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(54) **Title**: JUNCTION MODULE OF BUILDING INTEGRATED PHOTOVOLTAIC SYSTEM

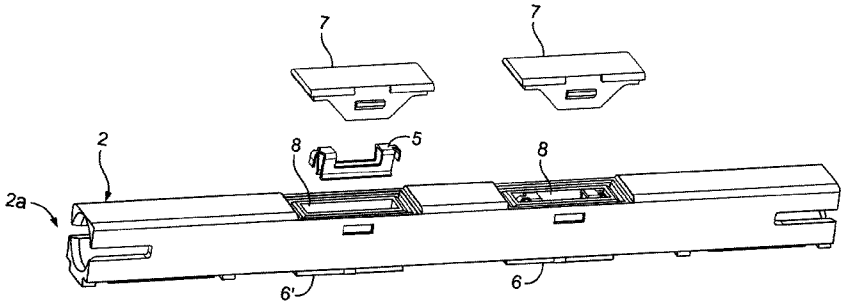

FIG. 2

(57) **Abstract**: Disclosed is a junction module of a building integrated photovoltaic system. The system comprises a housing, a conductive member accommodated in said housing, and a first opening provided in a first surface of the housing. Through the first opening, lead terminals electrically connected with the positive and negative electrodes of a solar cell panel electrically connect with the conductive member accommodated in the housing. The system further comprises a resilient clip for clamping the lead terminal and the conductive member together, so that the lead terminal and the conductive member form a stable electrical connection. With above configuration, the junction module of present invention is advantageous as less time-consuming and more cost effective in production over the conventional welding operation. Moreover, a firm and stable electrical connection between the lead terminal of the solar cell assembly and the conductive element is achieved, therefore, reliability and qualification rate of the finished product are greatly improved.

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JUNCTION MODULE OF BUILDING INTEGRATED PHOTOVOLTAIC SYSTEM

BACKGROUND OF THE INVENTION

Field of Invention

The present invention relates to the field of the building integrated photovoltaic (BIPV) technology, more particularly, to a junction module for building integration photovoltaic system.

Description of the Related Art

Solar energy is a kind of renewable energy source. Converting solar energy into electricity could save the resource of energy and mitigate increasing demands in power supply, and reduce the environment pollution as well. Therefore, this technology receives much attention and interest from the public. As a conventional way of utilizing the solar energy, the solar cell assembly (photovoltaic assembly) is mounted on the accomplished roof through a support, and a junction module to cooperate with the assembly usually is disposed at the backside of the latter.

A new solar energy utilizing technology, called "building integrated photovoltaic technology (BIPV)" has been brought forward recently, in which the solar cell (photovoltaic) product is integrated into a part of the building, such as a sunlight roof, a window and curtain wall glass, hence the integrated part could provide electricity while providing daylight or protection from wind, rain. In the aforementioned BIPV technology, the connection terminal (welding strip) extending from the photovoltaic element of the solar cell assembly typically forms electrical connection with the conductive element of the junction module through welding, and afterwards, a sealant is applied to achieve a sealing.

However, the above junction module has the following defects or disadvantages: firstly, the electrical connection between the connection terminal (welding strip) from the solar cell assembly and the conductive element of the junction module is formed by welding, which requires much time and results in the high production cost due to the complexity of welding; secondly, the welding process involves requirements in several aspects, for example, the power supply requirement in the field, the gas for the welding and the environment temperature, which may cause a problem or bring about additional expenses; thirdly, for the sake of good appearance of the building, the allowable volume of the junction module in the integrated part is usually quite small, and implementing welding operation in such a small space will undoubtedly increase the difficulty of the welding operation, and decrease the

reliability and rate of the qualified finished product. Lastly, because the connection formed by welding is a permanent connection, it is hard to separate the solar cell assembly from the junction module where maintenance, fixing or repairing is needed.

Summary of Invention

The present invention has been made to overcome or alleviate at least one aspect of the above mentioned disadvantages.

Accordingly, an object of the present invention is to provide a junction module of a building integrated photovoltaic system which can be easily mounted and removed.

Another object of the present invention is to provide a junction module which, by replacing the welding junction with a resilient clip, enables the lead terminal of the solar cell assembly to form a stable electrical connection with the conductive member in the junction module.

According to one aspect of present invention, a junction module of a building integrated photovoltaic system comprises a housing, a conductive member accommodated in the housing, and a first opening provided in a first surface of the housing. Through the first opening, lead terminals electrically connected with the positive and negative electrodes of a solar cell panel electrically connect with the conductive member accommodated in the housing. The junction module further comprises a resilient clip for clamping the lead terminal and the conductive member together, so that the lead terminal and the conductive member form a stable electrical connection.

Preferably, the conductive member includes two substantial flat opposite sides, and the resilient clip has a cross-section in the shape of a substantial triangle with its vertex open. In the cross-section, the resilient clip includes a bottom wall and two opposite side walls extending from the two ends of the bottom wall in an acute angle with respect to the latter. When the resilient clip clamps the lead terminal, the two opposite side walls of the resilient clip are brought into contact with the lead terminal and apply a biasing force to it, so that the lead terminal and the conductive member form a stable electrical connection.

Alternatively, the conductive member may include a substantial cylindrical portion, and the cross-section of the resilient clip is in the shape of a substantial triangle with its vertex open. The resilient clip includes a bottom wall and two opposite side walls extending from the two ends of the bottom wall in an acute angle with respect to the latter. When the resilient clip clamps the lead terminal, the bottom wall and two opposite side walls of the

resilient clip are substantially tangent with the periphery of the cylindrical portion of the conductive member being wrapped around by the lead terminal, so that the lead terminal and the conductive member form a stable electrical connection.

Further, the junction module further comprises a second opening provided in the housing at the opposite side of the first surface, and a cover connected to the second opening of the housing for covering the second opening.

Preferably, when the cover is connected to the second opening of the housing, the bottom wall of the resilient clip abuts against an inner wall of the cover, so as to prevent the clip from coming away in the direction of the second opening.

In one embodiment, a positioning mechanism is provided in the abutment of the bottom wall of the resilient clip and the inner wall, so as to further limit the displacement of the resilient clip via the cover.

More specifically, the positioning mechanism comprises a positioning protrusion provided on one of the bottom wall of the resilient and the inner wall of the cover, and a positioning depression provided on the other of the bottom wall of the resilient and the inner wall of the cover. When the bottom wall of the resilient abuts against the inner wall of the cover, the positioning protrusion is brought into engagement with the positioning depression so as to limit the displacement of the resilient clip.

In one embodiment, the two side walls of the resilient clip form a bending portion at the ends of them respectively, so that the ends of the two side walls of the resilient clip extend in directions away from each other.

In a preferred embodiment, when the housing is substantially in the shape of a hollow cylinder, at least one end of the housing is formed into a closed end or is provided with a hole for connecting with an external cable directly or via a cable connector.

Furthermore, a sealing piece is further provided between the cover and the second opening to form a seal between the cover and the housing.

In one embodiment, the conductive member includes a first conductive member and a second conductive member; and the junction module further comprises a bypass diode connected between the first and second conductive members.

Optionally, an end of the conductive member is adapted to be inserted into a connector connected with an end of the housing, and the other end of the conductive member is provided with a socket mating with a pin of the bypass diode.

In one embodiment, the resilient clip includes a first resilient clip and a second resilient clip. The first and second resilient clips clamp the two lead terminals connected with the positive and negative electrodes of the solar cell panel, and the first and the second conductive members together, respectively, so as to form a stable electrical connection between them.

Preferably, the junction module further comprises a further first opening provided in the first surface of the housing. Through the first opening and the further first opening, the two lead terminals connected to the positive and negative electrodes of the solar cell panel are electrically connected with the first and second conductive members in the housing, respectively.

With the above configuration, the present invention provides at least one of following advantages over the prior arts: firstly, the present invention uses a resilient clip in lieu of the welding process, hence avoiding the inherent problem of a welding process, i.e. being time-consuming and resulting in a high production cost. In the meantime, the requirements for implementing the present invention are easy to be met, thus the cost relating to requirements involving the welding operation are dramatically decreased; secondly, the junction module according to the present invention conforms to the trend of miniaturization of components of a building integrated photovoltaic system, with easy assembling operation whilst ensuring a firm and stable electrical connection between the lead terminal of the solar cell assembly and the conductive element, which contributes to an increased reliability and qualification rate of the finished product; moreover, by using the resilient clip, the junction module can be detached from the connection between the solar cell assembly, compared with the permanent connection in the prior art, the maintenance and inspection of the internal elements of the junction module can be carried out more conveniently.

Another object of the present invention is to provide a junction module of a building integrated photovoltaic system, comprising a housing having a first opening, the first opening being provided in a first surface of the housing for the insertion of lead terminals electrically connected with the positive or negative electrodes of a solar cell panel; a connection conductor accommodated in the housing; and circular or elliptic resilient clip accommodated in the housing, the clip clamping the lead terminal electrically connected with the positive or negative electrodes of a solar cell panel and the connection conductor together so as to form a stable electrical connection.

Preferably, the junction module further comprises a second opening at a second surface which is at a side of the first surface of the housing.

Further, the junction module also comprises a cover being connected to the second opening of the housing for covering the second opening.

In one embodiment, the junction module further comprises a conductive member accommodated in the housing, wherein the conductive member being in electrical connection with the connection conductor.

More specifically, the connecting conductor includes a first connection conductor and a second connection conductor, the circular or elliptic resilient clip includes a first clip and a second clip, the first and second clips clamp the two lead terminals connected with the positive and negative electrodes of the solar cell panel, and the connecting conductor together, so as to form a stable electrical connection.

In one embodiment, the conductive member includes a first conductive member and a second conductive member; and the junction module further comprises a bypass diode connected between the first and second conductive members.

In an exemplified embodiment, an end of the conductive member is adapted to be inserted into a cable connector connected with an end of the housing, and the other end of the conductive member is provided with a socket mating with a pin of the bypass diode.

In one embodiment, the connection conductor is welded on the conductive member, alternatively the connection conductor may be wrapped around the conductive member, so that the connection conductor and the conductive member forms a stable electrical connection.

In a preferred embodiment, when the cover is connected to the second opening of the housing, an outer wall of the circular or elliptic resilient clip abuts against an inner wall of the cover, so as to apply a biasing force to the clip through the cover to prevent the clip from coming away in the direction of the second opening.

In an exemplified embodiment, the cross section of the conductive member is substantially circular or semicircular.

In one embodiment, the housing is substantially in the shape of a hollow cylinder, at least one end of the housing is formed into a closed end or is provided with a hole for connecting with an external cable directly or via a cable connector.

Preferably, a sealing piece is further arranged between the cover and the second opening to form a seal between the cover and the housing.

Optionally, the first and second connection conductors extend from the first and second conductive members, respectively, and integrate with the first and second conductive member.

In a preferred embodiment, the junction module further comprises a further first opening provided in the first surface of the housing, and the two lead terminals connected to the positive and negative electrodes of the solar cell panel are electrically connected with the first and second connection conductors in the housing respectively, through the first opening and the further first opening, respectively.

