(19) Europäisches Patentamt
European Patent Office
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(11) **EP 1 850 425 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
31.10.2007 Bulletin 2007/44

(51) Int Cl.:
H01R 31/06 *(2006.01)* *H01R 13/58* *(2006.01)*

(21) Application number: **06008403.5**

(22) Date of filing: **24.04.2006**

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

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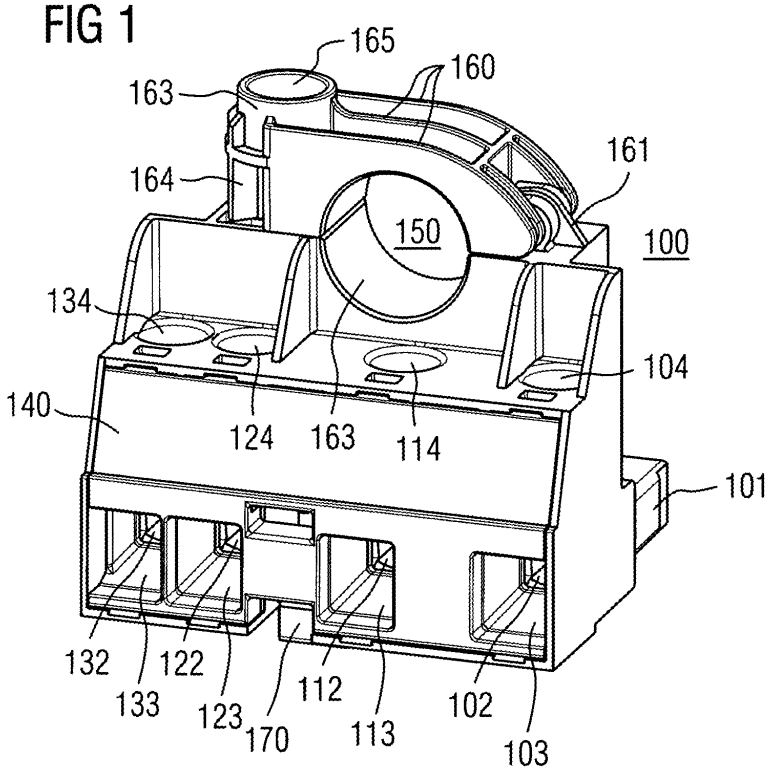
Remarks:
Amended claims in accordance with Rule 86 (2) EPC.

(54) **A plug-type connector, an adapter, and a system and a method for connecting a low-voltage switching device to a power cable**

(57) A method for connecting a low-voltage switching device (500), in particular a contactor, to a power cable, comprising the steps of: i) connecting the power cable to a connector (100), ii) connecting the low-voltage switching device (500) to an adapter (300), and iii) connecting said connector (100) to said adapter (300). Independent claims for a plug-type connector, an adapter and a system.

FIG 1



EP 1 850 425 A1

Description

Field of the invention

[0001] The invention relates to devices and methods for making an electrical connection between a power cable and a low-voltage switching device.

Background of the invention

[0002] Low-voltage switching devices, especially contactors, circuit breakers or different kinds of relays that are adapted to switch currents of power circuits in the low-voltage range, between 100 Volt and 1000 Volt, are usually connected to a power cable by clamping. Some of the most common possibilities are cage- or different kinds of screw clamp terminals, the latter of which is shown in Figure 5 as the connecting terminals in a contactor.

[0003] In Figure 5, showing an example of a state-of-the-art low-voltage switching device 500, to connect the low-voltage switching device 500 electrically to a power cable, the screws 521, 522, 523 are rotated for each phase terminal so long that the respective clamps 501, 502, 503 clamp a lead between themselves and a contact pole 511, 512, 513. The walls 551, 552, 553, 554 are of electrically isolating material for improving isolation between the different phases.

[0004] Connecting a low-voltage switching device to a power cable takes some time, regardless what kind of clamping is used. Under circumstances it is desirable to have the time required to make the electrical connection as short as possible. In particular, if an electrical installation comprising low-voltage switching devices and power cables is constructed and tested in a testing location and then installed on an operational site, releasing the connection between the low-voltage switching device and the respective power cable should be as fast and uncomplicated as possible. Furthermore, the technician should be able to connect the leads in the original order to ensure correct order of rotary current phases.

[0005] EP 1 447 829 A1 and WO 2006/027336 show different possibilities to relieve the latter shortcoming. These solutions may not be too well suitable to use if there is no permanent wiring, or if the low-voltage switching device has clamp terminals for receiving leads of a power cable terminals, in which case the extra effort of opening and closing would still be required when re-installing an installation comprising low-voltage switching devices and power cables.

