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(54) **BIOMETRIC BELT CONNECTOR**

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Publication Classification

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A61B 5/00	(2006.01)
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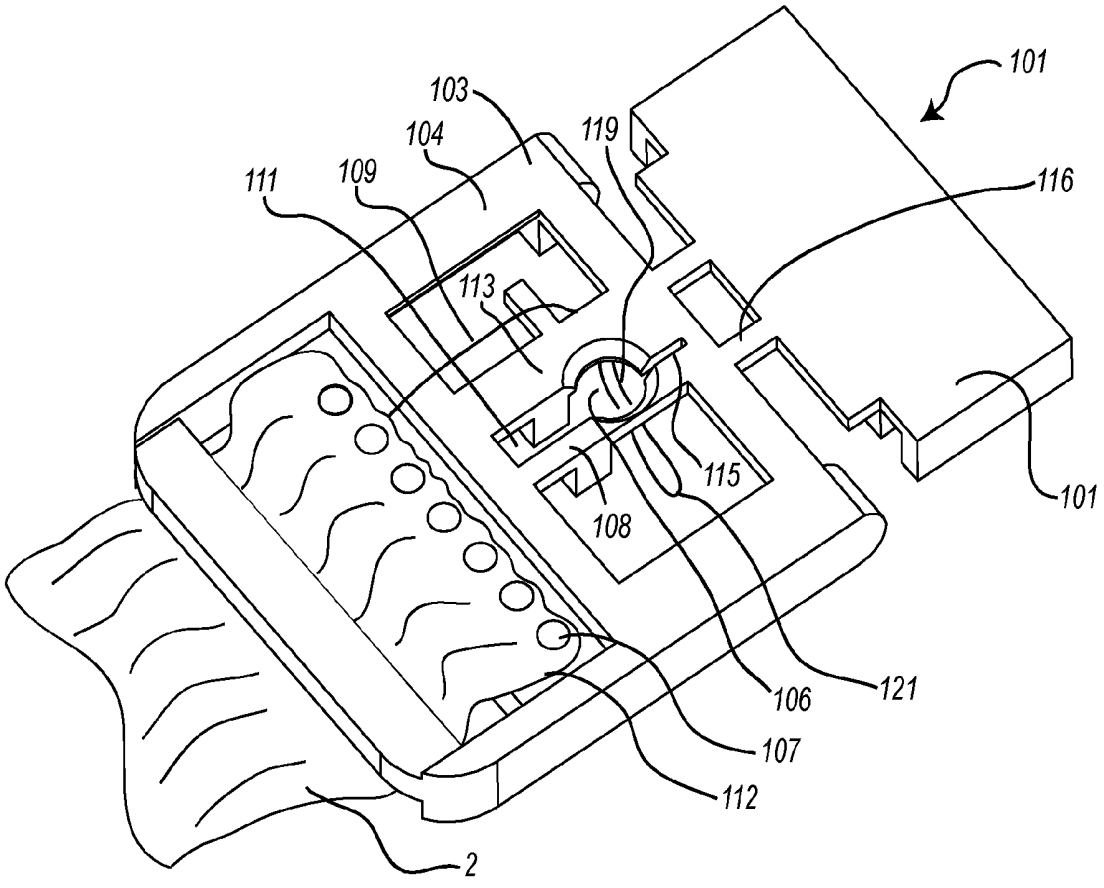
H01R 12/77	(2006.01)
H01R 4/48	(2006.01)

(52) **U.S. Cl.**

CPC ***H01R 13/20*** (2013.01); ***A61B 5/0806*** (2013.01); ***A61B 5/6831*** (2013.01); ***H01R 11/22*** (2013.01); *H01R 2201/12* (2013.01); ***H01R 4/48*** (2013.01); *A61B 2562/227* (2013.01); *H01R 12/775* (2013.01); ***H01R 12/777*** (2013.01)

(57) **ABSTRACT**

An electrode belt connector is provided for electrically connecting a conductor of an electrode belt to a first snap portion of a snap connector electrode configured to be connected to a biometric device. The electrode belt connector includes a frame and an electrically conductive portion. The frame defines a corresponding second snap portion configured to mate with the first snap portion of the snap connector electrode. The electrode belt connector further includes a connecting portion configured to electrically connect the conductor of the electrode belt to the first snap portion of the snap connector electrode.



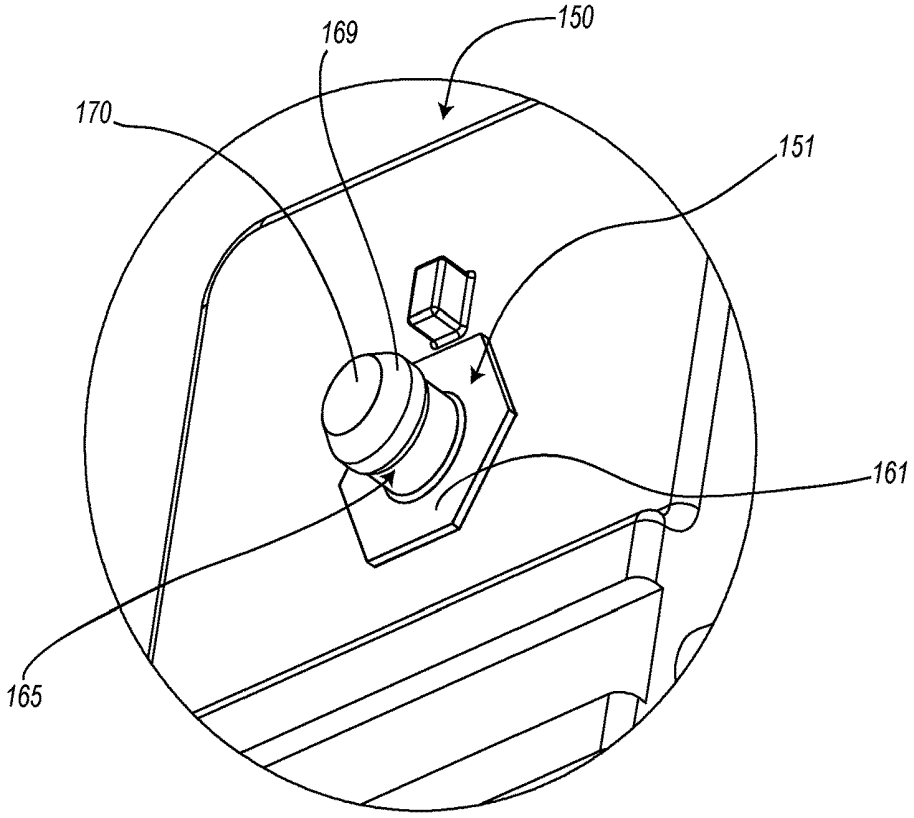


FIG. 1A

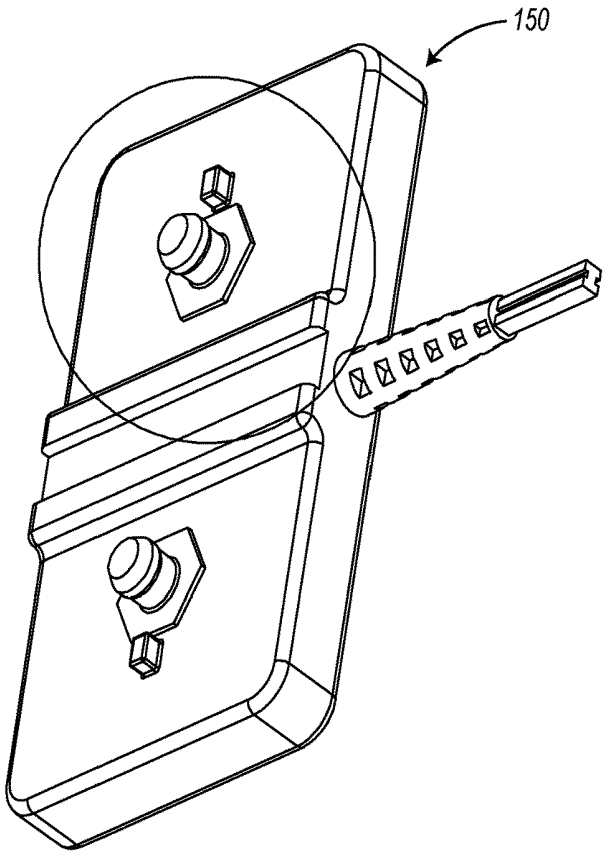


FIG. 1B

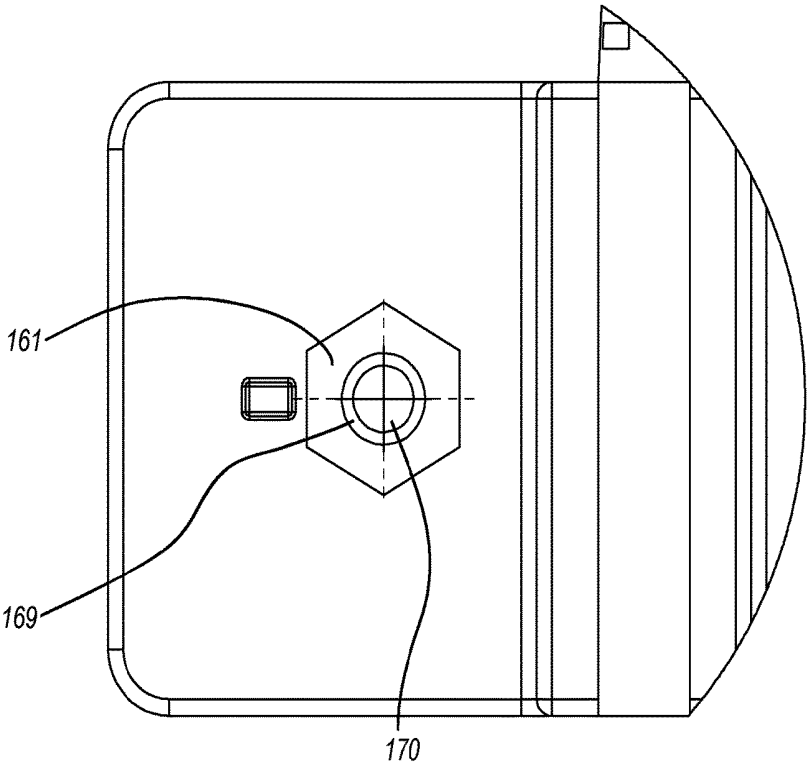


FIG. 1C

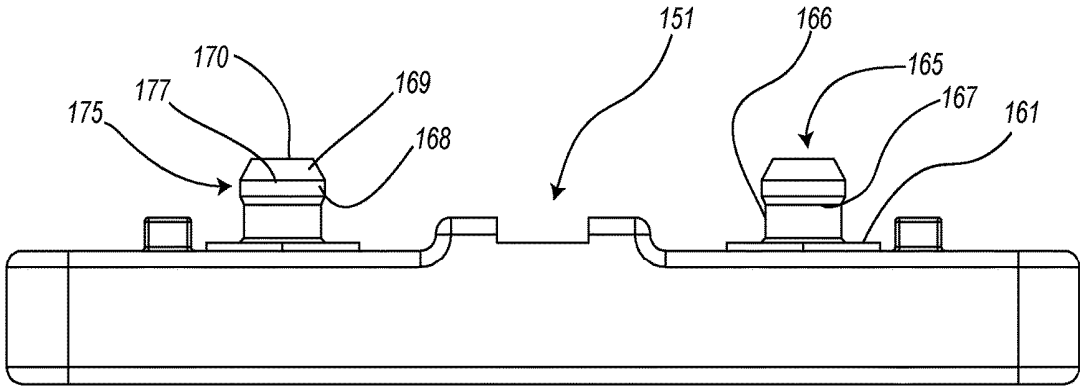


FIG. 1D

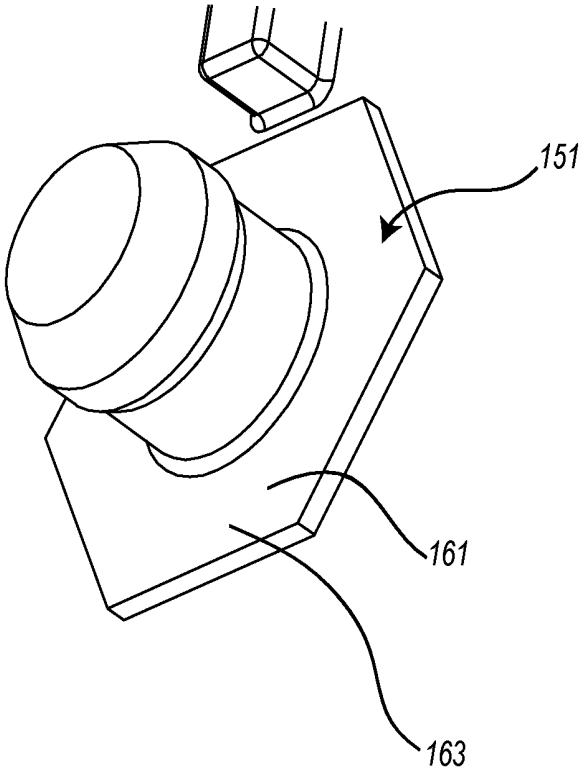


FIG. 1E

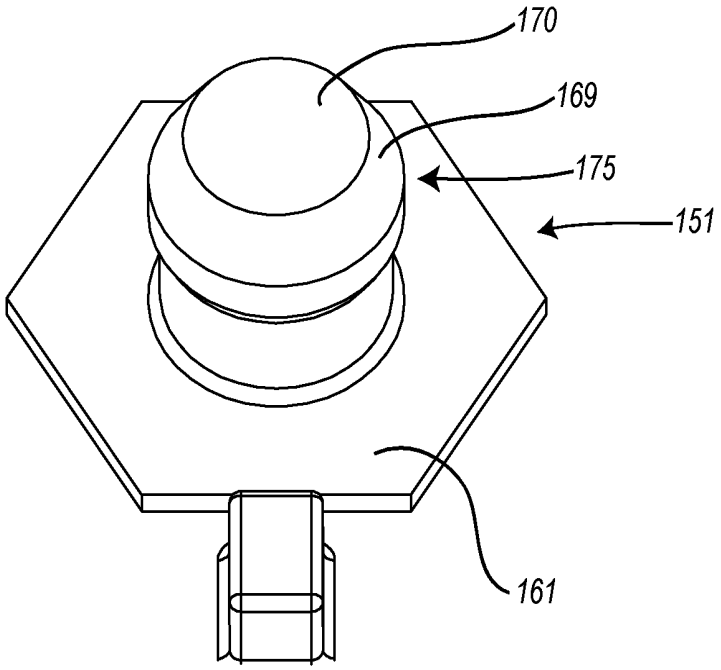


FIG. 1F

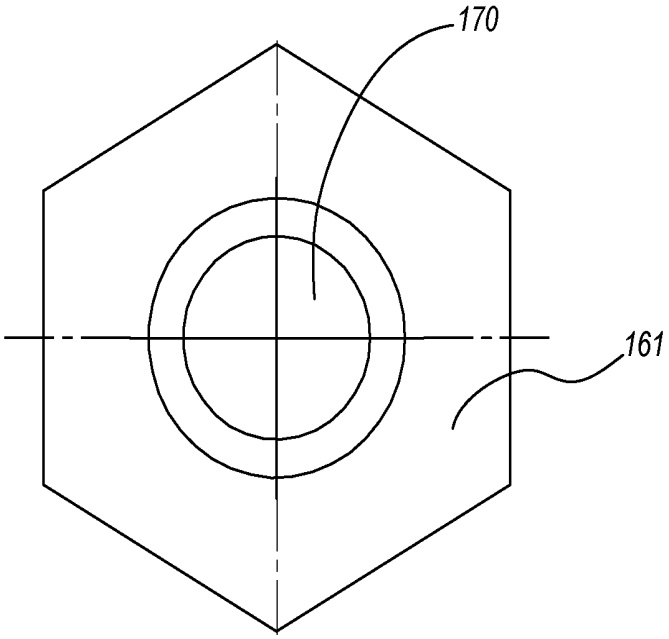


FIG. 1G

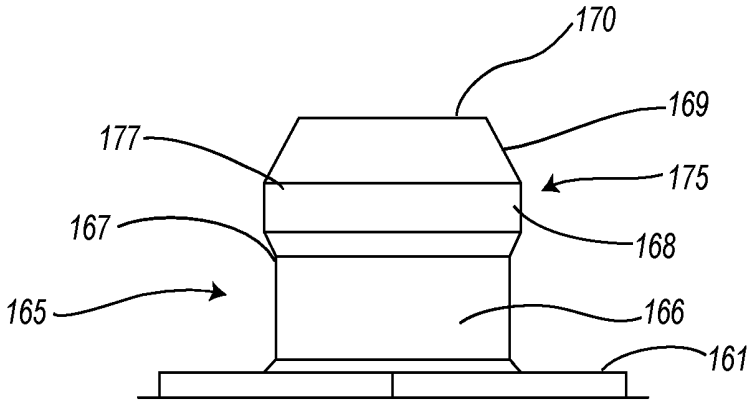


FIG. 1H

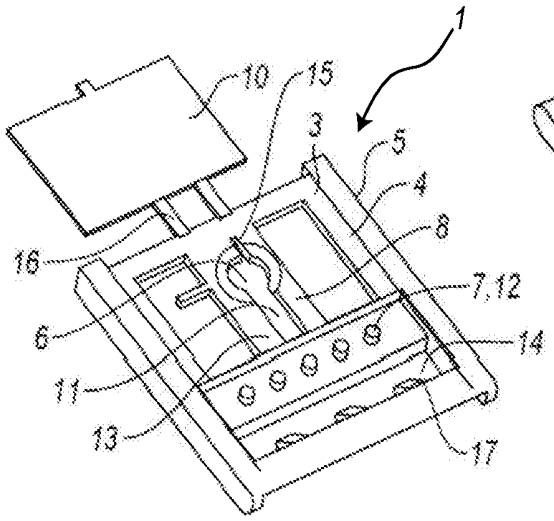


FIG. 2A

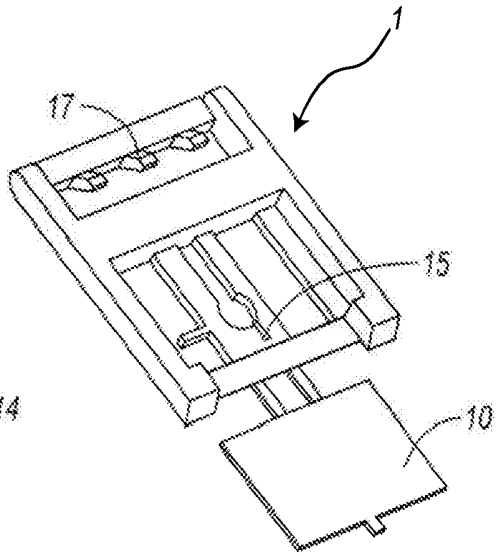


FIG. 2B

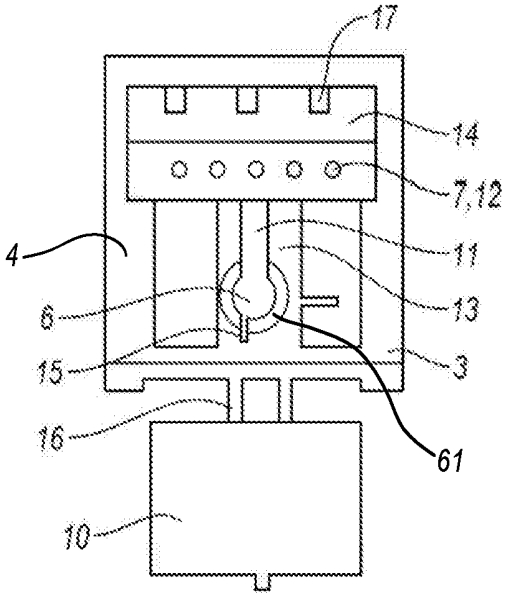


FIG. 2C

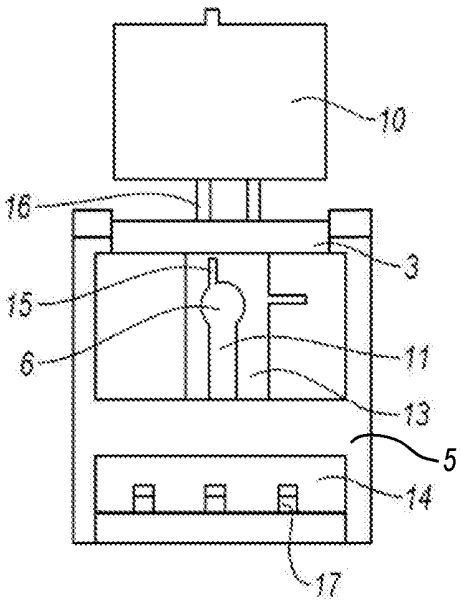


FIG. 2D

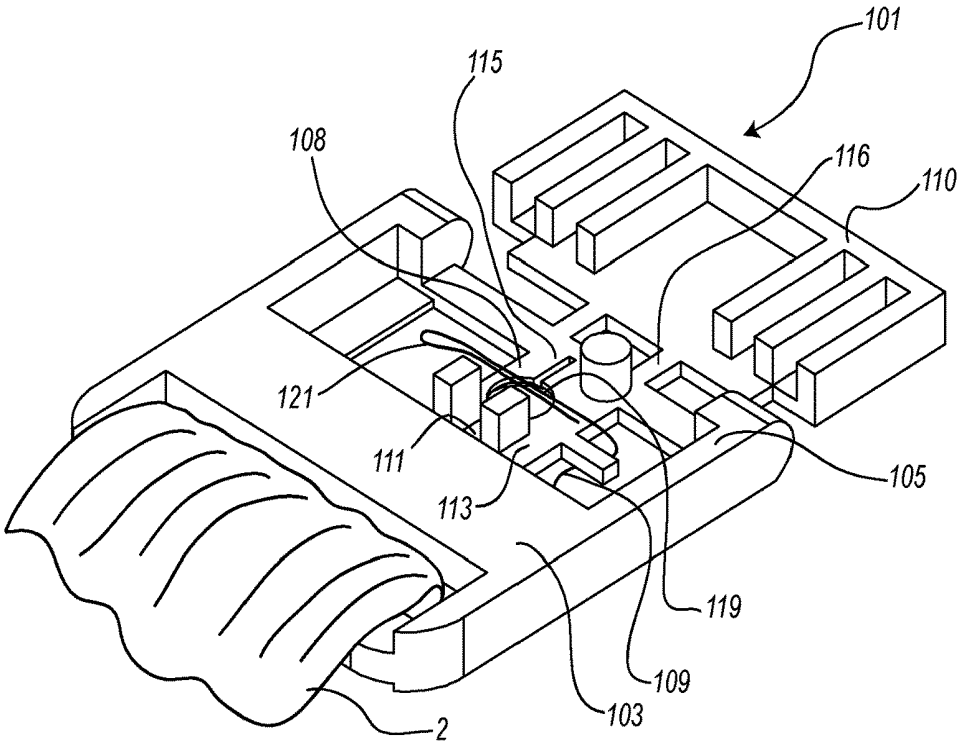

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FIG. 3A

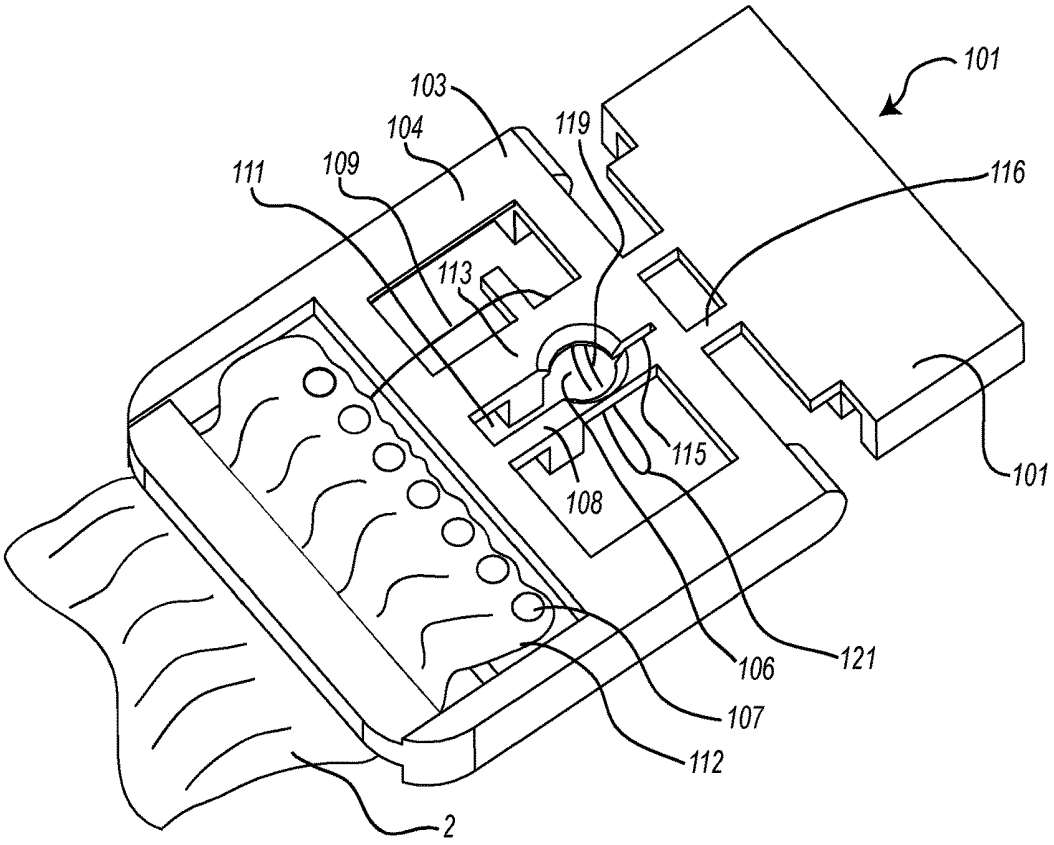
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FIG. 3B