With the above configuration, the present invention provides at least one of following advantages over the prior art: firstly, the present invention uses a resilient clip in lieu of a welding process, hence avoiding the inherent problem of the welding process, i.e. being time-consuming and resulting in a high production cost. In the meantime, the requirements for implementing the present invention are easy to be met, thus the cost relating to requirements from the welding operation are dramatically decreased; secondly, the junction module according to present invention conforms to the trend of miniaturization of components of a building integrated photovoltaic system, with easy assembling operation whilst ensuring a firm and stable electrical connection between the lead terminal of the solar cell assembly and the conductive element, which contributes to an increased reliability and qualification rate of the finished product; moreover, by using the resilient clip, the junction module can be detached from the connection between the solar cell assembly, compared with the permanent connection in the prior art, the maintenance and inspection of the internal elements of the junction module can be carried out more conveniently.

Brief Description of the Drawings

Fig. 1 is a perspective view of a junction module of a building integrated photovoltaic system according to an embodiment of the present invention;

Fig. 2 is an exploded perspective view of the junction module of Fig. 1;

Fig. 3 is a longitudinal cross-sectional view of the junction module of Fig. 1;

Fig. 4 is a perspective view showing the connection relationship between the conductive member, the resilient clip and the lead terminals of the junction module of Fig. 3, wherein the housing is removed for simplicity;

Fig. 5 is a front elevation of the junction module of a building integrated photovoltaic system according to an embodiment of the invention;

Fig. 6 is a cross sectional view taken along A-A line of Fig. 5, wherein Fig.6 is a cross sectional view of the resilient clip according to an embodiment, taken along A-A line of Fig. 5,

Fig.7 is a cross sectional view of the resilient clip according to another embodiment, taken along A-A line of Fig. 5.

Fig. 8 is a perspective view of a junction module of a building integrated photovoltaic system according to an embodiment of the present invention;

Fig. 9 is a front elevation of the junction module of Fig. 8;

Fig. 10 is a perspective view of the junction module of Fig. 8 with the cover removed;

Fig. 11 is a perspective view showing the connecting relationship between the conductive member, the connection conductor and the lead terminals of the junction module of Fig. 10, wherein the housing is removed for simplicity;

Fig. 12 is a perspective view showing the connecting relationship between the conductive member, the connection conductor, the resilient clip and the lead terminals of the junction module of Fig. 10, with the housing removed;

Fig. 13 is a perspective view of the process of assembly of the resilient clip, the lead terminal and the cover; and

Fig. 14 is a cross sectional view taken along the F-F line of Fig. 10.

Detailed Description of Preferred Embodiments

Preferred embodiments of the present invention will be described hereinafter in detail with reference to the attached drawings, wherein the like reference numerals refer to the like elements throughout the specification. These embodiments should not be construed as being limited to the embodiment set forth herein, rather for illustrative purpose.

Referring to Figs. 1-6, a junction module 1 of a building integrated photovoltaic system according to an embodiment of the invention comprises a housing 2, a conductive member 3 accommodated in the housing; an opening 6 provided in a surface, for instance, the lower surface (in Fig. 1) of the housing. Through the opening 6, lead terminals 4 electrically connected with the positive or negative electrodes (not shown) of a solar cell panel electrically connect with the conductive member 3 accommodated in the housing 2. The junction module further comprises a resilient clip 5, which clamps the lead terminal 4 and the

conductive member 3 together, so that the lead terminal 4 and the conductive member 3 form a stable electrical connection. In the above junction module, the housing 2 could be made of insulating material. The lead terminal 4 and the conductive member 3 both are made of conductive material of copper, aluminium and the like.

Referring to Figs. 2, 3, the housing 2 is substantially in the shape of a hollow cylinder, and at least one end of the housing 2 is provided with a hole 2a for connecting with an external cable directly. For instance, in Figs. 2, 3 the left end of the housing 2 could be connected to a positive electrode cable, and the right end of the housing 2 could be connected to a negative electrode cable. The positive and negative electrode cables may connect with the positive and negative electrode cables in the neighbouring junction module through cable connectors (not shown) respectively, so as to increase the output power of the building integrated photovoltaic system. In an alternative embodiment, in the above opening 2a, the conductive member 3 could connect with an external cable via a cable connector (not shown). Optionally, at least one end of the housing 2 in the shape of a hollow cylinder could be formed into a closed end.

Moreover, the junction module according to an embodiment of the present invention takes a shape of a cubic cylinder, which can be embedded into a frame of a window panel in a building. However, the present invention is not limited to this, the junction module can take any appropriate shape, such as circular cylinder and prism, so as to be accommodated in frame of window panels or sunlight roof etc.

Referring to Figs. 4-6, the connection between the conductive member 3, the resilient clip 5 and the lead terminals 4 according to an embodiment of present invention would be described. Fig. 4 is a perspective view showing the connection relationship between the conductive member, the resilient clip and the lead terminals of the junction module of Fig. 3, with the housing being removed for the sake of simplicity; Fig. 5 is a front elevation of the junction module of a building integrated photovoltaic system according to an embodiment of the invention; and Fig. 6 is a cross sectional view along A-A line of Fig. 5.

Referring to Figs. 4 and 6, the conductive member 3 includes two substantial flat opposite sides 31, 32; and the cross-section of the resilient clip is in the shape of a substantial triangle with an angle, for example, its point angle or its vertex open, and the resilient clip includes a bottom wall 51 and two opposite side walls 52, 53 extending from the two ends of the bottom wall 51 in an acute angle with respect to the latter. The resilient clip 5 is made of

a resilient material, such as metal material, for instance, spring steel, or non-metal material, for instance, polyurethance plastic. Since the two opposite side walls 52, 53 extend from the two ends of the bottom wall 51 in an acute angle, the two opposite side walls 52, 53 of the resilient clip 5, under the resilient force, will apply a clamping force to a component disposed therebetween, for instance, the conductive member 3 and lead terminals 4. Referring to Figs. 5, 6, the lead terminals 4 is disposed between the resilient clip 5 and the conductive member 3. In one embodiment, the lead terminal 4 is flexible, and at least partly wraps around the conductive member 3. Accordingly, when the resilient clip 5 clamps the lead terminal 4, the two opposite side walls 52, 53 of the resilient clip 5 are brought into contact with the lead terminal 4 and apply a biasing force to it, so that the lead terminal 4 and the conductive member 3 form a stable electrical connection.

Although a preferred embodiment of the connection between the resilient clip 5, the conductive member 3 and the lead terminals 4 has been described in conjunction with Fig. 6, present invention is not limited to this. Referring to Fig. 7, in another embodiment, the conductive member 3 includes a substantial cylindrical portion wrapped around by the lead terminal 4. Like the embodiment discussed above, the cross-section of the resilient clip 5 is in the shape of a substantial triangle with its vertex open, and the resilient clip 5 includes a bottom wall and two opposite side walls extending from the two ends of the bottom wall in an acute angle with respect to the latter. When the resilient clip 5 clamps the lead terminal 4, the bottom wall and two opposite side walls of the resilient clip are substantially tangent with the periphery of the cylindrical portion of the conductive member, so that the lead terminal 4 and the conductive member 3 form a stable electrical connection.

The above exemplary embodiments for teaching the arrangement of the resilient clip 5, the conductive member 3 and the lead terminal 4 are for the purpose of illustration, and may have various modifications or variations in which the resilient clip 5 contacts with the lead terminal 4 and applies a biasing force to it so that the resilient clip 5 and the lead terminal 4 form a stable electrical connection. In other words, the precise structure of the respective components illustrated in the drawings of present application is just an exemplary configuration and not intended to limit the present invention. For instance, the cross section of the resilient clip 5 could be in any shape so long as the resilient clip 5 and the lead terminal 4 are in good contact and a biasing force to be applied to the lead terminal 4, so that the lead

terminal 4 and the conductive member 3 form a stable electrical connection, and among all doable modifications, there is no restriction to the longitudinal structure (referring to Fig. 4).

Referring to Figs. 1, 2, the junction module 1 further comprises an opening 8 arranged at the opposite side of the lower surface of the housing 2, i.e. the upper surface of the housing 2. Moreover, the junction module may include a cover 7, which is connected to the opening 8 of the housing 2 for covering the opening 8. Through the opening 8, the resilient clip 5 can be conveniently placed in the housing 2, so as to contact with the lead terminal 4 and apply a biasing force to the same, thereby the lead terminal 4 and the resilient clip 5 form a stable electrical connection. By virtue of the cover 7 connected to the opening 8 of the housing 2 to cover the opening, the side of opening 8 could be sealed for protecting the internal components of the junction module from moisture, heat and other environmental elements. It should be noted that the opening 8 is not indispensable, when the resilient clip 5 is placed in the housing 2 through the opening 6 at the lower surface, the opening 8 can be omitted.

In the above embodiment, when the cover 7 is connected to the opening 8 of the housing 2, the resilient clip 5 may be not be in engagement with the cover 7. Alternatively, in another embodiment illustrated in Fig. 6, when the cover 7 is connected to the opening 8 of the housing 2, the bottom wall 51 of the resilient clip 5 abuts against the inner wall of the cover 7, hence the resilient clip is prevented from coming away in the direction of the second opening.

Further, the bottom wall 51 of the resilient clip 5 and the inner wall of the cover 7 can be engaged with each other by means of a positioning mechanism, so as to further limit the displacement of the resilient clip 5 by the cover 7. Referring to Fig. 6, an exemplary positioning mechanism comprises a positioning protrusion 54 provided on inner side of the bottom wall 51 of the resilient clip 5 and a positioning depression 55 provided on the inner wall of the cover 7. When the bottom wall 51 of the resilient clip 5 abuts against the inner wall of the cover 7, the positioning protrusion 54 is brought into engagement with the positioning depression 55 so as to limit the displacement of the resilient clip 5 in directions, such as the left and the right directions in Fig. 6 and a direction perpendicular to the sheet. It should be noted that, though in above embodiment, the positioning protrusion 54 is provided at the inner side of the bottom wall 51 of the resilient clip 5 and the positioning depression 55 is provided in the inner wall of the cover 7, the present invention is not limited to such an

arrangement. Alternatively, the positioning protrusion 54 may be provided in the inner wall of the cover 7 while the positioning depression 55 is provided at the inner side of the bottom wall 51 of the resilient clip 5. Furthermore, the positioning protrusion 54 and the positioning depression 55 can be formed into a crisscross pattern, so that the displacement of the resilient clip 5 in two directions along which the crisscross extends is limited when the positioning depression 55 having a shape of a crisscross engages with the positioning protrusion 54. Referring to Fig. 6, the two side walls 52, 53 of the resilient clip 5 form bending portions 56 at the ends of them, respectively, so that the ends of the two side walls 52, 53 of the resilient clip 5 extend in directions away from each other. Through forming the ends of the side walls 52, 53 into bending portions 56, the scratch or damage to the lead terminal 4 and a side surface 31 of the conductive member 3 could be avoided, which otherwise will happen in the case that the ends of the side walls 52, 53 are not bent.

