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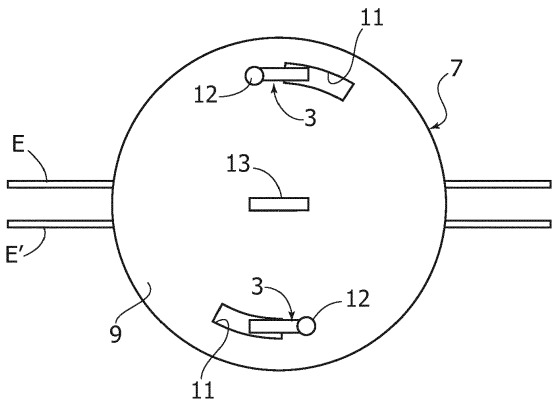
(54) CONNECTING DEVICE FOR LIGHTING DEVICES, CORRESPONDING LIGHTING SYSTEM AND METHOD

(57) Connecting device for connecting lighting devices each with a printed circuit board (P), comprising:
- at least one pair of electrical connectors (1) assembled on a second side (P2) of the printed circuit board (P), wherein each electrical connector (1) has at least one connecting portion defining a receptacle (2) provided for receiving an electrically-powered cable (E, E'), the electrical connectors (1) being arranged with the receptacles (2) substantially facing each other and facing in a direction substantially parallel to the plane of the printed circuit board (P),
- at least one pair of fastening elements (3) assembled on said second side (P2) of said printed circuit board (P),
- a top element (7) coupled with a lighting device, having at least two openings (11) provided for receiving, respectively, one fastening element (3) of said pair assembled on said printed circuit board (P).

FIG. 12



EP 3 521 696 A1

Description

Technical field

[0001] The present description refers to lighting devices.

[0002] One or more embodiments can be applied to connecting devices for connecting lighting devices using electrically-powered lighting sources, for example, solid-state lighting sources such as LED sources.

Technological background

[0003] In the field of lighting devices, such as LED lighting modules, one of the most important requirements to be met is that of obtaining an easy electrical connection between different lighting modules. In most applications, the electrical connection is guaranteed by two or more electrical connection cables. The wiring of the modules presents some problems, such as, for example:

- the maximum distance between the modules is determined by the length of the electrical connection cables;
- if the modules are mounted close to each other, it is necessary to ensure that cable portions do not interfere with the light emitted by the modules; and
- to weld the cables directly onto each of the LED modules it is necessary to apply a rather complex process.

[0004] Finally, another disadvantage of the known solutions to date for electrically connecting the modules is represented by the limited possibility of adapting the modules to measure according to their final application.

Object and summary

[0005] One or more embodiments aim to overcome the drawbacks outlined above.

[0006] According to one or more embodiments, this object can be achieved thanks to a connecting device having the characteristics referred to in the following claims. One or more embodiments may also refer to a corresponding lighting system and method.

[0007] The claims form an integral part of the technical disclosure provided here in relation to embodiments.

[0008] One or more embodiments may offer one or more of the following advantages:

- possibility of defining any distance between the LED modules, without any limitation due to the wiring of the electrical connection cables,
- possibility of using a single electrical cable element to connect different LED modules,
- possibility of avoiding damage to the dielectric layer of the printed circuit board, possibly caused by inserting electrical cables onto connectors,
- possibility of guaranteeing the electrical connection of an LED module by means of a mechanical device (top element) as well, which improves the durability of the connection,
- possibility of easily fastening the LED module within a lighting apparatus.

Brief description of the figures

[0009] One or more embodiments will be now described, purely by way of non-limiting example, with reference to the attached figures, wherein:

- Figure 1 is a schematic plan view of a lighting device and of some elements of a connecting device incorporating embodiments;
- Figures 2 and 3 are schematic side views of some elements illustrated in the previous figure;
- Figure 4 is a schematic front view of the elements illustrated in Figure 1;
- Figure 5 is a schematic side view of the elements illustrated in Figure 1;
- Figure 6 is a schematic plan view of additional elements of a connecting device incorporating embodiments;
- Figures 7 and 8 show, respectively, a schematic front view and a schematic side view of the details illustrated in Figure 6;
- Figures 9 to 13 are schematic views illustrating the steps of a method for producing the connection of a lighting device with a connecting device illustrated in the previous figures.

[0010] It will be appreciated that, for clarity and simplicity of illustration, the various figures may not be reproduced on the same scale.