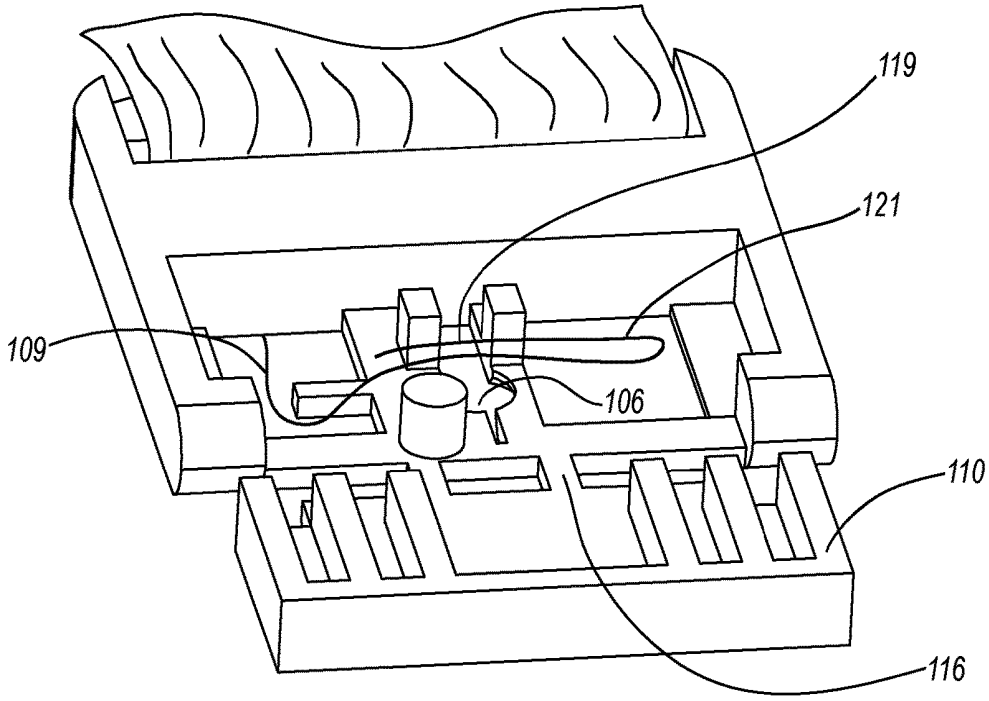

FIG. 3C

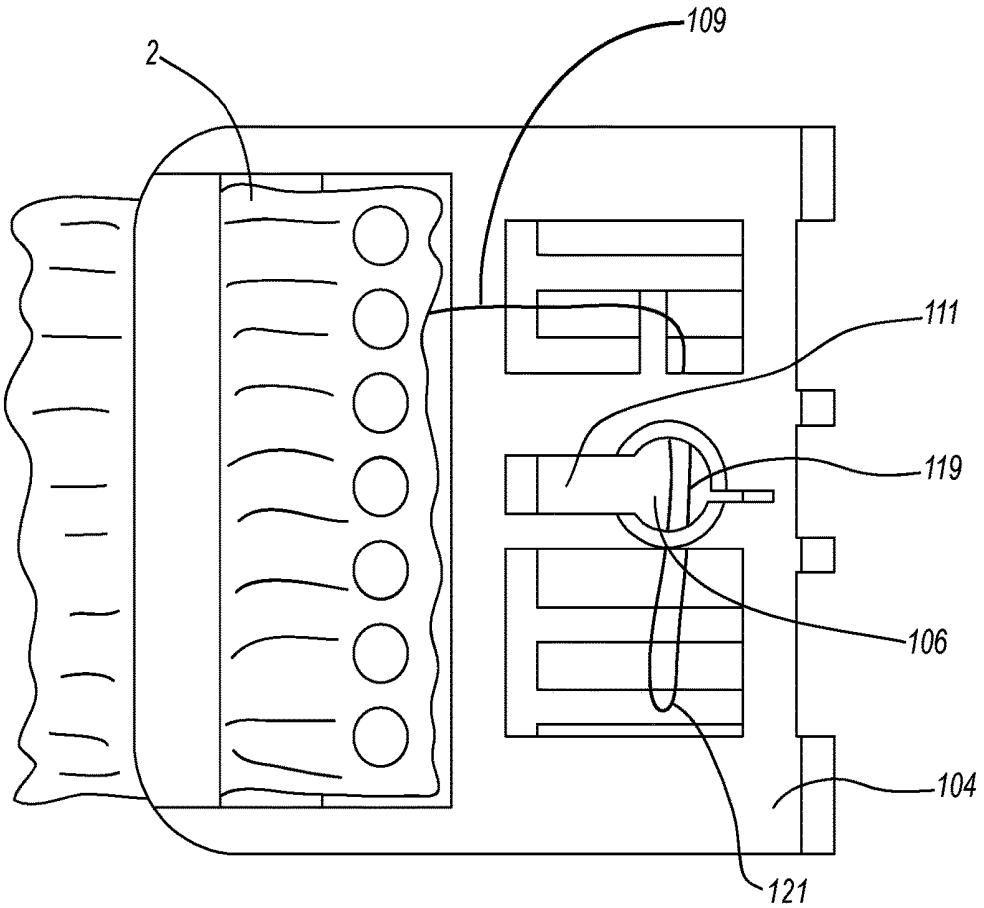

FIG. 3D

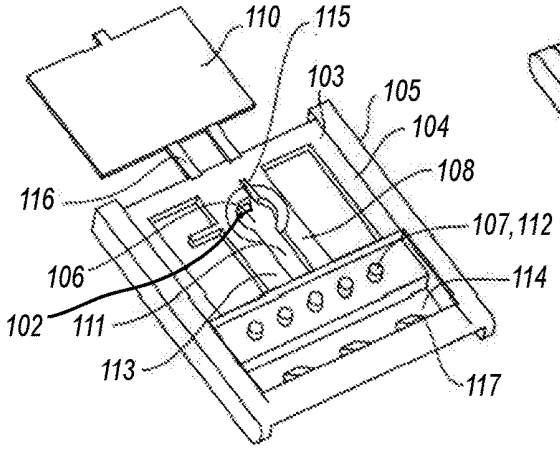

FIG. 3E

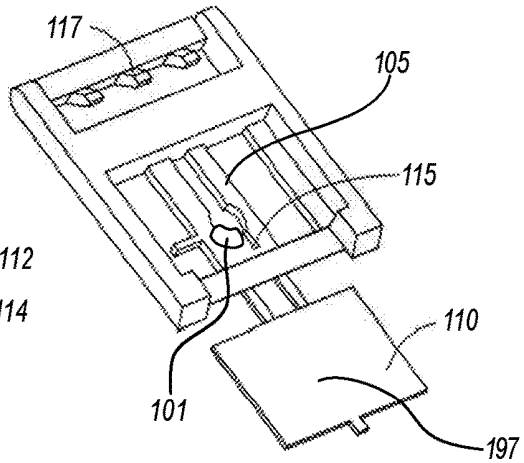

FIG. 3F

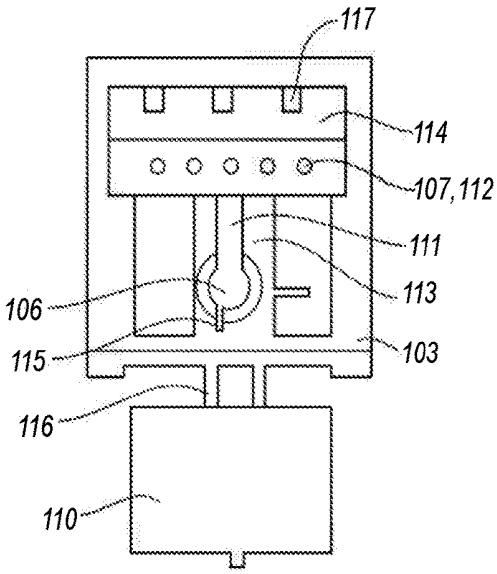

FIG. 3G

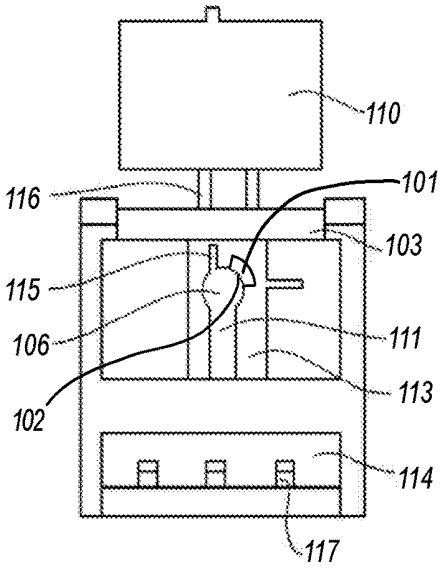

FIG. 3H

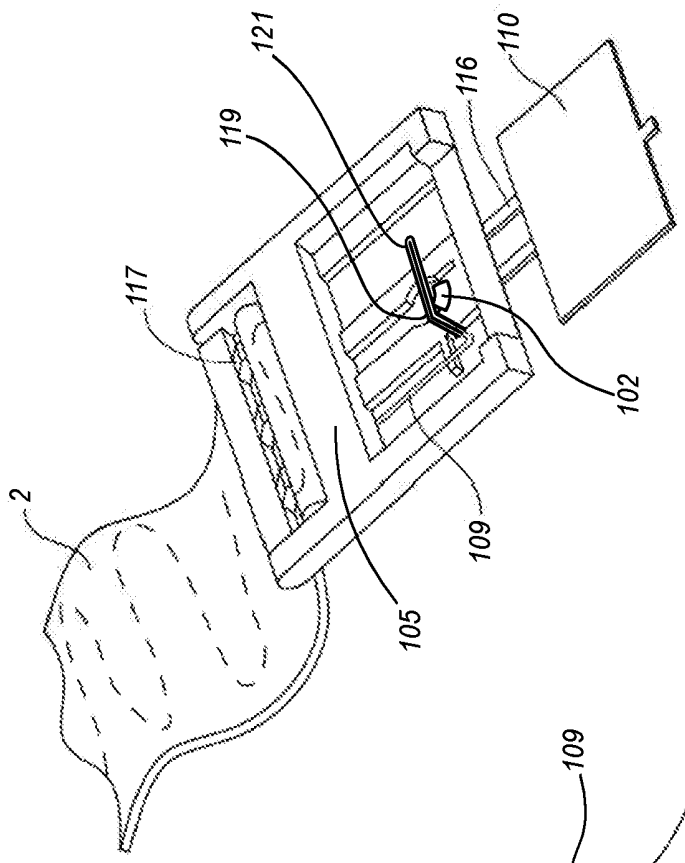
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FIG. 3J

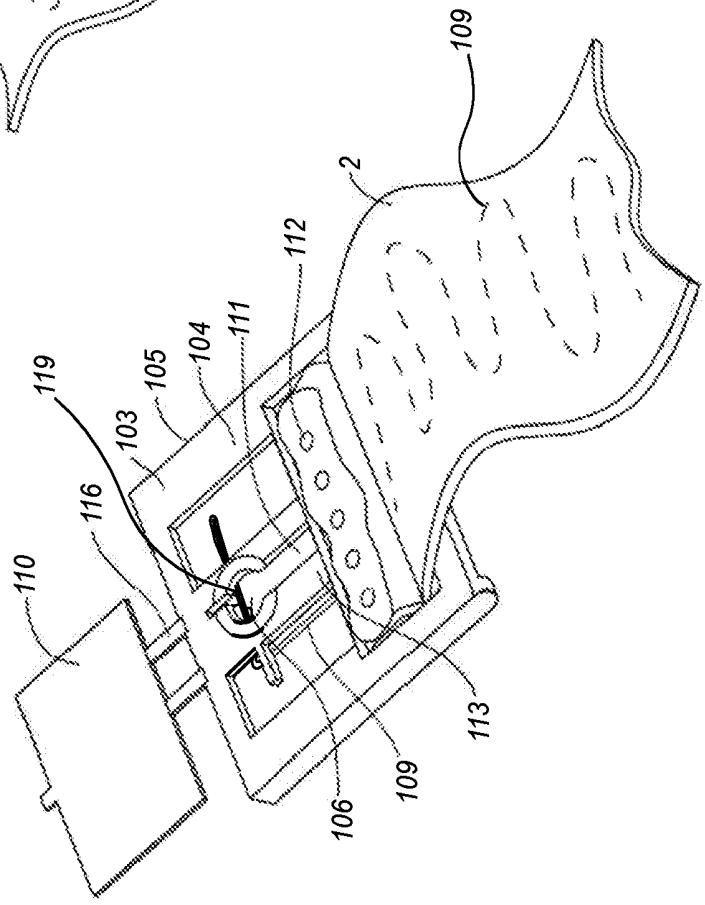
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FIG. 3I

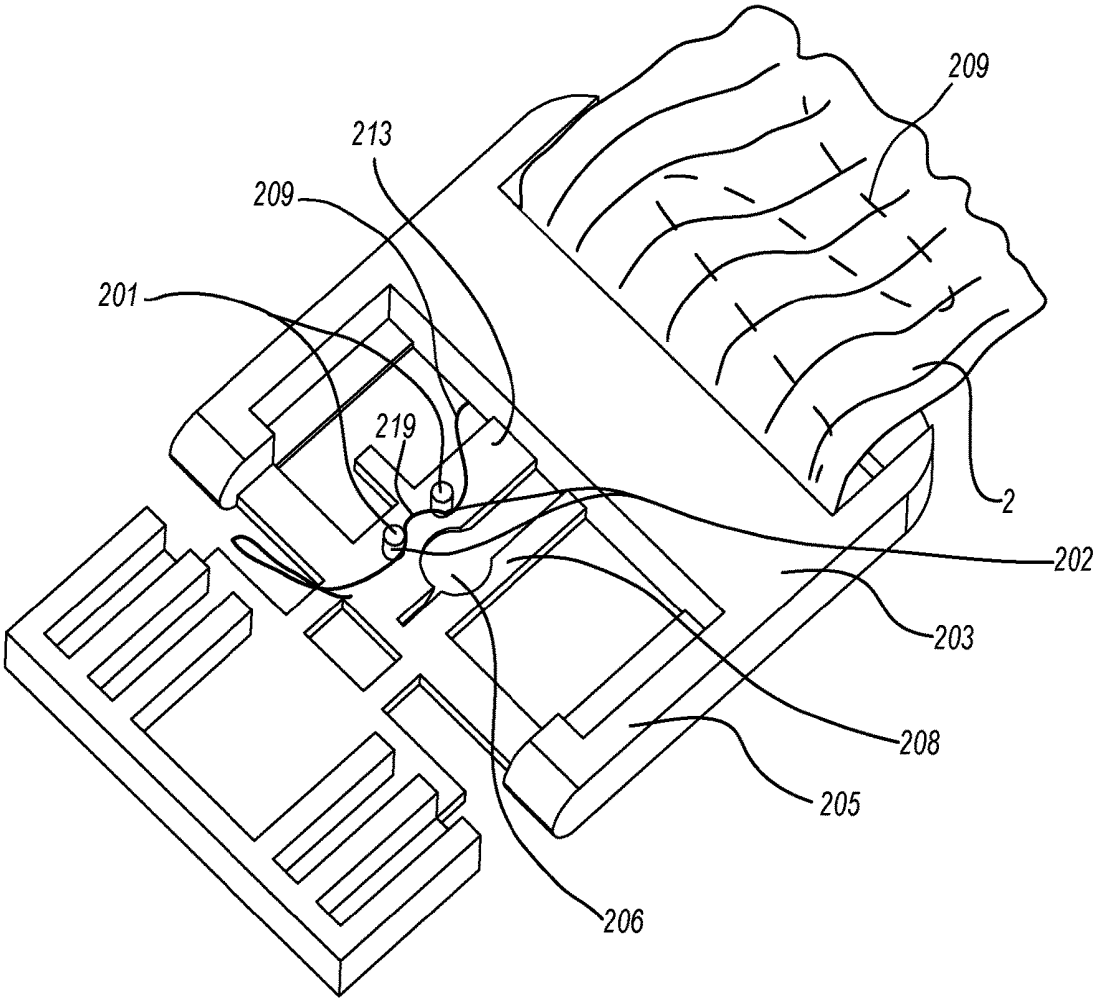

FIG. 4A

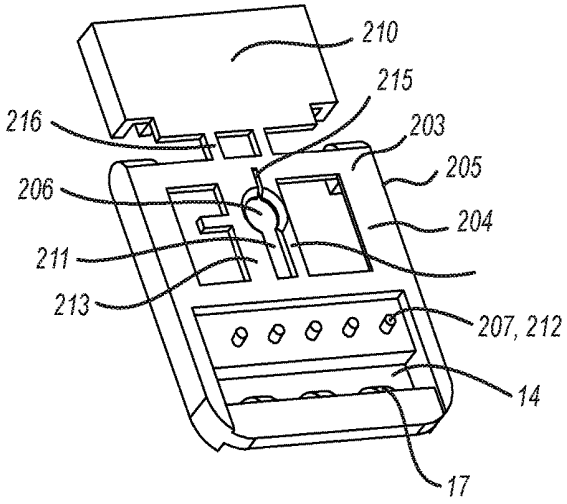

FIG. 4B

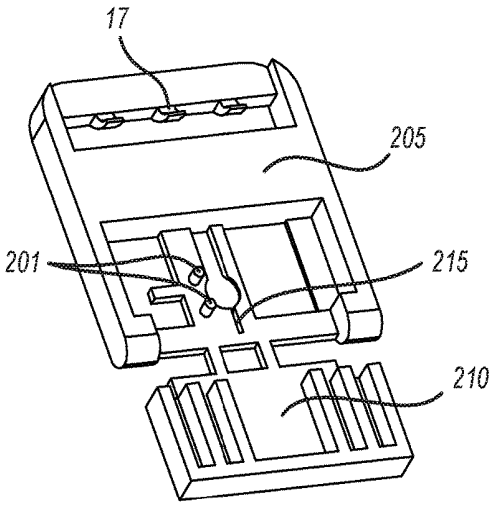

FIG. 4C

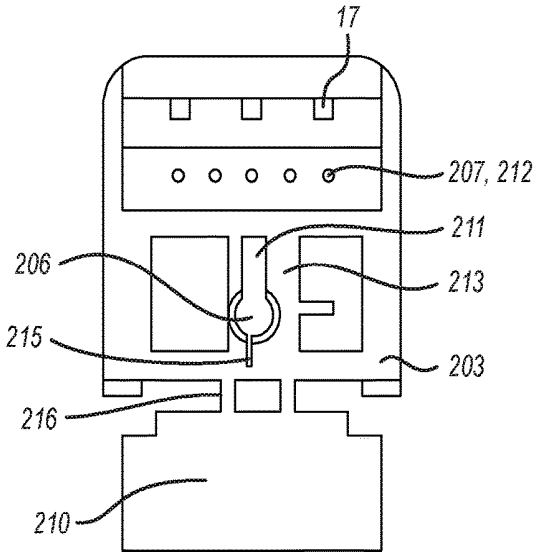

FIG. 4D

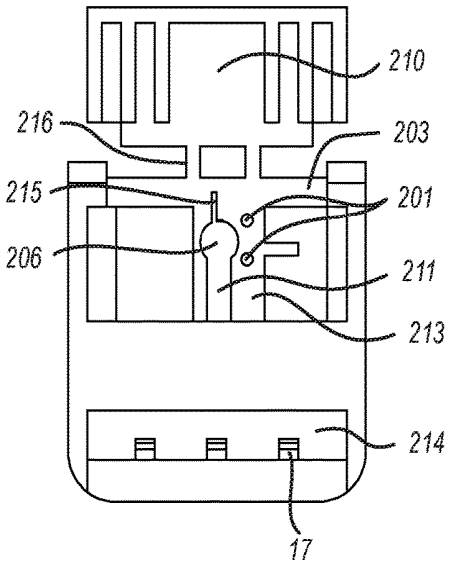

FIG. 4E

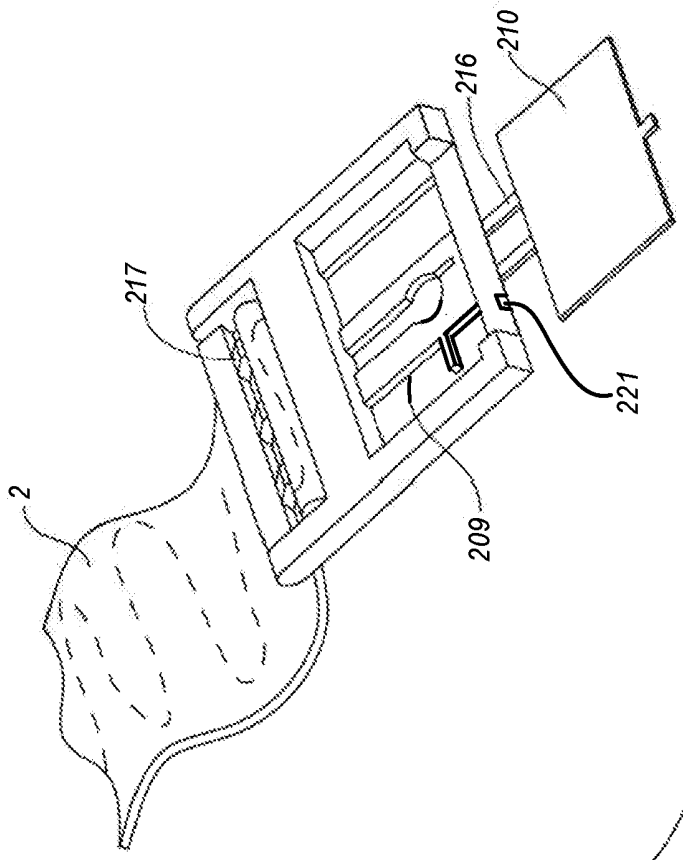
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FIG. 4G