In the embodiment illustrated in Fig. 6, a sealing piece 9 is further provided between the cover 7 and the opening 8 to form a seal between the cover 7 and the housing 2. In one embodiment, as illustrated in Fig. 6, the cover 7 is in the shape of an inverted "U", and includes a bottom portion 71 and two parallel side wall portions 72. Correspondingly, a slot 21 is provided in the housing 2 to accommodate the side wall portions 72 of the cover 7. It is preferred that the sealing piece 9 is provided between the slot 21 of the housing 2 and the side wall portions 72 of the cover 7 so as to provide a sealing between them. Although it is illustrated in the embodiment that the sealing piece 9 is provided between the slot 21 of the housing 2 and the side wall portions 72 of the cover 7, the present invention is not limited to this. As persons having ordinary skills in the art could appreciate, the sealing piece 9 can be arranged at any position between the cover 7 and the opening 8, so long as it ensures hermetical sealing between the housing 2 and the cover 7.

Referring to Fig. 6, a clasping protrusion 73 is provided in the side wall portion 72 of the cover 7 so as to correspond with a clasping hole 22 formed in the housing 2. The clasping protrusion 73 could resiliently deform and hence the side wall portion 72 can be inserted into the slot 21 of the housing 2. Upon arrival at the clasping hole 22, the clasping protrusion 73 returns to it original shape and enters into the clasping hole 22, so that the cover 7 is connected to the housing 2 to seal the opening 8. It should be noted that the cover 7 may be connected to the housing 2 so as to seal the opening 8 by way of a variety of connection means, such as screws and hinges.

Referring to Figs. 3-4, in an embodiment, the conductive member 3 includes a first conductive member 3' and a second conductive member 3''; and the junction module 1 further comprises a bypass diode 10 connected between the two conductive members 3', 3''. As shown in Figs. 3, 4, under the biasing action of the resilient clip 5, the two lead terminals 4 connected with the positive and negative electrodes of the solar cell panel connect with the first and the second conductive members 3', 3', respectively. The two ends of the first and second conductive members 3', 3'' could be joined to positive or negative electrode connection cable (not shown). In a preferred embodiment, each electrode connection cable could connect with neighbouring cell module in series via a connector or another connection cable, so as to increase the output power of the BIPV module. The positive and negative electrode connection cables of the two outmost modules produce an output power at a certain voltage, thus outputting the power of the whole solar cell module. The bypass diode 10 is arranged in a direction opposite to the direction of the current generated by the cell, so as to provide an alternative current path in case that one of the cells fails.

In a preferred embodiment, one end of the conductive member 3 is adapted for insertion into a cable connector connected with an end of the housing 2, and the other end of the conductive member 3 is provided with a socket 30 mating with the pins 10a, 10b of the bypass diode 10. Though the one end of the conductive member 3 illustrated in Fig. 4 has a shape of a cylinder, the present invention is not limited to this, and other shapes, for example, a prismatic shape, are possible.

Referring to Figs. 2, 4, in the above embodiment, the resilient clip 5 includes first and second resilient clips 5', 5'', the two clips clamp the two lead terminals 4 and the first and second conductive members 3', 3'' together respectively, so that the two lead terminals 4 connected to the positive and negative electrodes of the solar cell panel are in stable electrical connection with the first and second conductive members 3', 3''

Further, as shown in Figs. 1-3, the junction module further comprises a further opening 6' provided in the lower surface of the housing 2. Through the opening 6 and the further opening 6', the two lead terminals 4 connected to the positive and negative electrodes of the solar cell panel are electrically connected with the first and second conductive members 3', 3'' in the housing 2, respectively. Corresponding to the opening 6 and the further opening 6', two openings 8 are provided in the side surface of the housing 2.

Though in the above embodiment, the two lead terminals 4 are connected to the first and second conductive members 3', 3'' through the opening 6 and the further opening 6', respectively, the present invention is not limited to this. For example, the opening 6 and the further opening 6' could be replaced by a single opening, through which the two lead terminals 4 are connected to the conductive members 3', 3'' in the housing 2, respectively.

As apparent from the above, the present invention provides an improved junction module for a building integrated photovoltaic system. Compared with the prior art, the present invention uses resilient clip instead of welding process, hence avoiding the problem in association with the welding process, i.e. being time-consuming and resulting in a high production cost. In the meanwhile the requirements for implementing the present invention are easy to be met, thus the cost relating to requirements involving the welding operation are dramatically decreased; secondly, the junction module according to present invention conforms to the trend of miniaturization of components of a building integrated photovoltaic system, with easy assembling operation whilst ensuring a firm and stable electrical connection between the lead terminal of the solar cell assembly and the conductive element, which contributes to an increased reliability and rate of the qualified product; moreover, by using the resilient clip, the junction module can be detached from the connection between the solar cell assembly, compared with the permanent connection in prior arts, the maintenance and inspection of the internal elements of the junction module can be carried out more conveniently.

Although the various embodiments of the present invention in conjunction with the drawings have been described, those skilled in the art shall recognize that these embodiments disclosed in the drawings are illustrations of the manners that the present invention may be practiced. It is to be understood that the present invention is not limited to these specific embodiments. Similarly, the terms used in the description for indicating an orientation, such as, "upper", "lower", "upper surface", "lower surface" etc, though correspond to the upper or lower portion of the figures concerned, they may refer to any orientation, which if viewed from a contrary angle or lateral side, might correspond to "lower", "upper" or "left" and "right".

Referring to Figs. 8-14, a junction module 1101 of a building integrated photovoltaic system according to a second embodiment of the invention comprises a housing 102 having a first opening 106, the first opening being provided in a surface, for instance, the lower surface

(in Fig. 1) of the housing for the insertion of lead terminals 104 electrically connected with the positive or negative electrodes of a solar cell panel; a connection conductor 110 accommodated in the housing 102; and a circular resilient clip 105 accommodated in the housing, the clip 105 clamps the lead terminal 104 and the connection conductor 110 together so as to form a stable electrical connection. In above junction module, the housing 102 could be made of insulating material. The lead terminal 104 and the connection conductor 110 both are made of conductive material of copper, aluminium and the like.

Although in Fig. 8 it is illustrated that the resilient clip 105 is a cylinder having a circular cross section, but the present invention is not limited to this. For example, the cross section of the resilient clip 105 can be elliptic. The resilient clip 105 is constructed of resilient material, such as rubber, silicone, etc., accordingly the clip is capable of restoring to its original shape after application of an external force thereto is cancelled.

Referring to Figs. 8-10, the junction module 101 further comprises a further opening 108 arranged at a side of the lower surface of the housing 102, for instance, the side surface in Fig. 10. Moreover, the junction module may include a cover 107, the cover is connected to the opening 108 of the housing 102 for covering the opening 108. As seen from Fig. 14, when the cover 107 is connected to the opening 108 of the housing 102, an outer wall of the circular or elliptic resilient clip 105 abuts against an inner wall of the cover 107, so as to apply a biasing force to the clip 105 through the cover 107 to prevent the clip 105 from coming away in the direction of the opening 108.

The cover 107 may be connected to the housing 102 so as to seal the opening 108 by way of a variety of connection means, such as screw, hinge and clasp. By virtue of the cover 107 connected to the opening 108 of the housing 102 to cover the same, the side of opening 108 could be sealed for protecting the internal components of the junction module from moisture, heat and other environmental elements. It should be noted that the opening 108 is not indispensable, when the resilient clip 105 is placed in the housing 102 through an opening 106 at the lower surface, the opening 108 can be omitted.

In the embodiment illustrated in Fig. 14, a sealing piece 109 is further provided between the cover 107 and the opening 108 to form a seal between the cover 107 and the housing 102. Apparently, the sealing piece 109 can be arranged at any position between the cover 107 and the opening 108, so long as it ensures hermetical seal between the cover and the opening 108.

Referring to Figs. 11-12 and 14, in one embodiment, the junction module 101 further includes a conductive member 103 made of conductive material and accommodated in the housing 102, and the conductive member 103 is in electrical connection with the connection conductor 110. In a preferred embodiment, the connecting conductor 110 includes a first connection conductor 110' and a second connection conductor 110'', the circular or elliptic resilient clip 105 includes a first clip 105' and a second clip 105'', the first and second clips clamp the two lead terminals 104 connected with the positive and negative electrodes of the solar cell panel and the connecting conductor 110 together so as to form a stable electrical connection.

Referring to Figs. 11-12, in an embodiment, the conductive member 103 includes a first conductive member 103' and a second conductive member 103''; and the junction module 101 further comprises a bypass diode 111 connected between the first and second conductive members 103', 103''.

Referring to Fig. 11, in a preferred embodiment, one end of the conductive member 1-3 is adapted for insertion into a cable connector (not shown) connected with an end of the housing 102, and the other end of the conductive member 103 is provided with a socket 130 mating with the pins 111a, 111b of the bypass diode 111. Though the one end of the conductive member 103 illustrated in Fig. 11 has a shape of a cylinder, the present invention is not limited to this, and other shapes, for example, a prismatic shape, are possible.

Referring to Fig. 14, in an embodiment, the connection conductor 110 is wrapped around the conductive member 103, so that the connection conductor 110 and the conductive member 103 form a stable electrical connection. As an alternative, the connection conductor 110 may be welded on the conductive member 103 so as to form a stable electrical connection as well. An example of welding operation may include laser welding, soldering and arc welding.

Referring to Fig. 14, in some embodiments the cross section of the conductive member 103 is substantially semicircular. It should be noted that the present invention is not limited to that, and the shape of the cross section of the conductive member 103 can take other forms, for example, in the shape of a circle.

Referring to Figs. 8-10, the housing 102 is substantially in the shape of a hollow cylinder, and at least one end of the housing 102 is provided with a hole 102a for connecting with an external cable directly. For instance, in Figs. 9, 10 the left end of the housing 102

could be connected to a positive electrode cable, and the right end of the housing 102 could be connected to a negative electrode cable. The positive and negative electrode cables may connect with the positive and negative electrode cables in the neighbouring junction module through cable connectors (not shown) respectively, so as to increase the output power of the building integrated photovoltaic system. Alternatively, in above opening 102a, the conductive member 103 could connect with an external cable via a cable connector (not shown). Optionally, at least one end of the housing 102 in the shape of a hollow cylinder could be formed into a closed end.

In the following description, the connection relation between the connection conductor 110, the conductive member 103, the resilient clip 105 and the lead terminal 104 will be described in conjunction with Figs. 11-14. In these drawings, Fig. 11 is a perspective view showing the connecting relationship between the conductive member, the connection conductor and the lead terminals of the junction module of Fig. 10, wherein the housing is removed for simplicity; Fig. 12 is a perspective view showing the connecting relationship between the conductive member, the connection conductor, the resilient clip and the lead terminals of the junction module of Fig. 10, with the housing removed; Fig. 13 is a perspective view of the process of assembly of the resilient clip, the lead terminal and the cover; and Fig. 14 is a cross sectional view taken along the F-F line of Fig. 9.