Summary of the invention

[0006] An object of the invention is to bring out a solution for electrically connecting a low-voltage switching device to a power cable in a fast and uncomplicated manner.

[0007] This object can be achieved with a plug-type connector according to claim 1 and with an adapter according to claim 5, or with a system according to claim 9, and by using a method according to claim 14.

[0008] The dependent claims describe various advantageous aspects of the invention.

Advantages of the invention

[0009] If a plug-type connector comprises a body comprising a first set of openings and a set of legs comprising a second set of openings, and clamp terminals in said body, suitable for clamping leads of a power cable that are introduced through openings of said first set so that each of said clamp terminals will be accessible from a responsive opening of said second set, the leads of the power cable can be accessed via the legs for electrical connection by also other connecting means than clamps. This contributes for the speedy connecting and disconnecting of the power cable. If the openings of the second set are located at the free ends of the legs, the unintented electrical connection to the leads of the power cable may be better avoided which improves security of the individuals working at the installation.

[0010] If an adapter comprises a body comprising recesses accessible from outside of said body, and terminals extending into said recesses from inside said body, the other ends of said terminals sticking out from said body, the adapter may, on one hand, be used to receive a plug-type connector and, on the other hand, be connected to a low-voltage switching device. This facilitates the speedy connecting and disconnecting of the power cable to or from the low-voltage switching device.

[0011] Advantageously, if a system for connecting a low-voltage switching device to a power cable comprises a plug-type connector according to any one of claims 1 to 4, and an adapter according to any one of claims 5 to 8, wherein the plug-type connector and the adapter are matched to provide a stable electrical connection, the system may be connected or disconnected easily and relatively fast. Furthermore, if the system further comprises a low-voltage switching device, in particular a contactor, comprising clamping terminals on its output side, and wherein said other ends and said clamping terminals are matched, a power cable can be connected to the low-voltage switching device quickly and in a relatively uncomplicated manner.

[0012] A method for connecting a low-voltage switching device to a power cable comprises the steps of connecting the power cable to a connector, connecting the low-voltage switching device to an adapter, and connecting said connector to said adapter.

[0013] Since the low-voltage switching device is not directly connected to the leads of the power cable by clamp terminals, the releasing and repeated connecting of the low-voltage switching device may be carried out faster, especially if the connector is a plug-type connector, let alone if the plug-type connector, the adapter and the low-voltage switching device form a system accord-

ing to any one of claims 11 to 13.

List of Figures

[0014] In the following, the invention is described in more detail by way of examples shown in the accompanying drawings 1 to 6, of which:

Figure 1 shows a plug-type connector in perspective view;

Figure 2 shows the plug-type connector as seen above from the direction of the legs;

Figure 3 shows an adapter in a perspective view;

Figure 4 shows the adapter as seen above from the direction of the recesses that are adapted to receive the legs;

Figure 5 is a side view of a contactor according to prior art; and

Figure 6 shows the contactor connected to an adapter, and the adapter connected to a plug-type connector.

[0015] Same reference numerals refer to similar structural elements throughout the Figures.

Detailed description

[0016] Figure 1 shows a plug-type connector 100 in perspective view. The plug-type connector 100 comprises a body 140 that comprises a set of openings 103, 113, 123, 133 for receiving leads of a power cable. A power cable has usually three phase leads, a fourth lead for the protective earth is preferably provided as well. In Figure 1, the opening 133 would be the opening for the protective earth.

[0017] For each of the openings 103, 113, 123, 133 there is provided a clamp terminal 102, 112, 122, 132 in the body 140. Each of the clamp terminals 102, 112, 122, 132 is suitable for clamping a lead of a power cable that is introduced through the responsive opening 103, 113, 123, 133 into the clamp terminal 102, 112, 122, 132.

[0018] A clamp terminal 102, 112, 122, 132 is accessible from a responsive opening provided in a leg 101, 111, 121, 131. Legs 101, 111, 121, 131 are shown in Figure 2, wherein also openings 201, 211, 221, 231 are illustrated. The legs 101, 111, 121, 131, like preferably also the rest of the plug-type connector 100, are made of halogen-free material, advantageously having a flammability classification UL94 V0 or better.

[0019] The leads of the power cable are thus introduced to the clamp terminals 102, 112, 122, 132 through the openings 103, 113, 123, 133. If the clamp terminals 102, 112, 122, 132 are screw clamps, there may be locking screws 104, 114, 124, 134 provided too.