Detailed description

[0011] In the following description, various specific details are illustrated aimed at a thorough understanding of examples of one or more embodiments. The embodiments can be implemented without one or more of the specific details, or with other methods, components, materials, etc. In other cases, known structures, materials, or operations are not shown or described in detail to avoid obscuring various aspects of the embodiments. The reference to "an embodiment" in the context of this description indicates that a particular configuration, structure or characteristic described in relation to the embodiment is included in at least one embodiment. Therefore, phrases such as "in an embodiment", possibly present in different places of this description do not necessarily refer to the same embodiment. Moreover, particular conformations, structures or characteristics can be combined in a suitable manner in one or more embodiments and/or associated with the embodiments in a different way from that

illustrated here, for example, a characteristic here exemplified in relation to a figure may be applied to one or more embodiments exemplified in a different figure.

[0012] The references illustrated here are only for convenience and do not therefore delimit the field of protection or the scope of the embodiments.

[0013] In the attached drawings, a connecting device is illustrated for connecting lighting devices using electrically-powered lighting sources S.

[0014] For example, the lighting device can be made in the form of an LED lighting module using solid-state light radiation sources, such as LED sources.

[0015] Modules of this nature can comprise (see, for example, Figures 1, 4 and 5) a support substantially similar to a Printed Circuit Board - PCB - on which a plurality of electrically-powered light radiation sources S are distributed, for example, LED sources. The printed circuit board P may have a first side P1, a second side P2 opposite the first side P1, and a side surface which joins the first side P1 and the second side P2. With reference to the example illustrated in the figures, the lighting sources S are arranged at the first side P1 of the printed circuit board P (Figures 4 and 5).

[0016] The power supply (and, possibly, the control) of the modules can be implemented by means of electrical power lines, here exemplified in the form of two cables E, E' (Figure 9).

[0017] A lighting module of the type indicated above can be made with any shape and dimensions, for example, with a circular shape (Figure 1).

[0018] Lighting devices (modules) of the type considered above are known in the art, which makes it unnecessary to provide a more detailed description here.

[0019] One or more embodiments can, therefore, provide a connecting device for connecting lighting devices using electrically-powered lighting sources.

[0020] In one or more embodiments, the connecting device may comprise at least one pair of electrical connectors 1, arranged for implementing the electrical connection (power supply and, possibly, control) of the light radiation sources - for example those indicated with S in Figure 5 - by means of electric cables E, E' (one for the positive pole and the other for the negative pole). In the embodiment illustrated in the drawings, the connecting device comprises a single pair of electrical connectors 1.

[0021] In one or more embodiments, the pair of electrical connectors 1 can be assembled on the second side P2 of the printed circuit board P (Figures 1, 4 and 5).

[0022] In one or more embodiments, each electrical connector 1 may comprise at least one portion which can be assembled, (for example by welding), above the second side P2 of the printed circuit board P, particularly at a corresponding welding path arranged on the side P2 of the printed circuit board P.

[0023] In one or more embodiments, each electrical connector 1 has at least one connecting portion defining a receptacle 2 arranged to receive an electrically-powered cable E, E' (Figure 3), in order to provide an electrical connection of the lighting devices using electrically-powered light sources (Figure 9). In one or more embodiments, the inner walls of the receptacles 2 are arranged to affect an insulating layer of the respective electrically-powered cable E, E' and to come into contact with a conductive part of the electrically-powered cable E, E'.

[0024] In one or more embodiments, the electrical connectors 1 are arranged, in their assembled condition on the second side P2 of the printed circuit board P, with the receptacles 2 substantially facing each other and facing in a direction substantially parallel to the plane of the printed circuit board P (see plan view of Figure 1 and side view of Figure 5).

[0025] In one or more embodiments, the connecting device may further comprise at least one pair of fastening elements 3 (Figure 2) which can be assembled on the second side P2 of the printed circuit board P (Figures 1, 4, 5). In the illustrated example, the connecting device comprises a single pair of fastening elements 3.

[0026] In one or more embodiments, the connecting device may further comprise a top element 7 which can be coupled with the lighting device (Figures 6 and 10). The top element 7 has a first face 8 and a second face 9 opposite the first face 8. In the coupled condition of the top element 7 with the lighting device, the first face 8 of the top element 7 faces the second side P2 of the printed circuit board P (Figures 10 and 11).

[0027] According to the embodiment illustrated in the drawings, the top element 7 has a circular shape in order to couple with the lighting device, also having a circular shape, but of course they can be made with a different shape with respect to what is illustrated.

[0028] In one or more embodiments, the top element 7 comprises at least two openings 11 arranged to receive, respectively, one of the fastening elements 3 assembled on the second P2 side of the printed circuit board P (Figure 6).