Firstly, the connection conductor 110 is placed in the housing 102 through the opening 106. Then in a preferred embodiment, the connection conductor 110 is welded on or is wrapped around the conductive member 103, so that the connection conductor 110 and the conductive member 103 form a stable electrical connection. Next, the lead terminal 104 connected with the positive or negative electrode of the solar cell panel is disposed in the housing 102 through the opening 106, so that one side of the lead terminal 104 is in contact with the connection conductor 110. Next, the circular or elliptic resilient clip 105 is disposed on the housing 102 through the opening 108, so that the clip 105 contacts the other side of the lead terminal 104. Lastly, the cover 107 is connected to the opening 108, so that an outer wall of the clip 105 and an inner wall of the cover 107 abut against each other, so as to apply a biasing force to the clip 105 through the cover 107 to prevent the clip 105 from coming away in the direction of the opening 108. Under the biasing action of the clip 105, the lead terminal 104 electrically connected with the positive or negative electrodes of a solar cell

panel and the connection conductor 110 are clamped together so as to form a stable electrical connection.

The connecting manner for the resilient clip 105, the connection conductor 110 and the lead terminal 104 as described above is not considered to be limitative, but be illustrative. Based on the forgoing embodiment, a person skilled in the art can make many modifications and variations, in which the resilient clip 105 is joined to the lead terminal 104 and a biasing force can be applied to the lead terminal 104, so that the lead terminal 104 and the connection conductor 103 form a stable electrical connection as required. As to other components which have been illustrated in the drawings in detail, they are also for illustrative purposes instead of a limitation to the present invention. For example, there is no restriction to the longitudinal structure of the resilient clip 105 (referring to Fig. 12), as long as its inherent resilient force serves as a biasing force to the lead terminal and hence forms a stable electrical connection between the lead terminal 104 and the conductive member 103.

In a preferred embodiment, as shown in Fig. 10, the junction module further comprises: a further opening 106' provided in the lower surface of the housing 102, and through the opening 106 and the further opening 106' respectively, the two lead terminals 104 connected to the positive and negative electrodes of the solar cell panel are electrically connected with the first and second connection conductors 110', 110'' in the housing 102, respectively. Furthermore, in the preferred embodiment, the conductive member 103 includes two conductive members 103', 103''; the junction module further comprises a bypass diode 111 connected between the two conductive members 103', 103''. As illustrated in Figs. 11, 12, under the biasing force from the resilient clip 105, the two lead terminals 104 connected to the positive and negative electrodes of the solar cell panel are electrically connected with the first and second connection conductors 110', 110'' in the housing 102 respectively. Since the first and second connection conductors 110', 110'' are electrically connected with the first and second conductive members 103', 103'', the two lead terminals 104 are brought into electrical connection with the first and second conductive members 103', 103''.

Besides, the two ends of the first and second conductive members 103', 103'' could be joined to positive or negative electrode connection cable (not shown). In a preferred embodiment, each electrode connection cable could connect with a neighbouring cell module in series via a connector or another connection cable, so as to increase the output power.

The positive and negative electrode connection cables of the two outmost modules produce an output power at a certain voltage, which becomes the electricity that the whole solar cell module outputs. The bypass diode 111 is arranged in a direction opposite to the direction of the current generated by the cell, so as to provide an alternative current path in case of a cell failure. Referring to Fig. 10, two openings 108 are provided in the side surface of the housing 102 to correspond to the opening 106 and the further opening 106'.

Referring to Figs. 12, 13, in the above embodiment, the resilient clip 105 includes first and second resilient clips 105', 105'', the two clips clamp the two lead terminals 104 and the first and second conductive members 110, 110' together respectively, so that the two lead terminals 104 connected to the positive and negative electrodes of the solar cell panel are in a stable electrical connection with the first and second connection conductors 110', 110''.

Though in the above embodiment, the two lead terminals 104 are connected to the first and second connection conductors 110', 110'' through the opening 106 and the further opening 106', respectively, the present invention is not limited to this. For example, the opening 106 and the further opening 106' could be replaced by a single opening, through which the two lead terminals 104 are connected to the connection conductors 110', 110'' in the housing 102.

In addition, although in preferred embodiment, the connection conductor 110 is welded on or wrapped around the conductive member 103 to form a stable electrical connection there between, it is just for the purpose of illustration and is not intended to be limiting, for instance, the first and second connection conductors 110, 110' can extend from the first and second conductive members 103', 103'' respectively, and integrate with the latter.

Moreover, the junction module of the present invention takes a shape of a cubic cylinder, which can be embedded into a frame of a window panel in a building. However, the present invention is not limited to this, the junction module can take any appropriate shape, such as circular cylinder and prism, so as to be accommodated in the frame of window panels or sunlight roof etc.

As apparent from the above, the present invention provides an improved junction module for a building integrated photovoltaic system. Compared with the prior art, the present invention uses a resilient clip instead of a welding process, hence avoiding the inherent problem of a welding process, i.e. being time-consuming and resulting in a high

production cost, and at the same time, the present invention eliminates the requirements which the welding operation must take into account, accordingly, the corresponding expense for meeting these requirements are saved; secondly, the junction module according to present invention conforms to the trend of miniaturisation of components of a building integrated photovoltaic system, with easy assembling operation whilst ensuring a firm and stable electrical connection between the lead terminal of the solar cell assembly and the conductive element, which contributes to an increased reliability and rate of the qualified product; moreover, by using the resilient clip, the junction module can be detached from the connection between the solar cell assembly, compared with the permanent connection in prior art, the maintenance and inspection of the internal elements of the junction module can be carried out more conveniently.

Although the various embodiments of the present invention in conjunction with the drawings have been described, those skilled in the art shall recognize that these embodiments disclosed in the drawings are illustration of the manners that the present invention may be practiced. It is to be understood that the present invention is not limited to these specific embodiments. Similarly, the terms used in the description for indicating an orientation, such as, “upper”, “lower”, “upper surface”, “lower surface” etc. though correspond to the upper or lower portion of the figures concerned, but they may refer to any orientations, which if viewed from a contrary angle or lateral side, might correspond to “lower”, “upper” or “left” and “right”.

Although several exemplary embodiments have been shown and described, it would be appreciated by those skilled in the art that various changes or modifications may be made in these embodiments without departing from the principles and spirit of the disclosure, the scope of which is defined in the appended claims and their equivalents.

Claims

1. A junction module of a building integrated photovoltaic system, comprising:

a housing;

a conductive member accommodated in said housing;

a first opening provided in a first surface of the housing through which lead terminals electrically connected with the positive and negative electrodes of a solar cell panel electrically connect with said conductive member accommodated in said housing; and

a resilient clip for clamping the lead terminal and the conductive member together, so that the lead terminal and the conductive member form a stable electrical connection.

2. The junction module according to claim 1, whereincharacterised in that

said conductive member includes two substantial flat opposite sides; and

the cross-section of said resilient clip is in a shape of a substantial triangle with its vertex open, and the resilient clip includes a bottom wall and two opposite side walls extending from the two ends of the bottom wall in an acute angle with respect to the latter, wherein:

when the resilient clip clamps the lead terminal, said two opposite side walls of the resilient clip are brought into contact with the lead terminal and apply a biasing force to it, so that the lead terminal and the conductive member form a stable electrical connection.

3. The junction module according to claim 1, whereincharacterised in that

said conductive member includes a substantial cylindrical portion, and

the cross-section of said resilient clip is in a shape of a substantial triangle with its vertex open, and the resilient clip includes a bottom wall and two opposite side walls extending from the two ends of the bottom wall in an acute angle with respect to the latter, wherein

when the resilient clip clamps the lead terminal, said bottom wall and said two opposite side walls of the resilient clip are substantially tangent with the periphery of the cylindrical portion of the conductive member wrapped around by the lead terminal, so that the lead terminal and the conductive member form a stable electrical connection.

4. The junction module according to any one of claims 1-3, further comprising

a second opening provided in the housing at the opposite side of said first surface;

a cover connected to the second opening of the housing for covering the second opening.

5. The junction module according to claim 4, wherein

when said cover is connected to the second opening of the housing, said bottom wall of the resilient clip abuts against an inner wall of the cover, so as to prevent said clip from coming away in the direction of the second opening.

6. The junction module according to claim 5, wherein

the bottom wall of the resilient clip and the inner wall of the cover are engaged with each other by means of a positioning mechanism, so as to further limit the displacement of said resilient clip through the cover.

7. The junction module according to claim 6, wherein the positioning mechanism comprising:

a positioning protrusion provided on one of the bottom wall of said resilient clip and the inner wall of the cover; and

a positioning depression provided on the other of the bottom wall of said resilient clip and the inner wall of the cover,

when the bottom wall of said resilient clip abuts against the inner wall of the cover, said positioning protrusion is brought into engagement with the positioning depression so as to limit the displacement of said resilient clip.

8. The junction module according to claim 2 or 3, wherein

said two side walls of the resilient clip form a bending portion at the ends of them respectively, so that the ends of said two side walls of the resilient clip extend in directions away from each other.

9. The junction module according to claim 1, wherein

the housing is substantially in a shape of a hollow cylinder,

at least one end of said housing is formed into a close end or is provided with a hole for connecting with an external cable directly or via a cable connector.

10. The junction module according to claim 4, wherein

a sealing piece is further provided between the cover and the second opening to form a seal between the cover and the housing.

11. The junction module according to claim 1 or 9, wherein

the conductive member includes a first conductive member and a second conductive member; and

the junction module further comprises a bypass diode connected between the first and second conductive members.

12. The junction module according to claim 11, wherein

an end of the conductive member is adapted to be inserted into a connector connected with an end of the housing, and the other end of the conductive member is provided with a socket mating with a pin of the bypass diode.

13. The junction module according to claim 11 or 12, wherein

said resilient clip includes a first resilient clip and a second resilient clip, the first and second resilient clips clamp the two lead terminals connected with the positive and negative electrodes of the solar cell panel, and the first and the second conductive members together, so as to form a stable electrical connection between them.

14. The junction module according to claim 13, further comprising

a further first opening provided in the first surface of the housing, and through said first opening and said further first opening, the two lead terminals connected to the positive and negative electrodes of the solar cell panel are electrically connected with the first and second conductive members in the housing, respectively.

15. A junction module of a building integrated photovoltaic system, according to claim 1 characterised in that the clip is a circular or elliptic resilient clip accommodated in said housing

16. The junction module according to claim 15, wherein

the conductor member includes a first connection conductor and a second connection conductor,

the circular or elliptic resilient clip includes a first clip and a second clip, said first and second clips clamp said two lead terminals connected with the positive and negative electrodes of the solar cell panel, and said connecting conductor together, so as to form stable electrical connection.

17. The junction module according to claim 15, wherein

said connection conductor is welded on or wrapped around the conductive member, so that said connection conductor and said conductive member forms a stable electrical connection.