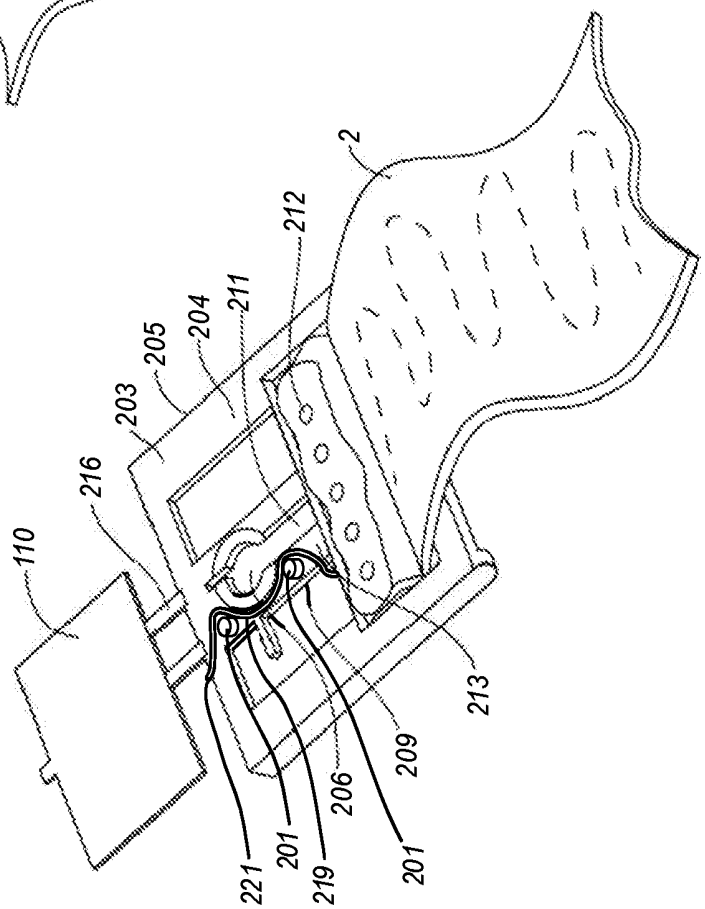
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FIG. 4F

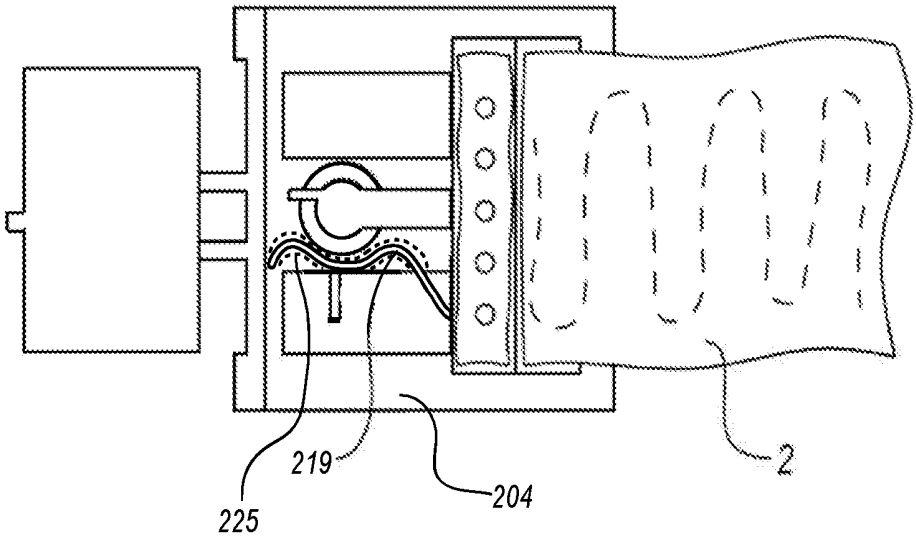

FIG. 4H

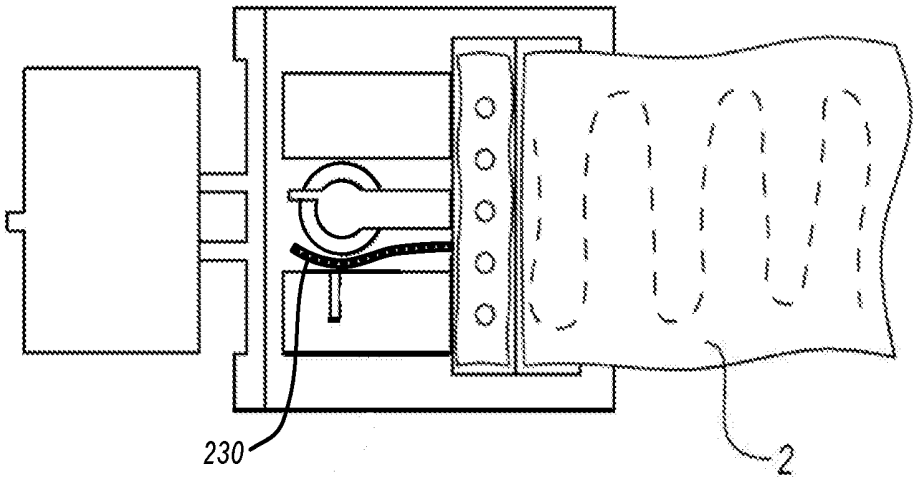

FIG. 4I

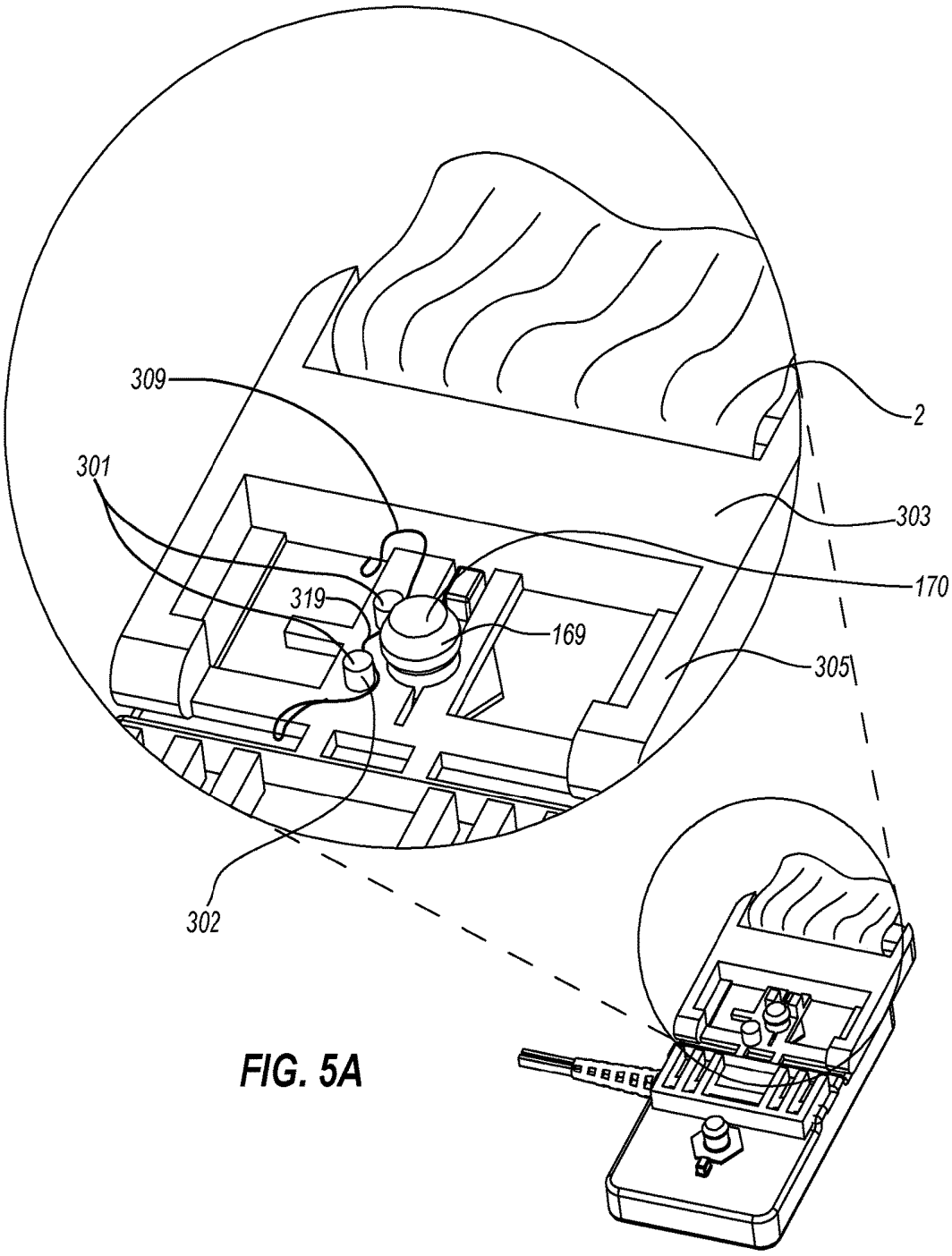

FIG. 5A

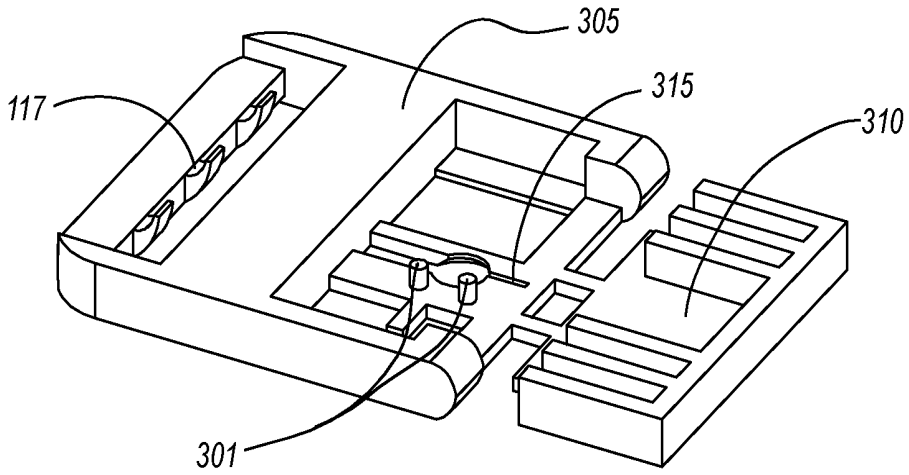

FIG. 5B

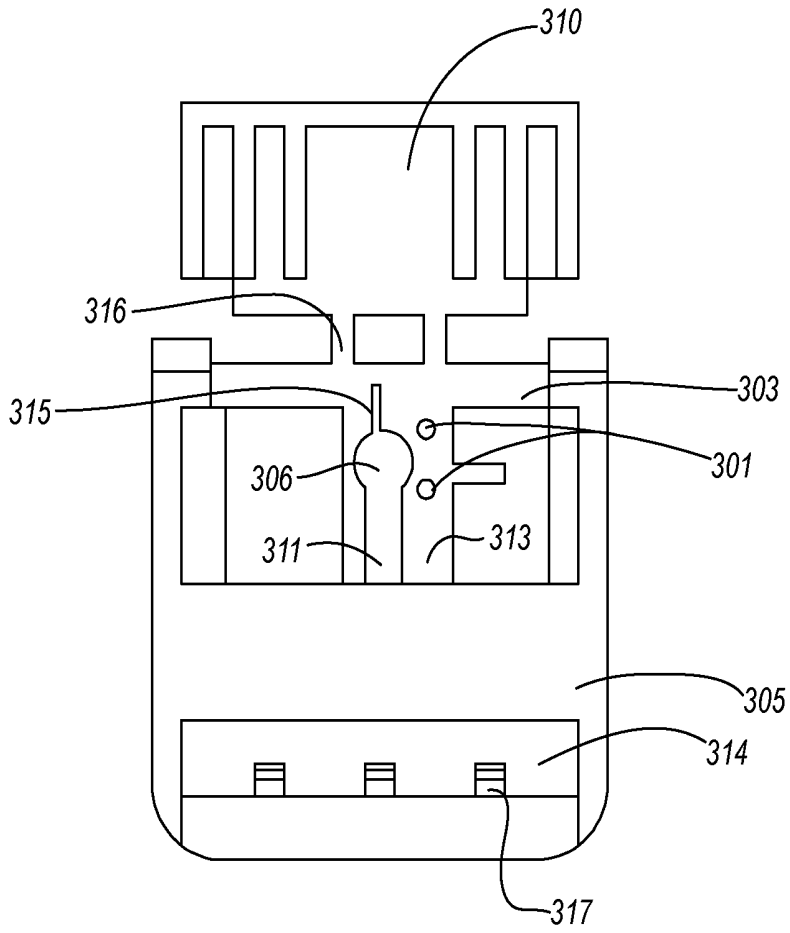

FIG. 5C

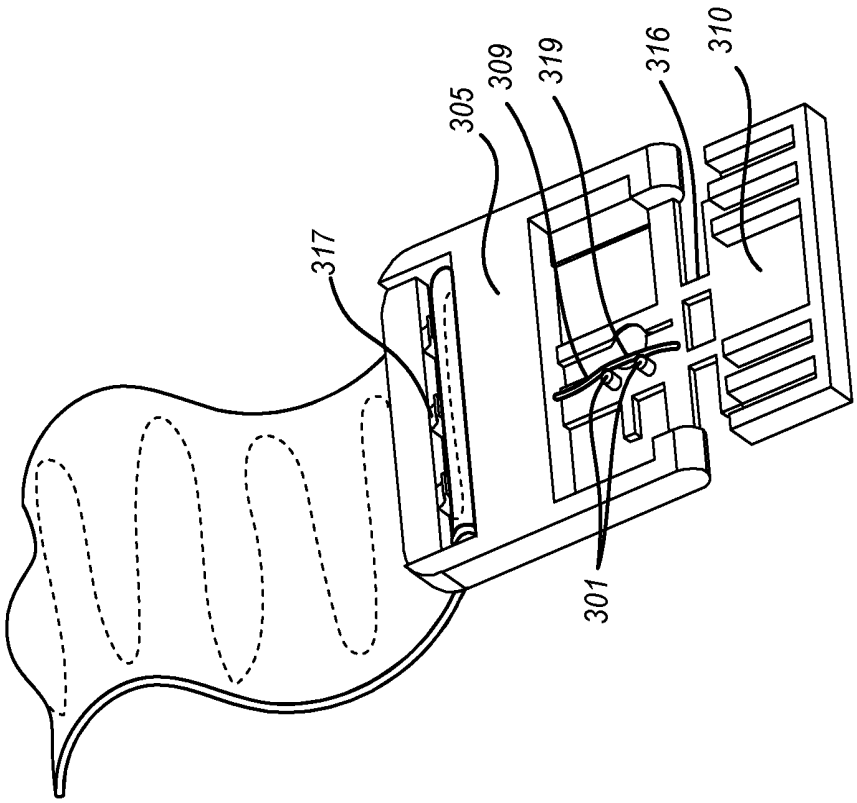
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FIG. 5E

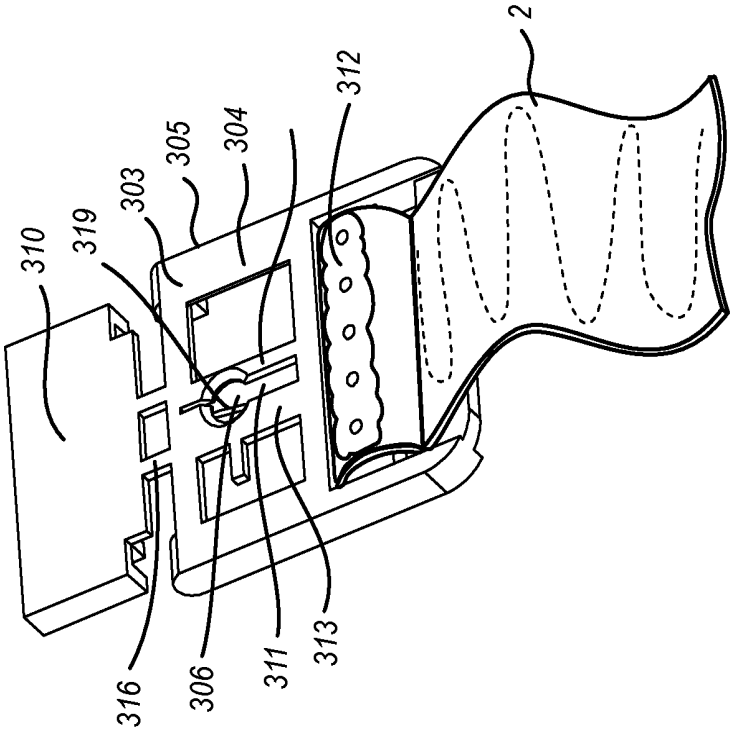
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FIG. 5D

