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(54) ELECTRICAL CONNECTION SYSTEM

(57) In an embodiment, it is provided an electrical connection system comprising:
a plug comprising at least one pin having a cam; and
a socket comprising:
at least one receptacle configured to receive the pin, and at least one connector configured to contact the cam of the pin to establish an electrical connection between the pin and the receptacle,

the pin and the receptacle being configured for mutual motion between at least an inserted configuration and a plugged configuration, wherein
in the inserted configuration, the pin is configured to be displaced by a mutual displacement within the receptacle, and
in the plugged configuration, the pin and the receptacle are configured to be mutually moved by a mutual movement different from the mutual displacement, to establish or disrupt contact between the cam of the pin and the connector.

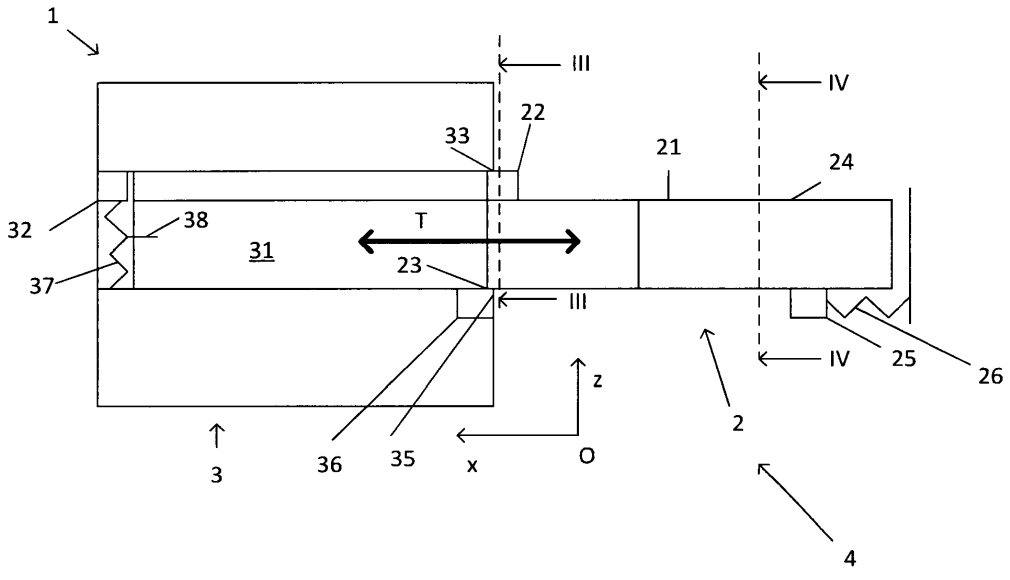

Fig. 1

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Description

Field of the Invention

[0001] The invention relates to electrical connection systems, in particular but not only to systems comprising a plug and a socket. The invention relates in particular but not only to electrical connection systems for high power applications, e.g. to systems sustaining currents from about 100A and more, such as electric drives used in rail transport as non-limiting examples. The invention also relates, respectively, to plugs and sockets of such electrical connection systems.

Background of the Invention

[0002] Electrical connection systems for high power (from about 100A and more) comprising a plug and a socket generally comprise relatively large connectors in order to sustain the high power going though the systems. The known relatively large connectors make the plugging of the plug into the socket relatively hard to achieve for a user, particularly when the electrical connection systems have two or more contacts (case of multipole connectors) and/or when the electrical connection systems are used in rough conditions, such as in adverse weather conditions as non-limiting examples.

Summary of the Invention

[0003] Aspects and embodiments of the invention are set out in the appended claims. These and other aspects and embodiments of the invention are also described herein.

Brief Description of Drawings

[0004]

Figure 1 schematically illustrates an example system comprising a plug and a socket, in an inserted configuration;
Figure 2 schematically illustrates an example system comprising a plug and a socket, in a plugged configuration;
Figure 3 corresponds to a cross section along line III-III of Figure 1;
Figure 4 corresponds to a cross section along the line IV-IV of Figure 1;
Figure 5 illustrates a perspective view of another example system comprising a plug and a socket;
Figure 6a illustrates a perspective view of the system of Figure 5 comprising a plug and a socket, in an inserted configuration;
Figure 6b illustrates a perspective view of the system of Figure 5, in a plugged configuration, at the start of a mutual movement between a pin and a receptacle;
Figure 6c illustrates a perspective view of the system of Figure 5, in a locked configuration, with contact between connectors and cams being established;
Figure 7 illustrates, in a perspective view, another example system, comprising three pins and three receptacles;
Figure 8 illustrates, in a perspective view, a socket of the system of Figure 7;
Figure 9 illustrates, in a perspective view, a pin of the system of Figure 7;
Figure 10 illustrates, in a front perspective view, a detail of a socket of the system of
Figure 7;
Figure 11 illustrates a pin and a receptacle of the system of Figure 7, in an inserted configuration;
Figure 12 is a back perspective view of the system of Figure 11;
Figure 13 is a back view of the system of Figure 11;
Figure 14 illustrates, with a partially cut part, a pin and a receptacle of the system of
Figure 11, in a plugged configuration;
Figure 15 is a back perspective view of the system of Figure 14;
Figure 16 is a back view of the system of Figure 14; and
Figure 17 is a perspective view of an example connector.

[0005] In the Figures like reference numerals are used to indicate like elements.

Specific Description of example embodiments

Overview

[0006] Embodiments of the disclosure relate to an electrical connection system having a plug and a socket. The plug has at least a pin having a cam. The socket has a receptacle. The receptacle may receive the pin to establish a mechanical contact for an electrical connection between the pin and the receptacle, e.g. as the pin contacts a connector of the socket.

[0007] The pin and the receptacle are configured such that, when the pin is inserted within the receptacle, the pin may be displaced within the receptacle. In some examples, contact between the cam and any connectors is limited once the pin is inserted within the receptacle. In some examples, the pin may be displaced within the receptacle without the cam of the pin touching any connectors of the socket. When the pin is inserted within the receptacle, the pin may be displaced to be further inserted within the receptacle or displaced such that the pin may be less inserted within the receptacle. Embodiments of the disclosure enable a user to displace the pin within the receptacle with limited force, e.g. without applying a force, against a connector of the socket. The displacement of the pin within the receptacle may be relatively easy.

[0008] Once the pin is fully inserted in the receptacle, the pin and the receptacle may be plugged to each other. When the pin and the receptacle are plugged to each other, the pin and the receptacle may be mutually moved to establish contact between the cam of the pin and a connector of the socket. The mutual movement may be reversed to disrupt the contact between the cam of the pin and the connector of the socket. Embodiments of the disclosure enable a user to establish or disrupt contact between the cam and the connector (and e.g. an electrical connection between the pin and the receptacle, depending whether power is provided or not) once the pin is plugged (e.g. fully inserted) in the receptacle. The establishment or the disruption of the contact between the pin and the receptacle may be relatively safe. In some examples, power may be provided only after the contact is established. In some examples, power may be provided before the contact is established (e.g. the power is provided continuously), and the electrical connection happens concurrently with the contact between the cam and the connector. The establishment (e.g. power on and contact between the cam and the connector) or the disruption (e.g. power off or no contact between the cam and the connector) of the electrical connection between the pin and the receptacle may be relatively safe.

[0009] In embodiments, the mutual movement in the plugged configuration may be different from the mutual displacement in the inserted configuration. The plug and the socket may also be locked to each other once the contact is established between the cam of the pin and the connector of the socket. Embodiments of the disclosure enable a user to lock the plug and the socket before or at the same time an electrical connection between the pin and the receptacle is established. The maintaining of the electrical connection between the pin and the receptacle may be relatively safe. The plug and the socket may also be unlocked to enable the disruption of the contact between the cam and the connector, e.g. the plug and the socket may also be unlocked after or at the same time as the disruption of the electrical connection between the pin and the receptacle.

Detailed description of example embodiments

[0010] Figures 1 to 4 schematically illustrate an example of an electrical connection system 1 comprising a plug 2 and a socket 3. The example system 1 will first be described with reference to Figures 1 and 2.

[0011] The plug 2 comprises at least one pin 21 having a cam 22. In embodiments, the pin 21 may be connected to a wire (not illustrated in the figures) connected to an electrical load. In embodiments, the plug 2 may comprise more than one pin 21, such as at least two pins or more, such as three pins as a non-limiting example.

[0012] The socket 3 comprises at least one receptacle 31 configured to receive the pin 21. The socket 3 comprises also at least one connector 32 configured to contact the cam 22 of the pin 21. As explained in more detail below, at the same time or after the connector 32 is in contact with the cam 22, an electrical connection may be established between the pin 21 and the receptacle 31. In embodiments, the receptacle 31 may be connected to an power source, such as a voltage source and/or a current source (not illustrated in the figures), such as the electrical grid but other power sources are envisaged. In some examples, once the connector 32 is in contact with the cam 22, an electrical connection may be established between the pin 21 and the receptacle 31, e.g. by switching on the voltage source and/or the current source. In some examples, the voltage source and/or the current source may be on before the contact is established, and the electrical connection may be established at the same time as the contact between the cam 22 and the connector 32.