[0020] The power cable can be locked with a strain-relief collar 160 so that a throughpass 150 is formed between the strain-relief collar 160 and the counterpart part 163 of the body 140. The strain-relief collar 160 is preferably pivotable around a hinge 161, and the power cable can be locked by closing the strain-relief collar 160 around the cable with a screw through the screw opening 165 so that the upper part 163 will be fastened to the lower part 164. To improve strength and stiffness, the strain-relief collar 160 may be provided with wings 160.

[0021] A latch member, such as a latch finger 270 mounted on a latch slide 170 is preferably provided too.

[0022] The date of manufacture, testing, check or installation can be stamped or sticked on a reserved area 280.

[0023] Figure 3 shows an adapter 300 in a perspective view. The adapter 300 comprises terminals 411, 412, 413 (shown in Figure 4), the ends of which are located in the recesses 421, 423, 425 (also shown in Figure 4). The other ends 311, 321, 331 of the terminals 411, 412, 413 stick out of the body 340 of the adapter 300, the terminals 411, 412, 413 may then have a bent shape to save space.

[0024] As shown in Figure 4, the recesses 421, 423, 425, 426 are accessible from outside of the body 340. The terminals 411, 412, 413 extend into recesses 421, 423, 425. Between the recesses 421, 423, 425 there may be further recesses 422, 424 to increase stiffness of the adapter 300. The space between the recesses 421, 423, 425, or, in other words, between the ends of terminals 411, 412, 413 extending into the recesses 421, 423, 425, there may be insulation sheets 401, 402, 403, 404, 405, 406, 407 of an electrically insulating material that is preferably a halogen-free material. The body 340 is preferably made of halogen-free material, advantageously having a flammability classification UL94 V0 or better.

[0025] Legs 101, 111, 121 of the plug-type connector 100 can be placed into the responsive recesses 421, 423, 425 so that the ends of the terminals 411, 412, 413 penetrate into the openings 201, 211, 221 at the ends of the legs 101, 111, 121. The other ends 311, 321, 331 of the terminals 411, 412, 413 can then be connected to the low-voltage switching device 500 in the manner shown in Figure 6.

[0026] Leg 131 with opening 231 for the protective earth from clamp terminal 132 is similarly connected to the adapter 300. From the adapter 300, the protective earth can be connected to the low-voltage switching device 500 via opening 383 to a terminal 381, via a connecting means such as a screw clamp 382.

[0027] The end faces 350 of the body 340 preferably comprise cut-out regions 351, 352, 353, 354 that are matched with walls 551, 552, 553, 554 of a low-voltage switching device 500 so that the low-voltage switching device 500 can be brought closer to the adapter 300.

[0028] The plug-type connector 100 and adapter 300 are matched so that when the legs 101, 111, 121, 131

are properly in place in the recesses 421, 423, 425, 426, the terminals 411, 412, 413 in the adapter 300 provide a stable electrical connection between the out-sticking ends 311, 321, 331 of the terminals 411, 412, 413 and the corresponding clamp terminals 102, 112, 122.

[0029] The low-voltage switching device 500 and the adapter 300 are matched so that when the out-sticking ends 311, 321, 331 of the terminals 411, 412, 413 of the adapter 300 are properly in place in the clamps 501-523 of the low-voltage switching device 500, the responsive terminals 511, 512, 513 of the low-voltage switching device have a stable electrical connection between the terminals 411, 412, 413 of the adapter 300.

[0030] Figure 6 shows the contactor connected to an adapter, and the adapter connected to a plug-type connector.

[0031] When the electrical installation is built up for testing, the low-voltage switching device 500 is mounted to the wall, the adapter 300 is fastened to the low-voltage switching device 500 and the plug-type connector 100 is connected to a power cable and then plugged to the adapter 300.

[0032] In order to prepare the electrical installation for bringing to a production site, the plug-type connector 100 is removed from the adapter 300 and the low-voltage switching device 500 is dimounted from the wall. It is not necessary to dismount the adapter 300 or the power cable.

[0033] On the production site, when building up the electrical installation for production use, the low-voltage switching device 500 with the adapter 300 already mounted is mounted to the wall, and the power cable with the already mounted plug-type connector 100 is connected by plugging the plug-type connector 100 into the adapter 300.

[0034] In order to avoid unintentionally disengaging the plug-type connector 100 from the adapter 300, the plug-type connector 100 can preferably be released from the adapter 300 only by inserting a tool, such as a screw driver, into a tool opening of the adapter 300 and displacing the latch member, such as by turning the latch finger 270.

