PLUG ASSEMBLY, IN PARTICULAR FOR A COOLING CONTAINER

[0001] The invention relates to a multi-pole plug assembly, in particular in the form of a plug, with several contact elements, two of which are arranged on a turning device.

[0002] For reasons of compatibility and operational safety, the structure of multi-pole electrical power plug assemblies is specified in standards such as DIN EN 60309-1 and DIN EN 60309-2. The interaction of a distinctive nose with a distinctive groove ensures hereby that a plug and a socket/coupling can be joined together only in a predefined relative rotational position with respect to the plugging axis. Furthermore, the standard specifies the position of the contact elements (contact pins or contact sleeves) in relation to the distinctive groove/nose for various electrical operating parameter ranges.

[0003] CN105140684 discloses a plug assembly for cooling containers in which all four contact pins can be rotated relative to the housing.

[0004] EP 841 726 A2 discloses a multi-pole plug assembly, in which two contact pins connected to an outer conductor are arranged on a rotatable rotor. This enables a user to exchange the positions of the two contact pins with otherwise identical plug image of all the contact pins of the plug assembly. With this device, known as a "phase reverser", the relative sequence of the electrical phases on the contact pins of the plug assembly can thus be changed in order, for example, to change the rotation direction of a connected three-phase machine.

[0005] Aspects of the invention are defined in the independent claims. Preferred configurations are set forth in the subclaims. Hence plug assemblies provided in accordance with the techniques disclosed herein may be more reliable, comfortable and flexible with standardized arrangements of the contact elements.

[0006] The multi-pole plug assemblies as herein described typically involve a plug assembly as a "plug" with contact pins or as a "socket" or "coupling" with contact sleeves. The assembly may include the following components:

a) At least two contact elements, i.e. electrically conductive structures, which come into contact with complementary contact elements of a complementary plug assembly in the mated state and thus enable transmission of current.

b) A turning device on which a first contact element and a second contact element of the afore-mentioned at least two contact elements are arranged, so that their positions can be exchanged by the user, if necessary.

[0007] Such a multi-pole plug assembly may be characterized in that the first contact element and the second contact element are different in terms of their plugging compatibility. That is, the first and second contact elements cannot both be mated with the same complementary contact element. For example, the first and second contact elements may have different (inner or outer) diameters. In particular, they can be cylindrical pins of different diameters (and/or different cross-sectional shape).

[0008] The multi-pole plug assembly with the afore-mentioned features a) and b) may be characterized in that the first contact element is connected to an outer conductor and the second contact element to a protective conductor or to a neutral conductor. By definition, an "outer conductor" (also called "phase") should guide hereby in the operating state one of the phases of an electrical three-phase current. A "neutral conductor" is connected to the common node of the outer conductor, and the "protective conductor" (or ground conductor) is connected to earth or ground.

[0009] The above features of the plug assemblies may in particular be combined with each other. In other words, the first contact element connected to an outer conductor and the second contact element connected to a protective conductor can be different in terms of their plugging compatibility.

[0010] In known plug assemblies with a turning device, two identically shaped contact pins, which are connected to different outer conductors (phases), are exchanged with one another. In contrast thereto, in the plug assemblies as described herein, a positional interchange of two contact elements is made possible, which are assigned to fundamentally different electrical functions. Thus, the plug assembly can be used together with complementary plug assemblies depending on positioning of the turning device, which are typically assigned in the context of a standard or norm to different categories (operating parameters).

[0011] The concrete technical design of the turning device can be implemented in various ways. In particular, the first and the second contact elements can be arranged on a common (insulating) rotor, which is rotatably supported on the remaining plug assembly insert, in which the remaining contact elements are mounted. Advantageously, the positions of the rotor in which the contact elements have just swapped their (standard) positions are stabilized and/or locked. This can be realized, for example, by a locking device. Rotation of the turning device and, optionally, release of a locking device is typically possible for the user without much difficulty, for example with a conventional screwdriver. The turning device is preferably accessible only when the plug assembly is not mated with another plug assembly so as to preclude operation in the current-carrying state. An exemplary concrete realization of a turning device can be taken from EP 841 726 A2, the contents of which are fully incorporated into the present application.

[0012] As already explained, the contact elements can be configured, for example, as contact sleeves or as contact pins (theoretically, a plug assembly may include a combination of contact pins and contact sleeves). Preferably, all contact elements are configured as contact pins, so that by definition the plug assembly involves a plug.

[0013] Furthermore, the plug assembly preferably has a distinctive feature, which permits a mating of the plug assembly with a complementary plug assembly only

in a predefined relative rotational position (with respect to the plugging axis, in which direction the plug assemblies are plugged together). The distinctive feature can be configured in particular as a distinctive nose and/or distinctive groove. The uniqueness of mating relates hereby to the plug assemblies in their entirety, i.e. in particular with respect to their casing. Interchangeability of the positions of two contact elements relative to a plug assembly casing is independent thereof.

[0014] The plug assembly can be configured in terms of the geometric positions and/or shapes of its contact elements, in particular according to the standard DIN EN 60309-2. Optionally, other features of the plug assembly may also meet this standard.

[0015] The position of contact elements may be within the scope of the standard DIN EN 60309 - 2 via fictitious clock positions (in relation to the plan view upon a socket and with a predefined location of a distinctive feature such as e.g. a distinctive groove/nose). In this regard, the first contact element and the second contact element can be arranged in particular at positions 3^h (clock) or 6^h or vice versa (with location of the distinctive feature on 6^h).