[0029] Furthermore, in one or more embodiments, the top element 7 comprises at least two hollow portions 12 each arranged near a respective opening 11 (Figure 6). The hollow portions 12 are arranged to receive a respective end portion 6 of the fastening elements 3, in order to ensure a mechanical connection between the top element 7 and the fastening elements 3 assembled on the second side P2 of the printed circuit board P.

[0030] In one or more embodiments, the top element 7 further comprises at least two protruding elements 10 rigidly connected to the first face 8 (Figures 7 and 8). The function of the protruding elements 10 is explained in detail in the following description.

[0031] The fastening elements 3 may be hook-shaped, comprising a base portion 4 which can be assembled on the second side P2 of the printed circuit board P, an intermediate portion 5 designed to protrude from a respective opening 11 of the top element 7 when the top element 7 is coupled with the lighting device, and an end portion 6 arranged to engage in one of the hollow portions 12 of the top element 7 (Figures 2 and 12).

[0032] In one or more embodiments, with reference to the assembled condition on the printed circuit board P, the two fastening elements 3 are arranged on the second side P2 of the printed circuit board P at two peripheral positions diametrically opposite and aligned along a first direction (Figure 1).

[0033] In one or more embodiments, with reference to the assembled condition on the printed circuit board P, the two electrical connectors are arranged on the second side P2 of the printed circuit board P at two peripheral positions diametrically opposite and aligned along a second direction (Figure 1).

[0034] In one or more embodiments, the aforesaid first and second directions form an angle of less than 90° between each other (Figure 1).

[0035] Moreover, in one or more embodiments, the two fastening elements 3, in their assembled condition, on the second side P2 of the printed circuit board P have their intermediate portions 5 extending in two opposite directions (Figure 4).

[0036] As said previously, in one or more embodiments, the top element 7 comprises at least two protruding elements 10 rigidly connected to the first face 8 (Figures 7 and 8).

[0037] In the coupled condition of the top element 7 with the printed circuit board P, the protruding elements 10 protrude in the direction of the printed circuit board P, and are configured to push, respectively, one of the electrically-powered cables E, E' into the respective receptacle 2 of the connecting portion of the connector 1 (Figure 13).

[0038] In the example illustrated in the drawings, the top element 7 has a screwdriver insert 13 at the second face 9, arranged to be engaged by a screwdriver, so as to rotate the top element 7 with respect to the printed circuit board P (Figure 10). Following rotation of the top element 7, the end portions 6 of the fastening elements 3, when assembled on the printed circuit board P and passed through the openings 11, respectively engage one of the hollow portions 12 of the top element 7, so as to attach the top element 7 to the fastening elements 3 (Figures 12 and 13). Furthermore, following rotation of the top element 7 with respect to the printed circuit board P, the protruding elements 10 of the top element 7 push, respectively, one of the electrically-powered cables E, E' into the respective receptacle 2 of the connecting portion of the connector 1 (Figures 11, 12 and 13).

[0039] Of course, in one or more embodiments it is possible to use electrical connectors 1 and fastening elements 3 having a different shape with respect to what is illustrated in the drawings according to the intended application.

[0040] It will also be appreciated that characteristics or details exemplified with reference to one of the figures described above can also be transposed (individually or in combination with each other) to embodiments exemplified in different figures.

[0041] One or more embodiments may have one or more of the following advantages:

- possibility of defining any distance between the LED modules, without any limitation due to the wiring of the electrical connection cables,
- possibility of using a single electrical cable element (one for the positive pole and another for the negative pole) to connect different LED modules,
- possibility of avoiding damage to the dielectric layer of the printed circuit board, possibly caused by inserting electrical cables onto connectors,
- possibility of guaranteeing the electrical connection of an LED module by means of a mechanical device (top element) as well, which improves the durability of the connection,
- possibility of easily fastening the LED module into a lighting apparatus.

[0042] One or more embodiments may concern a connecting device for connecting lighting devices using electrically-powered lighting sources (e.g. S), the lighting devices comprising a printed circuit board (e.g. P) having a first side (e.g. P1) on which said lighting sources (e.g. S) are located, and a second side (e.g. P2) opposite to said first side (P1), said connecting device comprising:

- at least one pair of electrical connectors (e.g. 1) which can be assembled on said second side (e.g. P2) of said printed circuit board (e.g. P), wherein each electrical connector (e.g. 1) has at least one connecting portion defining a receptacle (e.g. 2) provided for receiving an electrically-powered cable (e.g. E, E'), the electrical connectors (e.g. 1) of said at least one pair being arranged, in their assembled condition, on said second side (e.g. P2) of said printed circuit board (e.g. P), with the receptacles (e.g. 2) substantially facing each other and facing in a direction substantially parallel to the plane of the printed circuit board (e.g. P),
- at least one pair of fastening elements (e.g. 3) which can be assembled on said second side (e.g. P2) of said printed circuit board (e.g. P),
- a top element (e.g. 7) which can be coupled with a lighting device, said top element (e.g. 7) comprising at least two openings (e.g. 11) provided for receiving, respectively, one fastening element (e.g. 3) of said pair assembled on said printed circuit board (e.g. P).