[0035] In particular, the invention is very useful for preparing the load-side connections between the low-voltage switching device 500 and the load, such as electric motor, since the power cables between the low-voltage switching device 500 and load are usually tested before bringing to the production site, whereas the power cables from the distribution network to the low-voltage switching does not necessarily need to be tested before changing installation.

[0036] Even though the invention was disclosed with reference to examples, the skilled person appreciates that the intented scope of protection is not limited by the examples but by the accompanying patent claims.

Claims

1. A plug-type connector (100), **comprising:**

- a body (140) comprising a first set of openings (103, 113, 123) and a set of legs (101, 111, 121) comprising a second set of openings (201, 211, 221); and
- clamp terminals (102, 112, 122) in said body (140), suitable for clamping leads of a power cable that are introduced through openings (103, 113, 123) of said first set;

wherein:

each of said clamp terminals (102, 112, 122) being accessible from a responsive opening (201, 211, 221) of said second set.

2. A plug-type connector (100) according to claim 1, **wherein:**

said openings (201, 211, 221) of the second set are located at the free ends of said legs (101, 111, 121).

3. A plug-type connector (100) according to claim 1 or 2, **wherein:** said legs (101, 111, 121) comprise isolating material, preferably halogen-free material.

4. A plug-type connector (100) according to any one of the preceding claims 1 to 3, further **comprising:** a strain-relief collar (160) adapted to form together with a counterpart part (163) of said body (140) a through-pass (150) for said power cable.

5. An adapter (300), **comprising:**

- a body (340) comprising recesses (421, 423, 425) accessible from outside of said body (340); and
- terminals (411, 412, 413) extending into said recesses (421, 423, 425) from inside said body (340), the other ends (311, 321, 331) of said terminals (411, 412, 413) sticking out from said body (340).

6. An adapter (300) according to claim 5, **further comprising:** insulation sheets (401, 402, 403, 404, 405, 406, 407) at sides of said recesses (421, 423, 425).

7. An adapter (300) according to claim 5 or 6, **wherein:** said other ends (311, 321, 331) of said terminals (411, 412, 413) have a fork-like shape.

8. An adapter (300) according to any one of claims 5 to 7, **wherein:** said body (340), or if the adapter (300) being dependent on claim 6, said insulation sheets

(401 - 407), comprises insulating halogen-free material.

9. A system for connecting a low-voltage switching device (500), in particular a contactor, to a power cable, comprising:

- a plug-type connector (100) according to any one of claims 1 to 4; and
- an adapter (300) according to any one of claims 5 to 8; wherein said plug-type connector (100) and adapter (300) are matched.

10. A system according to claim 9, further comprising matched latch members (170) adapted to releasably lock said adapter (300) with said connector (100).

11. A system according to claim 9 or 10, further comprising a low-voltage switching device (500), in particular a contactor, comprising clamping terminals (501, 511, 521; 503, 513, 523; 505, 515, 525) on its output side, and wherein said other ends (311, 321, 331) and said clamping terminals (501, 511, 521; 503, 513, 523; 505, 515, 525) are matched.

12. A system according to claim 11, wherein: said clamping terminals (501, 511, 521; 503, 513, 523; 505, 515, 525) are screw clamps.

13. A system according to claim 12, wherein: and said adapter (300) is an adapter according to claim 7.

14. A method for connecting a low-voltage switching device (500), in particular a contactor, to a power cable, the method **comprising the steps of:**

- connecting the power cable to a connector (100);
- connecting the low-voltage switching device (500) to an adapter (300); and
- connecting said connector (100) to said adapter (300).

15. A method as set out in claim 14, wherein: said connector (100) is a plug-type connector.

16. A method as set out in claim 15, wherein: said plug-type connector (100), said adapter (300) and said low-voltage switching device (500) form a system according to any one of claims 11 to 13.

17. A method as set out in any one of claims 14 to 16, wherein: said power cable is a load-side power cable and the adapter (300) is connected to the load-side of the low-voltage switching device (500).

Amended claims in accordance with Rule 86(2) EPC.

1. An adapter (300), **comprising:**

- a body (340) comprising recesses (421, 423, 425) accessible from outside of said body (340); and
- terminals (411, 412, 413) extending into said recesses (421, 423, 425) from inside said body (340), the other ends (311, 321, 331) of said terminals (411, 412, 413) sticking out from said body (340) and having a fork-like shape.