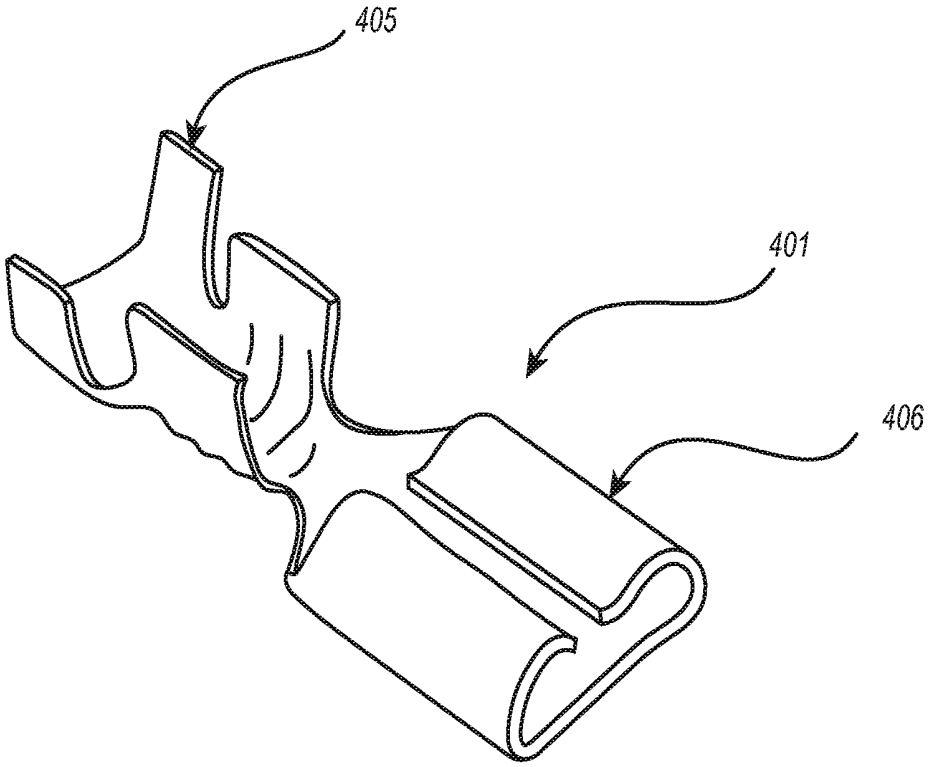

FIG. 6

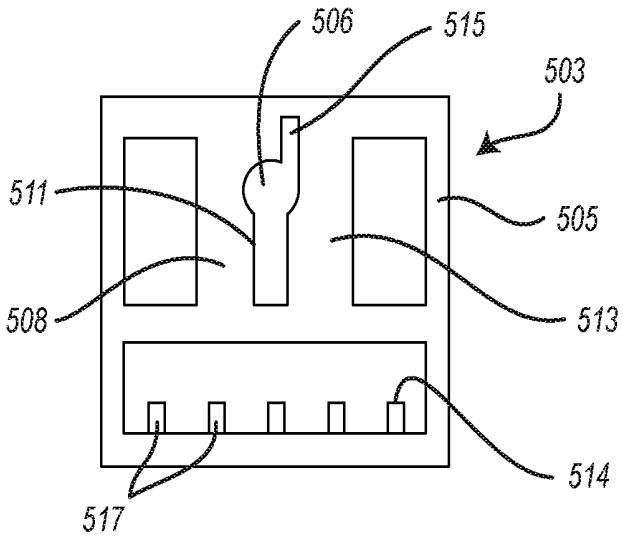

FIG. 7A

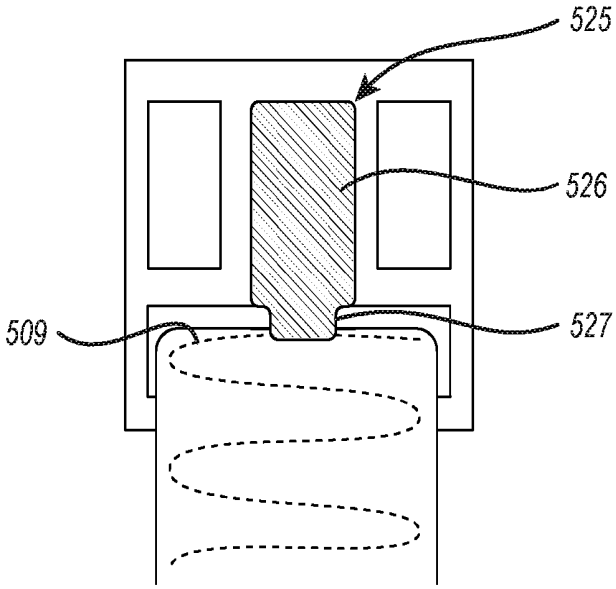

FIG. 7B

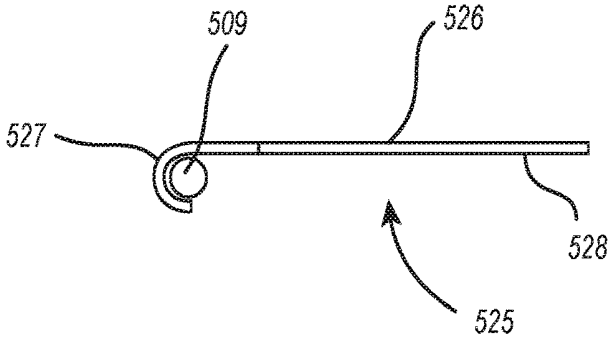

FIG. 7C

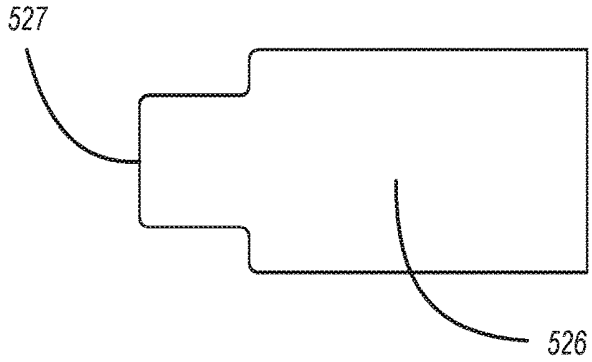

FIG. 7D

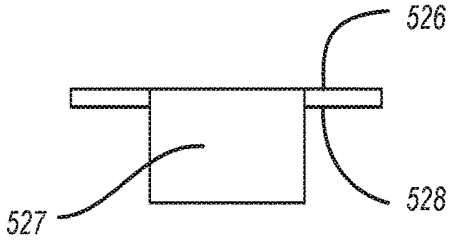

FIG. 7E

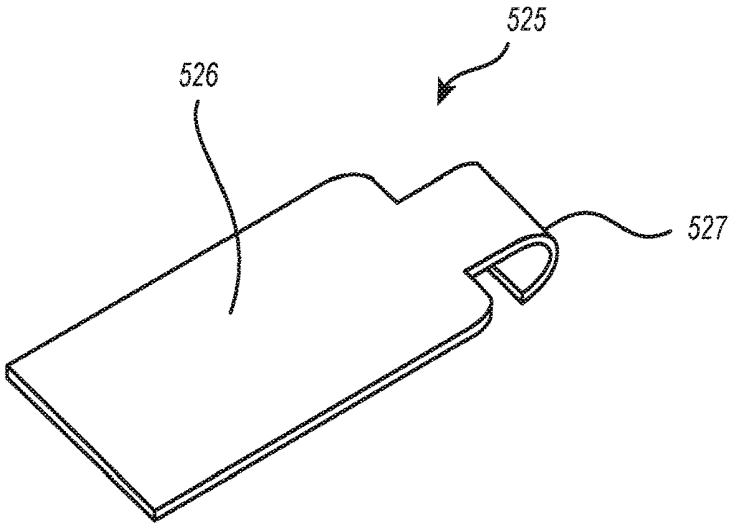

FIG. 7F

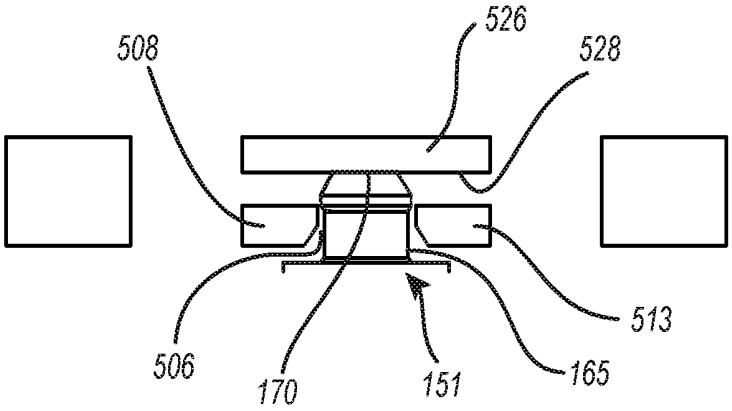

FIG. 7G

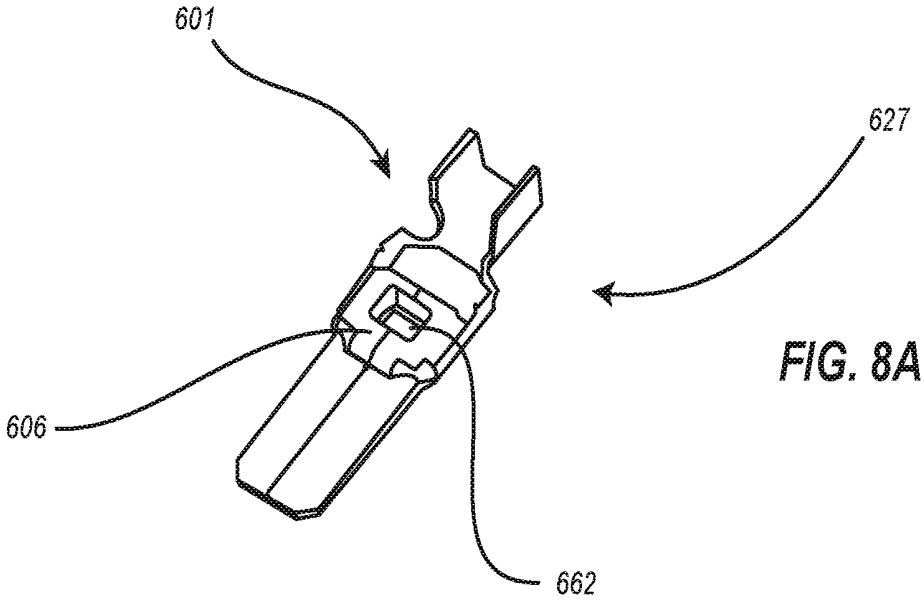

FIG. 8A

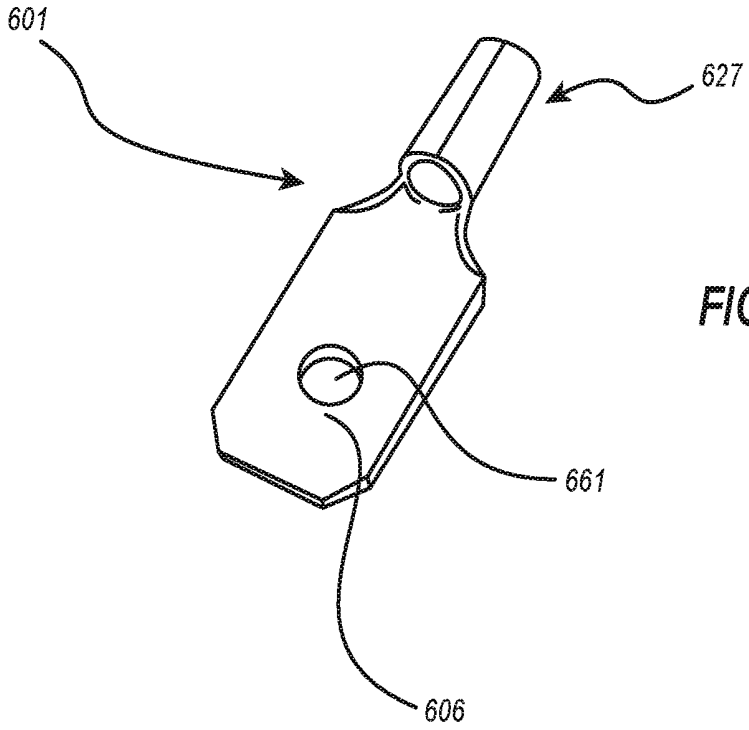

FIG. 8B

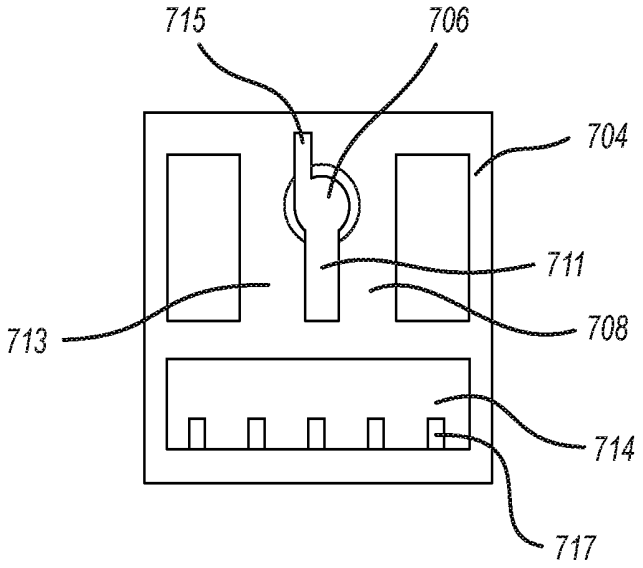

FIG. 9A

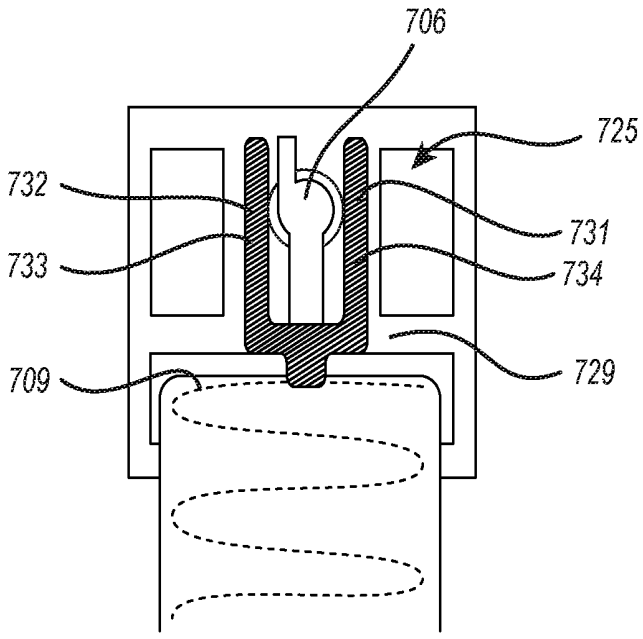

FIG. 9B

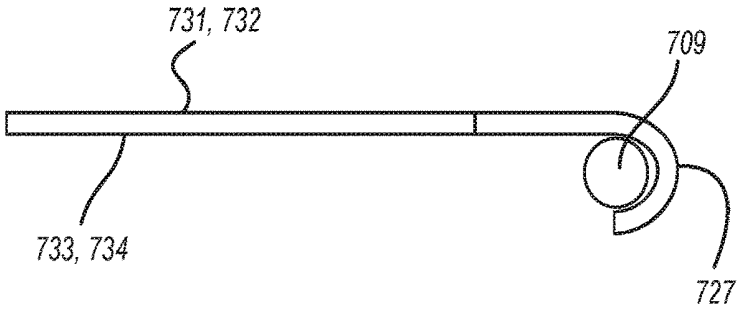

FIG. 9C

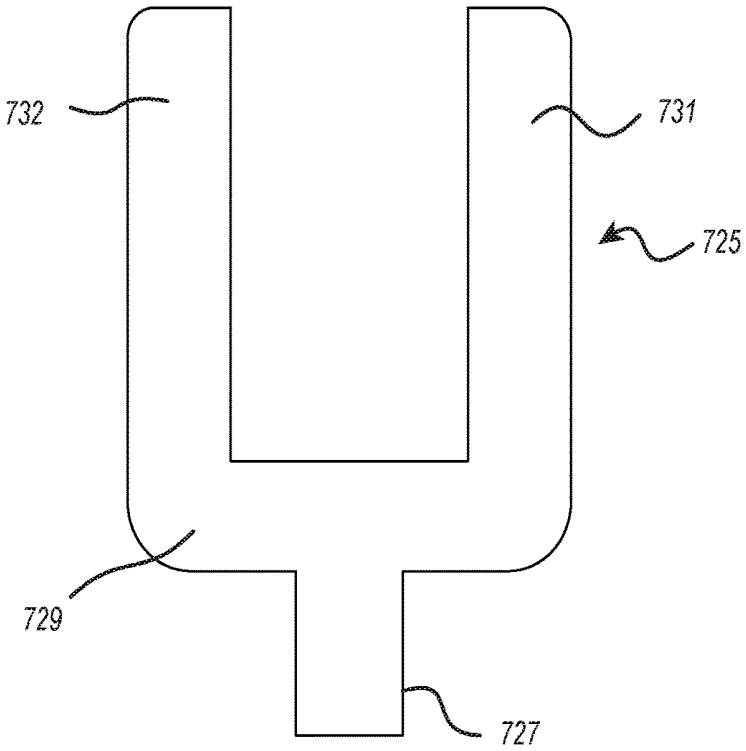

FIG. 9D

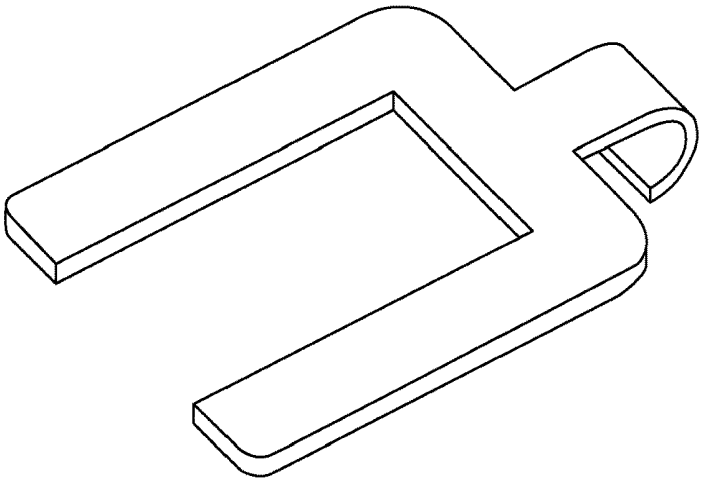

FIG. 9E

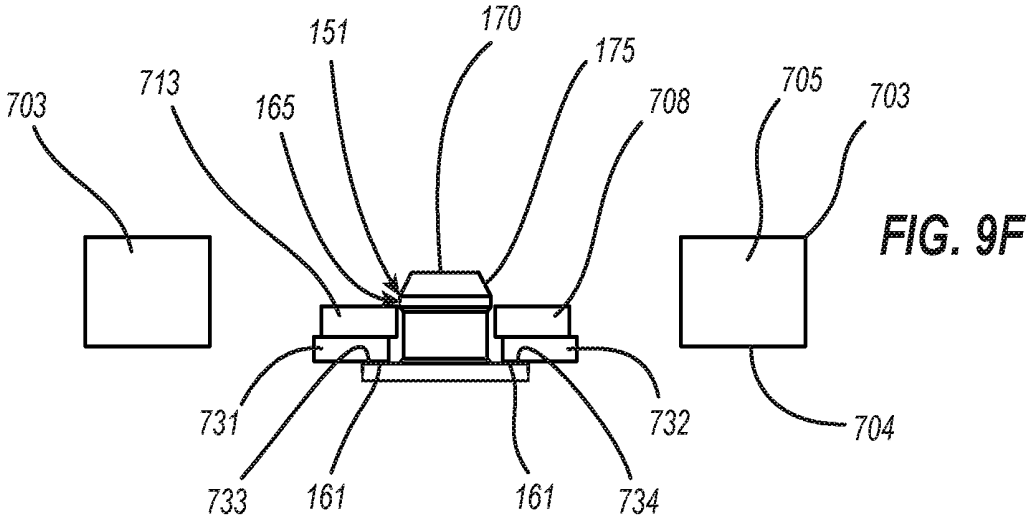
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FIG. 9F