[0043] In one or more embodiments, said top element (e.g. 7) also comprises at least two hollow portions (e.g. 12), each located close to one respective opening (e.g. 11) of said top element (e.g. 7), said hollow portions (e.g. 12) being provided for receiving a respective portion of one of said fastening elements (e.g. 3), in order to guarantee mechanical connection between said top element (e.g. 7) and said pair of fastening elements (e.g. 3) assembled on the second side (e.g. P2) of said printed circuit board (e.g. P).

[0044] In one or more embodiments said top element (e.g. 7) has a first face (e.g. 8) and a second face (e.g. 9) opposite to said first face (e.g. 8), in the coupled condition of said top element (e.g. 7), with said lighting device, said first face (e.g. 8) of the top element (e.g. 7) and said second side (e.g. P2) of the printed circuit board (e.g. P) facing each other, said top element (e.g. 7) further comprising at least two protruding elements (10) rigidly connected to said first face (e.g. 8), in such a way that, in the coupled condition of said top element (e.g. 7) with said lighting device, and in the assembled condition of said at least one pair of connectors (e.g. 1) on said printed circuit board (e.g. P), said protruding elements (e.g. 10) protrude towards the printed circuit board (e.g. P) and are configured for pushing, respectively, one of the electrically-powered cable (e.g. E, E') into one receptacle (e.g. 2) of the connector (e.g. 1).

[0045] In one or more embodiments the two fastening elements (e.g. 3) of said at least one pair are located, in their assembled condition, on said second side (e.g. P2) of said printed circuit board (e.g. P), at two diametrically opposite peripheral positions and aligned along a first direction,

- the two electrical connectors (e.g. 1) of said at least one pair are located, in their assembled condition, on said second side (e.g. P2) of said printed circuit board (e.g. P), at two additional diametrically opposite peripheral positions and aligned along a second direction,
- said first direction and said second direction forming an angle of less than 90°.

[0046] In one or more embodiments, each fastening element (e.g. 3) is hook-shaped and comprises a base portion (e.g. 4) which can be assembled on said second side (e.g. P2) of said printed circuit board (e.g. P), an intermediate portion (e.g. 5) configured to project from one of the openings (e.g. 11) of the top element (e.g. 7) when the top element (e.g. 7) is coupled with the lighting device, and an end portion (e.g. 6) provided to engage one of said hollow portions (e.g. 12) of the top element (e.g. 7).

[0047] In one or more embodiments, the two fastening elements (e.g. 3) of said at least one pair are located, in their assembled condition, on said second side (e.g. P2) of said printed circuit board (e.g. P), with their intermediate portions (e.g. 5) extending towards two opposite directions.

[0048] In one or more embodiments, said top element (e.g. 7) comprises a screwdriver insert (e.g. 13) at its second face (e.g. 9), provided for being engaged by a screwdriver, in order to cause rotation of the top element (e.g. 7) with respect to the printed circuit board (e.g. P) and to engage the end portions (e.g. 6) of the fastening elements (e.g. 3) assembled on the printed circuit board (e.g. P) and passed through the openings (e.g. 11) with one of the hollow portions (e.g. 12) of the top element (e.g. 7), in order to attach the top element (e.g. 7) to the fastening elements (e.g. 3).

[0049] One or more embodiments may concern a lighting system, comprising:

- a plurality of lighting devices using electrically-powered lighting sources (e.g. S), each lighting device comprising a printed circuit board (e.g. P),
- a plurality of connecting devices according to any of the previous claims, for connecting the lighting devices using two electrically-powered cables (e.g. E, E') passing along all the lighting devices.

[0050] One or more embodiments may concern a method for providing connection of a lighting device comprising the following steps:

- providing at least one lighting device using electrically-powered lighting sources (e.g. S), said at least one lighting device comprising a printed circuit board (e.g. P) having a first side (e.g. P1) on which said lighting sources (e.g. S) are located, and a second side (e.g. P2) opposite to said first side (e.g. P1),
- providing at least one connecting device according to any of the claims 1-7,
- assembling said at least one pair of electrical connectors (e.g. 1) and said at least one pair of fastening elements (e.g. 3) on said second side (e.g. P2) of said printed circuit board (e.g. P),
- arranging at least one electrically-powered cable (E, E') within a respective receptacle (e.g. 2) of the connector (1),
- arranging said top element (e.g. 7) above said second side (e.g. P2) of said printed circuit board (e.g. P), passing each fastening element (e.g. 3) into a respective opening (e.g. 11) of the top element (e.g. 7),
- rotating said top element (e.g. 7) with respect to the printed circuit board (e.g. P), for engaging each end portion (e.g. 6) of each fastening element (e.g. 3) within a respective hollow portion (e.g. 12) of the top element (e.g. 7) and for pushing the electrically-powered cable (e.g. E, E') into the respective receptacle (e.g. 2) of the connector (e.g. 1) by means of a respective protruding element (e.g. 10)

[0051] Without prejudice to the underlying principles of the invention, the details of construction and the embodiments may vary, even significantly, with respect to those illustrated here, purely by way of non-limiting example, without departing from the scope of the invention.

[0052] This field of protection is defined by the attached claims.

LIST OF REFERENCE SIGNS

Electrical power supply lighting sources	S
Printed circuit board	P

(continued)

First side	P1
Second side	P2
Electrical connector	1
Receptacle	2
Electrically-powered cable	E, E'
Fastening elements	3
Top element	7
Opening	11
Hollow portion	12
First face	8
Second face	9
Protruding element	10
Base portion	4
Intermediate portion	5
End portion	6
Screwdriver insert	13

Claims

1. A connecting device for connecting lighting devices using electrically-powered lighting sources (S), the lighting devices comprising a printed circuit board (P) having a first side (P1) on which said lighting sources (S) are located and a second side (P2) opposite to said first side (P1), said connecting device comprising:

- at least one pair of electrical connectors (1) which can be assembled on said second side (P2) of said printed circuit board (P), wherein each electrical connector (1) has at least one connecting portion defining a receptacle (2) provided for receiving an electrically-powered cable (E, E'), the electrical connectors (1) of said at least one pair being arranged, in their assembled condition, on said second side (P2) of said printed circuit board (P), with the receptacles (2) substantially facing each other and facing in a direction substantially parallel to the plane of the printed circuit board (P),
- at least one pair of fastening elements (3) which can be assembled on said second side (P2) of said printed circuit board (P),
- a top element (7) which can be coupled with a lighting device, said top element (7) comprising at least two openings (11) provided for receiving, respectively, one fastening element (3) of said pair assembled on said printed circuit board (P).

2. A connecting device according to claim 1, wherein said top element (7) also comprises at least two hollow portions (12) each located close to one respective opening (11) of said top element (7), said hollow portions (12) being provided for receiving a respective portion of one of said fastening elements (3), in order to guarantee mechanical connection between said top element (7) and said pair of fastening elements (3) assembled on said second side (P2) of said printed circuit board (P).

3. A connecting device according to any of the previous claims, wherein said top element (7) has a first face (8) and a second face (9) opposite to said first face (8), in the coupled condition of said top element (7), with said lighting device, said first face (8) of the top element (7) and said second side (P2) of the printed circuit board (P) facing each other, said top element (7) further comprising at least two protruding elements (10) rigidly connected to said first face (8), in such a way that, in the coupled condition of said top element (7) with said lighting device, and in the assembled condition of said at least one pair of connectors (1) on said printed circuit board (P), said protruding elements (10) protrude towards the printed circuit board (P) and are configured for pushing, respectively, one of the electrically-powered cable (E, E') into one receptacle (2) of the connector (1).

4. The connecting device of any of the previous claims, wherein:

- the two fastening elements (3) of said at least one pair are located, in their assembled condition, on said second side (P2) of said printed circuit board (P), at two diametrically opposite peripheral positions and aligned along a first direction,
- the two electrical connectors (1) of said at least one pair are located, in their assembled condition, on said second side (P2) of said printed circuit board (P), at two additional diametrically opposite peripheral positions and aligned along a second direction,
- said first direction and said second direction forming an angle of less than 90°.

5. A connecting device according to claim 2, wherein each fastening element (3) is hook-shaped and comprises a base portion (4) which can be assembled on said second side (P2) of said printed circuit board (P), an intermediate portion (5) configured to project from one of the openings (11) of the top element (7) when the top element (7) is coupled with the lighting device, and an end portion (6) provided to engage one of said hollow portions (12) of the top element (7).

6. A connecting device according to claim 5, wherein the two fastening elements (3) of said at least one pair are located, in their assembled condition, on said second side (P2) of said printed circuit board (P),

with their intermediate portions (5) extending towards two opposite directions.