[0013] As illustrated in Figures 1 and 2, the pin 21 and the receptacle 31 are configured for mutual motion between at least an inserted configuration and a plugged configuration. Figure 1 illustrates the system 1 with the pin 21 and the receptacle 31 being in the inserted configuration.

[0014] In the inserted configuration, the pin 21 is, at least partly, located within the receptacle 31 of the socket 3. In the example of Figure 1, the cam 22 of the pin 21 is in limited contact with the connector 32 (e.g. maybe in contact only because of small tilt or vibration during the insertion within the receptacle 31). In some examples, the cam 22 of the pin 21 is not in contact with the connector 32. As illustrated by double arrow T of Figure 1, in the inserted configuration, the pin 21 is configured to be displaced within the receptacle 31. In embodiments, the receptacle 31 may be fixed and the pin 21 may be displaced with respect to the receptacle 31, although in some embodiments the pin 21 may be fixed and the receptacle 31 may be displaced with respect to the pin 21. In the inserted configuration, the pin 21 may be displaced to be further inserted within the receptacle 31, e.g. displaced towards the left hand side in Figure 1. Additionally or alternatively, in the inserted configuration, the pin 21 may be displaced within the receptacle 31 such that the pin 21 may be less inserted within the receptacle 31, e.g. displaced towards the right hand side in Figure 1. It will be appreciated from Figure 1 that embodiments of the disclosure enable a user to displace the pin 21 within the receptacle 31 by applying a limited for against the connector 32 of the socket 3. Embodiments of the disclosure enable a user to displace the pin 21 within the receptacle 31 without applying a force against the connector 32 of the socket 3, e.g. when the cam 22 is not in contact with the connector 32. The displacement of the pin 21 within the receptacle 31 may be relatively easy.

[0015] As illustrated in Figures 1 and 3, in the inserted configuration, the displacement of the pin 21 within the receptacle 31 may comprise a translation T.

[0016] Figure 2 illustrates the system 1 with the pin 21 and the receptacle 31 being in the plugged configuration.

[0017] As illustrated in Figure 2, in the plugged config-

uration, the pin 21 and the receptacle 31 are configured to be mutually moved, as illustrated by double arrow R, so that contact between the cam 22 and the connector 32 may be established. In embodiments, the mutual movement R may be different from the mutual displacement T described above. In embodiments, the contact between the cam of the pin and the connector depends on the mutual movement R. In the example of Figure 2, the plugged configuration corresponds to a configuration where the pin 21 is fully inserted in the receptacle 31. Once the pin 21 is fully inserted in the receptacle 31, the pin 21 and the receptacle 31 may be plugged to each other. As can be understood from the schematic illustration by Figure 2, the contact between the cam 22 and the connector 32 may be established, and in some embodiments may depend on the mutual movement R. In embodiments, the receptacle 31 may be fixed and the pin 21 may be moved with respect to the receptacle 31. In some embodiments, the pin 21 may be fixed and the receptacle 31 may be moved with respect to the pin 21. In embodiments, both the receptacle 31 and the pin 21 may be moved with respect to each other. When the mutual movement R starts, e.g. the cam 22 is moved towards the left hand side from the illustration of Figure 2 and/or the connector 32 is moved towards the right hand side from the illustration of Figure 2. When the mutual movement R starts, the contact between the cam 22 and the connector 32 may be just established. It should be understood that the more the cam 22 and/or the connector 32 are mutually moved as explained above, the more the contact between the cam 22 and the connector 32 may be established. It should also be understood that the mutual movement R described above may be reversed to disrupt the contact between the cam 22 and the connector 32 of the socket. In some examples, to disrupt the contact between the cam 22 and the connector 32, the cam 22 may be moved towards the right hand side from the illustration of Figure 2 and/or the connector 32 may be moved towards the left hand side from the illustration of Figure 2. Embodiments of the disclosure enable a user to establish or disrupt contact between the cam 22 and the connector 32, once the pin 21 is plugged in the receptacle 31. The establishment or the disruption of the contact between the cam 22 and the connector 32 may be relatively safe. As explained above, embodiments of the disclosure enable a user to establish or disrupt an electrical connection between the pin 21 and the receptacle 31, once the pin 21 is plugged in the receptacle 31. The establishment or the disruption of the electrical connection between the pin 21 and the receptacle 31 may be relatively safe.

[0018] As illustrated in Figure 4, in the plugged configuration, the mutual movement between the pin 21 and the receptacle 31 may comprise a rotation R. In some embodiments the rotation R may be comprised within a range of angles, such as R may be comprised between 5 degrees and 45 degrees, such as comprised between 10 degrees and 40 degrees, for example 20 or 30 degrees. Other values for the rotation are possible and envisaged.

[0019] In embodiments of the disclosure, when the pin 21 and the receptacle 31 are in the inserted configuration, mutual rotation of the pin 21 and the receptacle 31 is inhibited. Embodiments of the disclosure prevent establishment of the electrical connection before the pin and the receptacles are plugged (e.g. before the pin 21 is fully inserted in the receptacle 31). Alternatively or additionally, in some embodiments of the disclosure, the contact between the cam 22 and the connector 32 is established first, e.g. when the line power is off (e.g. the power source is off or turned off), and then the electrical connection between the pin and the receptacle is established when the line power is on (e.g. the power source is on or turned on). Alternatively or additionally, in some embodiments of the disclosure, the line power is provided before establishment of the contact, the electrical connection is established at the same time as the contact between the cam 22 and the connector 32.

[0020] As illustrated in the figures, and in particular in Figure 3, in embodiments of the disclosure the socket 3 comprises an interface 33. The interface 33 of the socket 3 has an opening 332 with a cross section not having a rotational symmetry. In the example of Figure 3, the opening 332 has summits 300. In embodiments, the opening 332 has a polygonal cross section. In the example of Figures 3 and 4, the opening 332 has a quadrilateral cross section, but other geometries are envisaged, such as hexagonal cross sections as non-limiting examples.

[0021] As illustrated in Figure 1, the pin 21 comprises a distal part 23 comprising the cam 22. As illustrated in Figure 3, the distal part 23 has a cross section 233 which is complimentary to the cross section of the opening 332 of the interface 33. As illustrated in Figure 3, the cross section 233 does not have a rotational symmetry, but may have a discrete (360°/n, n being a natural integer, with n=4 in the example of Figure 3) rotational symmetry. In the example of Figure 3, the cross section 233 has summits 300. In the example of Figure 3, the distal part 23 has a quadrilateral cross section 233, but other geometries are envisaged, such as hexagonal cross sections as non-limiting examples. The distal part 23 and the interface 33 are configured to inhibit mutual rotation of the pin 21 and the receptacle 31 while the pin 21 and the receptacle 31 are in the inserted configuration as illustrated in Figure 1, e.g. when the distal part 23 of the pin 21 is located in the interface 33. In the configuration of Figure 1, the pin 21 is not fully inserted in the receptacle 31.

[0022] As illustrated in the figures, and in particular in Figure 4, in embodiments of the disclosure, the pin 21 comprises a proximal part 24 not comprising the cam 22. Embodiments of the disclosure enable mutual rotation when the proximal part 24 is located in the interface 33. The proximal part 24 has a cross section 234 which is configured to enable mutual rotation of the pin 21 and the receptacle 31 while the proximal part 24 of the pin 21

is located in the interface 33, e.g. in the plugged configuration, e.g. when the pin 21 is fully inserted in the receptacle 31. As illustrated in Figure 4 the proximal part 24 has a cross section 234 having rotational symmetry, such that mutual rotation of the pin 21 and the receptacle 31 is enabled while the proximal part 24 of the pin 21 is located in the interface 33.

[0023] As illustrated in Figures 1 and 2, the system 1 is further configured to inhibit mutual motion of the pin 21 and the receptacle 31 in a locked configuration.

[0024] The locked configuration may be established when, e.g. after or concurrently, the electrical connection between the pin 21 and the receptacle 31 is established. In the locked configuration, the plug 2 and the socket 3 may be locked to each other. Embodiments of the disclosure thus enable the maintaining of the electrical connection between the pin 21 and the receptacle 31, such that the system 1 is relatively safe to use for the user.

[0025] As illustrated in Figures 1 and 2, the plug and the socket comprise a locking mechanism 4. The locking mechanism 4 comprises at least one spud 25, at least one groove 35 and at least one hole 36. In the example of Figures 1 and 2, the spud 25 is located on the plug 2, and the groove 35 and the hole 36 are located on the socket 3, although other locations are envisaged. As illustrated in Figure 2, in the plugged configuration, the spud 25 cooperates with the groove 35 and may assist the mutual movement (such as the rotation R) of the pin 21 and the receptacle 31 (e.g. the groove 35 may guide the spud 25 in its movement) during a first phase, and then may lock the plug and the socket when the hole 36 is aligned with the spud 25 and the spud 25 is located in the hole 36. In embodiments of the disclosure, the spud 25 is located in the hole 36 in the locked configuration, so as to lock the pin 21 in the receptacle 31, and to inhibit mutual movement R of the pin 21 and the receptacle 31.