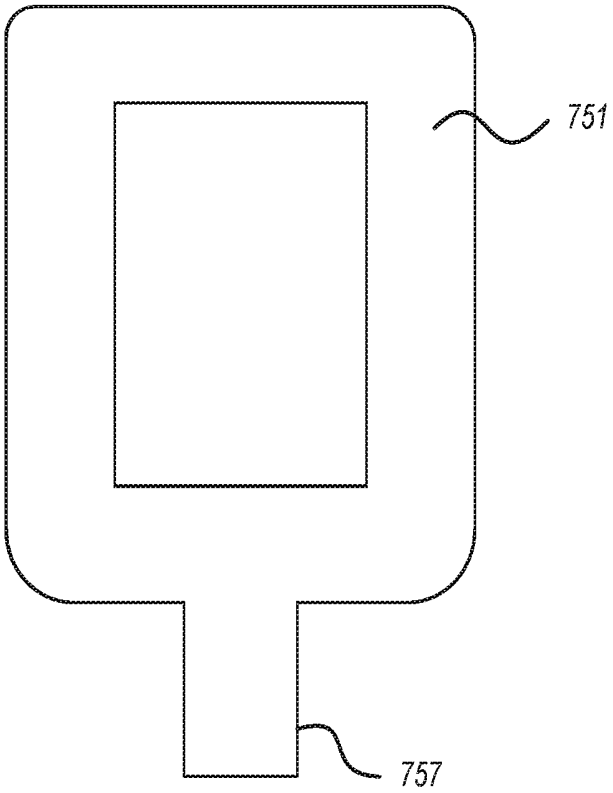
751
757

FIG. 9G

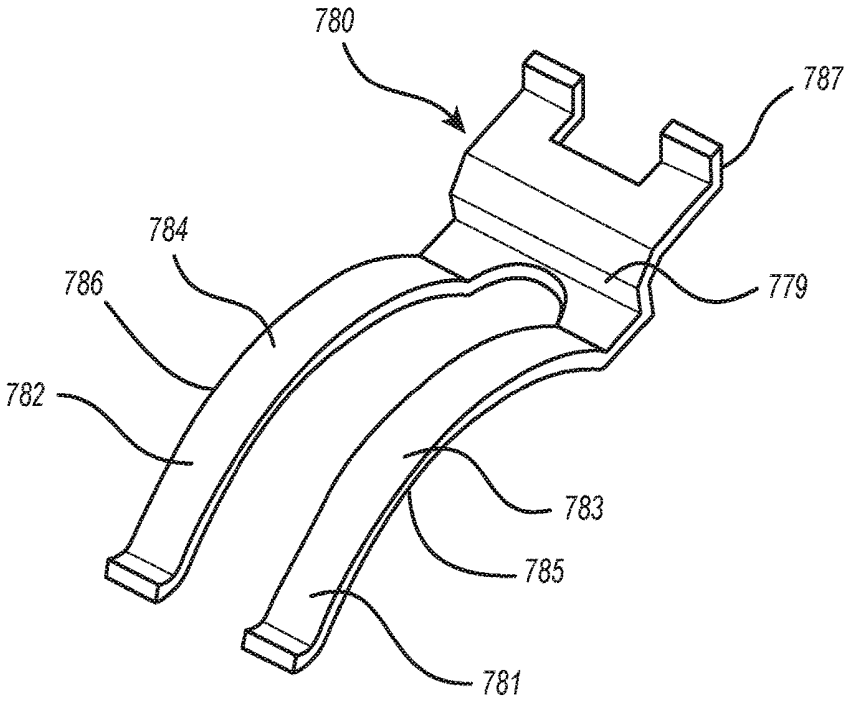

FIG. 9H

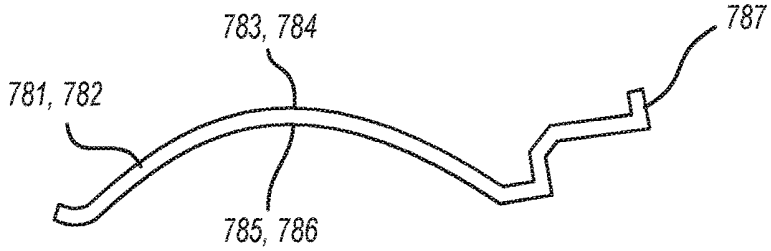

FIG. 9I

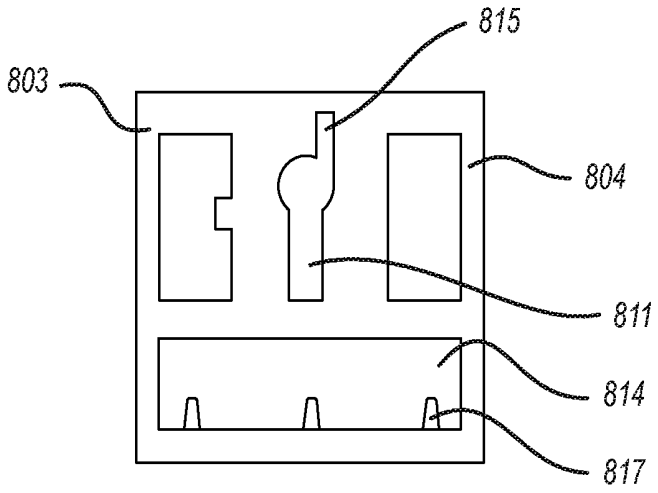

FIG. 10A

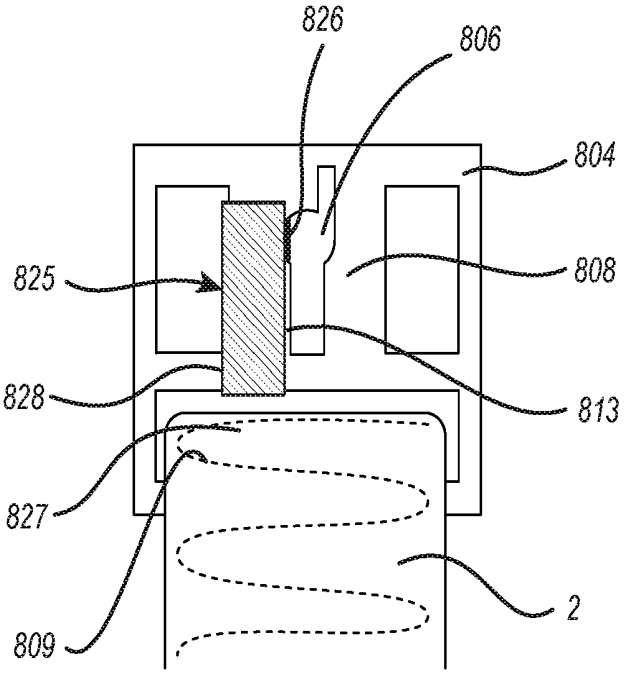

FIG. 10B

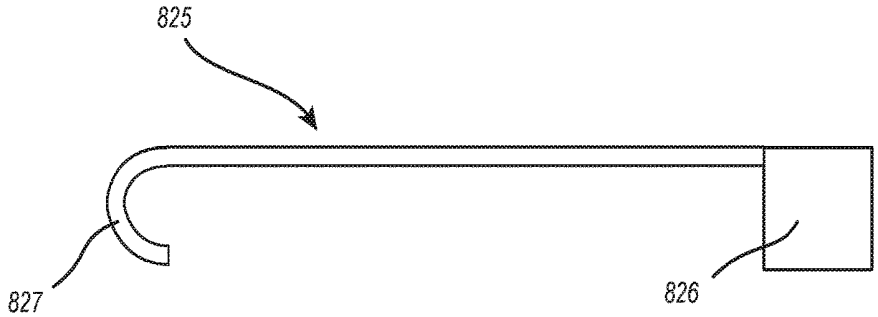

FIG. 10C

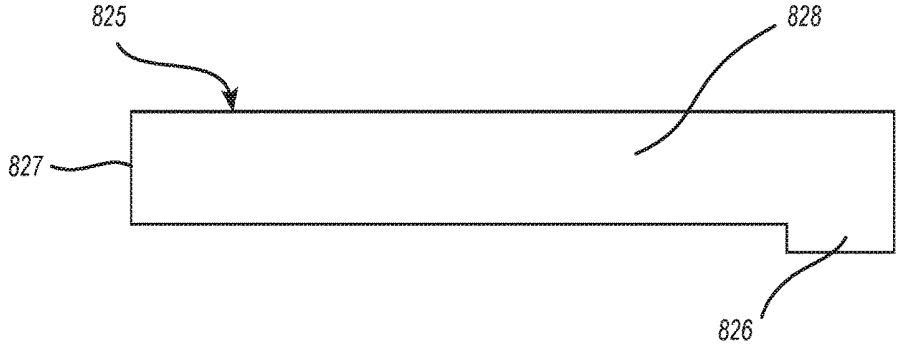

FIG. 10D

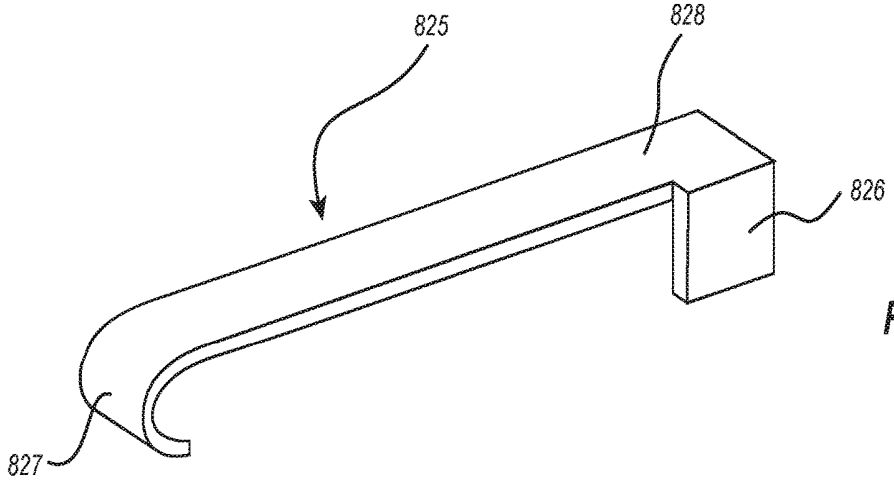

FIG. 10E

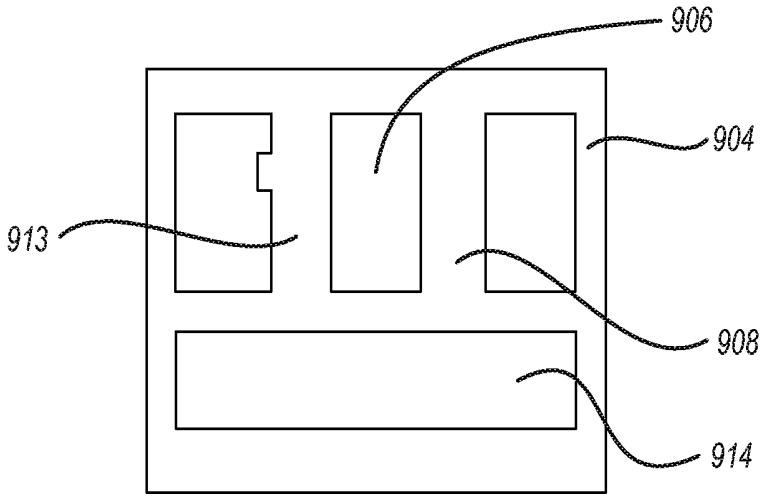

FIG. 11A

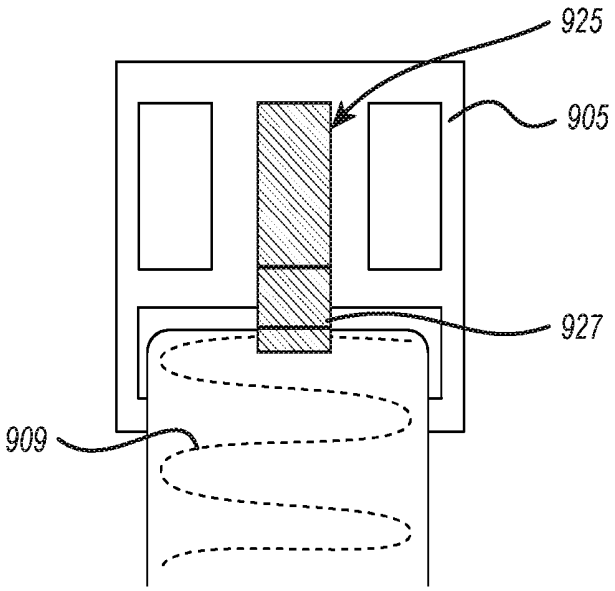

FIG. 11B

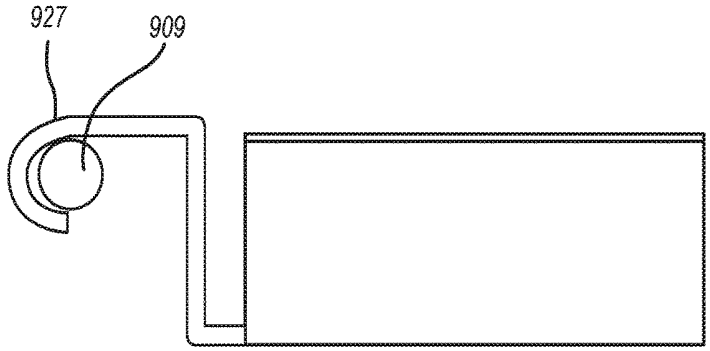

FIG. 11C

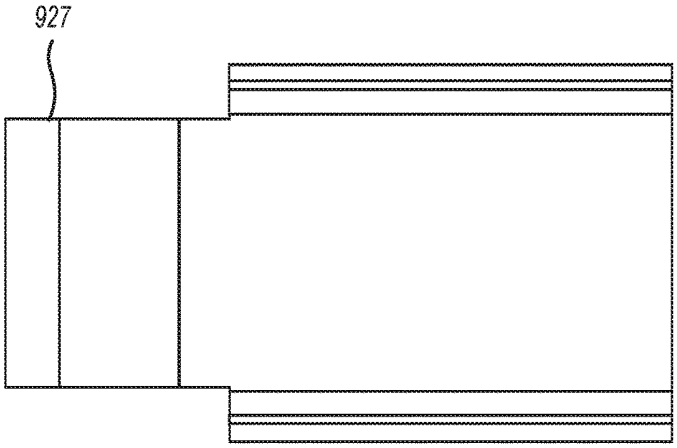

FIG. 11D

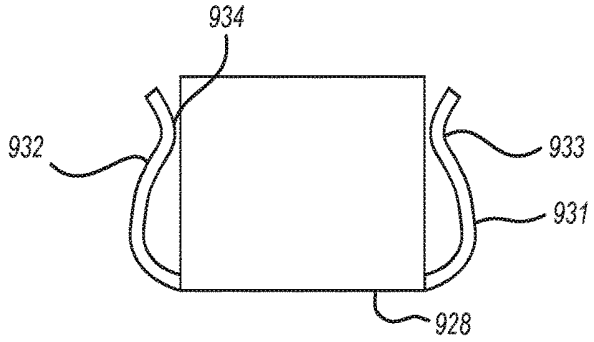

FIG. 11E

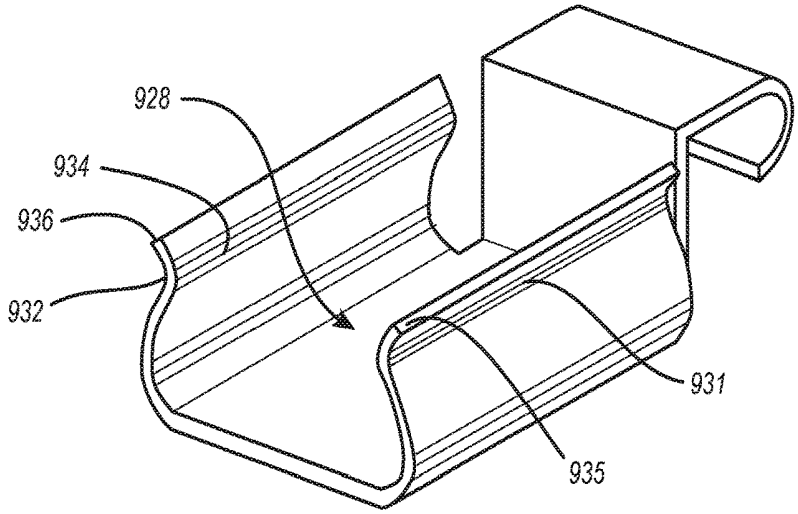

FIG. 11F

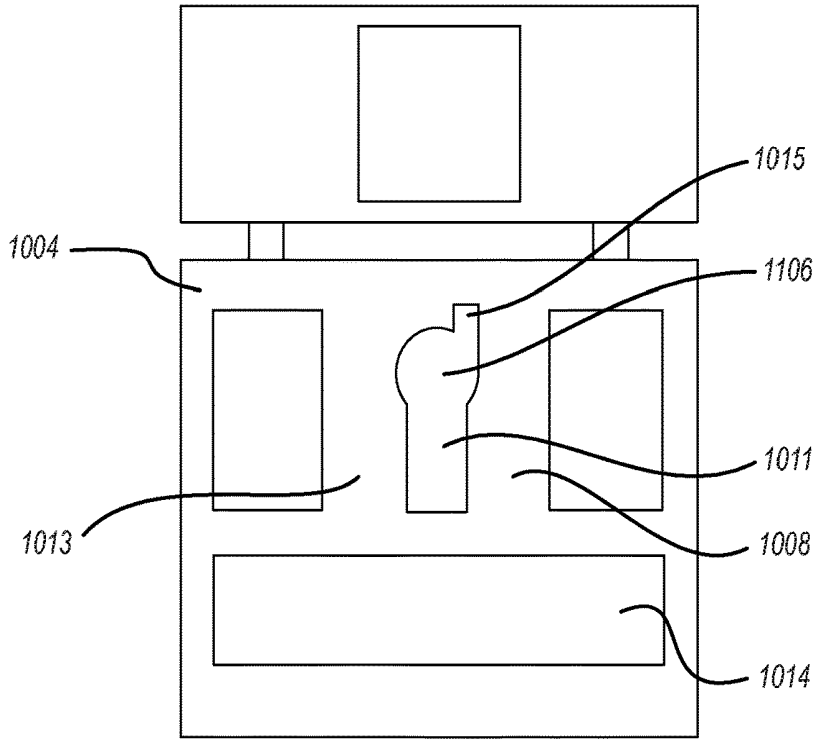

FIG. 12A

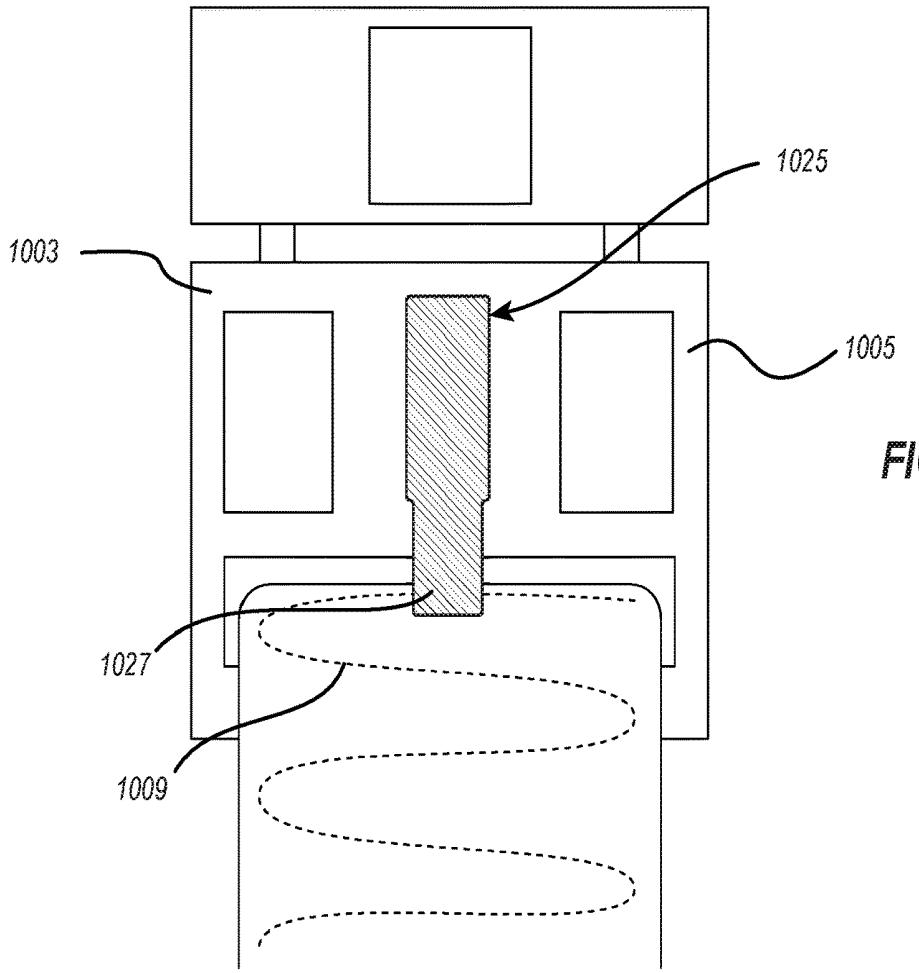

FIG. 12B

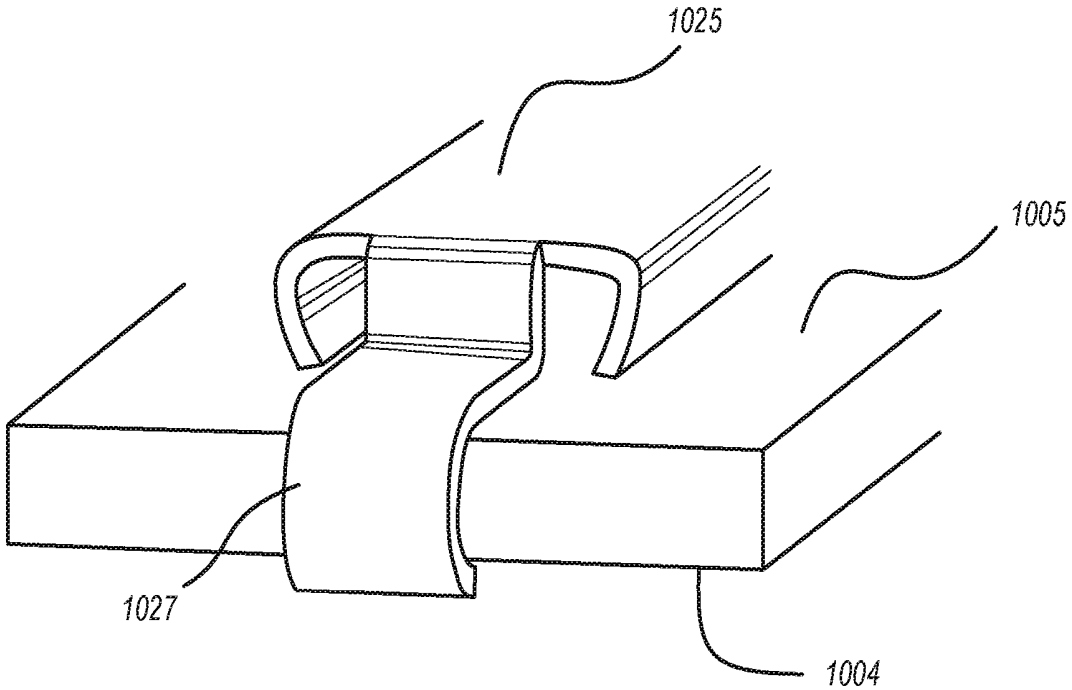

FIG. 12C

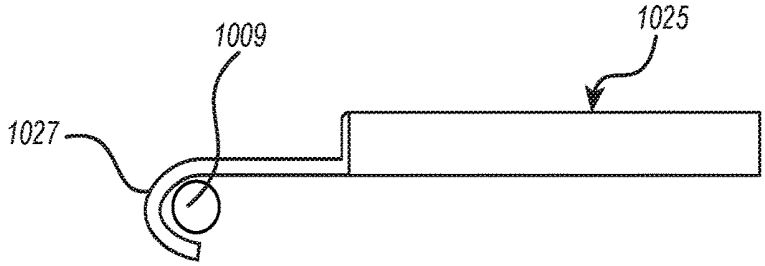

FIG. 12D

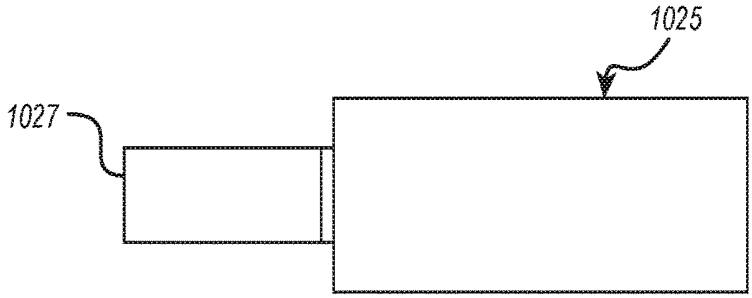

FIG. 12E

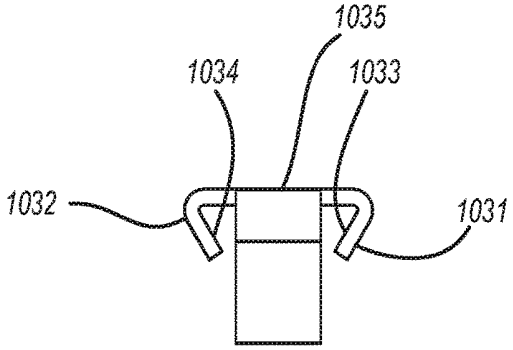

FIG. 12F

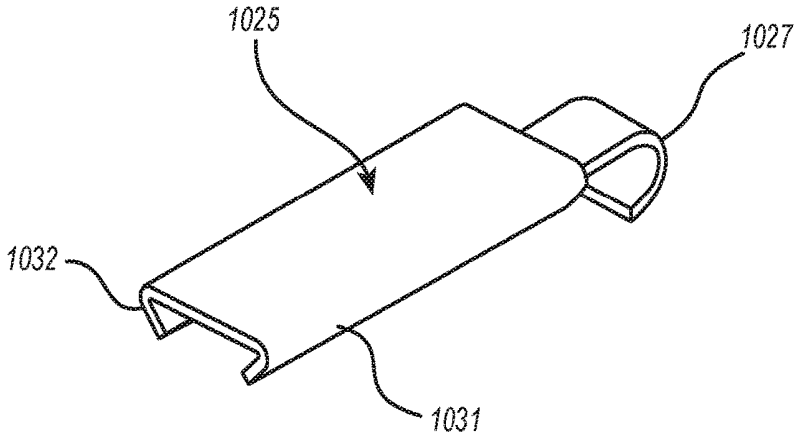

FIG. 12G

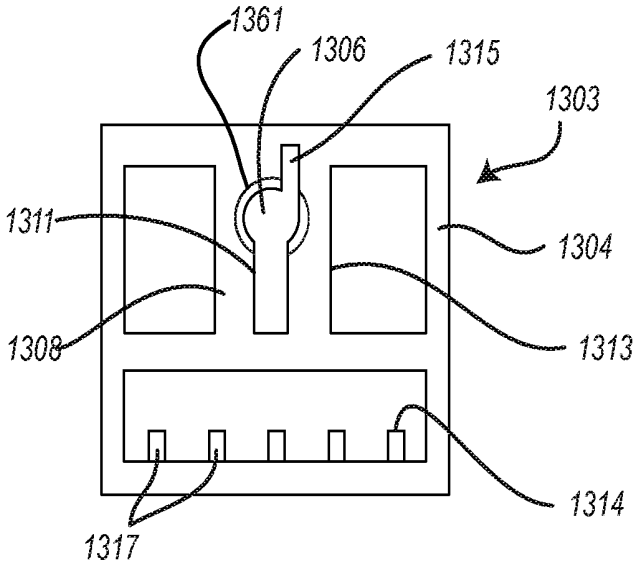

FIG. 13A

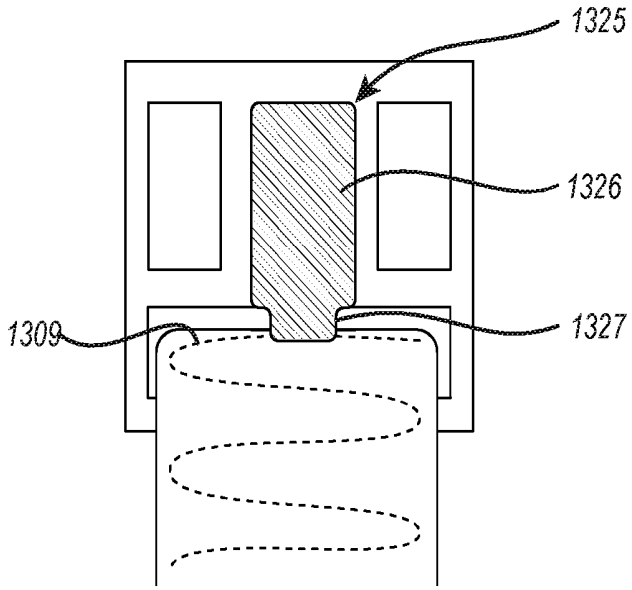

FIG. 13B

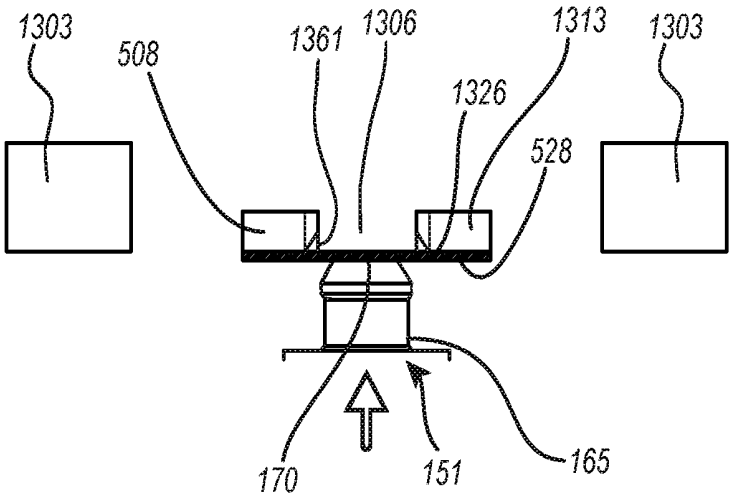

FIG. 13C

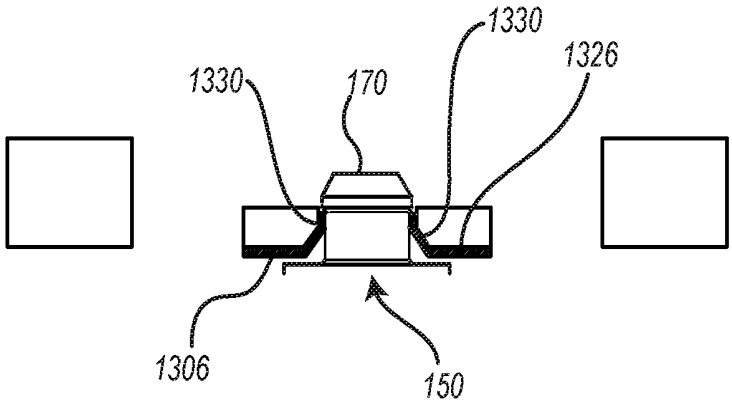

FIG. 13D

BIOMETRIC BELT CONNECTOR

FIELD OF THE DISCLOSURE

[0001] The present disclosure is within the field of medical devices, in particular biometric devices for measuring biosignals, and relates particularly to electrodes for such devices and in particular electrode belts and connectors for such belts.