7. A connecting device according to claim 6, wherein said top element (7) comprises a screwdriver insert (13) at its second face (9), provided for being engaged by a screwdriver, in order to cause rotation of the top element (7) with respect to the printed circuit board (P) and to engage the end portions (6) of the fastening elements (3) assembled on the printed circuit board (P) and passed through the openings (11) with one of the hollow portions (12) of the top element (7), in order to attach the top element (7) to the fastening elements (3).

8. A lighting system comprising:

- a plurality of lighting devices using electrically-powered lighting sources (S), each lighting device comprising a printed circuit board (P),
- a plurality of connecting devices according to any of the previous claims, for connecting the lighting devices using two electrically-powered cables (E, E') passing along all the lighting devices.

9. A method for providing connection of at least one lighting device comprising the following steps:

- providing at least one lighting device using electrically-powered lighting sources (S), said at least one lighting device comprising a printed circuit board (P) having a first side (P1) on which said lighting sources (S) are located and a second side (P2) opposite to said first side (P1),
- providing at least one connecting device according to any of the claims 1-7,
- assembling said at least one pair of electrical connectors (1) and said at least one pair of fastening elements (3) on said second side (P2) of said printed circuit board (P),
- arranging at least one electrically-powered cable (E, E') within one respective receptacle (2) of the connector (1),
- arranging said top element (7) above said second side (P2) of said printed circuit board (P), passing each fastening element into one respective opening (11) of the top element (7),
- rotating said top element (7) with respect to the printed circuit board (P), for engaging each end portion (6) of each fastening element (3) within a respective hollow portion (12) of the top element (7) and for pushing the electrically-powered cable (E, E') into the respective receptacle (2) of the connector (1) by means of one respective protruding element (10).