18. The junction module according to claim 15, wherein

when the cover is connected to the second opening of the housing, an outer wall of said circular or elliptic resilient clip abuts against an inner wall of the cover, so as to apply a biasing force to the clip through said cover to prevent said clip from coming away in the direction of the second opening.

* * * * * * *

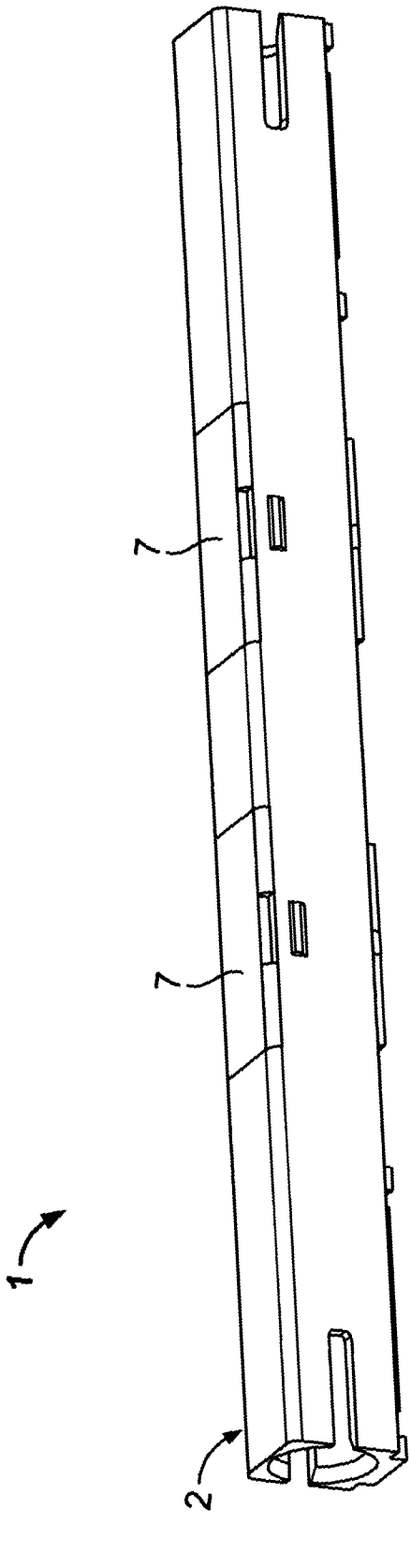

FIG. 1

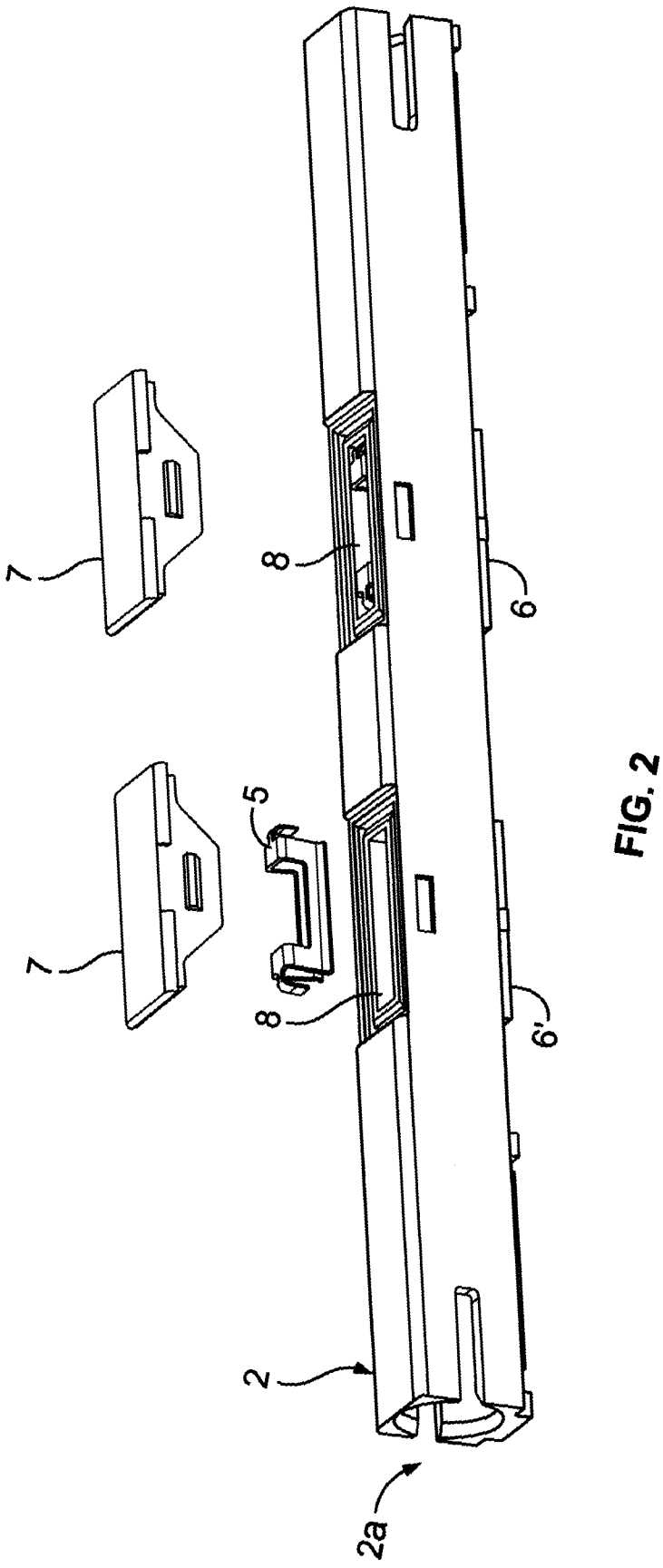

FIG. 2

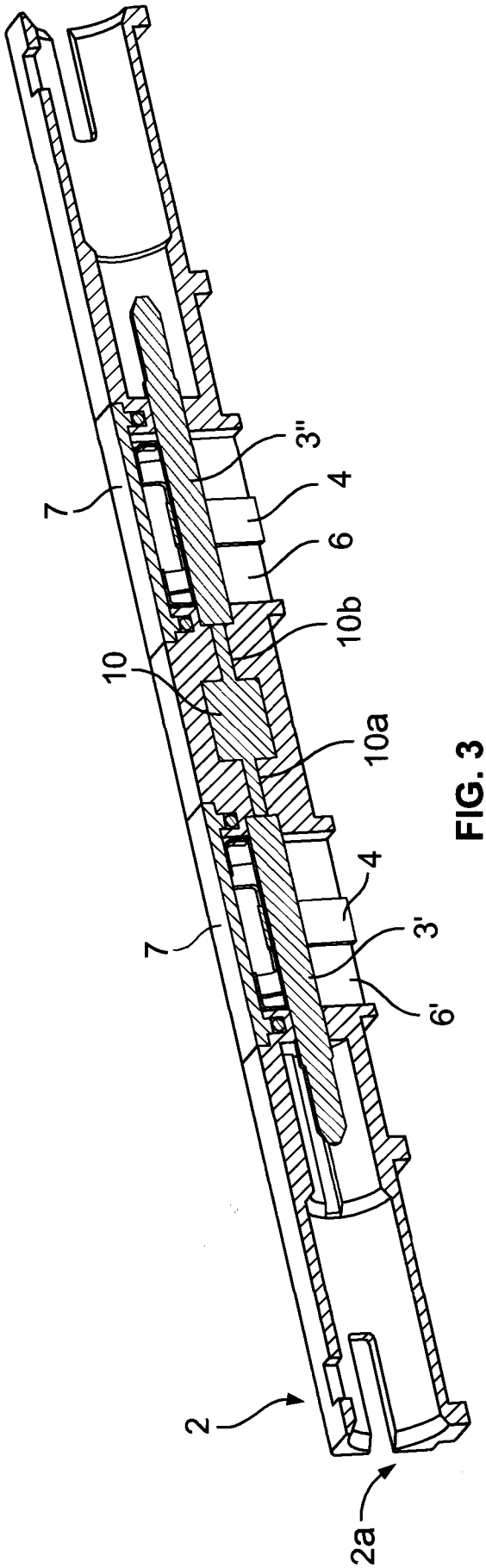

FIG. 3

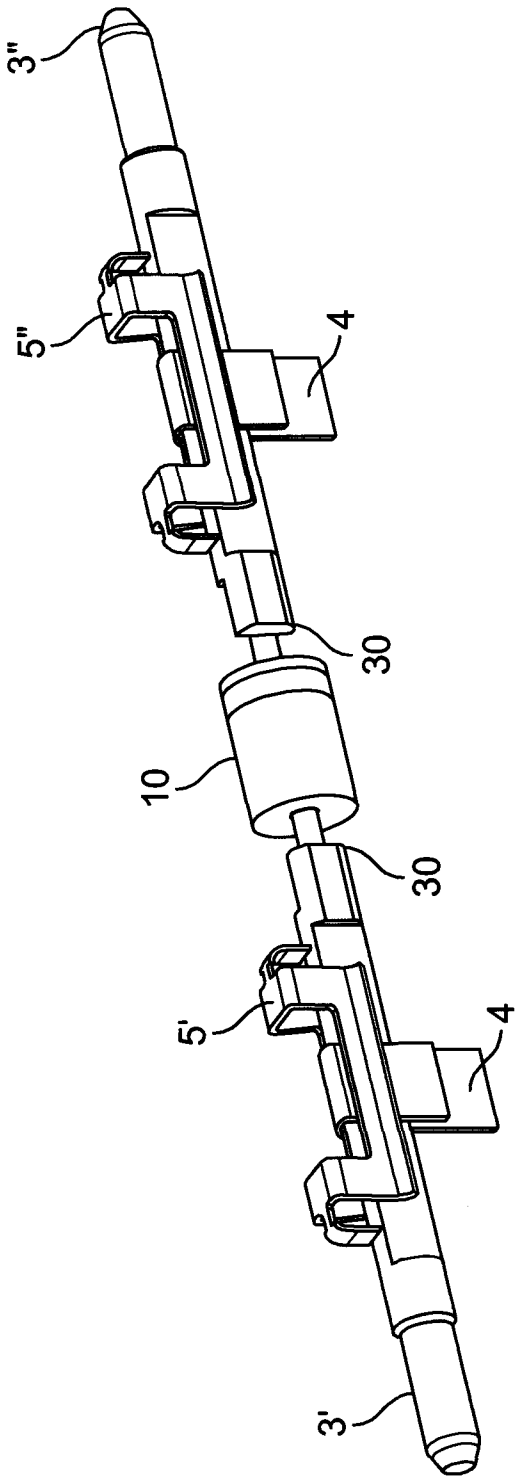

FIG. 4

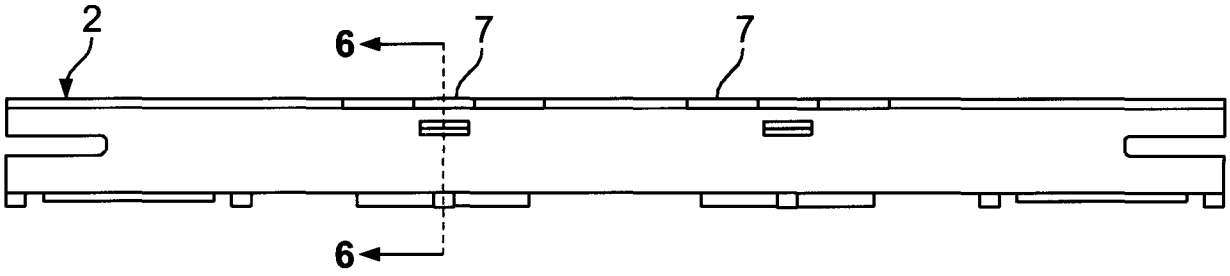

FIG. 5

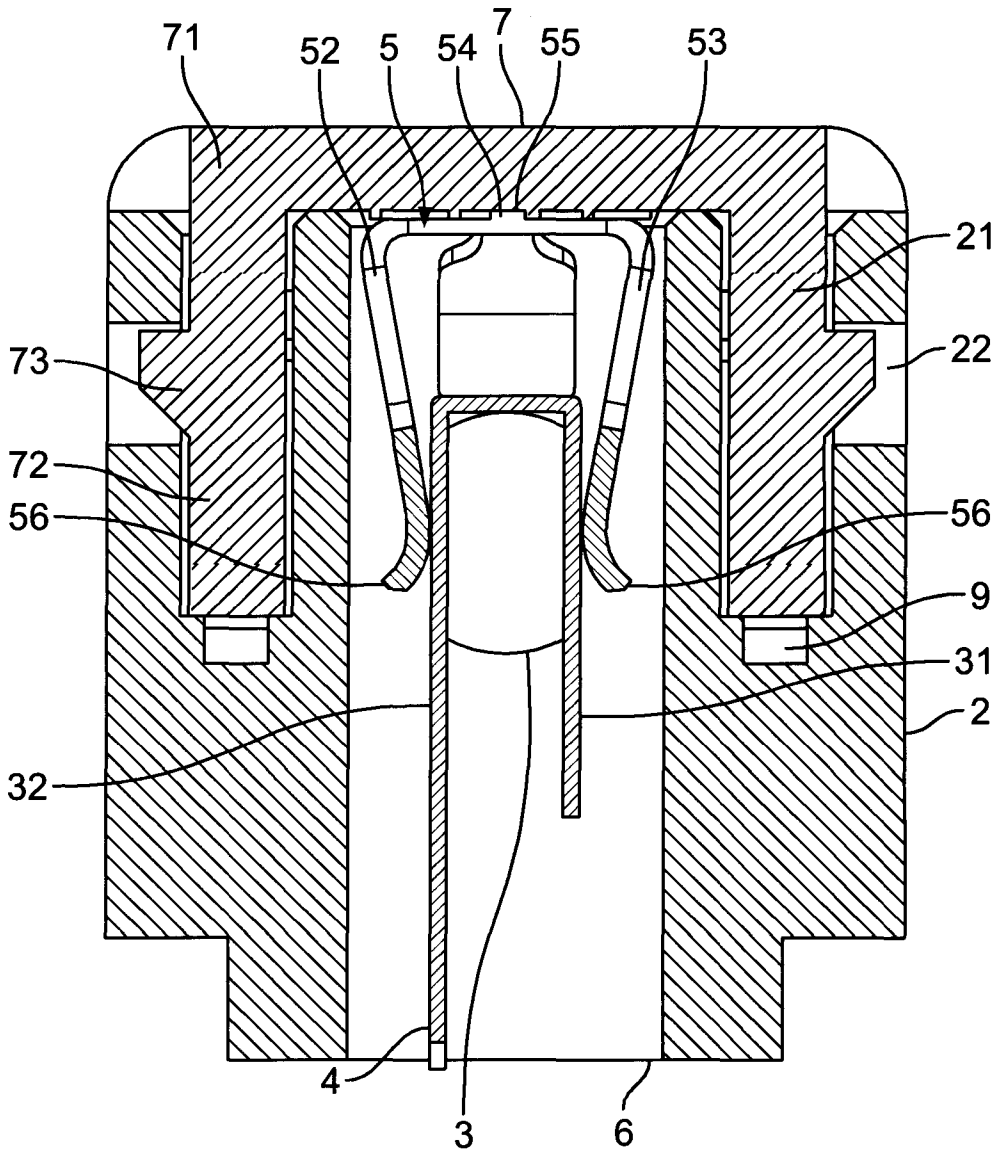