BACKGROUND

[0002] Electrode belts are known, both for direct contact galvanic electrodes used to measure cardiography signals and inductive belts used in respiratory inductive plethysmography. Such belts have various types of connectors, for transmitting the received signal to the respective device. There remains a need for improved belt connectors that are reliable and easy to use and maintain. Further, due to the signal measured by the electrode belt, there is a need for a reliable and very low-resistance electrical connection between conductor within the belt and an electrical connector of a mating biometric device.

SUMMARY

[0003] The disclosure provides an electrode belt connector for electrically connecting a conductor of an electrode belt to a male snap portion of a snap connector electrode configured to be connected to a biometric device. The electrode belt connector includes a frame defining a receiving hole, the receiving hole being configured to receive a protrusion of the male snap portion of the snap connector electrode. The electrode belt connector further includes an electrically connective portion configured to electrically connect a wire of the electrode belt to the male snap portion of the snap connector.

BRIEF DESCRIPTION OF THE FIGURES

[0004] FIGS. **1**A, **1**B, **1**C, **1**D, **1**E, **1**F, **1**G, and **1**H illustrate a male snap portion of snap connector according to an embodiment.

[0005] FIGS. **2**A, **2**B, **2**C, and **2**D illustrate a frame portion of snap connector according to an embodiment.

[0006] FIGS. **3**A, **3**B, **3**C, **3**D, **3**E, **3**F, **3**G, **3**H, **3**I and **3**J illustrate an electrode belt connector according to another embodiment.

[0007] FIGS. **4**A, **4**B, **4**C, **4**D, **4**E, **4**F, **4**G, **4**H, and **4**I illustrate an electrode belt connector according to another embodiment.

[0008] FIGS. **5**A, **5**B, **5**C, **5**D, and **5**E illustrate an electrode belt connector according to another embodiment.

[0009] FIG. **6** illustrates a conductive connector according to an embodiment.

[0010] FIGS. **7**A, **7**B, **7**C, **7**D, **7**E, **7**F, and **7**G illustrate an electrode belt connector according to another embodiment.

[0011] FIGS. **8**A and **8**B illustrate conductive connectors according to other embodiments.

[0012] FIGS. **9**A, **9**B, **9**C, **9**D, **9**E, **9**F, **9**G, **9**H, and **9**I illustrate an electrode belt connector according to another embodiment.

[0013] FIGS. **10**A, **10**B, **10**C, **10**D, and **10**E illustrate an electrode belt connector according to another embodiment.

[0014] FIGS. **11**A, **11**B, **11**C, **11**D, **11**E, and **11**F illustrate an electrode belt connector according to another embodiment.

[0015] FIGS. **12**A, **12**B, **12**C, **12**D, **12**E, **12**F, and **12**G illustrate an electrode belt connector according to another embodiment.

[0016] FIGS. **13**A, **13**B, **13**C, and **13**D illustrate an electrode belt connector according to another embodiment.

DETAILED DESCRIPTION

[0017] The disclosure provides a belt connector for electrically connecting an electrode belt to a biometric device to be carried on a human or animal body. The belt connector may be made from one single piece which can be economically manufactured in order to function as a single-use consumable, to be used with a matching biometric device. The belt connector may comprise a plastic or a molded plastic frame having a front side and a rear side. The frame may have a receiving hole which has radial flexibility to function as a female snap button fastener to receive and fasten on the front side of the frame a male snap protrusion. The belt connector may further comprises fastening means for fastening to the frame a belt end of said electrode belt, and a member adjacent to said snap fastener receiving hole to engage an electrode wire end electrically connected to said belt such that said wire end is in electrical contact with said hole, either by extending into the hole or coming in electrical contact e.g. through a bridging conductor or a conductive connector, with a conducting male snap fastener inserted in said receiving hole.

[0018] The belt connector and belt may be configured such that a person wearing the belt under operation is insulated from current running through the belt, to meet existing standards for medical devices. The belt connector of the present disclosure is configured accordingly, and in an embodiment, the belt connector may comprises a shield member which is arranged on the rear side of said frame (toward the patient or carrier) to electrically shield the wire end from the rear side exterior of the belt connector.

[0019] The belt connector may comprise a cover enclosing the connector and wire end. The cover may suitably include a pre-perforated hole overlapping the hole of the frame, or in other embodiments is made from such material that can readily be perforated by pressing the connector onto a male fastener which fits the receiving hole of the frame.

[0020] The belt end may be fixedly engaged with the connector and the electrode wire connected to the connector such that the electrode wire is in electrical contact with the female snap fastener hole and thereby comes in electrical contact with a conducting male snap fastener inserted in the hole.

[0021] The belt end may be engaged with the belt connector in a fashion allowing adjustment of the length of the belt.

[0022] The disclosed belt connector is suitable for various types of electrode belts, such as for cardiographic measurements, both in clinical settings or for training purposes, but also for belts such as RIP (respiratory inductive plethysmography) belts.

[0023] As mentioned above, the belt connector is intended for electrically connecting an electrode belt to a biometric device, the term biometric device in this context includes any device that receives electrical biosignals as well as extension cables, intermediate devices, connecting boxes, etc. or other means for receiving and transmitting the biosignals.

[0024] The belt connector may be made from any of various suitable non-conducting materials, including, but not limited to, polymers or plastic materials, such as but not limited to ABS (acrylonitrile butadiene styrene), PC/ABS, polyethylene, e.g. low density polyethylene (LDPE) or high density polyethylene (HDPE), or derivatives such as polyethylene terephthalate (PET) or polyfluoroethylene (PTFE), or polypropylene, polyvinyl chloride, or polyamide (nylon). In other embodiments the connector may be made from paper based material or other material from natural fibers or a rubber material.

[0025] The electrode belt is generally a flexible belt such as commonly used in respiratory inductance plethysmography (RIP) devices. Such an electrode belt may be a flexible textile belt where an electrode wire is interwoven in the belt or can be laminated between two layers, typically in a zig-zag fashion to allow longitudinal elasticity.

[0026] The frame of the connector has a front side and a rear side, which are defined as follows: the front side of the frame faces the biometric device which is fastened onto the connector for operation and the rear side faces away from the device. In an embodiment, the rear side of the connector may face the body of the patient when mounted, i.e. the belt connector comes between the patient and the biometric device. However, the biometric device can also be configured such that the biometric device faces the patient and the belt connectors lie on top of the device, i.e. connects to the device on the face of the device facing away from the patient, thus in such embodiment the front side of the connectors face the patient and the rear side face away from the patient.

[0027] The frame may have or define a receiving hole with radial flexibility to function as a female snap button fastener for receiving and fastening on the front side of the frame a male snap protrusion. A mating biometric device may thus have a corresponding mating male snap fastener which can be fastened securely onto the belt connector. The hole can be shaped circular or semi-circular. Further, the hole may have a shape different from a circular or a semi-circular shape. For example, the hole may any other suitable shape, such as a general elongated shape shaped by two parallel members, suitably including guiding members to ensure proper positioning of the mating male snap member, a square opening, a rectangular opening, an elliptical opening, triangular opening, or a combination of any of such openings.

[0028] The receiving hole may have radial flexibility, which may be achieved by one or more slot extending from said hole.

[0029] FIG. **1**A shows an enlarged view of a portion of a biometric device **15** of FIG. **1**B. As shown in FIG. **1**A, a biometric device **150** may have a mating portion including male snap portion **151** of a snap connector. The male snap portion **151** is electrically connected to the internal electrical leads of the biometric device **150**. As shown in FIGS. **1**A to **1**D, and in the enlarged drawings of FIGS. **1**E to **1**H, the male snap portion **151** may include a male snap foundation **161** from which a male snap protrusion **165** extends. As shown particularly in FIGS. **1**D and **1**H, the male snap protrusion may include a cylindrically shaped protrusion shaft **166** that extends perpendicular or nearly perpendicularly from the surface of male snap foundation **161**. Protrusion shaft **166** may have a lateral surface **167**. On a distal end of the protrusion shaft **166**, the cross-sectional diameter of the male snap protrusion **165** may enlarge at the underside bevel **168**, forming a bulged portion **175**, the bulged portion **175** being formed at the distal end of the male snap protrusion **165**. The underside bevel **168** may extend to a lateral surface **177** of the bulged portion, the lateral surface **177** having a cylindrical shape with a cross-sectional diameter greater than the protrusion shaft **166**. The bulged portion may further have a top bevel **169** where the cross-sectional diameter reduces. A top surface **170** is formed adjacent to the upper edge of the top bevel **169**. Male snap portion **151** is made of an electrically conductive material, including, but not limited to brass, copper, aluminium, steel, gold, or other metals or metal alloys, or even non-metal electrically conducting materials.

[0030] As shown in the embodiments of FIGS. **2**A to **2**D, a biometric belt connector **1** includes a frame **3** configured to be electrically connected to an electrode belt **2**. The frame **3** may have a front side **4** and a rear side **5**, a circular or semi-circular shaped receiving hole **6** with radial flexibility to function as a female snap button fastener. The receiving hole **6** may include a bevelled edge portion **61** on front side **4** to more easily receive and guide a male snap fastener into hole **6**. The frame **3** may be a molded frame, and further may be made from a molded plastic material. Frame **3** may include fasteners **7**, such as pins, which may comprise a ridge member **12**. According to the first embodiment, the ridge member **12** may include a series of butts or pins **7** which are provided transverse or substantially to the belt direction and to which the belt end can be fastened onto with heat melting or gluing. The frame **3** may include two members, first member **8** and second member **13**, that extend adjacent to hole **6**. First member **8** and second member **13** may extend parallel to each other. Or in another embodiment, first member **8** may be arranged at an angle to second member **13**. The two members **8**, **13** may form a first slot **11** that extends from the hole **6**. First member **8** and second member **13** may also form a second slot **15**. Second slot may be formed across the hole **6** from the first slot **11**.

[0031] Thus two slots **11** and **15** may extend across from each other in a direction substantially parallel to a direction of the belt to which the connector **1** is to be connected. The one or more slots may be formed or defined by at least one of the elongated members **8**, **13**. Members **8**, **13** may have flexibility transverse to their longitudinal axis (e.g. by being sufficiently thin), thus imparting flexibility to the width of the hole **6**. The hole **6** may thus be between two elongated members **8**, **13** where one or both have sufficient and suitable flexibility to provide a snap fastener hole with suitable fastening strength.

[0032] Either one of first member **8** or second member **13**, formed adjacent to said snap fastener receiving hole, may engage an electrode wire coming from the belt end. This wire may thus be pushed into electrical contact with a conducting male snap fastener provide in said receiving hole, either by extending into the hole, through the hole a single time or extending through the hole multiple times, for example, by being wrapped around one or both of the first member **8** or the second member **13**, or coming in electrical contact with the hole, e.g., through a bridging conductor or conductive connector.

[0033] The elongated members **8**, **13** and slots **11**, **15** may be formed to provide the hole **6** with sufficient flexibility (i.e. elasticity in the width of the hole) to function as a female snap fastener. The member **13** may also function to engage an electrode wire end **9** from the belt end electrically

connecting the belt **2** with the hole **6** and which comes in electrical contact with a conducting male snap fastener inserted in said hole. The connector further comprises a belt slot **14** with teeth members or pins **17**, through which slot a loop of said belt **2** can be inserted such that it is held by the teeth/pins when pulled back, to adjust the length of the belt.

[0034] The connector further comprises a shield member **10** which may be molded in one piece with the frame **3** and joined to the frame with foldable hinges **16** such that the shield member **10** can be folded over to cover the rear side **5** of the hole **6** and wire end **9**.

[0035] In one embodiment, the wire end may be crimped onto said member such that the crimping tubing fixes the wire and conducts and connects electrically the wire to the receiving hole, such that thus the wire and the belt is in electrical contact with a conducting male snap fastener inserted in said receiving hole.

[0036] The slot mentioned above can also function to provide an additional opening for a mating male projection on the biometric device. By this arrangement it is assured that the device cannot be (or is unlikely to be) incorrectly fastened, and the device will not fit any generic non-proprietary belts having connectors with female fasteners but without the correctly shaped and placed extended hole.

[0037] The connector frame has in another embodiment a separate further hole, not joined to the main fastener and electrical connection hole, where the further hole can mate with a corresponding male projection on said biometric device. Alternatively, the biometric device can have a female hole for mating with a corresponding male projection on the belt connector.

[0038] The connector frame further comprises a fastener to fasten the frame to a belt end of an electrode belt. The fastener can in one embodiment comprise a slot with a row of teeth, pins or hooks, transverse to the belt direction, to engage a belt end. The belt slot provides for insertion of a loop of the belt through the belt slot to be held securely by the row of teeth, pins, or hooks, such that the belt length is adjusted and fixed, so that a user can later re-adjust the length.

[0039] In another embodiment, the fastening means comprise a ridge member, which can be a flat or sharp elongated ridge or ridge or row comprising pins or hooks, which ridge lies transverse to the belt direction and to which a belt end can be fastened onto with heat melting or gluing. Alternatively, the ridge member can have pins hooks that grab onto the belt fabric without need of heating.

[0040] The frame may also have an adjustment slot for user adjustment of the belt, which can configured with either of the two described fastening means, the adjustment slot having a row of teeth, pins or hooks transverse to the belt direction, through which adjustment slot a loop of said belt can be inserted, which hooks onto the teeth/pins when pulled on, such that the length of the belt can be readily adjusted but also secured in the desired adjusted length.

[0041] The connector may include a cover substantially or essentially fully enclosing the frame, which cover either includes a pre-made hole overlapping the receiving hole of the frame, or can be readily perforated by pressing the connector onto a male fastener which fits the receiving hole of the frame. A suitable cover can be arranged by a suitably sized paper, plastic or fabric sticker (foldable sheet with glue on one side) which sticker is folded over the frame after the belt end has been fastened and the wire end electrically connected to the receiving hole, or the cover can be from but not limited to a paper envelope, a plastic envelope and a textile envelope, which envelope is suitably fastened by gluing, sewing or the like.

[0042] In the embodiments where the biometric device has a further male projecting member which fits within the slot of the frame or within a separate mating hole, the cover is suitably arranged with corresponding openings for such hole or slot for receiving such mating male member, and the cover may also have a suitable hole allowing the protrusion of a male protruding member being a part of the frame which fits in a mating receiving hole or slot on the mating biometric device.

[0043] In an embodiment, the connector comprises a shield member which is arranged on the rear side of the frame to electrically shield the wire from the rear side exterior of the belt connector. The shield member is in one embodiment a sheet member extending from the frame, which sheet member is configured to be folded over onto the rear side of the frame to cover said hole and engaged wire. Such shield member molded in one piece with the frame with enough strength but suitably flexible to allow folding at least once without braking allows the use of a cover enclosing the frame, which cover need not be electrically insulating, as the shield insulates the only part of the connector which could conduct electrical current of the connector, except through the hole.

[0044] According to another embodiment illustrated in FIGS. **3**A to **3**J, instead of threading an end portion of the electrode wire through the receiving hole, an end portion **109** of an electrode wire from belt **2** is arranged to extend across or bypass a portion of the receiving hole **106** defined in frame **103** by first member **108** and second member **113**. Thus, the end portion of electrode wire **109** is arranged to extend across the receiving hole **106** on the rear side **105** of the frame **103** (the rear side **105** being the side of the frame **103** that is opposite of the frame from the front side **104** of the frame **103** that is positioned in contact with the biometric device).

[0045] According to the embodiments of FIGS. **3**A to **3**J, the belt connector **101** is configured such that when the male snap portion penetrates the hole **106**, radial flexibility of first and second members **108** and **113** fasten the frame to the male snap portion, and upon fastening the frame to the male snap portion, a contact portion **119** of the wire **109** provided in belt **2** is forced into contact with a distal portion of the male snap portion, for example, the contact portion **119** of the wire is forced against the top surface **170** or a surface of the top bevel **169** of the male snap portion **151** or both. According to the embodiment of FIGS. **3**A to **3**J, a reliable electrical connection between the contact portion **119** and the male snap portion **151** can be secured. According to the embodiment, the electrode wire **109** can be formed into a looped portion **121** to provide additional (e.g. doubled) surface area as the contact portion **119** of the wire. Additionally, an inside surface of the shield **110** or an additional lid may provide structural support to force the contact portion **119** of the electrode wire into secure contact with the male snap portion **151**.

[0046] The contact portion **119** of the electrode wire can be held in place by passing or extending across the receiving hole **106** through various means. For example, as shown in FIGS. **3**E, **3**F, and **3**H, a contact member **101** may be formed adjacent or near hole **106**, and contact member **101** may

have a lateral surface **102** configured to exert a lateral force onto an area of contact portion **119** of the electrode wire. Thus, the contact portion **119** of the electrode wire can be maintained in position. Although not shown, multiple contact members **101** may be formed or defined by frame **103** to hold contact portion **119** of electrode wire **109** to extend across a rear side **105** of said frame **103**. Similarly, although not shown, contact portion **119** may be held in place by an adhesive applied to a portion of first member **108** or second member **113**. Or in another embodiment, a groove or a recess portion, or a plurality of grooves or recess can be formed in a portion of the frame adjacent to hole **106**, for example, on the rear side **105** of the frame **103** at first member **108** or **113**, or both. The groove(s) or recess portion(s) can be configured to at least partially envelop a portion of electrode wire **109** to maintain a contact portion **119** of the electrode wire to extend across or bypass the receiving hole **106**. Alternatively, although not shown, a contact member, adhesive, or groove me similar be formed or applied to an inside surface **197** of shield **110** or an additional lid structure, to maintain the contact portion **119** in place against, for example, the top surface **170** of the male snap protrusion **151**.

[0047] According another embodiment, as shown in FIGS. **4**A to **4**I, a contact portion **219** of an end portion of the belt electrode wire **209** is held on a rear side **205** of the frame **203** (the side of the frame **203** facing toward the biometric device). According to this embodiment, the contact portion **219** of electrode wire end **209** extends substantially along the rear side **205** of second member **213**. Accordingly, when the male snap portion is inserted and snapped into hole **206**, the contact portion **219** of the electrode wire end **209** is forced into contact with a surface of the male snap foundation **161**, or a portion of the lateral surface of the protrusion shaft **167**, or both. According to this embodiment, a reliable and repeatable electrical connection between the contact portion **219** of the electrode wire end **209** and the conductive male snap portion can be secured upon inserting and fastening the male snap portion **151** into receiving hole **206**.

[0048] As shown in FIG. **4**B-**4**D, contact members **201** can extend from frame **203** in a direction substantially perpendicular to the electrode wire end **209**. Contact members **201** may each have lateral surfaces **202** configured to hold the contact portion **219** in place near the receiving hole **206**. Similarly, electrode wire end **209** maybe formed to have a looped portion **221** to provide additional wire and area to contact portion **219** to contact the surface of male snap foundation **161**.

[0049] In addition to, or alternatively to, the contact members **201**, the contact portion **219** of the electrode wire **209** may be held or secured in place by an adhesive **225** applied to a front side **204** of second member **213**, as shown in FIG. **4**H. Or alternatively, or in addition to the contact members **201** or an applied adhesive, a groove or recessed portion **230** may be formed in a surface of first or second member, the groove or recessed portion **230** (FIG. **4**I) being arranged to at least partially hold or secure the contact portion **219** of electrode wire **209** in place, at the front side **204**, or alternatively at rear side **205** of the frame **203** in sufficiently close proximity to receiving hole **206** to make contact with the male protrusion **151** when inserted into receiving hole **206**. First member **208** and second member **213** thus provide a resilient force not only to the male protrusion **151** when it penetrates through receiving hole **206**, but first member **208** and second member **213** may also provide a contact force to push the contact portion **219** into a secure and reliable connection with a surface of the male snap foundation **161**, or a portion of the lateral surface of the protrusion shaft **167**, or both.

[0050] According to another embodiment, as shown in FIGS. **5**A to **5**E, a contact portion **319** of electrode wire **309** is held in place on a rear side **305** of frame **303**, such that when the male protrusion **151** penetrates through receiving hole **306**, the contact portion **319** is forced to the side of the hole **306** such that at least a portion of lateral surface **167** of protrusion shaft **166**, a lateral surface **177** of bulged portion **175**, a surface of top bevel **169**, and/or a surface of underside bevel **168** is forced into contact with contact portion **319**. Contact portions **319** may also be held in position by structural support from an inside surface of shield **310**. According to the embodiment of FIG. **5**A, contact members **301** having lateral surfaces **302** may be provided to hold the contact portion **319** in place and exert a lateral force upon contact portion **319** when the male snap portion **151** penetrates hole **306**. Contact members **301** may be formed of various shapes so long as they provide the lateral support and force. As shown in the embodiment of FIG. **5**A, the contact portions **319** may have a circular cross-sectional shape, but other shapes may also be used, such as square, rectangular, semi-circular, or a shape having a lateral surface **302** with a concave surface area. There may be a single contact members, or as shown in FIG. **5**A, two or more contact members **301** may be provided.

