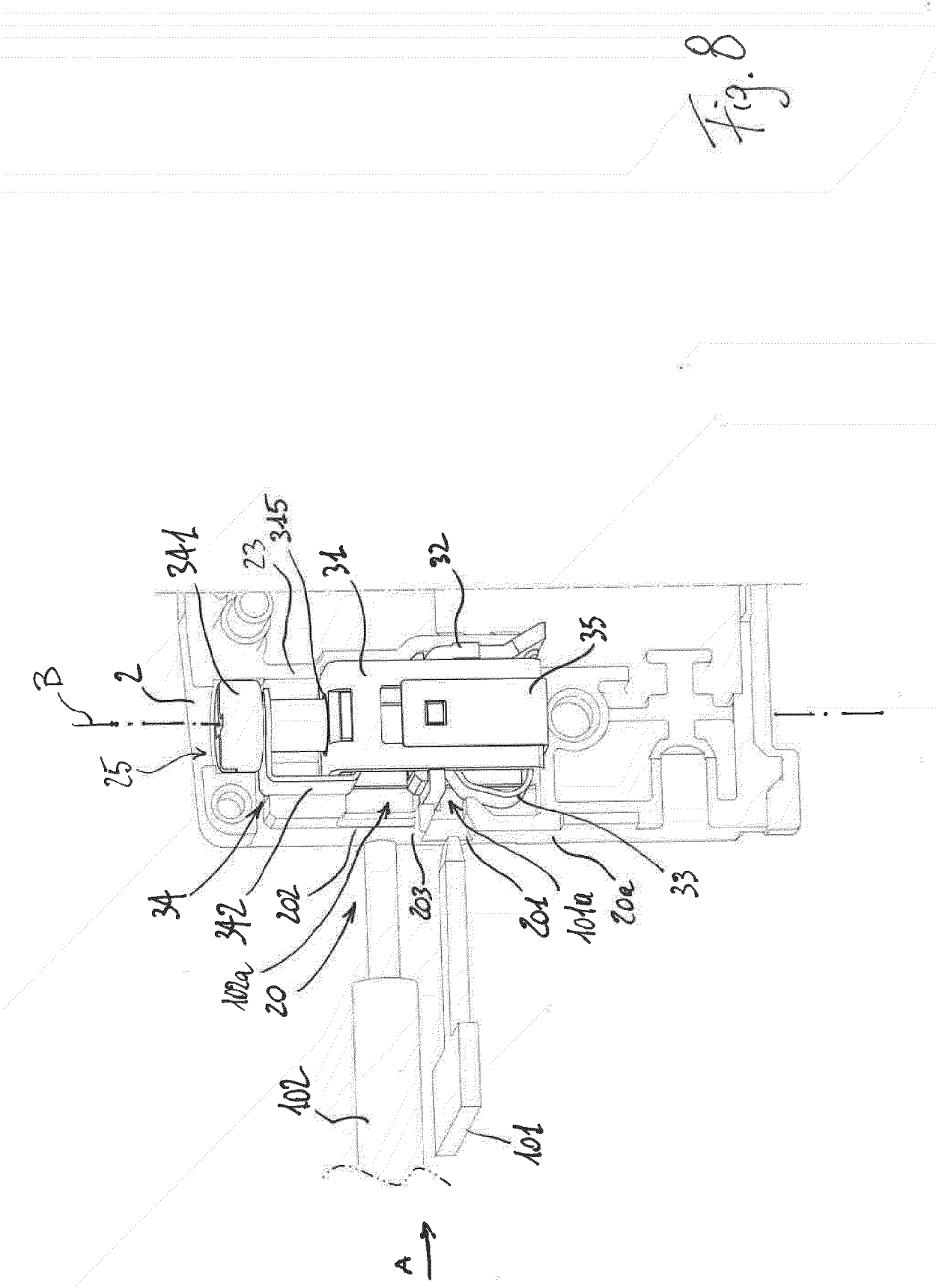


Fig. 8

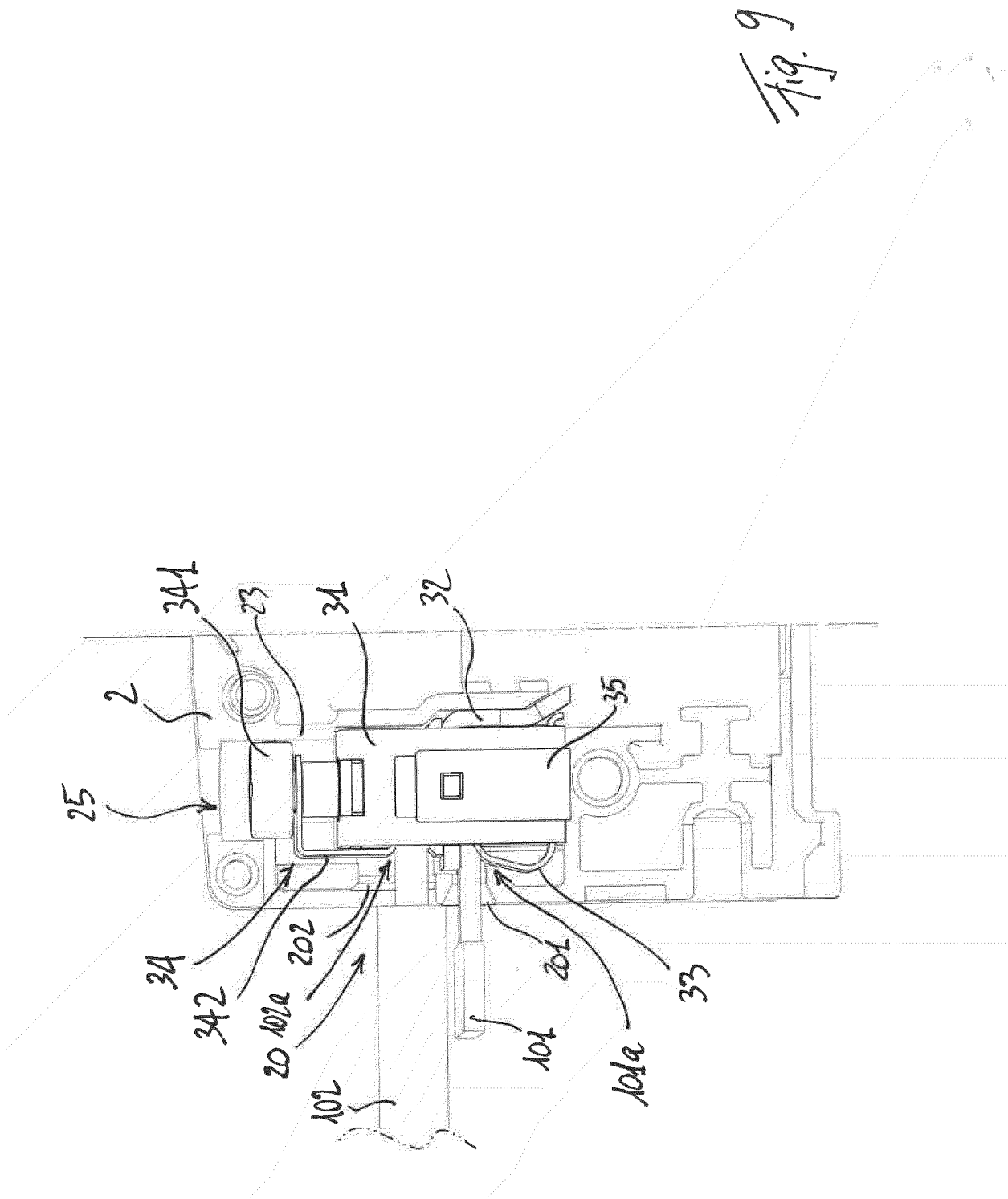


Fig. 9



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Application Number

EP 24 15 0151

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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		6 June 2024	Vautrin, Florent
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			
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