FIG. 6

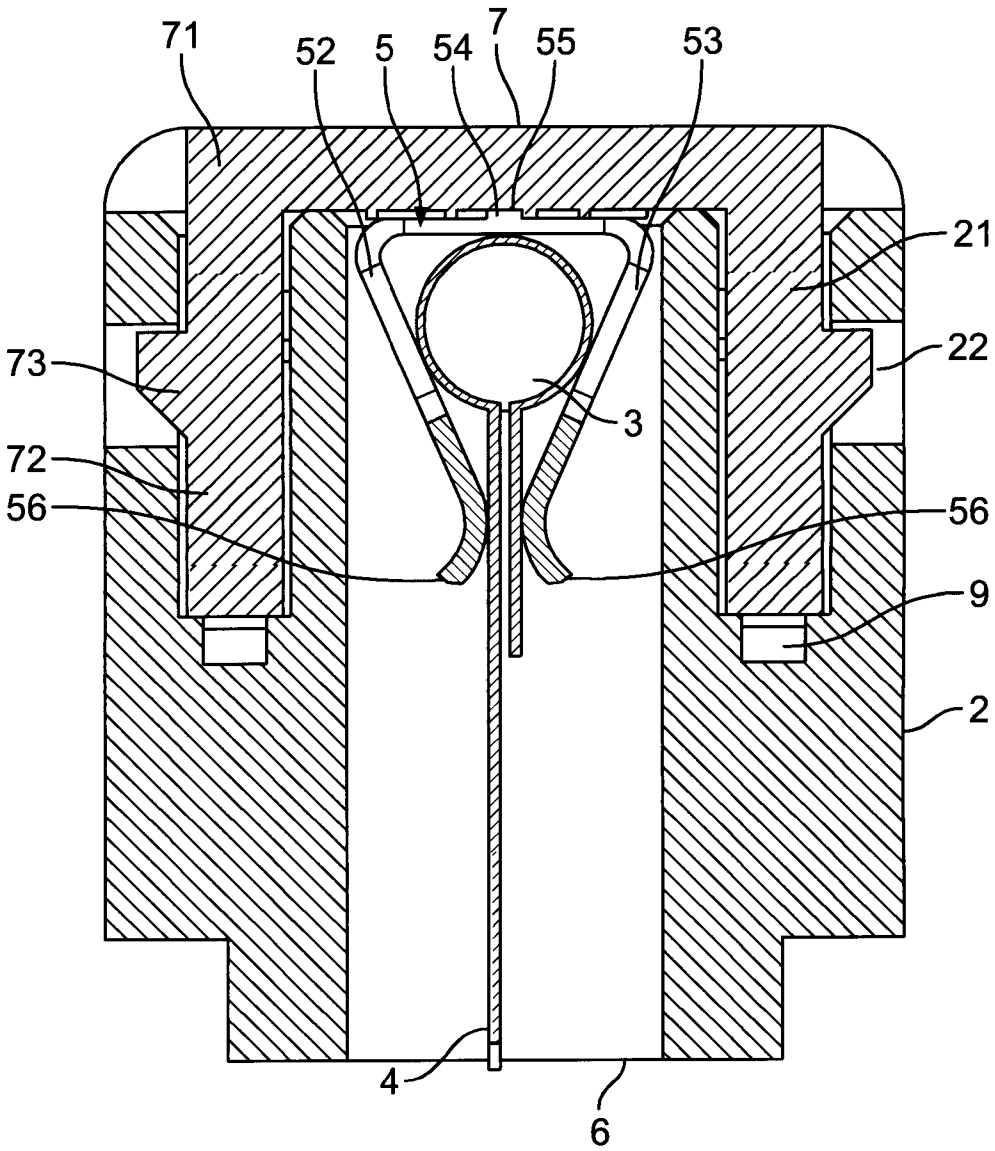

FIG. 7

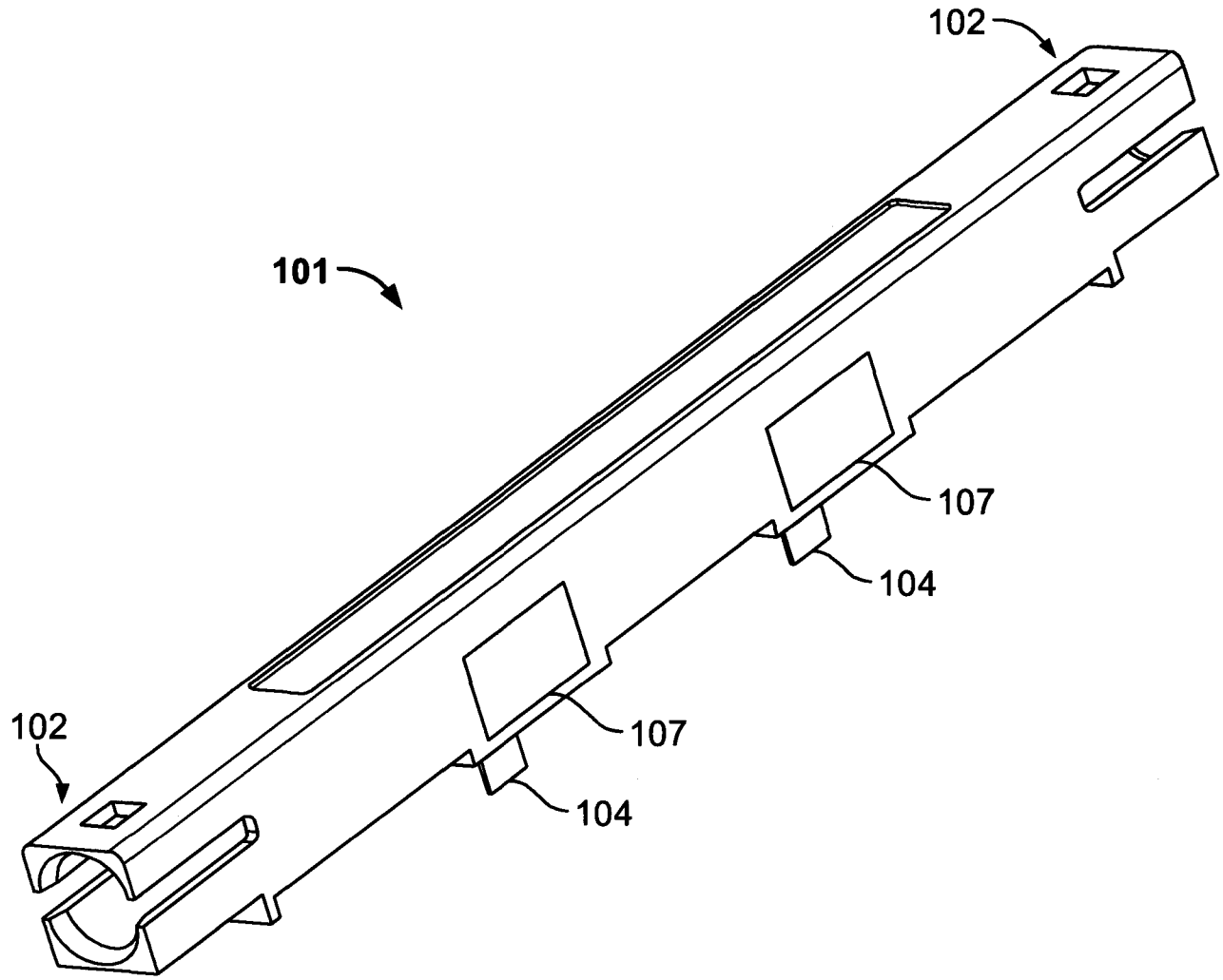

FIG. 8

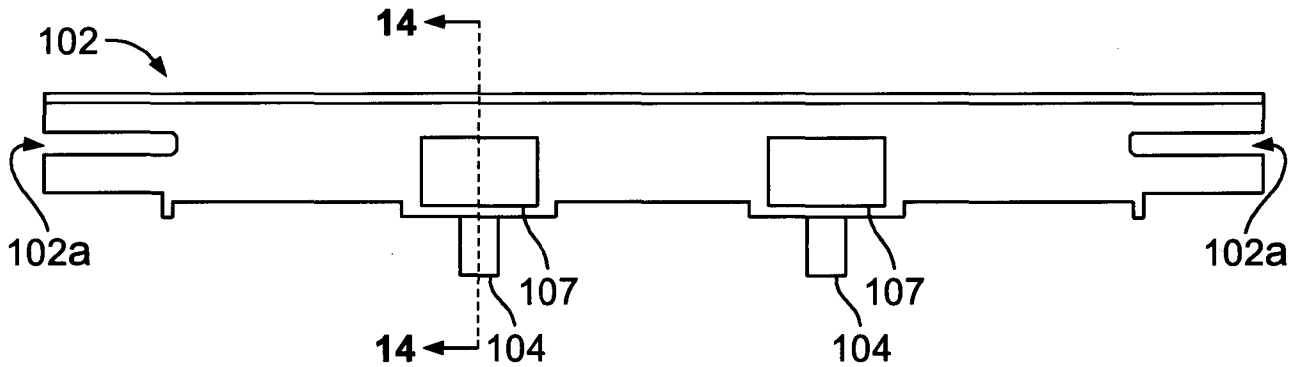

FIG. 9

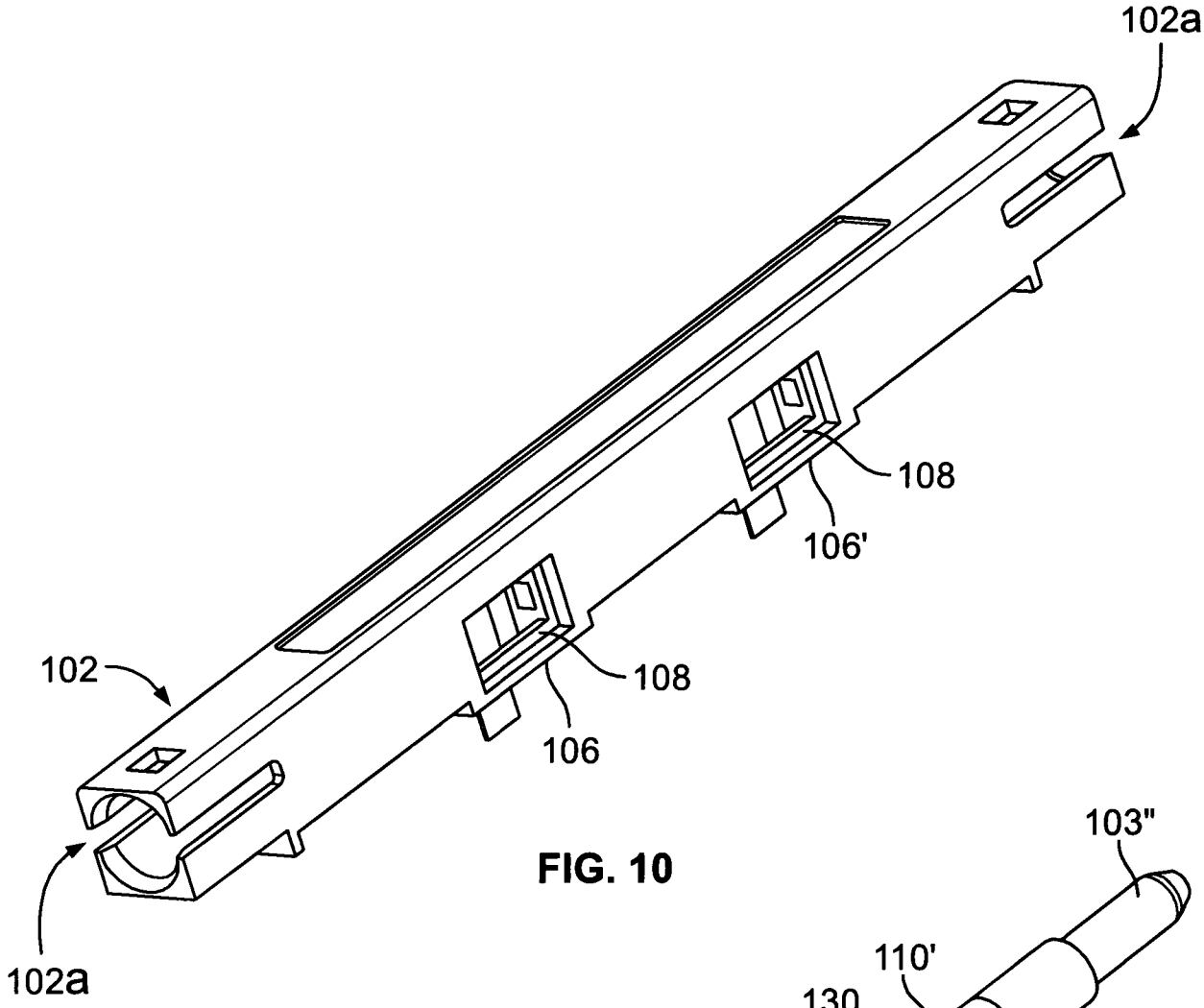
102a
108
106'
102
108
106
102a

FIG. 10

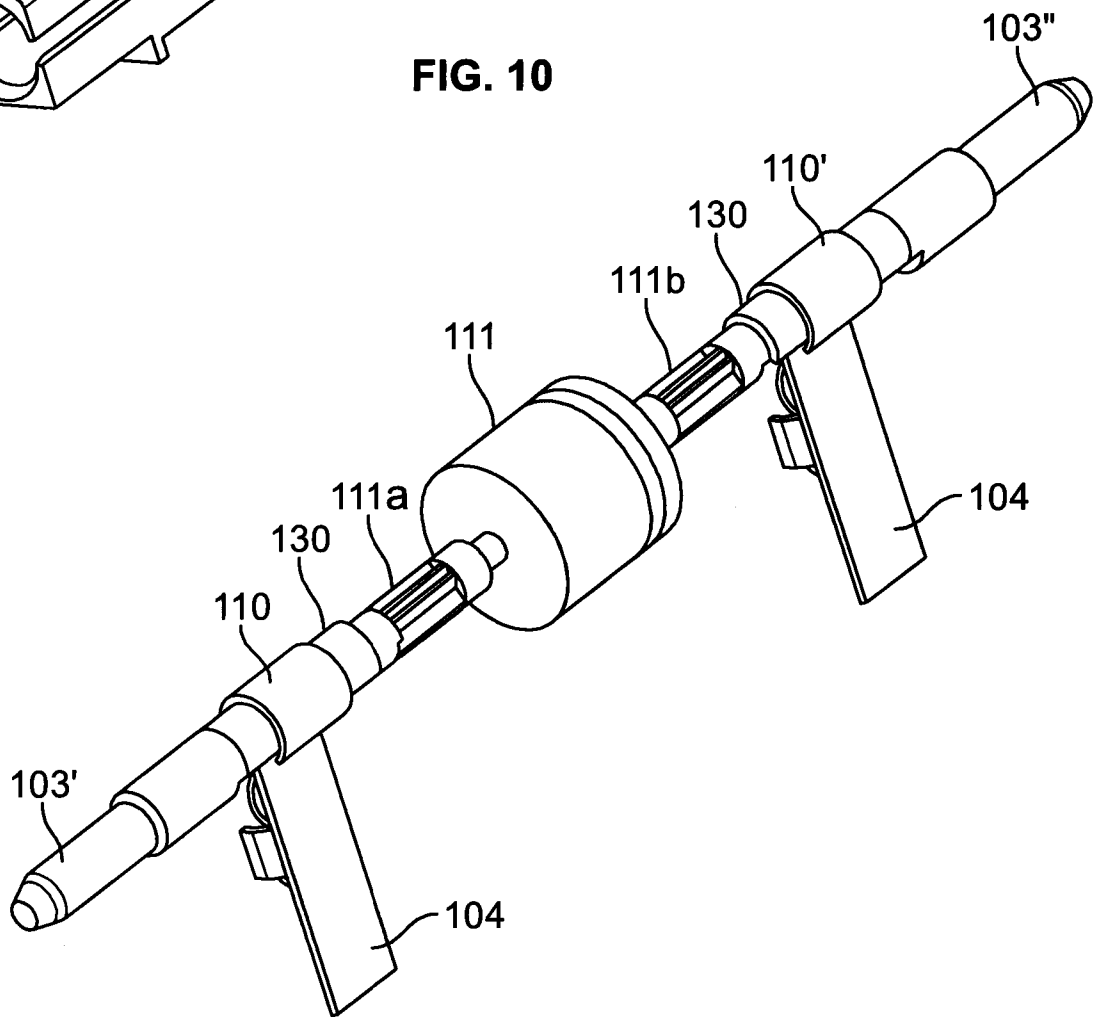
103"
110'
130
111b
111
111a
130
110
104
103'
104