[0051] In addition to, or alternatively to, the contact member(s) **301**, the contact portion **319** of the electrode wire **309** may be held or secured in place by an adhesive applied to first or second member. Or alternatively, or in addition to the contact members **301** or an applied adhesive, a groove or recessed portion may be formed in a surface of first or second member **308**, **313**, the groove or recessed portion being arranged to at least partially hold or secure the contact portion adjacent to the rear side of the receiving hole **306**. Alternatively, a contact member, adhesive, or groove, or other means, may be provided on an inside surface of shield **310** or another lid structure to maintain the contact portion **319** in lateral contact with the male snap portion **151** when inserted into hole **306**.

[0052] In other embodiments, as shown in FIG. **6**, a conductive connector or bridging conductor may be used to contact a surface of the male snap portion. Such a conductive connector may include an electrical crimp shoe **401**, including a wire connector **405** and a contact portion **406**, the wire connector **405** being configured to be connected (such as by crimping) to an end portion of the electrode wire of the belt. The contact portion **406** may be arranged with the belt connector frame in such a way as way to contact a surface of a male snap portion **151**. A belt connector according to such an embodiment may provide a reliable and easily repeatable connection between a biometric device and a wire belt electrode.

[0053] According to an embodiment, as shown in FIGS. **7**A to **7**G, a frame **503** may be provided having a rear side **505**. The frame may include a first member **508** and a second member **513** that define a receiving hole **506**. The first member **508** and second member **513** may further define a first slot **511**, and may additionally define a second slot **515**. The frame **503** may further include a belt slot **514** with teeth **517** configured to attach the frame **503** to a belt **2**, as shown in FIG. **7**B.

[0054] A conductive connector **525** may be provided and coupled at least partially to the surface of the frame **503** at the rear side **505** of the frame (opposite from the biometric device connector). Conductive connector **525** may include a contact plate **526** that covers, at least partially or entirely, the receiving hole **506**. Conductive connector **525** may further include a wire connector **527**, which may be a wire crimp configured to be crimped onto an end portion **509** or an electrode wire end of belt **2**. As shown in FIG. **7**C, contact plate may have a contact surface **528** configured to at least partially contact a top surface **170** or a portion of top bevel **169**, or both, of the male snap portion **151** when the male snap portion is inserted and fastened within receiving hole **506**, as shown in the cross-sectional view of FIG. **7**G. When inserted into receiving hole **506**, first member **508** and second member **513** may provide a radial flexibility to the receiving hole **506**, which causes the male snap portion **151** to be securely held within receiving hole **506**.

[0055] Additionally, although not shown, similar to other embodiments, frame **503** may include a shield or lid portion attached to the frame body by one or more flexible hinges. A shield or lid portion may provide additional support to a surface of contact plate **526** opposite from the contact surface **528**, to provide a more secure electrical connection between the contact plate **526** and the tope surface **170** or a portion of top bevel **169** of male snap protrusion **151**.

[0056] Conductive connector **525** may be coupled to frame **503** by an adhesive. Conductive connector **525** may also be coupled to frame **503** through a crimping mechanism. Contact plate **526** may also be bent to have a concavity facing away from the frame **503**, such as to provide a spring force in an opposite direction to the insertion direction of the male snap portion **151** into the hole **506**. Such a spring force may provide a secure and solid contact of the contact plate **526** against the top portions of the male snap portion **151** during movement.

[0057] As shown in the embodiments of FIGS. **8**A and **8**B, the conductive connector **601** may include a contact portion **606** and a wire connector **627**. In the embodiment of FIG. **8**A, the contact portion **606** may include a rectangular cut-out **662** configured to couple or contact a top portion (top surface **170** or a portion of top bevel **169**) of the male snap portion **151**. In the embodiment of FIG. **8**A, the rectangular cut-out **662** may be configured to mate with a male snap portion having a rectangular or square cross-sectional area or rectangular or square top surface. In the embodiment of FIG. **8**B, a circular cut-out **661** is provide configured to mate with a male snap portion having a circular cross-sectional area, or a circular top surface. In another embodiment, the conductive connector may be forked-shaped, with a base portion and two arms that extend parallel to each other from the base portion. The fork-shaped conductive connector may be configured to be fit on a rear side **605** of the frame **603**, and may be arranged between the frame **603** and a lid or shield. With such a fork-shaped conductive connector, an internal portion of the arms may be forced into contact with a top portion of the male snap protrusion **151**.

[0058] According to another embodiment, as shown in FIGS. **9**A to **9**F, a frame **703** having a front side **704** and a rear side **705**, may be configured to be coupled to a fork-shaped conductive connector **725** on the front side **704** of frame **703**. The fork-shaped conductive connector **725** may include a base portion **729**, a first arm **731**, and a second arm **732**. The first arm **731** may be substantially parallel to the second arm **732**. The conductive connector **725** may further include a wire connector **727** (such as wire crimp), configured to connect the conductive connector, both physically and electrically, to the electrode wire end **709** of the electrode belt. Each, or at least one of, first arm **731** and/or second arm **732** may have a contact surface **733**, **734**, configured to contact a surface of male snap foundation **161**, a lateral surface **167** of protrusion shaft **165**, or both.

[0059] Thus, as shown in the cross-sectional view of FIG. **9**F, first arm **731** is provide between first member **708** and a portion of male snap foundation **161**, and/or second arm **732** is provided between second member **713** another portion of male snap foundation **161**, when the male snap portion **151** is inserted through hole **706**. The underside bevel **168**, in conjunction with the radial flexibility of the first member **708** and **713** providing flexibility transvers to their longitudinal axis, thus forcing the first arm **731** and the second arm **732** into secure contact with the male snap foundation **161**.

[0060] According to another embodiment, as shown in FIG. **9**G, the conductive connector may be a rectangular ring-shaped conductive connector **751**, with a wire connector **757**. The ring-shaped conductive connector **751** may be configured to be placed on a front side **704** of the frame **703**, similar to the fork-shaped conductive connector **725**, to be placed into secure physical and electrical contact with the male snap foundation **161**.

[0061] In another embodiment, shown in FIGS. **9**H and **9**I, the first arm **781** and second arm **782** of fork-shaped conductive connector **780** may extend from base portion **779** and may be bent to form a concave surface facing toward the frame **703**, such that a spring force is provided by the first arm **781** and second arm **782**. A secure contact may be provided between contact surfaces **783** and **784** (of first arm **781** and second arm **782**, respectively) and the male snap foundation **161**, when the male snap portion **151** is inserted into the receiving hole. Conductive connector **780** may include a wire connector **787** (such as a crimp) to physically and electrically connect the conductive connector to an end portion of a wire electrode of the electrode belt.

[0062] As shown in FIGS. **10**A to **10**E, in another embodiment, a conductive connector **825** is provided with a contact portion **826** configured to at least be partially inserted into receiving hole **806** of frame **803**. In this embodiment, frame **803** includes first member **808** and second member **813** that define lateral sides of receiving hole **806**. First member **808** and second member **813** may also define first slot **811** and second slot **815**. Frame **803** has a front side **804** (configured to face toward the biometric device) and a rear side **805**. Frame **803** is configured to be coupled to conductive connector **825**.

[0063] Conductive connector includes body portion **829** extending from the wire connector **827** to the contact portion **826**. Contact portion **826** may be arranged (such as by bending) to extend in a plane perpendicular or nearly perpendicular to the direction in which the body portion **829** extends. Contact portion **826**, which may be shaped as a flag, thus may be inserted and attached into receiving hole **806** such that when male snap portion **151** is inserted into hole **806**, a contact surface of contact portion **826** may be brought into physical and electrical contact with a surface of male snap portion **151**. Radial flexibility of at least one of the first member **808** and second member **813** may provide a lateral force substantially perpendicular to the longitudinal axis of

the first member **808** or second member **813** as to force the contact portion securely against a lateral surface of male snap portion **151**.

[0064] Conductive connector **825** may be coupled to frame **803** by a crimping of the conductive connector to the frame, an adhesive, tension fitting, heat fitting, shrink fitting, a fastener, or other means of connection.

[0065] In another embodiment, as shown in FIGS. **11**A to **11**F, a U-shaped conductive connector **925** is provided. According to this embodiment, as shown in FIG. **11**A, a frame **903** includes a first member **908** and second member **913** provided adjacently to and define, at least in part, receiving hole **906**. Receiving hole **906** may be rectangular in shape, so as to receive and mate with a U-shaped conductive connector **925**. In this embodiment, the U-shaped conductive connector **925** is inserted into frame **903** and wire connector **927** is connected to electrode wire **909**, such as by crimping, soldering, or fastening. U-shaped conductive connector **925** is arranged with the opening of the U-shape, or the concavity of the U-shape to be pointed toward the front side **904** of the frame **903** such that the male snap portion **151** may be inserted into the opening formed by the U-shaped conductive connector **925**. As seen in a cross sectional view (FIG. **11**E), U-shaped conductive connector has first side portion **931** and an opposing second side portion **932**, each extending from base portion **928**. The first side portion **931** may have first contact surface **933** on the inside of first contact surface **931** and second contact surface **934** may have on the inside surface of second side portion **932**. Through the lateral force provided by the first member **908** and/or the lateral force provided by the second member **913**, the first contact surface **931** and second contact surface **934** are forced into secure contact with a lateral surface of male snap portion **151**.

[0066] Additionally, a restorative spring force of the first side portion **931** and second side portion **932** may provide a lateral force to hold first contact surface **931** and second contact surface **934** in contact with a lateral surface of male snap portion **151**. On a side of the conductive connector **925** opposite from the direction in which the first and second side portions extend, a shield (not shown) or lid attached to the rear side of the frame **903** may give additional support in the direction toward the biometric device. Additionally, respective lip portions **935**, **936**, of first and second side portions **931**, **932**, may extend onto a surface of front side **905** of the frame **903**, so as to maintain the conductive connector **925**, particularly when male snap portion **151** is inserted within the U-shaped conductive connector and hole **906**.

[0067] In another embodiment, as shown in FIGS. **12**A to **12**G, a frame **1003** has a front side **1004** and a rear side **1005**. The frame may include a first member **1008** and a second member **1013**, which define at least partially, a receiving hole **1006** with radial flexibility. First member **1008** and **1013** may further define first slot **1011** and second slot **1015**, which may contribute to the radial flexibility provided at receiving hole **1006**. A top spring conductive connector **1025** is provided having a wire connector **1027**, a first contact member **1031**, and a second contact member **1032**. The top spring conductive connector **1025** may be arranged on a rear side **1005** of frame **1003**, such that when a male snap portion **151** is inserted within receiving hole **1006**, lateral surfaces of male snap portion are brought and held in contact with inner contact surfaces of conductive connector **1025**, including first contact surface **1033** of first contact member **1031** and first contact surface of second contact member **1032**. Additionally, electrical contact can be made between an inner surface of the base portion **1035** of the conductive connector and a top surface **170** of the male snap portion **151**. The male snap portion **151** may then be securely held fastened to the belt connector due to the radial flexibility provided by first and second elongated members **1008** and **1013**, and may also be held in place by the spring force provided by the first contact member **1031** and the second contact member **1032**. Conductive connector **1025** may be coupled to frame **1003** by a crimping of the conductive connector **1025** to the frame, an adhesive, tension fitting, heat fitting, shrink fitting, a fastener, or other means of connection.

[0068] Wire connector **1027** may provide an electrical and physical connection between the conductive connector **1025** and the electrode wire end **1009**.

[0069] In another embodiment, as shown in FIGS. **13**A to **13**D, a frame **1303** has a front side **1304** and a rear side **1305**. The frame may include a first member **1308** and a second member **1313**, which define at least partially, a receiving hole **1306** with radial flexibility. First member **1308** and **1313** may further define one or more slots extending from said receiving hole **1306**, for example, first slot **1311** and second slot **1315**, as shown in FIG. **13**A. Said slots may contribute to the radial flexibility provided at receiving hole **1306**. Said receiving hole **1306** may have a bevelled edge **1361** on front side **1304** to more easily receive and guide a male snap **151** fastener into hole **1306**. When inserted into receiving hole **1306**, first member **1308** and second member **1313** may provide a radial flexibility to the receiving hole **1306**, which causes the male snap portion **151** to be securely held within receiving hole **1306**. Similar to other embodiments, the frame **1303** may further include a belt slot **1314** with teeth **1317** configured to attach the frame **1303** to a belt **2**, as shown in FIG. **13**B.

[0070] As shown in FIG. **13**B, a conductive connector **1325** may be provided the front side **1304** of the frame **1303**. The conductive connector may be a conductive foil configured to be easily penetrable by male snap portion **151** upon insertion of the male snap portion **151** into receiving hole **1306**. The conductive foil may be a metal foil, for example, a copper foil. The metal foil may also be an aluminium foil, or some other malleable metal foil. The conductive foil may also be a polymer or plastic foil with a conductive material provided thereon, such as a plastic or polymer foil with an aluminium or copper layer formed therein. Conductive connector may include a wire connector **1327** configured to crimp to the wire **1309** at an end portion of the wire of the belt. The wire connector may also include a solder portion or electrical adhesive that electrically and physical connects the conductive connector to the wire **1309** of the belt.

[0071] As shown in FIG. **13**B, the conductive connector **1325** include a surface contact portion **1326** configured to contact the snap portion **151** and allow penetration and tearing at least of a portion of the conductive connector **1325** upon penetration of the male snap portion **151** into the receiving hole **1306**. Although not shown, perforations may be provided at surface contact portion **1326**.

[0072] As shown in FIG. **13**C, which shows a cross-sectional view of the embodiment of FIG. **13**B, a top surface **170** of male snap portion **151** may be brought to contact the surface contact portion **1326** of the conductive connector **1325**, and upon application of sufficient force (for example,

manual force) the male snap portion **151** may be forced through surface contact portion **1326**, for example, by tearing at least a portion of the conductive connector **1325**, as shown in FIG. **13**D, at surface contact portion **1326**. Upon insertion of the male snap portion **151** into receiving hole **1306** through a portion of the conductive connector **1325**, one or more folded portions **1330** of conductive connector **1325** may be forced through at least a portion of the receiving hole **1306** and forced by the radial force applied by members **1308** and **1313** into contact with a least a lateral portion of male snap portion **151**. Further, a remaining portion of surface contact portion **1326** provides additional electrical contact and connection by contacting a surface of base portion **161** of the male snap electrode **151**. Thus, a reliable electrical connection can be provided between the wire **1309** of the belt and the male snap portion **151**, at reduced overall manufacturing costs.

[0073] In the embodiments above, radial flexibility of the receiving hole may be provided by the first member and the second member, which define at least partially the receiving hole and slots, such as a first slot and second slot, the second slot being arranged on a different side of the receiving hole from the first slot. But radial flexibility may be provided by different means. For example, a receiving hole may have radial flexibility due only to the material surrounding the receiving hole. For example, a frame may be formed entirely or partially from an elastic material, such a rubber or other elastic polymer. In another embodiment, a frame may include a portion, such as elongated members, formed of a molded and more firm plastic, while inner portion adjacent to the receiving hole, may be formed of a softer, more flexible and resilient material. Such a frame may be combined with the above-described configurations to provide a belt connector with a conductive connector or wire configured to securely contact a surface (either top, lateral, or foundation) of a corresponding male snap portion.

[0074] Additionally, in many of the above-described embodiments, the male snap portion may have a circular cross-sectional area in the top plan view. However, the male snap portion may have other shapes in the cross-sectional area in the top plan view, such as a rectangular, square, elliptical, triangular, or an asymmetric shape.

[0075] In another aspect, the present disclosure sets forth a process for making an electrode belt with biometric belt connectors, comprising:

[0076] placing an end of a flexible electrode belt with an incorporated wire onto a belt connector as defined above, in the suitable direction in which it is to be fastened onto the connector, such that a portion of the belt end extends beyond said ridge member or row of pins,

[0077] pressing a heat element ultrasonic hot body or other means of heat transfer onto said belt and ridge member, and through the action of the heat, shearing an end piece of the belt but leaving intact the incorporated wire, thus revealing an end of said wire, through the action of heat from said heat element, fastening by heat melting said belt to said ridge, and

[0078] fastening the wire end to a member adjacent to the hole of the connector frame, such that said end is in electrical contact with said hole and comes in electrical contact with a conducting male snap fastener inserted in said hole.

[0079] The process may further comprises enclosing the connector frame with the fastened belt end and connected wire with a cover such as suitably a cover as described above. The cover may include a shield coupled to the connector frame by flexible hinges.

[0080] According to another embodiment of the process for making an electrode belt with a biometric belt connector, a frame may be provided, the frame the frame having a receiving hole with radial flexibility. A conductive connector may be coupled to the frame, the conductive connector providing a secure and reliable electrical connection between the male snap portion that the connector is configured to receive and an electrode wide of the fastened belt.

[0081] The belt connector of the present disclosure may include the following features, or the various combinations of features as described below.

1. An electrode belt connector for electrically connecting a conductor of an electrode belt to a first snap portion of a snap connector electrode configured to be connected to a biometric device, the electrode belt connector comprising:

a frame defining a corresponding second snap portion, configured to mate with the first snap portion of the snap connector electrode; and

an connecting portion configured to electrically connect the conductor of the electrode belt to the first snap portion of the snap connector.

2. Any one of the above or below connectors wherein the first snap portion is a male snap portion.

3. Any one of the above or below connectors wherein the second snap portion is a receiving hole.

4. Any one of the above or below connectors wherein the second snap portion is a male snap portion.

5. Any one of the above or below connectors wherein the first snap portion is a receiving hole.

6. Any one of the above or below connectors wherein the electrode belt is a respiratory inductive plethysmography belt.

7. Any one of the above or below connectors wherein the male snap portion includes a male snap foundation.

8. Any one of the above or below connectors wherein the male snap portion includes a male snap protrusion extending substantially perpendicularly from the male snap foundation.

9. Any one of the above or below connectors wherein the male snap portion is electrically connected to the internal electrical leads of the biometric device.

10. Any one of the above or below connectors wherein the male snap protrusion includes a cylindrically shaped protrusion shaft that extends perpendicular or nearly perpendicularly from the surface of male snap foundation.

11. Any one of the above or below connectors wherein the protrusion shaft has a lateral.

12. Any one of the above or below connectors wherein on a distal end of the protrusion shaft, the cross-sectional diameter of the male snap protrusion enlarges at a underside bevel forming a bulged portion, the bulged portion being formed at the distal end of the male snap protrusion.

13. Any one of the above or below connectors wherein the underside bevel extends to a lateral surface of the bulged portion.

14. Any one of the above or below connectors wherein the lateral surface has a cylindrical shape with a cross-sectional diameter greater than the protrusion shaft.

15. Any one of the above or below connectors wherein the bulged portion has a top bevel where the cross-sectional diameter reduces.

16. Any one of the above or below connectors wherein a top surface is formed adjacent to the upper edge of the top bevel.
17. Any one of the above or below connectors wherein male snap portion is made of an electrically conductive material, including, brass, copper, aluminium, steel, gold, or other metals or metal alloys, or even non-metal electrically conducting materials.
18. Any one of the above or below connectors wherein the biometric belt connector is electrically connected to an electrode belt.
19. Any one of the above or below connectors wherein the belt connector comprises a frame having a front side and a rear side.
20. Any one of the above or below connectors wherein the frame defines a shaped circular or semi-circular hole **6** with radial flexibility to function as a female snap button fastener.
21. Any one of the above or below connectors wherein the frame is a molded frame.
22. Any one of the above or below connectors wherein the frame is made from a molded plastic material.
23. Any one of the above or below connectors wherein the frame includes fasteners, which comprise a ridge member to physically secure the belt to the frame.
24. Any one of the above or below connectors wherein the ridge member includes a series of butts or pins **7** which are provided transverse to the belt direction and to which the belt end can be fastened onto with heat melting or gluing.
25. Any one of the above or below connectors wherein the frame include two members, first member and second member, that extend adjacently to the hole.
26. Any one of the above or below connectors wherein first member and second member extend parallelly to each other.
27. Any one of the above or below connectors wherein first member is arranged at an angle to second member other than extending parallelly.
28. Any one of the above or below connectors wherein the two members form a first slot that extends from the hole.
29. Any one of the above or below connectors wherein first member and second member also form a second slot.
30. Any one of the above or below connectors wherein the second slot is formed across the hole from the first slot.
31. Any one of the above or below connectors wherein the two slots extend across from each other in the belt direction.
32. Any one of the above or below connectors wherein the one or more slots are formed or defined by at least one of the first or second elongated members.
33. Any one of the above or below connectors wherein members have flexibility transverse to their longitudinal axis (e.g. by being sufficiently thin), thus imparting flexibility to the width of the hole.
34. Any one of the above or below connectors wherein the hole is between two the elongated members, where one or both have sufficient and suitable flexibility to provide a snap fastener hole with suitable fastening strength.
35. Any one of the above or below connectors wherein either one of first member or second member, formed adjacent to said snap fastener receiving hole, engages an electrode wire coming from the belt end.
36. Any one of the above or below connectors wherein the wire is pushed into electrical contact with said receiving hole, either by extending into the hole, through the hole a single time or extending through the hole multiple times, for example, by being wrapped around one or both of the first member or the second member, or coming in electrical contact with the hole, e.g., through a bridging conductor or conductive connector.
37. Any one of the above or below connectors wherein the elongated members and the slots are formed to provide the hole with sufficient flexibility (i.e. elasticity in the width of the hole) to function as a female snap fastener.
38. Any one of the above or below connectors wherein the first or second member also functions to engage an electrode wire end from the belt end electrically connecting the belt with the hole and which comes in electrical contact with a conducting male snap fastener inserted in said hole.
39. Any one of the above or below connectors wherein the connector further comprises a belt slot with teeth members or pins, through which slot a loop of said belt can be inserted such that it is held by the teeth/pins when pulled back, to adjust the length of the belt.
40. Any one of the above or below connectors wherein the connector further comprises a shield member and/or a lid which are be molded in one piece with the frame and joined to the frame with foldable hinges such that the shield member or lid can be folded over to cover the rear side of the hole and/or wire end.
41. Any one of the above or below connectors wherein the wire end is crimped onto said member such that the crimping tubing fixes the wire and conducts and connects electrically the wire to the receiving hole, such that thus the wire and the belt is in electrical contact with a conducting male snap fastener inserted in said receiving hole.
42. Any one of the above or below connectors wherein the slot functions to provide an additional opening for a mating male projection on the biometric device such that it is assured that the device cannot be (or is unlikely to be) incorrectly fastened, and the device will not fit any generic non-proprietary belts having connectors with female fasteners but without the correctly shaped and placed extended hole.
43. Any one of the above or below connectors wherein the connector frame has a separate further hole, not joined to the main fastener and electrical connection hole, where the further hole is configured to mate with a corresponding male projection on said biometric device.
44. Any one of the above or below connectors wherein the biometric device has a female hole for mating with a corresponding male projection on the belt connector.
45. Any one of the above or below connectors wherein the connector frame further comprises a fastener to fasten the frame to a belt end of an electrode belt.
46. Any one of the above or below connectors wherein the fastener comprises a slot with a row of teeth, pins or hooks, transverse to the belt direction, to engage a belt end.
47. Any one of the above or below connectors wherein the belt slot provides for insertion of a loop of the belt through the belt slot to be held securely by the row of teeth, pins, or hooks, such that the belt length is adjusted and fixed, so that a user can later re-adjust the length.
48. Any one of the above or below connectors wherein the fastener comprises a ridge member, which is a flat or sharp elongated ridge or ridge or row comprising pins or hooks, which ridge lies transverse to the belt direction and to which a belt end can be fastened onto with heat melting or gluing.
49. Any one of the above or below connectors wherein the ridge member has pins or hooks that grab onto the belt fabric without need of heating.