[0026] As illustrated in Figures 1 and 2, the locking mechanism 4 further comprises a translation spring 26 configured to be pre-loaded in the inserted configuration and configured to bias the spud 25 on the groove 35 and the hole 36. As illustrated in Figures 1 and 2, the locking mechanism 4 further comprises a rotation spring 37 (e.g. such as a coil) configured to be pre-loaded in the inserted configuration as illustrated in Figure 1, and configured to bias the receptacle 31 and/or the pin 21 to assist the mutual movement R, such as the rotation, in the plugged configuration. At the end of the mutual movement R, the hole 36 is aligned with the spud 25. The spring 26 has also been pre-loaded (e.g. the spring 26 is pre-loaded in the inserted configuration) and is configured to bias the spud 25 on the groove 35 and the hole 36, at the end of the mutual movement R (e.g. assisted by the spring 37), the spud 25 enters the hole 36. As illustrated in Figures 1 and 2, the locking mechanism 4 further comprises a trigger 38 (e.g. a plate and/or a lever) configured, in some examples, to maintain the rotation spring 37 pre-loaded in the inserted configuration, as illustrated in Figure 1, and configured, in some examples, to release the rotation spring 37 in the plugged configuration (e.g. at the end of the insertion of the pin 21 in the receptacle 31) as illustrated in Figure 2. In the example of Figures 1 and 2, the trigger 38 is located on the socket 3, although other locations are envisaged.

[0027] More detailed embodiments according to the present disclosure will now be described with reference to Figures 5 to 17. In the examples of Figure 5 to 17, elements which are similar to the elements already described with reference to Figures 1 to 4 are not described in detail, for the sake of clarity.

[0028] A first example embodiment of the system 1 will now be described with reference to Figures 5 to 6c and 17. In the example of Figures 5 to 6c, the system 1 comprises one plug 2 and one socket 3. In the example of Figures 5 to 6c, the plug 2 and the socket 3 both have a cylindrical shape, but other shapes are envisaged.

[0029] The plug 2 comprises one pin 21, having a distal part 23 and a proximal part 24 and the socket 3 comprises one receptacle 31. In the first example embodiment of Figures 5 to 6c, the pin 21 forms a rotatable sub assembly of the plug 2, as described in more detail below.

[0030] In the example of Figures 5 to 6c, the pin 21 comprises several cams 22. In the example of Figure 5 to 6c, the cross section of the distal part 23 of the pin 21 has a hexagonal cross section. The pin 21 thus comprises six cams 22, each cam 22 being formed by a summit of the polygonal (i.e. hexagonal) cross section of the distal part 23. As more clearly shown in Figure 6a, the proximal part 24 of the pin 21 comprises a cross section which has a rotational symmetry. The socket 3 comprises six connectors 32, i.e. one connector for each cam 22 of the pin 21.

[0031] In embodiments of the disclosure, each connector 32 comprises at least one resilient (e.g. flexible) finger 321 configured to contact the cam 22. As illustrated in Figure 17, each connector 32 has at least one comb-like shape comprising a plurality of fingers 321. Embodiments of the disclosure enable each of the fingers 321 to contact the cam 22. Embodiments of the disclosure enable achievement of a contact between each of the fingers 321 and the cam 22, even if the surface of the cam 22 is irregular. It should be understood that the more the number of fingers 321, the better the contact between the connector 32 and the cam 22. In the example of Figure 17, each finger 321 comprises a curved section 322 configured to form a resilient cam follower for contacting the cam 22, e.g. in the plugged configuration. In embodiments of the disclosure, relatively good contact is achieved due to the shapes of the curved section 322 and the cam 22.

[0032] The first example embodiment of Figures 5 to 6c and 17 also comprises a locking mechanism 4. The locking mechanism comprises a spud 25, a groove 35, a hole 36, a translation spring 26 and a rotation spring (not illustrated in the figures). In embodiments, the rotation spring may be located in the socket and may act on the spud 25 as explained in further detail below. In em-

bodiments, the locking mechanism 4 may comprise a circular plate forming a ferrule 39 connected to the spud 25. The locking mechanism 4 also comprises a circular plate forming a trigger 38. The trigger 38 is located on the plug 2. The trigger 38 is located between the ferrule 39 and the distal part 23 of the pin 21, and the spud 25 is going through the trigger 38 through an opening in the trigger 38. In embodiments, the trigger 38 is linked to the pin 21 and cannot be moved with respect to the pin 21. In embodiments, the ferrule 39 may be translated with respect to the pin 21. The trigger 38 may be moved axially with respect to the ferrule 39. In embodiments, the translation spring 26 biases the ferrule 39 towards the socket 3. In embodiments, the rotation spring biases the pin 21 (e.g. by acting on the spud 25 and/or the pin 21) to assist mutual rotation for establishment of the contact between the cams 22 and the connectors 32. In embodiments, the rotation spring may be released by movement of the trigger 38 with respect to the ferrule 39 as explained in further detail below.

[0033] In operation, from a configuration where the plug 2 is not inserted in the socket 3, as illustrated in Figure 5, the pin 21 may be inserted in the receptacle 31 as illustrated in e.g. Figure 6a. As can be seen in Figure 6a, the pin 21 can be inserted in the receptacle 31 relatively easily, because the cams 22 of the pin 21 do not contact any of the connectors 32 of the socket 3. As illustrated in Figure 6b, once the pin 21 is fully inserted in the receptacle 31, the pin 21 and the receptacle 31 may be in the plugged configuration. The pin 21 may be rotated as illustrated by the arrow R, such that each of the cams 22 contacts a respective one of the connectors 32. As can be seen in Figure 6a, the rotation of the pin 21 with respect to the receptacle 31 is enabled by the rotational symmetry of the proximal part 24 of the pin 21, e.g. once the pin 21 is fully inserted in the receptacle 31. An electrical connection may be established between the pin 21 and the receptacle 31. Figure 6c shows that the contact between the cams 22 and the connectors 32 may be established during and/or at the end of the rotation R. It will be understood that the mutual movement R between the pin 21 and the receptacle 31 may be reversed from the configuration of Figure 6c to the configuration of Figure 6b to disrupt the contact between the cams 22 and the connectors 32.

[0034] As it is more apparent in Figure 5, the socket 3 also comprises an interface 33 which has a hexagonal cross section 332 conforming the hexagonal cross section of the distal part 23 of the pin 21, such as rotation is prevented between the pin 21 and the receptacle 31 in the inserted configuration of e.g. Figure 6a. In embodiments of the disclosure, contact between the cams 22 and the connectors 32 may be limited (e.g. prevented) during the insertion of the pin 21 into the receptacle 31. In embodiments of the disclosure, contact between the cams 22 and the connectors 32 may be limited and the pin 21 may be displaced within the receptacle 31 without applying any force against any connector 33 of the socket 3.

[0035] As illustrated in Figure 6b, once the pin 21 is fully inserted in the receptacle 31, the contact between the trigger 38 and the socket 3 releases the rotation spring (not illustrated in the figures), to assist the rotation R, e.g. by acting on the spud 25 and/or on the pin 21. At the end of the rotation R, the spud 25 becomes aligned with the hole 36. Once the spud 25 is located in front of the hole 36, the translation spring 26, biasing the ferrule 39 towards the socket 3, causes the spud 25 to enter the hole 36, enabling the system to be in the locked configuration. The mutual movement R is inhibited. In order to unlock the system 1, the ferrule 39 may be pushed against the bias of the translation spring 26 to release the spud 25 from the hole 36, and the rotation may be inverted, with the spud 25 cooperating with the groove 35. The rotation spring may thus be reloaded.

[0036] A second example embodiment of the system 1 will now be described with reference to Figures 7 to 16 and 17. In the system 1 of Figure 7 to 16, the elements which are similar to the elements already described with reference to Figures 1 to 4 and/or Figures 5 to 6c are not described in detail for the sake of clarity.

[0037] In the example of Figures 7 to 16, the system 1 comprises one plug 2 and one socket 3, and comprises three pins 21 and three receptacles 31. In the example of Figures 7 to 16, the plug 2 and the socket 3 both have a parallelepiped shape, but other shapes are envisaged.

[0038] The pins 21 have a distal part 23 and a proximal part 24. In the example of Figures 7 to 16, each of the pins 21 comprises several cams 22. In the example of Figure 7 to 16, the cross section of the distal part 23 of the pin 21 has a hexagonal cross section. As more clearly shown in Figure 9, the proximal part 24 of the pin 21 comprises a cross section which has a rotational symmetry. The socket 3 comprises six connectors 32 for each receptacle 31, i.e. one connector 32 for each cam 22 of each of the pins 21.

[0039] In the second example embodiment of Figures 7 to 16, each of the three receptacles 31 and the respective six connectors 32 forms a rotatable sub-assembly of the socket 3, as described in more detail below.

[0040] As illustrated in Figure 17, each connector 32 has a comb-like shape comprising a plurality of fingers 321.