FIG. 11

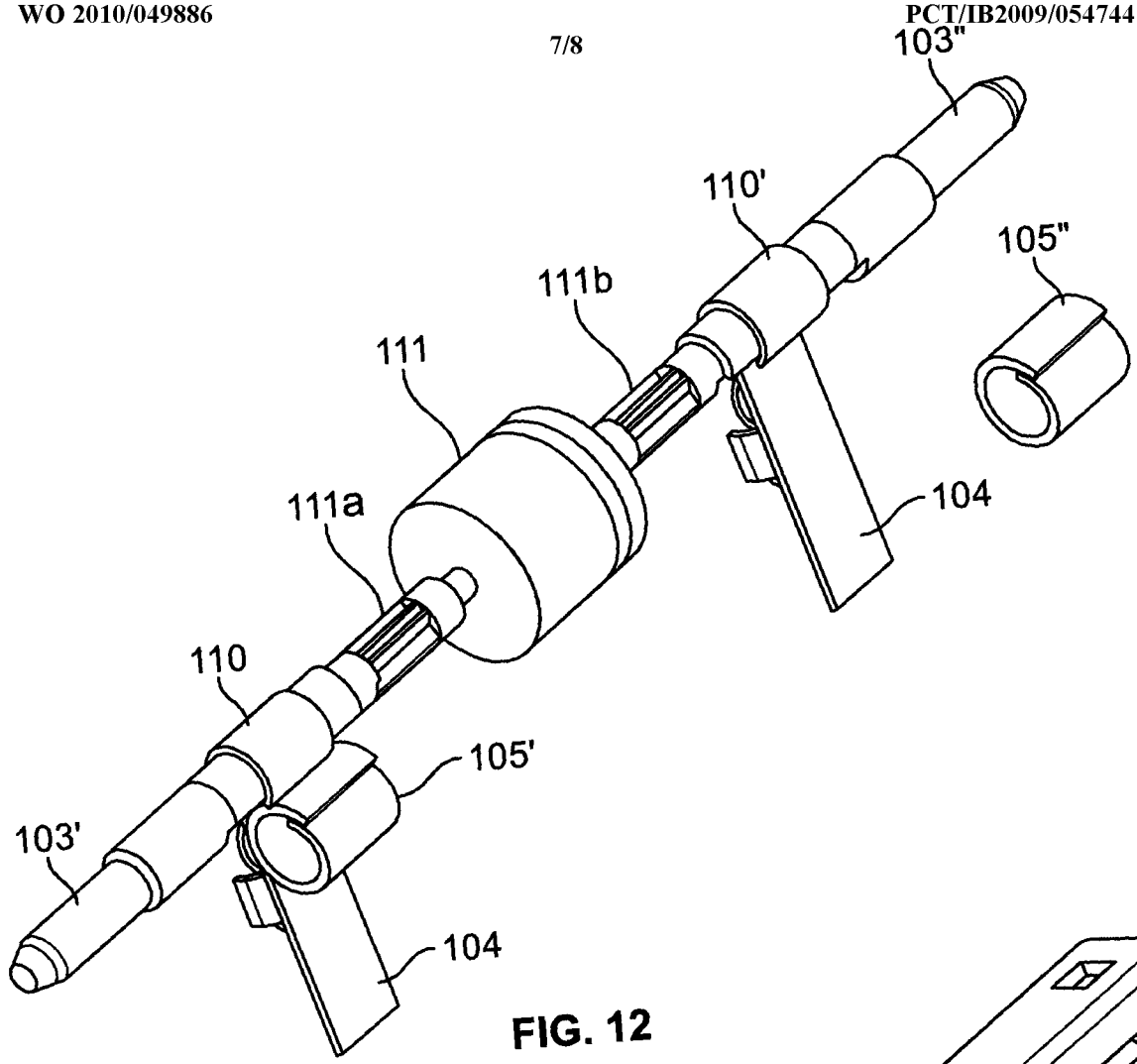
103"
110'
105"
111b
111
111a
104
110
105'
103'
104

FIG. 12

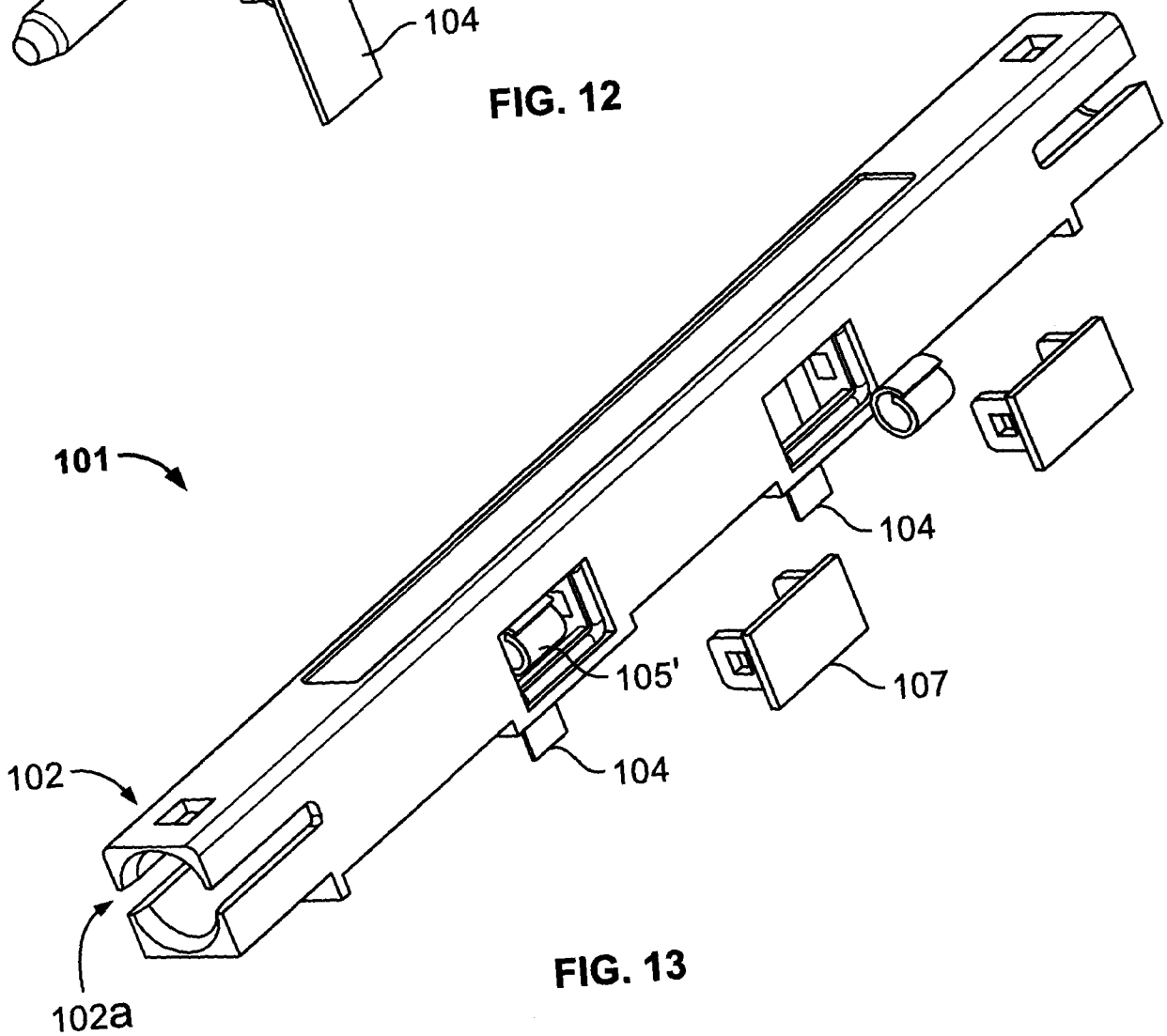
101
104
105'
107
104
102
102a

FIG. 13

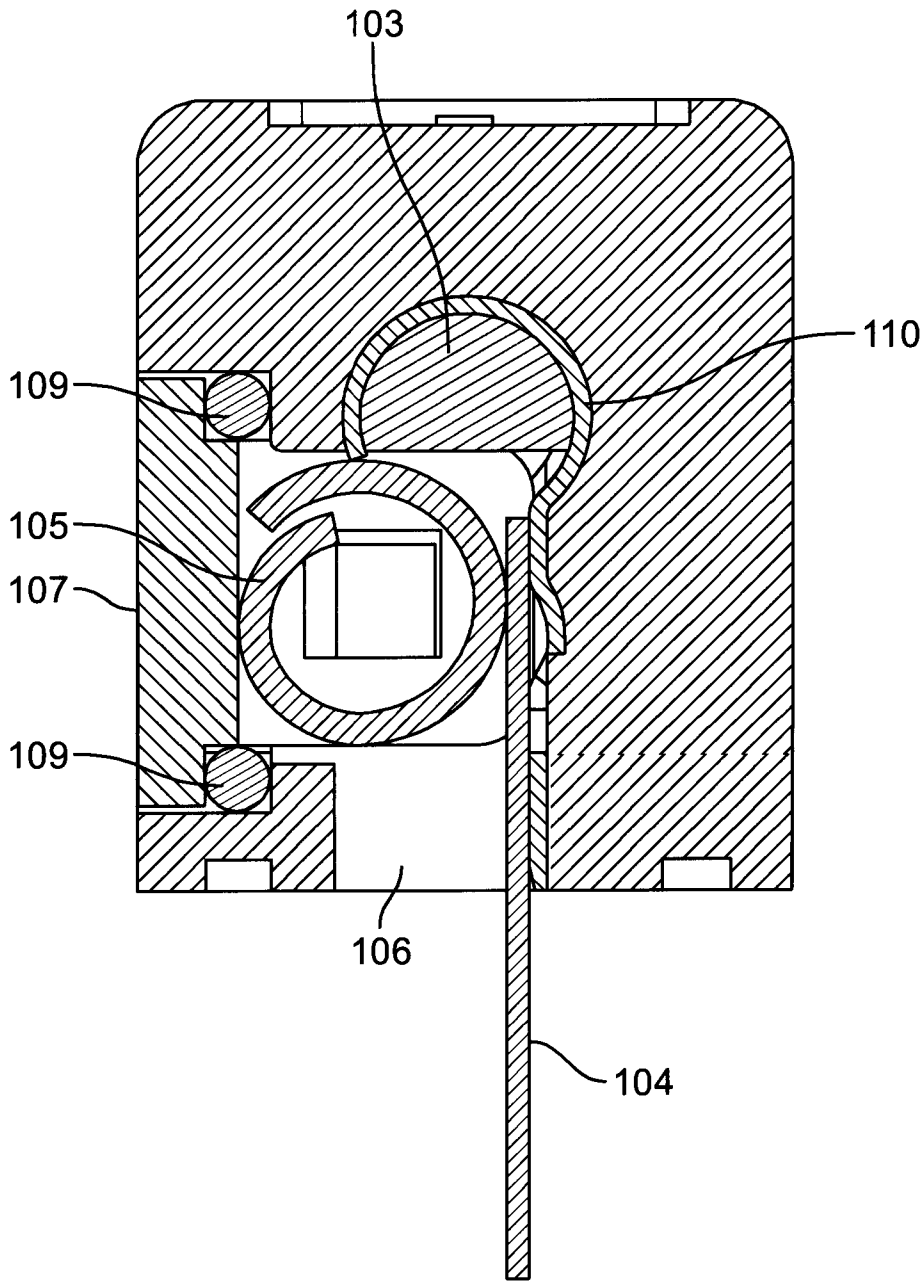

FIG. 14