2. An adapter (300) according to claim 1, **further comprising:**

insulation sheets (401, 402, 403, 404, 405, 406, 407) at sides of said recesses (421, 423, 425).

3. An adapter (300) according to claim 1 or 2, **wherein**: said body (340) comprises insulating halogen-free material, or if the adapter (300) being dependent on claim 2, said insulation sheets (401 - 407) comprise insulating halogen-free material.

4. A system for connecting a low-voltage switching device (500), in particular a contactor, to a power cable, **comprising:**

- an adapter (300) according to any one of claims 1 to 3;
- a plug- type connector (100) comprising

i) a body (140) comprising a first set of openings (103, 113, 123) and a set of legs (101, 111, 121) comprising a second set of openings (201, 211, 221); and
ii) clamp terminals (102, 112, 122) in said body (140), suitable for clamping leads of a power cable that are introduced through openings (103, 113, 123) of said first set, each of said clamp terminals (102, 112, 122) being accessible from a responsive opening (201, 211, 221) of said second set;

wherein said plug-type connector (100) and adapter (300) are matched.

5. A system according to claim 4, **wherein:** said openings (201, 211, 221) of the second set are located at the free ends of said legs (101, 111, 121).

6. A system according to claim 4 or 5, **wherein:** said legs (101, 111, 121) comprise isolating material, preferably halogen-free material.

7. A system according to any one of the preceding claims 4 to 6, further **comprising:** a strain-relief col-

lar (160) adapted to form together with a counterpart part (163) of said body (140) a throughpass (150) for said power cable.

8. A system according to any one of the preceding claims, further comprising matched latch members (170) adapted to releasably lock said adapter (300) with said connector (100).

9. A system according to any one of the preceding claims, further comprising a low-voltage switching device (500), in particular a contactor, comprising clamping terminals (501, 511, 521; 503, 513, 523; 505, 515, 525) on its output side, and wherein said other ends (311, 321, 331) and said clamping terminals (501, 511, 521; 503, 513, 523; 505, 515, 525) are matched.

10. A system according to claim 9, wherein: said clamping terminals (501,511,521; 503, 513, 523; 505, 515, 525) are screw clamps.