[0041] The second example embodiment of Figures 7 to 16 also comprises a locking mechanism 4. The locking mechanism comprises a plurality of spuds 25, a plurality of grooves 35, a plurality of holes 36, a plurality of translation springs (not illustrated in the figures), e.g. one translation spring for each pin 21, and a plurality of rotation springs (not illustrated in the figures), e.g. one rotation spring for each receptacle 31. In embodiments, the locking mechanism 4 may comprise a circular plate forming a ferrule 39 connected to the spuds 25. The locking mechanism 4 also comprises a circular plate forming a trigger 38. The trigger 38 is located on the plug 2. In embodiments, the trigger 38 is linked to the pin 21 and

cannot be moved with respect to the pin 21. In embodiments, the ferrule 39 may be translated with respect to the pin 21. The spuds 25 are located in holes of the trigger 38, but the trigger 38 may be moved axially with respect to the ferrule 39. The trigger 38 is located between the ferrule 39 and the distal part 23 of the pin 21. In embodiments, each of the translation springs biases the ferrule 39 towards the socket 3. In embodiments, each of the rotation spring biases the receptacle 31 to assist mutual rotation for establishment of the contact between the cams 22 and the connectors 32. In embodiments, the rotation spring may be released by movement of the trigger 38.

[0042] In operation, from a configuration where the plug 2 is not inserted in the socket 3, as illustrated in Figure 7, the pins 21 may be inserted in the receptacles 31 as illustrated in e.g. Figures 11 to 13. As can be seen in Figure 13, the pin 21 can be inserted in the receptacle 31 relatively easily, because the cams 22 of the pin 21 do not contact any of the connectors 32 of the socket 3. As illustrated in Figures 14 to 16, once the pins 21 are fully inserted in the receptacles 31, the pins 21 and the receptacles 31 may be in the plugged configuration. The receptacles 31 may be rotated as illustrated by the arrow R in Figure 16, such that each of the cams 22 contacts a respective one of the connectors 32. As can be seen in Figures 8 and 9, the rotation of each of the receptacles 31 with respect to each of the pins 21 is enabled by the rotational symmetry of the proximal part 24 of the pin 21, e.g. once the pin 21 is fully inserted in the receptacle 31. It will be understood that the mutual movement R between the pin 21 and the receptacle 31 may be reversed from the configuration of Figure 16 to the configuration of Figure 13 to disrupt the contact between the cams 22 and the connectors 32.

[0043] As it is more apparent in Figures 7 and 8, the socket 3 also comprises a plurality of interfaces 33 (one for each receptacle 31) which have a hexagonal cross section 332 conforming the hexagonal cross section of the distal part 23 of the pin 21, such as rotation is prevented between the pin 21 and the receptacle 31 in the inserted configuration of e.g. Figure 13. The holes 36 may be located in each of the interfaces 33. As illustrated in Figure 14, once the pin 21 is fully inserted in the receptacle 31, the trigger 38 may be translated with respect to the receptacle 31 so as to release the rotation spring (not illustrated in the figures), to assist the rotation R. Once the pin 21 is fully inserted in the receptacle 31, the contact between the trigger 38 and the socket 3 release the rotation spring (not illustrated in the figures), to assist the rotation R of the receptacle 31. Once the rotation R is complete, the spuds 25 are aligned with the holes 36 located in the interface 33. The translation spring, biasing the ferrule 39 towards the socket 3, causes the spuds 25 to cooperate with the grooves 35 and to enter the holes 36, enabling the system to be in the locked configuration. The mutual movement R is inhibited. In order to unlock the system 1, the ferrule 39 may be pushed against the bias of the translation spring, to remove the spuds 25 from the holes 36, and the rotation may be inverted, by rotating the receptacle 31 in the opposite direction to R. The rotation spring may thus be reloaded.

Modifications and variation

[0044] In embodiments, a cross section of electric wires which may be connected to the pins may be about 10mm, but other dimensions are envisaged. A length of the pin may be about 30mm, but other dimensions are envisaged. A cross section of the pin may be about 20mm, but other dimensions are envisaged.

[0045] In embodiments, the rotation spring and/or the translation spring may be omitted and the mutual displacement and/or the mutual movement may be performed and/or assisted manually by a user of the system.

[0046] Additionally or alternatively, the rotation spring may be located on the plug. Additionally or alternatively, the translation spring may be located on the socket.

[0047] Different types of metals may be envisaged to establish the contact between the pin and the receptacle. The pin and/or the receptacle may comprise metals such as brass and/or nickel and the connectors may comprise metal such as copper and/or beryllium.

[0048] The above embodiments are to be understood as illustrative examples, and further embodiments are envisaged. It is to be understood that any feature described in relation to any one embodiment may be used alone, or in combination with other features described, and may also be used in combination with one or more features of any other of the embodiments, or any combination of any other of the embodiments. Furthermore, equivalents and modifications not described above may also be employed without departing from the scope of the invention, which is defined in the accompanying claims.

Claims

1. An electrical connection system comprising:

a plug comprising at least one pin having a cam; and
a socket comprising:

at least one receptacle configured to receive the pin, and
at least one connector configured to contact the cam of the pin to establish an electrical connection between the pin and the receptacle,

the pin and the receptacle being configured for mutual motion between at least an inserted configuration and a plugged configuration, wherein in the inserted configuration, the pin is config-

ured to be displaced by a mutual displacement within the receptacle, and
in the plugged configuration, the pin and the receptacle are configured to be mutually moved by a mutual movement different from the mutual displacement, to establish or disrupt contact between the cam of the pin and the connector.

2. The system of claim 1, wherein, in the inserted configuration, the displacement comprises a translation, or wherein, in the inserted configuration, mutual rotation of the pin and the receptacle is inhibited.

3. The system of claim 1 or 2, wherein the socket comprises an interface having an opening with a cross section not having a rotational symmetry; and
wherein a distal part of the pin comprises the cam and has a cross section which is complementary to the cross section of the interface, to inhibit mutual rotation of the pin and the receptacle while the distal part of the pin is located in the interface, optionally wherein the distal part of the pin has a polygonal cross section, each of the summits of the polygonal cross section forming a cam, optionally wherein the cross section is hexagonal.

4. The system of any one of claims 1 to 3, comprising as many connectors as cams.

5. The system of any one of claims 1 to 4, wherein, in the plugged configuration, the mutual movement comprises a rotation, or wherein the rotation is comprised between 5 degrees and 45 degrees.

6. The system of claim 5, wherein the socket comprises an interface having a cross section; and
wherein a proximal part of the pin not comprising the cam has a cross section which is configured to enable mutual rotation of the pin and the receptacle while the proximal part of the pin is located in the interface.

7. The system of any one of claims 1 to 6, wherein the plugged configuration corresponds to a configuration where the pin is fully inserted in the receptacle.

8. The system of any one of claims 1 to 7, further configured to inhibit mutual motion of the pin and the receptacle in a locked configuration, optionally wherein in the locked configuration the plug and the socket are locked to each other, optionally wherein the plug and the socket comprise a locking mechanism comprising at least one spud and at least one hole,
the spud being located in the hole in the locked configuration, to inhibit the mutual movement in the locked configuration, optionally wherein the locking mechanism further comprises a translation spring configured to bias the at least one spud on the at least one hole, optionally wherein the locking mechanism further comprises a rotation spring configured to bias the receptacle and/or the pin to assist the mutual movement in the plugged configuration, optionally wherein the locking mechanism further comprises a trigger configured to release the rotation spring in the plugged configuration.

9. The system of any one of claims 1 to 8, wherein the pin is configured to form a rotatable sub-assembly of the plug, and/or wherein the receptacle and the connector are configured to form a rotatable sub-assembly of the socket, optionally wherein a rotation spring configured to bias the receptacle and/or the pin to assist the mutual movement in the plugged configuration is located on the socket.

10. The system of any one of claims 1 to 9, comprising at least two pins and at least two receptacles.

11. The system of any one of claims 1 to 10, wherein the connector comprises at least one resilient finger configured to contact the cam, optionally wherein the connector has at least one comb-like shape comprising a plurality of fingers, optionally wherein the finger comprises a curved section configured to form a resilient cam follower.

12. The system of any one of claims 1 to 11, wherein the contact between the cam of the pin and the connector depends on the mutual movement.

13. The system of any one of claims 1 to 12, wherein the cam of the pin is not in contact with the connector in the inserted configuration.

14. A plug for cooperating with a socket of an electrical connection system of any one of claims 1 to 13, comprising at least one pin having a cam,
the pin being configured for mutual motion with a receptacle of the socket, between at least an inserted configuration and a plugged configuration, wherein
in the inserted configuration, the pin is configured to be displaced by a mutual displacement within the receptacle, and
in the plugged configuration, the pin and the receptacle are configured to be mutually moved by a mutual movement different from the mutual displacement, to establish or disrupt contact between the cam of the pin and a connector of the socket, the connector being configured to contact the cam of the pin to establish an electrical connection between the pin and the receptacle.