FIG. 1

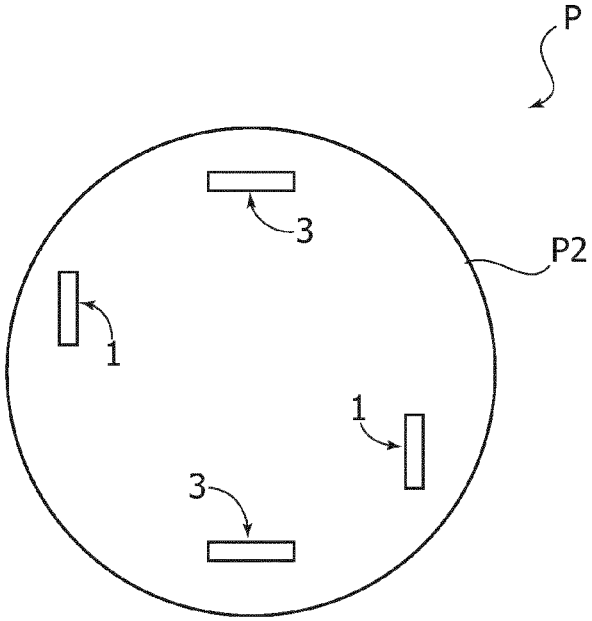


FIG. 2

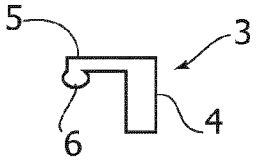


FIG. 3

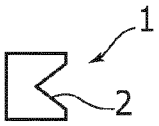


FIG. 4

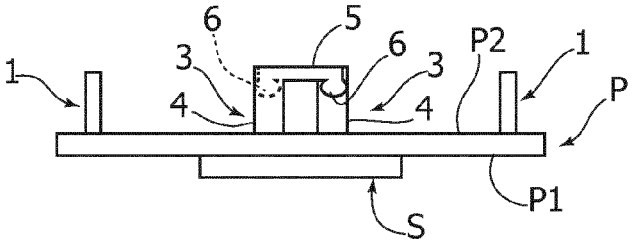


FIG. 5

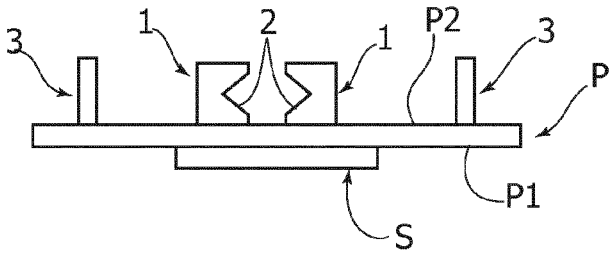


FIG. 6

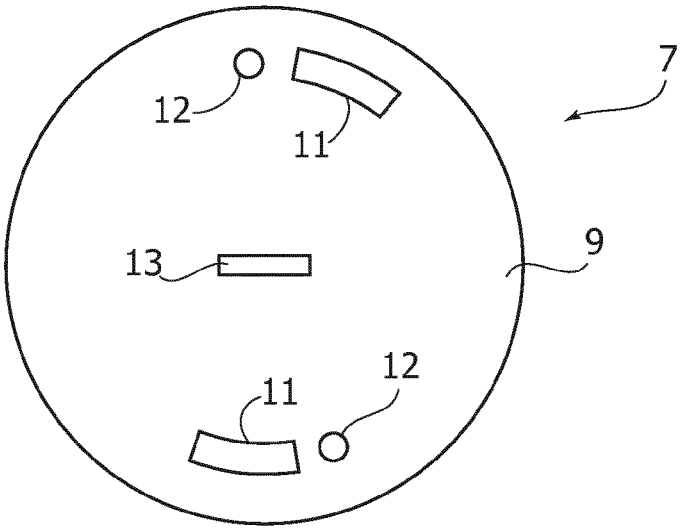


FIG. 7

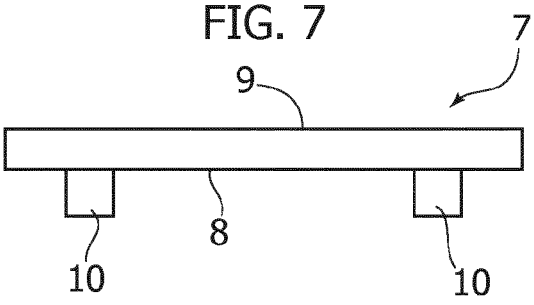


FIG. 8

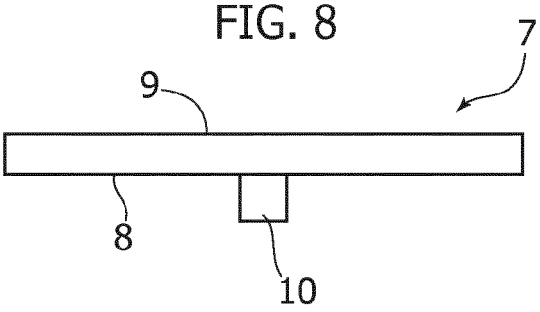


FIG. 9

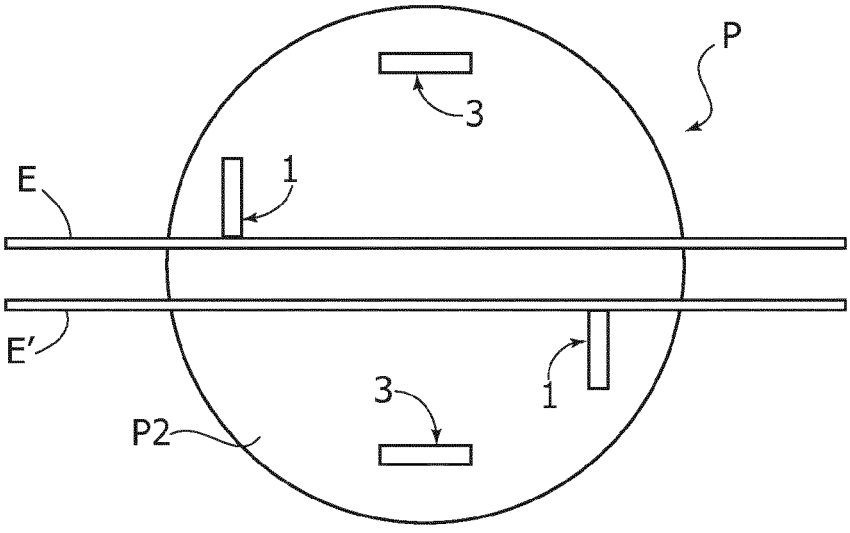