FIG 1

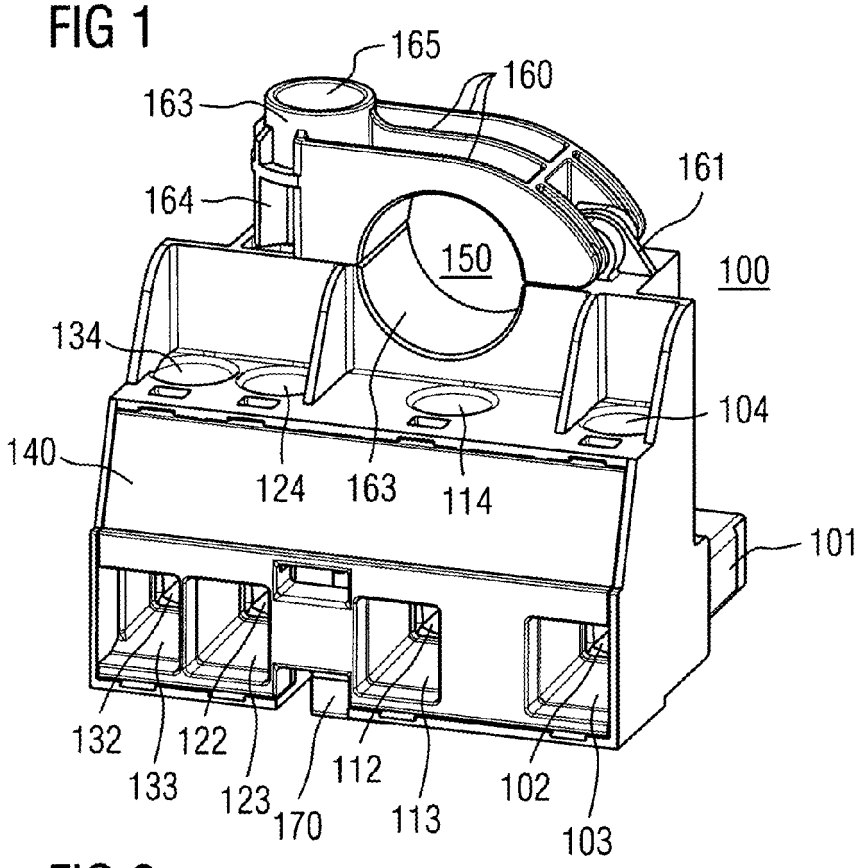

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FIG 2

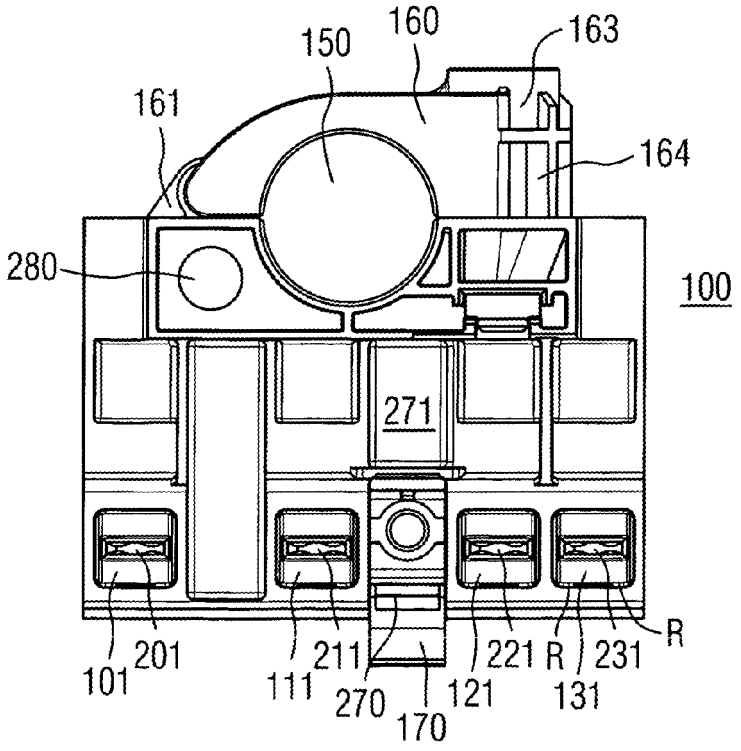
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FIG 3

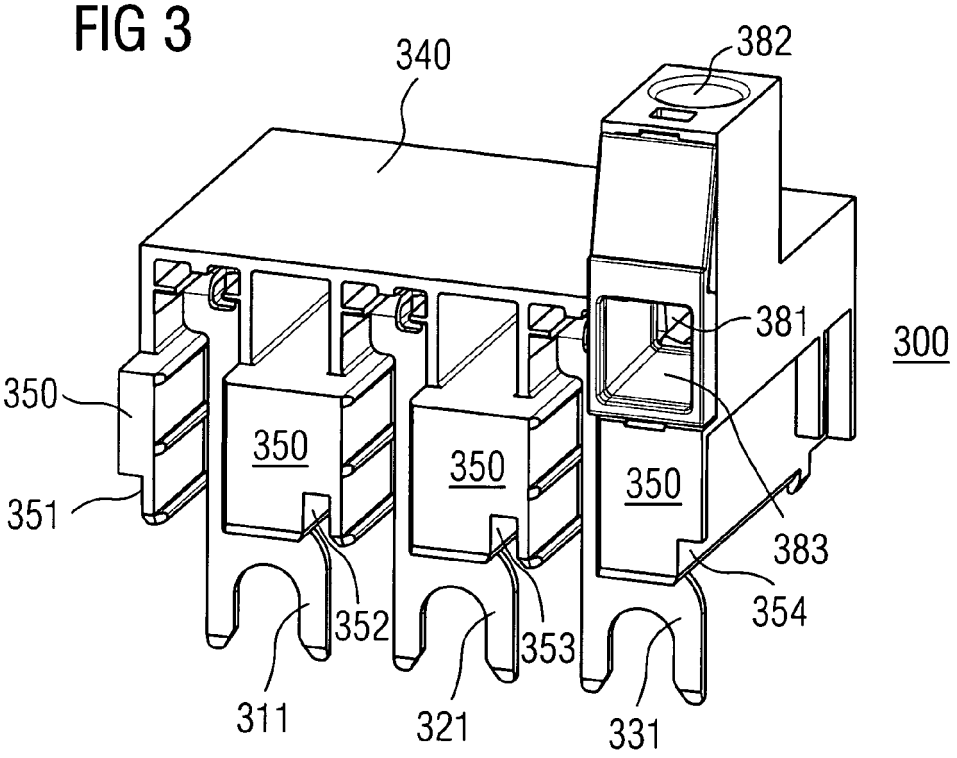
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FIG 4