15. A socket for cooperating with a plug of an electrical connection system of any one of claims 1 to 13, comprising:

at least one receptacle configured to receive a pin of the plug, and

at least one connector configured to contact a cam of the pin to establish an electrical connection between the pin and the receptacle,

the pin and the receptacle being configured for mutual motion between at least an inserted configuration and a plugged configuration, wherein in the inserted configuration, the pin is configured to be displaced by a mutual displacement within the receptacle, and

in the plugged configuration, the pin and the receptacle are configured to be mutually moved by a mutual movement different from the mutual displacement, to establish or disrupt contact between the cam of the pin and the connector.

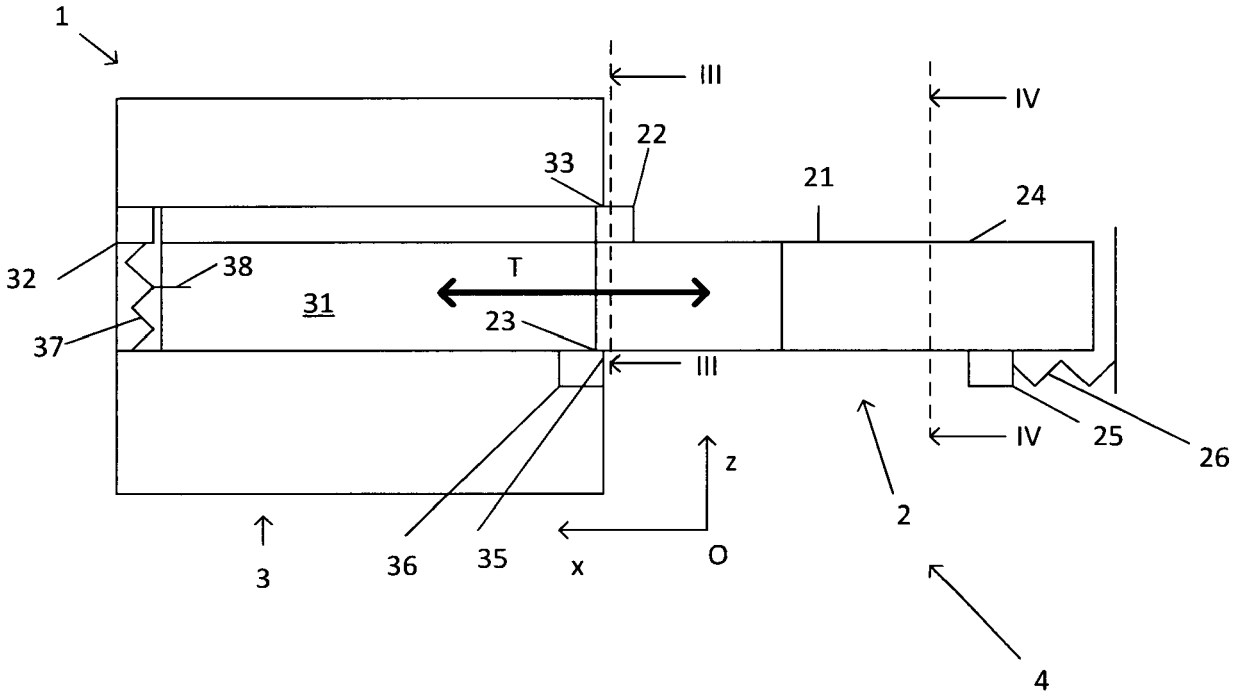
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Fig. 1

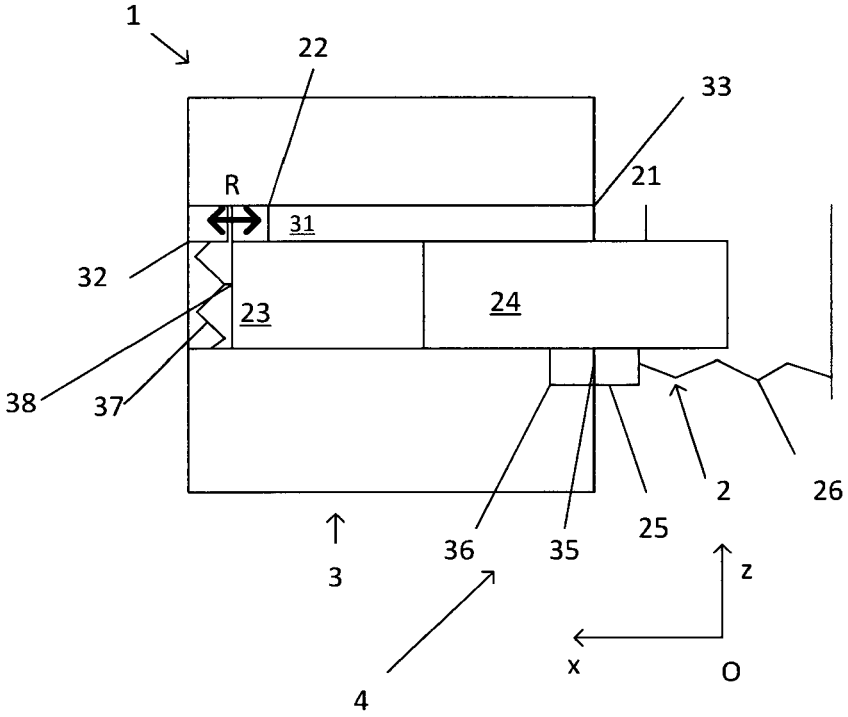
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Fig. 2

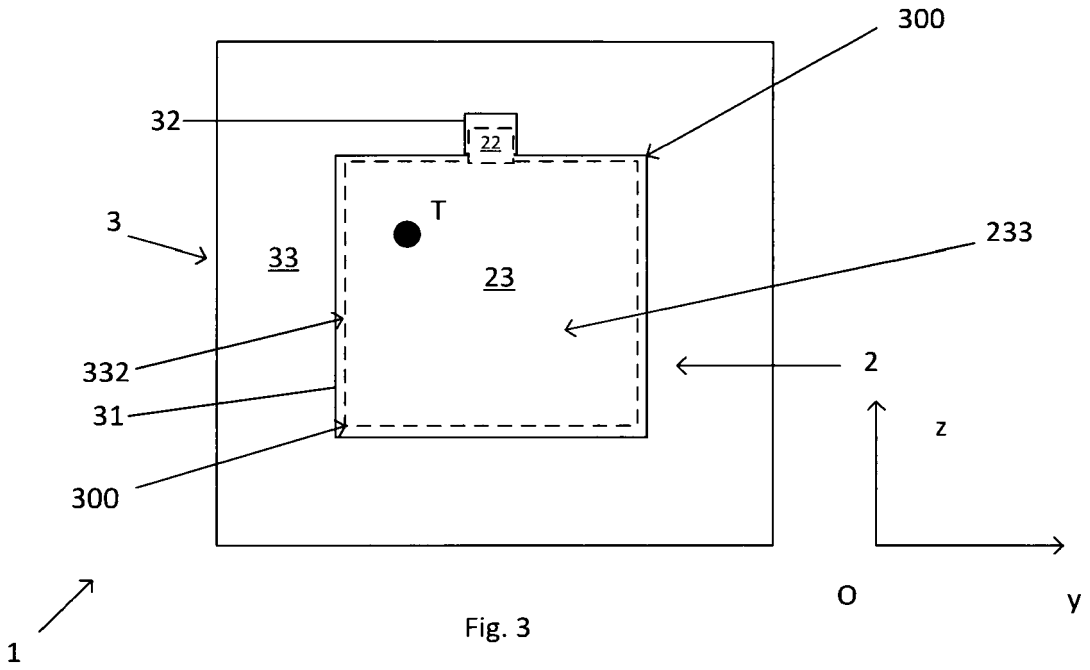
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Fig. 3

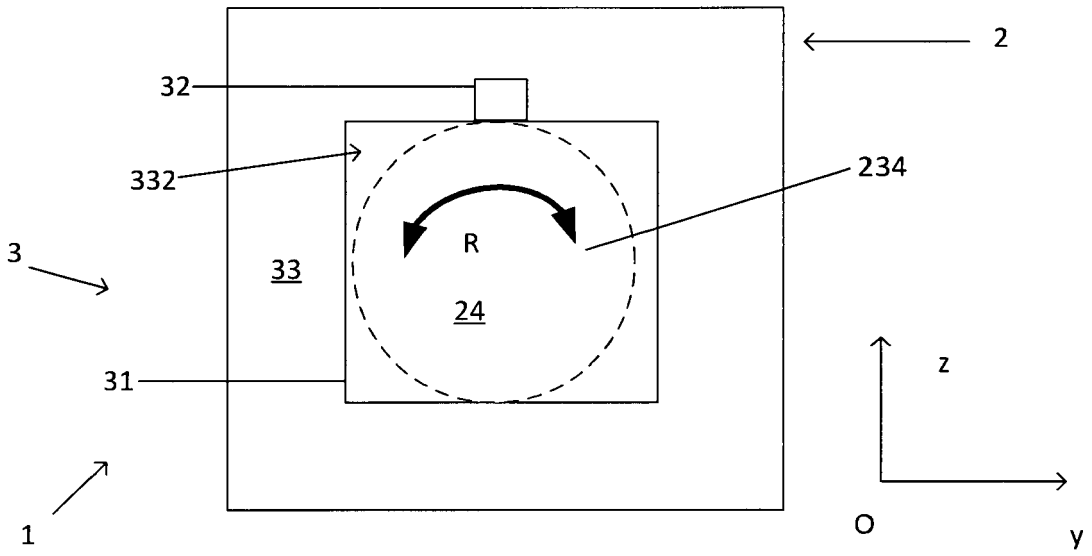
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Fig. 4