FIG. 10

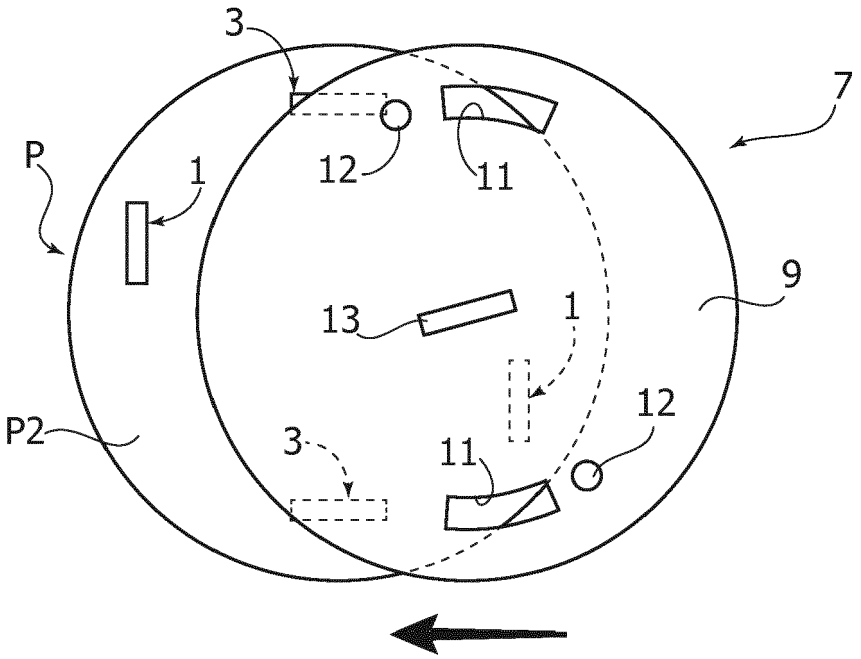


FIG. 11

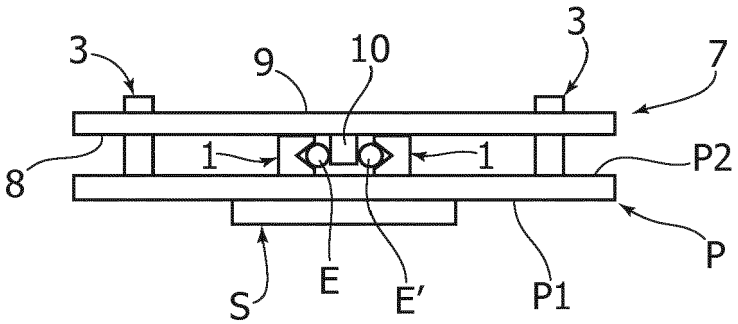


FIG. 12

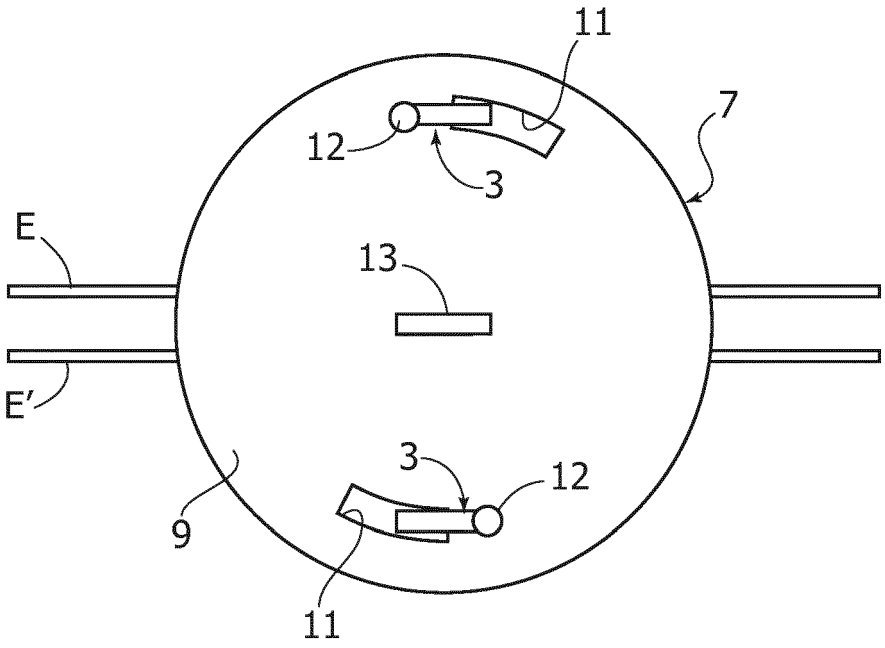
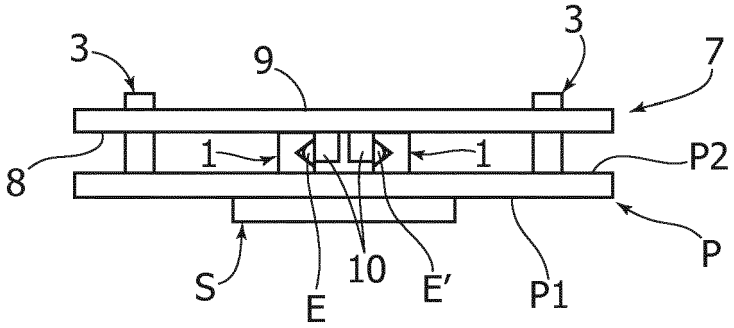


FIG. 13



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EUROPEAN SEARCH REPORT

Application Number
EP 19 15 1663

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The Hague	3 May 2019	Menn, Patrick

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