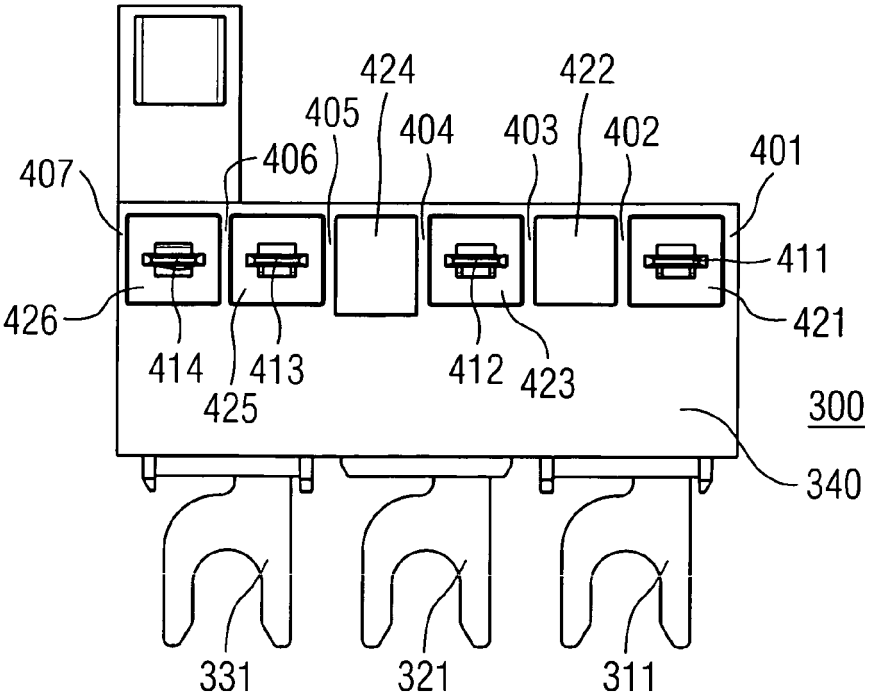
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FIG 5
(PRIOR ART)