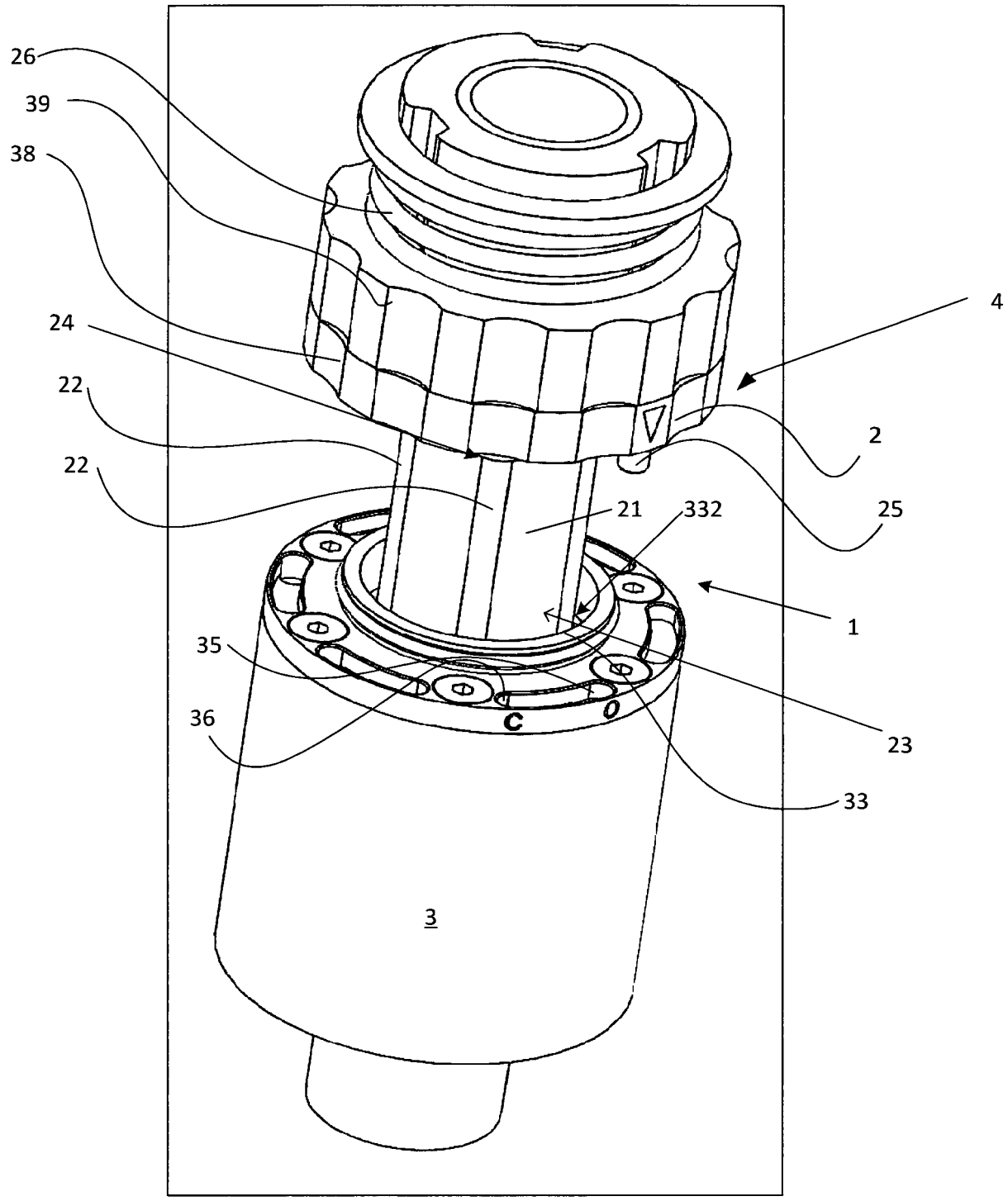


Fig. 5

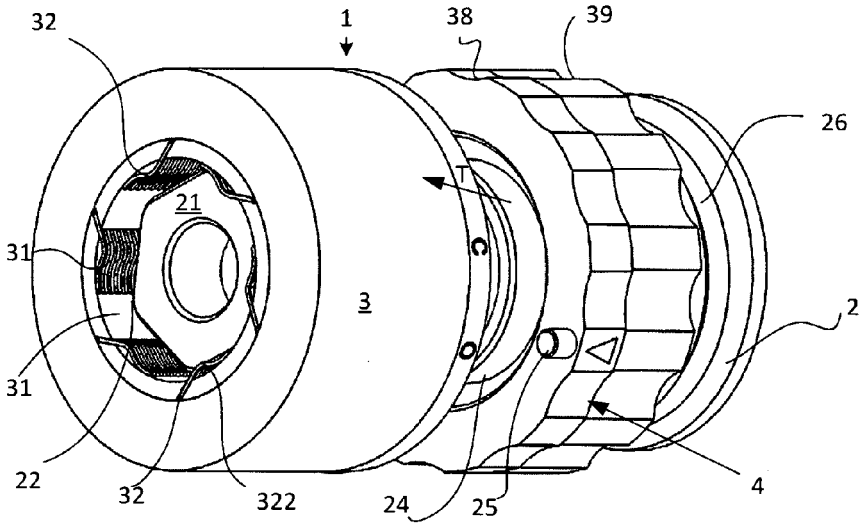


Fig. 6a

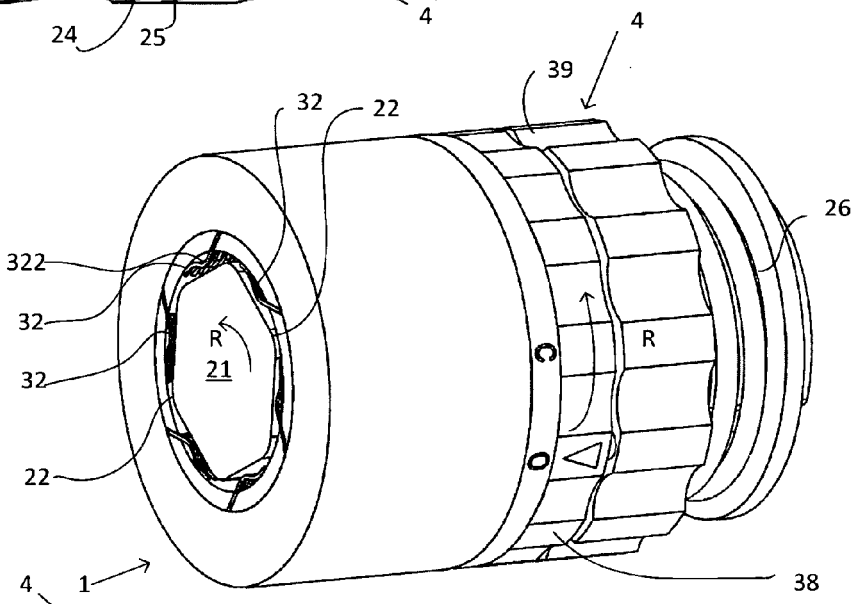


Fig. 6b

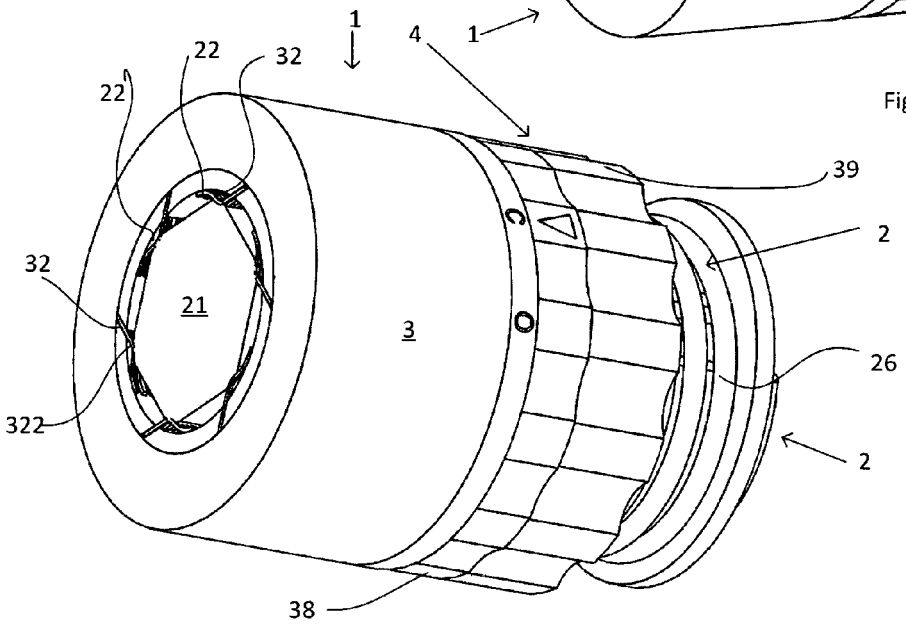


Fig. 6c