[0016] In addition or as an alternative, the plug assembly may also be designed such that the configuration resulting by exchanging the first and second contact elements allows safe operation of the plug assembly (or of the consumer connected thereto) in conjunction with plug assemblies according to the standard DIN EN 60309. In particular, regardless of the position of the turning device, no mating should be possible with a plug assembly according to DIN EN 60309, which causes overvoltage, for which the plug assembly and/or the consumer are not designed.

[0017] The plug assembly may in particular be four-pole, with the poles or contact elements being arranged at the corners of a square. Preferably, three contact elements are hereby occupied with the outer conductors (phases) of a three-phase alternating current and a fourth contact element with ground (protective conductor).

[0018] It is particularly preferred, when the plug assembly is a four-pole plug with an arrangement and shape of the contact pins according to the standard DIN EN 60309 - 2, wherein the contact pins of the 3^h and 6^h position (in relation to a corresponding socket!) are arranged on the turning device, so that their position can be exchanged, and wherein these interchangeable contact pins are connected to an outer conductor or to the protective conductor. According to standard DIN EN 60309 - 2, the plug assembly can then adopt the following configurations depending on the position of the turning device:

- Protective conductor in 3^h position: operation at 380 V, 50 Hz or 440 Volt, 60 Hz.
- Protective conductor in 6^h position: Operation at 380-415 V, 50 or 60 Hz.

[0019] The operating parameters of both configurations are electrically sufficiently similar so that a correspondingly designed consumer connected to the plug can be safely operated in both configurations.

[0020] Fixedly connected to the plug assembly may be in particular a device (consumer), in particular a cooling unit. A "fixed" connection means hereby that this connection cannot be changed or released in a simple manner and/or without tool by a user. In particular, the separation of the plug assembly from the device may require the intervention of an expert and/or loosening of screws or clamp connections and/or may not be possible in a non-destructive manner. In this way, it is ensured that the variable plug assembly is used only with a device designed for this purpose.

[0021] The device may in particular involve a cooling unit. Preferably, such a cooling unit is provided with a four-pole connector of the type mentioned above, in which the protective conductor contact pin can be placed selectively in 3^h position or in 6^h position. A safe operation of the cooling unit is then possible in both positions of the turning device.

[0022] As a separate element, a cooling unit, in particular in combination with a mobile cooling container, which is characterized in that it is equipped with a plug according to one of the afore-described embodiments is herein described.

[0023] In the following, the invention is described in greater detail with the aid of the figures with reference to an exemplary embodiment. It is shown in:

[0024] Figure 1 a section of a table of associations between protective conductor positions and electrical operating parameters according to standard DIN EN 60309-2;

[0025] Figure 2 a perspective view of a plug with the protective conductor-contact element in 3^h position;

[0026] Figure 3 the plug with the protective conductor contact element in the 6^h position.

[0027] Figure 1 reflects a simplified tabular overview of a part of the regulation content of standard DIN EN 60309 - 2. The table contains the associations specified

must be replaced. Moreover, there is acute risk because the faulty plug can now be inserted in all sockets of suitable size and number of poles, which, for example, have the clock position "5^{h}" voltages of 600 to 690V, for which normally the clearance and creepage distance of a 3^{h} plug are not designed.

[0031] A simple solution of the described problem is realized with a plug assembly, in which the position of the protective conductor contact element can be exchanged with that of an outer conductor contact element.

[0032] In this context, so-called phase reverser plugs according to DIN EN 60309 - 2 should be reminded of, which swap the position of two adjacent phase pins by mechanical rotation so as to change the rotation direction of the rotating field. Since the rotor or the turning device, which implements the pin swap, can be actuated from outside, no rewiring of the plug is necessary. The turning device also has mechanical end positions; but even without these a plug could not be inserted into a socket, when the pins are not appropriately positioned to the contact sleeves.

[0033] An plug for solving the afore-described cooling container problem is now being built such that a "clock change" - i.e. the change in position of the protective conductor contact pin ("PE pin") with an outer conductor contact pin ("PH pin") - establishes a modified plug having a mating face which can only be inserted into a socket that has a voltage and frequency which does not significantly differ from the socket with the original clock position. Such an "electric resemblance" is encountered between the 3^{h} and 6^{h} clock position of the variants "A" and "B" of Figure 1, which in addition have the same color code.

[0034] Figure 2 shows by way of a perspective view a plug 100 according to the afore-explained concept. The plug 100 includes a casing 101 with a collar 102 in surrounding relation to four contact pins K1, K2, K3 and PE. A first of these contact

5. Multi-pole plug assembly (100) according to at least one of the preceding claims, characterized in that it includes a distinctive feature (105), which permits the mating of the plug assembly (100) with a complementary plug assembly only in a predefined relative rotational position.

6. Multi-pole plug assembly (100) according to at least one of the preceding claims, characterized in that it is configured with respect to the positions and/or shapes of the contact elements (K1, K2, K3, PE) according to standard DIN EN 60309-2.

7. Multi-pole plug assembly (100) according to claim 6,
characterized in that the first contact element (K1) and the second contact element (PE) can be arranged at the positions 3^h and 6^h or vice versa.

8. Multi-pole plug-and-socket device (100) according to claim 6 or 7,
characterized in that the configurations resulting through exchange of the first contact element (K1) and the second contact element (PE) enables a safe operation of the plug assembly (100) in connection with plug assemblies according to the standard DIN EN 60309 - 2.

9. Multi-pole plug assembly (100) according to at least one of the preceding claims, characterized in that it is arranged for being fixedly connected to a device, in particular to a cooling unit.

10. Cooling unit, in particular in combination with a mobile refrigerated container, characterized in that it comprises a plug (100) according to at least one of claims 1 to 9.