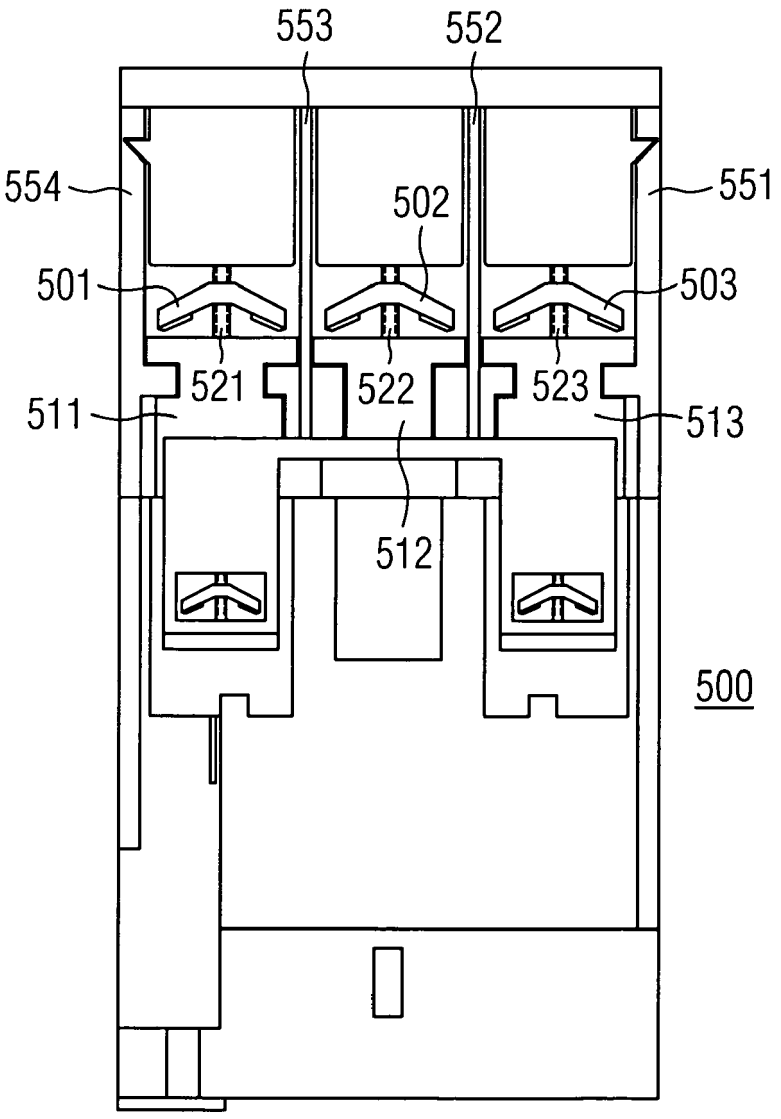
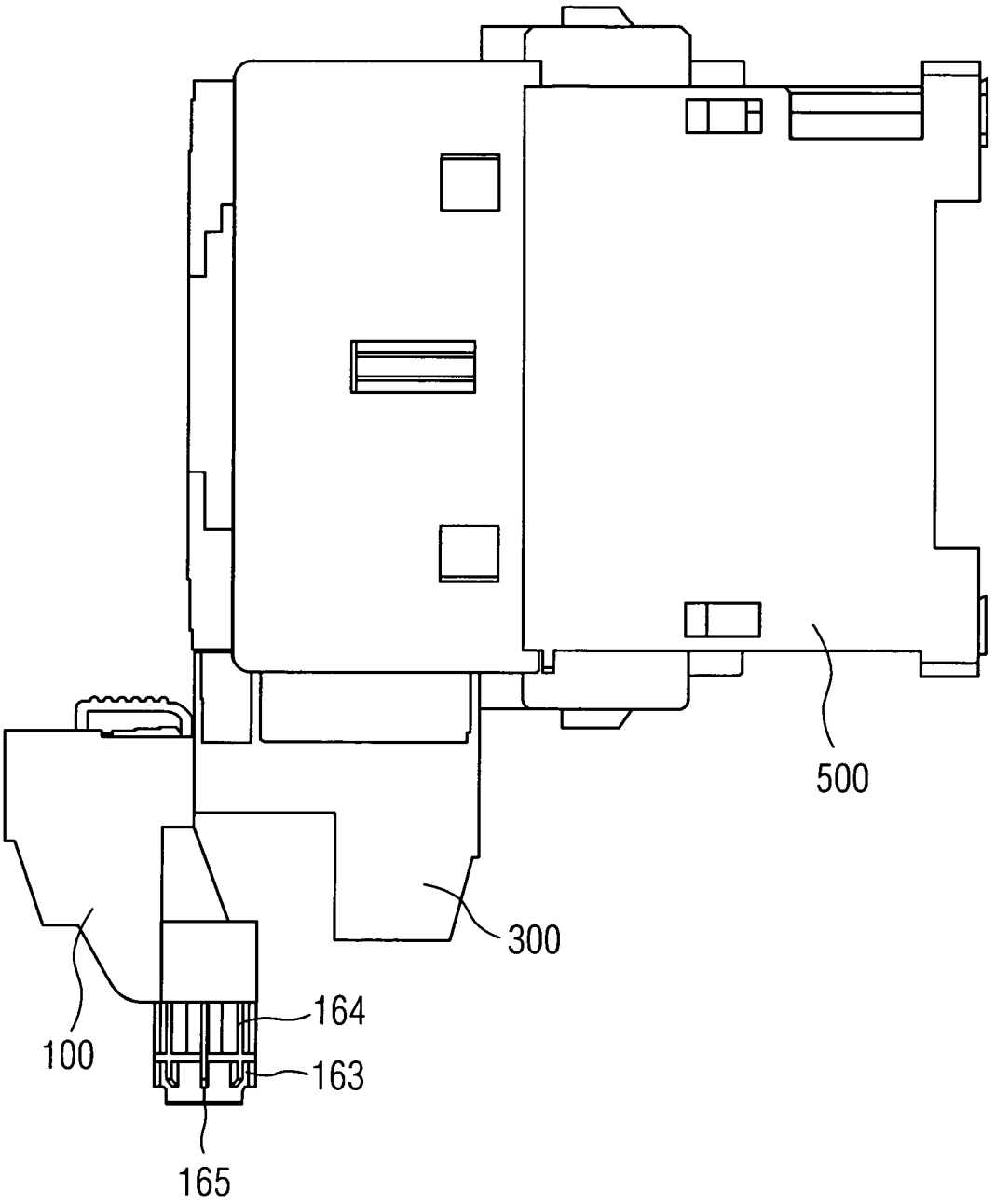


FIG 6



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EUROPEAN SEARCH REPORT

Application Number
EP 06 00 8403

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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
Munich	9 October 2006	SERRANO FUNCIA, J

CATEGORY OF CITED DOCUMENTS

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