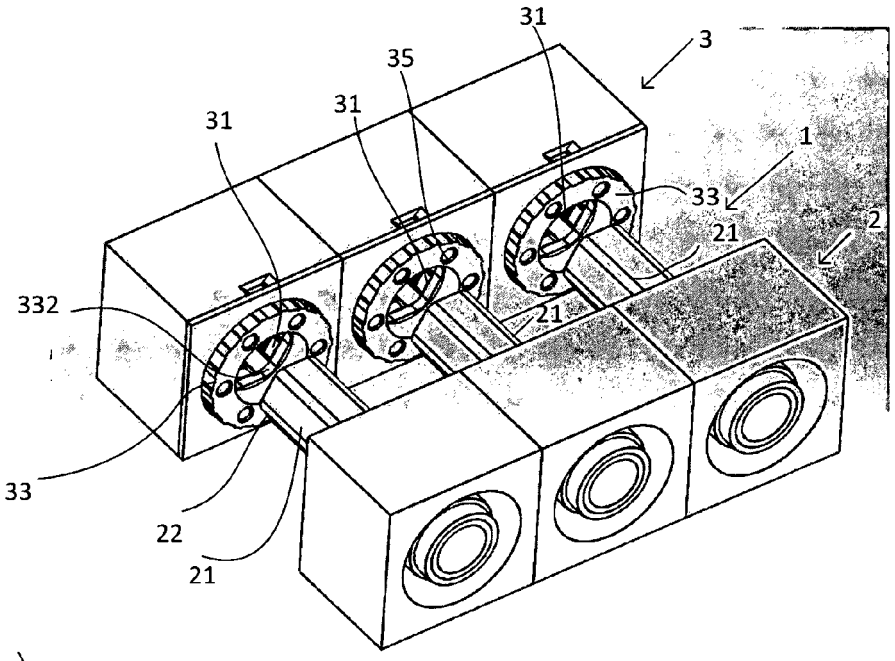


Fig. 7

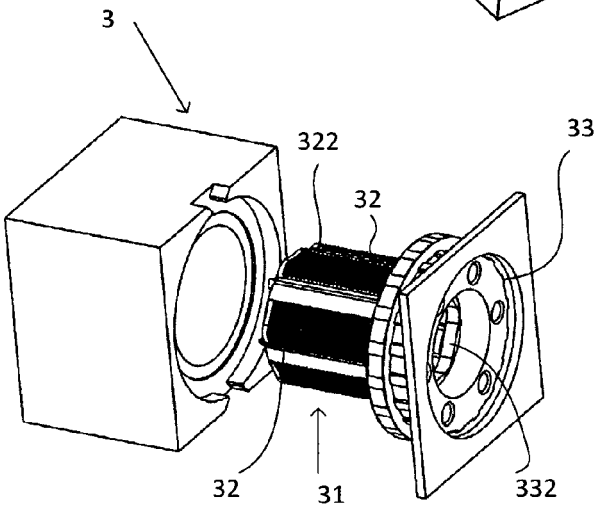
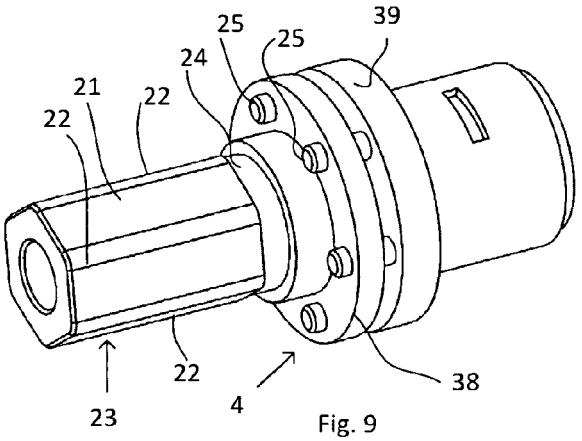


Fig. 8



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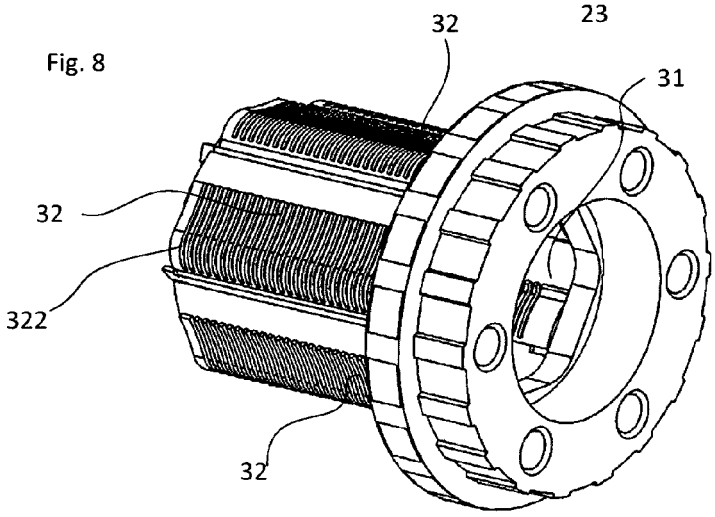

Fig. 10

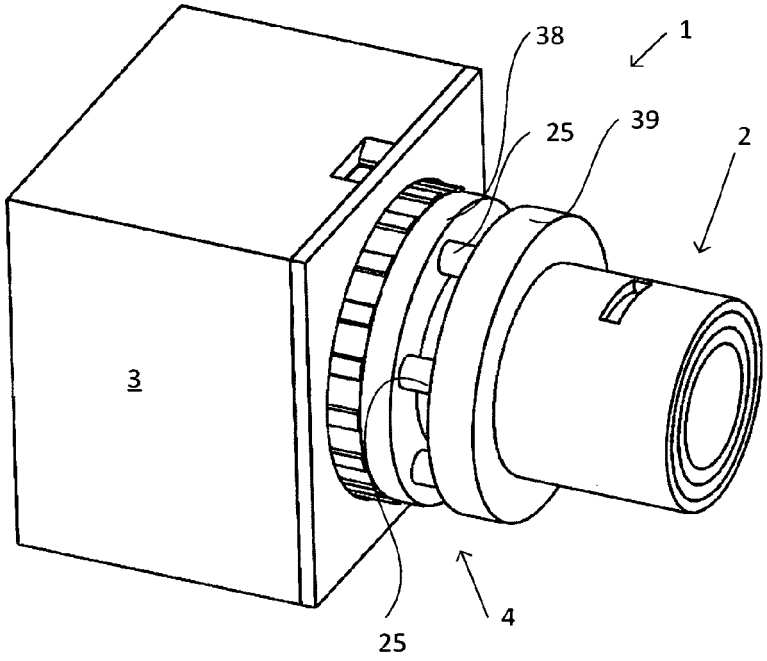

Fig. 11

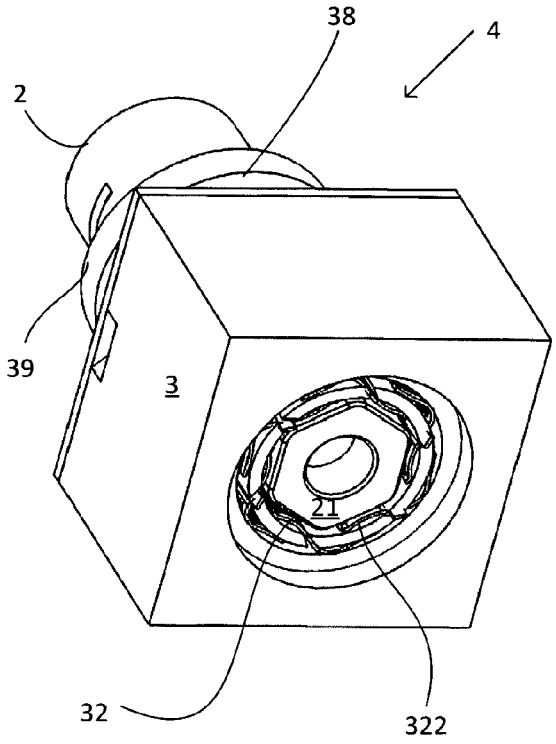

Fig. 12

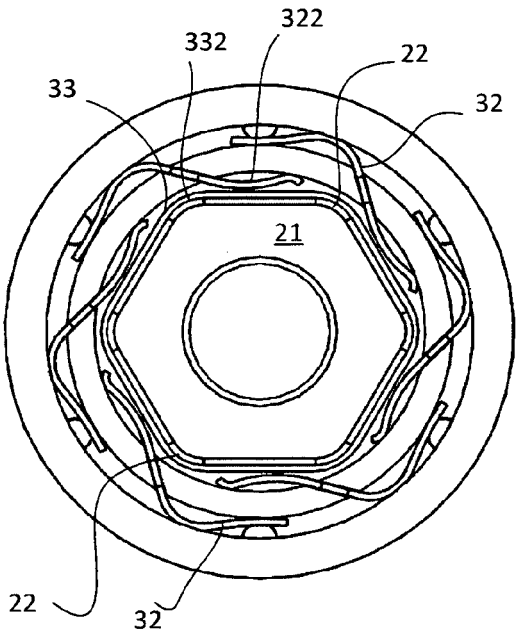

Fig. 13

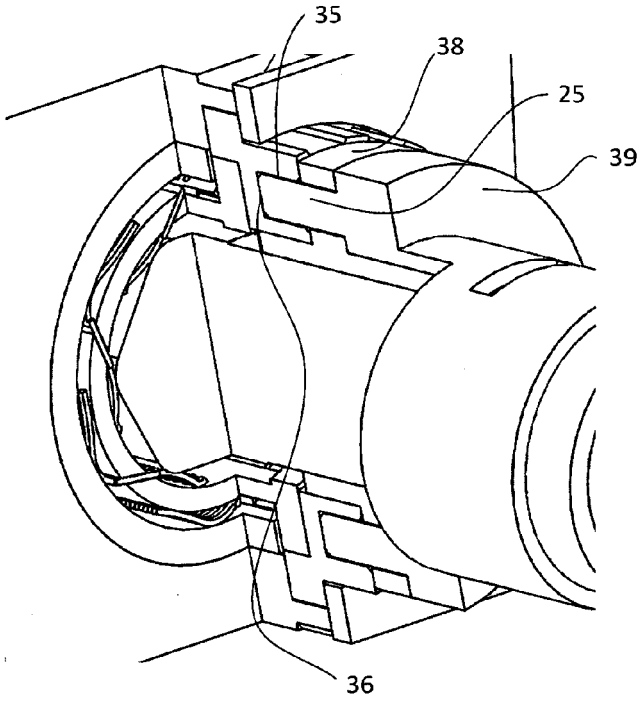

Fig. 14

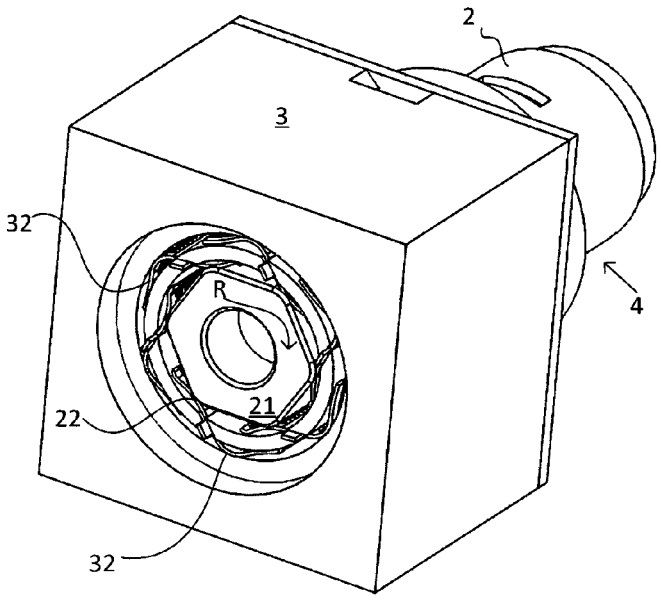

Fig. 15

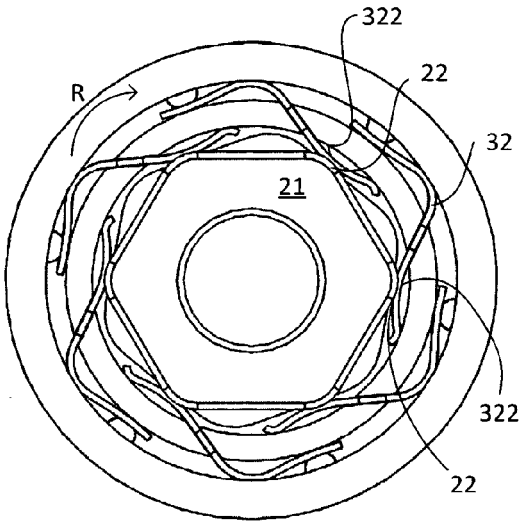

Fig. 16

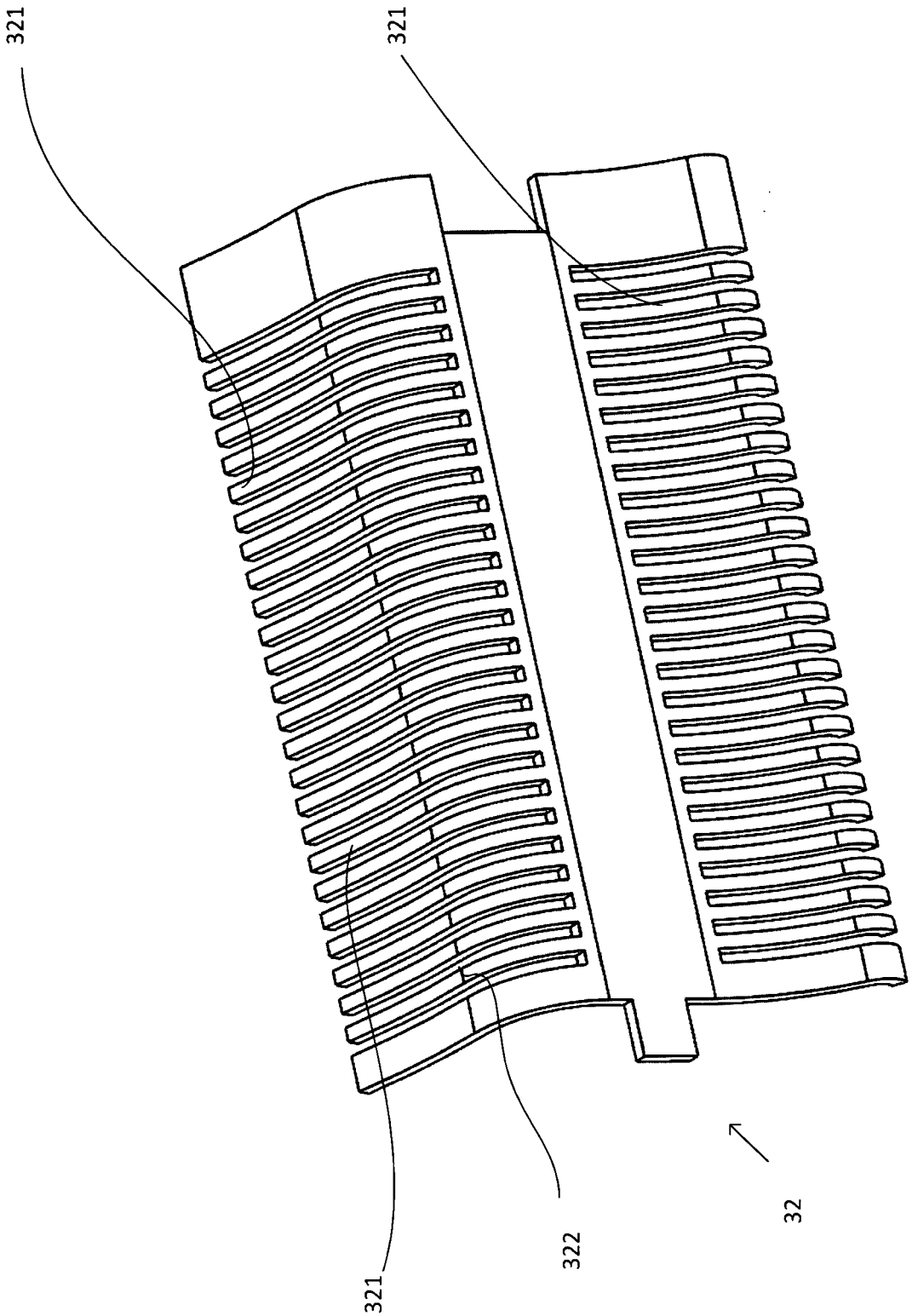

Fig. 17

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EUROPEAN SEARCH REPORT

Application Number
EP 17 42 5104

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 20 2012 008785 U1 (ROSENBERGER HOCHFREQUENZTECH [DE]) 20 November 2012 (2012-11-20) * paragraphs [0042] - [0056]; figures 1-13 *	1-15	INV. H01R13/71 H01R13/627
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X	US 2008/207042 A1 (SCHMIDT RALF [DE] ET AL) 28 August 2008 (2008-08-28) * paragraphs [0054] - [0058]; figures 1-6 *	1-7,9, 12-15	
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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	20 February 2018	López García, Raquel

CATEGORY OF CITED DOCUMENTS

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