50. Any one of the above or below connectors wherein the frame has an adjustment slot for a user to adjust the belt, which is configured with either of the two described fastening means, the adjustment slot having a row of teeth, pins or hooks transverse to the belt direction, through which adjustment slot a loop of said belt is inserted, which hooks onto the teeth/pins when pulled on, such that the length of the belt is readily adjusted but also secured in the desired adjusted length.

51. Any one of the above or below connectors wherein the connector includes a cover substantially or essentially fully enclosing the frame, which cover either includes a pre-made hole overlapping the receiving hole of the frame, or is readily perforated by pressing the connector onto a male fastener which fits the receiving hole of the frame.

52. Any one of the above or below connectors wherein the suitable cover is arranged by a suitably sized paper, plastic or fabric sticker (foldable sheet with glue on one side) which sticker is folded over the frame after the belt end has been fastened and the wire end electrically connected to the receiving hole, or the cover is from but not limited to a paper envelope, a plastic envelope and a textile envelope, which envelope is suitably fastened by gluing, sewing or the like.

53. Any one of the above or below connectors wherein the biometric device has a further male projecting member which fits within the slot of the frame or within a separate mating hole, the cover is suitably arranged with corresponding openings for such hole or slot for receiving such mating male member, and the cover has a suitable hole allowing the protrusion of a male protruding member being a part of the frame which fits in a mating receiving hole or slot on the mating biometric device.

54. Any one of the above or below connectors wherein the connector comprises a shield member which is arranged on the rear side of the frame to electrically shield the wire from the rear side exterior of the belt connector.

55. Any one of the above or below connectors wherein the shield member is a sheet member extending from the frame, which sheet member is configured to be folded over onto the rear side of the frame to cover said hole and engaged wire.

56. Any one of the above or below connectors wherein the shield member is molded in one piece with the frame with enough strength but suitably flexible to allow folding at least once without braking allows the use of a cover enclosing the frame, which cover need not be electrically insulating, as the shield insulates the only part of the connector which could conduct electrical current of the connector, except through the hole.

57. Any one of the above or below connectors wherein an end portion **109** of an electrode wire from belt **2** is arranged to extend across or bypass a portion of the receiving hole **106** defined in frame **103** by first member **108** and/or second member **113**.

58. Any one of the above or below connectors wherein the end portion of electrode wire **109** is arranged to extend across the receiving hole **106** on the rear side **105** of the frame **103** (the rear side **105** being the side of the frame **103** that is opposite of the frame from the front side **104** of the frame **103** that is positioned in contact with the biometric device).

59. Any one of the above or below connectors wherein the belt connector **101** is configured such that when the male snap portion penetrates the hole **106**, radial flexibility of first and second members **108** and **113** fasten the frame to male snap portion, and upon fastening the frame to the male snap portion, a contact portion **119** of the wire is forced into contact with a distal portion of the male snap portion.

60. Any one of the above or below connectors wherein the contact portion **119** of the wire is forced against the top surface **170** or a surface of the top bevel **169** of the male snap portion **151** or both.

61. Any one of the above or below connectors wherein a reliable electrical connection between the contact portion **119** and the male snap portion **151** is secured.

62. Any one of the above or below connectors wherein the electrode wire **109** is formed into a looped portion **121** to provide additional surface area as the contact portion **119** of the wire.

63. Any one of the above or below connectors wherein an inside surface of the shield **110** or an additional lid provide structure to force the contact portion **119** of the electrode wire into secure contact with the male snap portion **151**.

64. Any one of the above or below connectors wherein the contact portion **119** of the electrode wire is held in place bypassing or extending across the receiving hole **106** through various means.

65. Any one of the above or below connectors wherein a contact member **101** is formed adjacent or near hole **106** and is configured to hold the contact portion **119** of the electrode wire in position adjacent to the hole.

66. Any one of the above or below connectors wherein the contact member **101** has a lateral surface **102** configured to exert a lateral force onto an area of contact portion **119** of the electrode wire, thus, the contact portion **119** of the electrode wire is maintained in position.

67. Any one of the above or below connectors wherein multiple contact members **101** is formed or defined by frame **103** to hold contact portion **119** of electrode wire **109** to extend across a rear side **104** of said frame **103**.

68. Any one of the above or below connectors wherein a contact portion **119** is held in place by an adhesive applied to a portion of first member **108** or second member **113**.

69. Any one of the above or below connectors wherein a groove or recess portion is formed in a portion of the frame adjacent to hole **106**.

70. Any one of the above or below connectors wherein a groove or recess portion is formed in a portion of the frame adjacent to hole **106** on the rear side **105** of first member **108** or **113**, or both.

71. Any one of the above or below connectors wherein the groove or recess portion is configured to at least partially envelop a portion of electrode wire **109** to maintain a contact portion **119** of the electrode wire to extend across or bypass the receiving hole **106**.

72. Any one of the above or below connectors wherein a contact member, adhesive, or groove me similar be formed or applied ton an inside surface of shield **110** or an additional lid structure, to maintain the contact portion **119** in place against the top surface **170** of the male snap protrusion **151**.

73. Any one of the above or below connectors wherein a contact portion **219** is held on a front side **204** of the frame **203** (the side of the frame facing toward the biometric device).

74. Any one of the above or below connectors wherein the contact portion **219** of electrode wire end **209** extends substantially along the front side **204** of second member **213**.

75. Any one of the above or below connectors wherein, when the male snap portion is inserted and snapped into hole

206, the contact portion **219** of the electrode wire end **209** is forced into contact with the surface of the male snap foundation **161**, or a portion of the lateral surface of the protrusion shaft **167**, or both.

76. Any one of the above or below connectors wherein a reliable and repeatable electrical connection between the contact portion **219** of the electrode wire end **209** and the conductive male snap portion is secured upon inserting and fastening the male snap portion **151** into receiving hole **206**.

77. Any one of the above or below connectors wherein contact members **201** extend from frame **203** in a direction substantially perpendicular to the electrode wire end **209**.

78. Any one of the above or below connectors wherein Contact members **201** each have lateral surfaces **202** configured to hold the contact portion **219** in place near the receiving hole **206**.

79. Any one of the above or below connectors wherein electrode wire end **209** is formed to have a looped portion **221** to provide additional wire and area to contact portion **219** to contact the surface of male snap foundation **161**.

80. Any one of the above or below connectors wherein, in addition to, or alternatively to, the contact members **201**, the contact portion **219** of the electrode wire **209** is held or secured in place by an adhesive **225** applied to second member **213**.

81. Any one of the above or below connectors wherein, alternatively, or in addition to the contact members **201** or an applied adhesive, a groove or recessed portion **230** is formed in a surface of first or second member, the groove or recessed portion **230** being arranged to at least partially hole or secure the contact portion **219** of electrode wire **209** in place.

82. Any one of the above or below connectors wherein first member **208** and second member **213** provide a resilient force not only to the male protrusion **151** when it penetrates through receiving hole **206**, but first member **208** and second member **213** also provide a contact force to push the contact portion **219** into a secure and reliable connection with a surface of the male snap foundation **161**, or a portion of the lateral surface of the protrusion shaft **167**, or both.

83. Any one of the above or below connectors wherein a contact portion **319** of electrode wire **309** is held in place on a rear side **305** of frame **303**, such that when the male protrusion **151** penetrates through receiving hole **306**, the contact portion **319** is forced to the side of the hole **306** such that at least a portion of lateral surface **167** of protrusion shaft **166**, a lateral surface **177** of bulged portion **175**, a surface of top bevel **169**, and/or a surface of underside bevel **168** is forced into contact with contact portion **319**.

84. Any one of the above or below connectors wherein contact portion **319** is held in position by structural support from an inside surface of shield **310**.

85. Any one of the above or below connectors wherein contact members **301** having lateral surfaces **302** are provided to hold the contact portion **319** in place and exert a lateral force upon contact portion **319** when the male snap portion **151** penetrates hole **306**.

86. Any one of the above or below connectors wherein contact members **301** are formed of various shapes so long as they provide the lateral support and force.

87. Any one of the above or below connectors wherein there is a single contact members or two or more contact members **301** are provided.

88. Any one of the above or below connectors wherein, in addition to, or alternatively to, the contact member(s) **301**, the contact portion **319** of the electrode wire **309** is held or secured in place by an adhesive applied to first or second member.

89. Any one of the above or below connectors wherein, alternatively, or in addition to the contact members **301** or an applied adhesive, a groove or recessed portion are formed in a surface of first or second member **308**, **313**, the groove or recessed portion being arranged to at least partially hold or secure the contact portion adjacent to the rear side of the receiving hole **306**.

90. Any one of the above or below connectors wherein, alternatively, a contact member, adhesive, or groove, or other means, are provided on an inside surface of shield **310** or another lid structure to maintain the contact portion **319** in lateral contact with the male snap portion **151** when inserted into hole **306**.

91. Any one of the above or below connectors wherein a conductive connector or bridging conductor is used to contact a surface of the male snap portion.

92. Any one of the above or below connectors wherein the conductive connector includes an electrical crimp shoe, including a wire connector **405** and a contact portion **406**, the wire connector **405** being configured to be connected (such as by crimping) to the electrode wire of the belt.

93. Any one of the above or below connectors wherein the contact portion is arranged with the belt connector frame in such a way to contact a surface of a male snap portion.

94. Any one of the above or below connectors wherein the belt connector provides a reliable and easily repeatable connection between a biometric device and a wire belt electrode.

95. Any one of the above or below connectors wherein the frame **503** is provided having a rear side **505**.

96. Any one of the above or below connectors wherein the frame includes a first member **508** and a second member **513** that define a receiving hole **506**.

97. Any one of the above or below connectors wherein the first member **508** and second member **513** further define a first slot **511**, and additionally define a second slot **515**.

98. Any one of the above or below connectors wherein the frame **503** further includes a belt slot with teeth **517** configured to attach the frame **503** to a belt **2**.

99. Any one of the above or below connectors wherein a conductive connector **525** is be provided and coupled at least partially to the surface of the frame **503** at the rear side **505** of the frame (opposite from the biometric device).

100. Any one of the above or below connectors wherein conductive connector **525** includes a contact plate that covers, at least partially or entirely, the receiving hole **506**.

101. Any one of the above or below connectors wherein conductive connector **525** further includes a wire connector **527**, which are a wire crimp configured to be crimped onto an electrode wire end of belt **2**.

102. Any one of the above or below connectors wherein the contact plate **526** has a contact surface **528** configured to at least partially contact a top surface **170** or a portion of top bevel **169**, or both, of the male snap portion **151** when the male snap portion is inserted and fastened within receiving hole **506**.

103. Any one of the above or below connectors wherein, when the male snap protrusion is inserted into receiving hole **506**, first member **508** and second member **513** provide a

radial flexibility to the receiving hole **506**, which causes the male snap portion **151** to be securely held within receiving hole **506**.

104. Any one of the above or below connectors wherein frame **503** includes a shield or lid portion attached to the frame body by one or more flexible hinges.

105. Any one of the above or below connectors wherein the shield or lid portion provides additional support to a surface of contact plate **526** opposite from the contact surface **528**, to provide a more secure electrical connection between the contact plate **526** and the tope surface **170** or a portion of top bevel **169** of male snap protrusion **151**.

106. Any one of the above or below connectors wherein conductive connector **525** is coupled to frame **503** by an adhesive.

107. Any one of the above or below connectors wherein conductive connector **525** is coupled to frame **503** through a crimping mechanism.

108. Any one of the above or below connectors wherein contact plate **526** is bent to have a concavity facing away from the frame **503**, such as to provide a spring force in an opposite direction to the insertion direction of the male snap portion **151** into the hole **506**.

109. Any one of the above or below connectors wherein a spring force provides a secure and solid contact of the contact plate **526** against the top portions of the male snap portion **151** during movement.

110. Any one of the above or below connectors wherein the conductive connector **601** includes a contact portion **606** and a wire connector **627**.

111. Any one of the above or below connectors wherein the contact portion **606** includes a rectangular cut-out **662** configured to couple or contact a top portion (top surface **170** or a portion of top bevel **169**) of the male snap portion.

112. Any one of the above or below connectors wherein the rectangular cut-out **662** is configured to mate with a male snap portion having a rectangular or square cross-sectional area or rectangular or square top surface.

113. Any one of the above or below connectors wherein a circular cut-out **661** is provide configured to mate with a male snap portion having a circular cross-sectional area, or a circular top surface.

114. Any one of the above or below connectors wherein the conductive connector is forked-shaped, with a base portion and two arms that extend parallel to each other from the base portion.

115. Any one of the above or below connectors wherein the fork-shaped conductive connector is configured to be fit on a rear side **605** of the frame **603**, and is arranged between the frame **603** and a lid or shield.

116. Any one of the above or below connectors wherein with the fork-shaped conductive connector, an internal portion of the arms is forced into contact with a top portion of the male snap protrusion **151**.

117. Any one of the above or below connectors wherein a frame **703** having a front side **704** and a rear side **705**, are configured to be coupled to a fork-shaped conductive connector **725** on the front side **704** of frame **703**.

118. Any one of the above or below connectors wherein the fork-shaped conductive connector **725** includes a base portion **729**, a first arm **731**, and a second arm **732**.

119. Any one of the above or below connectors wherein the first arm **731** is substantially parallel to the second arm **732**.

120. Any one of the above or below connectors wherein the conductive connector **725** further includes a wire connector **727** (such as wire crimp), configured to connect the conductive connector, both physically and electrically, to the electrode wire end **709** of the electrode belt.

121. Any one of the above or below connectors wherein each, or at least one of, first arm **731** and/or second arm **732** has a contact surface **733**, **734**, configured to contact a surface of male snap foundation **161**, a lateral surface **167** of protrusion shaft **165**, or both.

122. Any one of the above or below connectors wherein a first arm **731** is provide between first member **708** and a portion of male snap foundation **161**, and/or second arm **732** is provided between second member **713** another portion of male snap foundation **161**, when the male snap portion **151** is inserted through hole **706**.

123. Any one of the above or below connectors wherein the underside bevel **168**, in conjunction with the radial flexibility of the first member **708** and **713** provides flexibility transvers to their longitudinal axis, thus forcing the first arm **731** and the second arm **732** into secure contact with the male snap foundation **161**.

124. Any one of the above or below connectors wherein the conductive connector is a rectangular ring-shaped conductive connector **751**, with a wire connector **757**.

125. Any one of the above or below connectors wherein the ring-shaped conductive connector **751** are configured to be placed on a front side **704** of the frame **703**, similar to the fork-shaped conductive connector, to be placed into secure physical and electrical contact with the male snap foundation **161**.

126. Any one of the above or below connectors wherein the first arm **781** and second arm **782** of fork-shaped conductive connector **780** extends from base portion **779** and is bent to form a concavity facing toward the frame **703**, such that a spring force is provided between first arm **781** and second arm **782**.

127. Any one of the above or below connectors wherein a secure contact is provided between contact surfaces **783** and **784** (of first arm **781** and second arm **782**, respectively) and the male snap foundation **161**.

128. Any one of the above or below connectors wherein conductive connector **780** includes a wire connector (such as a crimp) to physically an electrically connect the conductive connector to a wire electrode of the electrode belt.

129. Any one of the above or below connectors wherein a conductive connector **825** is provided with a contact portion **826** configured to at least be partially inserted into receiving hole **806**.

130. Any one of the above or below connectors wherein frame **803** includes first member **808** and second member **813** that define lateral sides of receiving hole **806**.

131. Any one of the above or below connectors wherein first member **808** and second member **813** define first slot **811** and second slot **815**.

132. Any one of the above or below connectors wherein frame **803** has a front side **804** (configured to face toward the biometric device) and a rear side **805**. Frame **803** is configured to be coupled with conductive connector **825**.

133. Any one of the above or below connectors wherein a conductive connector includes body portion **829** extending from the wire connector **827** to the contact portion **826**.

134. Any one of the above or below connectors wherein contact portion **826** is arranged (such as by bending) to

extend in a plane perpendicular or nearly perpendicular to the direction in which the body portion **829** extends.

135. Any one of the above or below connectors wherein contact portion **826**, which is be shaped as a flag, thus is inserted and attached into receiving hole **806** such that when male snap portion **151** is inserted into hole **806**, a contact surface of contact portion **826** be brought into physical and electrical contact with a surface of male snap portion **151**.

136. Any one of the above or below connectors wherein radial flexibility of at least one of the first member **808** and second member **813** provides a lateral force substantially perpendicular to the longitudinal axis of the first member **808** or second member **813** as to force the contact portion securely against a lateral surface of male snap portion **151**.

137. Any one of the above or below connectors wherein conductive connector **825** is coupled to frame **803** by a crimping of the conductive connector to the frame, an adhesive, tension fitting, heat fitting, shrink fitting, a fastener, or other means of connection.

138. Any one of the above or below connectors wherein a U-shaped conductive connector **925** is provided.

139. Any one of the above or below connectors wherein first member **908** and second member **913** are provided adjacently to and define at least in part receiving hole **906**.

140. Any one of the above or below connectors wherein receiving hole **906** is rectangular in shape, so as to receive and mate with the cross-sectional top plan shape of the U-shaped conductive connector **925**.

141. Any one of the above or below connectors wherein the U-shaped conductive connector is inserted into frame **903** and wire connector **927** is connected to electrode wire **909**, by crimping, soldering, or fastening.

142. Any one of the above or below connectors wherein U-shaped conductive connector **925** is arranged with the opening of the U-shape, or the concavity of the U-shape to be pointed toward the front side **904** of the frame **903** such that the male snap portion **151** are inserted into the opening formed by the U-shaped conductive connector **925**.

143. Any one of the above or below connectors wherein in a cross sectional view, U-shaped conductive connector has first side portion **931** and an opposing second side portion **932**, each extending from base portion.

144. Any one of the above or below connectors wherein the first side portion **931** has a first contact surface **933** on the inside surface and second side portion **932** has a first contact surface **934** on the inside surface of second side portion **932**.

145. Any one of the above or below connectors wherein, through the lateral force provided by the first member **908** and/or the lateral force provided by the second member **913**, the first contact surface **931** and second contact surface **934** are forced into secure contact with a lateral surface of male snap portion **151**.

146. Any one of the above or below connectors wherein, a restorative spring force of the first side portion **931** and second side portion **932** provide a lateral force to hold first contact surface **931** and second contact surface **934** in contact with a lateral surface of male snap portion **151**.

147. Any one of the above or below connectors wherein on a side of the conductive connector **925** opposite from the direction in which the first and second side portions extend, a shield (not shown) or lid attached to the rear side of the frame **903** gives additional support in the direction toward the biometric device.

148. Any one of the above or below connectors wherein respective lip portions **935**, **936**, of first and second side portions **931**, **932**, extend onto a surface of front side **905** of the frame **903**, so as to maintain the conductive connector **925**, particularly when male snap portion **151** is inserted within the U-shaped conductive connector and hole **906**.

149. Any one of the above or below connectors wherein a frame **1003** has a front side **1004** and a rear side **1005**.

150. Any one of the above or below connectors wherein the frame includes a first member **1008** and a second member **1013**, which define at least partially, a receiving hole **1006** with radial flexibility.

151. Any one of the above or below connectors wherein first member **1008** and **1013** further define first slot **1011** and second slot **1015**, which contribute to the radial flexibility provided at receiving hole **1006**.

152. Any one of the above or below connectors wherein a top spring conductive connector **1025** is provided having a wire connector **1027**, a first contact member **1031**, and a second contact member **1032**.

153. Any one of the above or below connectors wherein the top spring conductive connector is arranged on a rear side **1005** of frame **1003**, such that when a male snap portion **151** is inserted within receiving hole **1006**, lateral surfaces of male snap portion are brought and held in contact with inner contact surfaces of conductive connector **1025**, including first contact surface **1033** of first contact member **1031** and first contact surface of second contact member **1032**.

154. Any one of the above or below connectors wherein additionally, electrical contact is made between an inner surface of the base portion **1035** of the conductive connector and a top surface **170** of the male snap portion **151**.

155. Any one of the above or below connectors wherein the male snap portion **151** is securely held fastened to the belt connector due to the radial flexibility provided by first and second elongated members **1008** and **1013**, and is also held in place by the spring force provided by the first contact member **1031** and the second contact member **1032**.

156. Any one of the above or below connectors wherein conductive connector **1025** are coupled to frame **1003** by a crimping of the conductive connector **1025** to the frame, an adhesive, tension fitting, heat fitting, shrink fitting, a fastener, or other means of connection.

157. Any one of the above or below connectors wherein wire connector **1027** provides an electrical and physical connection between the conductive connector **1025** and the electrode wire end **1009**.

158. Any one of the above or below connectors wherein radial flexibility of the receiving hole is provided by the first member and the second member, which define at least partially the receiving hole and slots, such as a first slot and second slot, the second slot being arranged on a different side of the receiving hole from the first slot.

159. Any one of the above or below connectors wherein the receiving hole has radial flexibility due only to the material surrounding the receiving hole.

160. Any one of the above or below connectors wherein a frame is formed entirely or partially from an elastic material, such a rubber or other elastic polymer.

161. Any one of the above or below connectors wherein a frame includes a portion, such as elongated members, formed of a molded and more firm plastic, while inner portion adjacent to the receiving hole, are formed of a softer, more flexible and resilient material.

162. Any one of the above or below connectors wherein a frame is combined with the above-described configurations to provide a belt connector with a conductive connector or wire configured to securely contact a surface (either top, lateral, or foundation) of a corresponding male snap portion.

1. An electrode belt connector for electrically connecting a conductor of an electrode belt to a first snap portion of a snap connector electrode configured to be connected to a biometric device, the electrode belt connector comprising:

a frame defining a corresponding second snap portion configured to mate with the first snap portion of the snap connector electrode; and

a connecting portion configured to electrically connect the conductor of the electrode belt to the first snap portion of the snap connector electrode.

2. The belt connector according to claim **1**, wherein the first snap portion is a male snap portion.

3. The belt connector according to claim **1**, wherein the second snap portion is a receiving hole.

4. The belt connector according to claim **1**, wherein the electrode belt connector is configured to connect ends of a respiratory inductive plethysmography belt that includes said wire woven within the respiratory inductive plethysmography belt.

5. The belt connector according to claim **1**, wherein the frame includes a first member and a second member that define a receiving hole between the first member and the second member,

wherein the first member and the second member are configured to provide a radial resilient force to a male snap protrusion of the first snap portion when the male snap protrusion is inserted into said receiving hole.

6. The belt connector according to claim **5**, wherein the radial resilient force forces the connecting portion to electrically connect an electrically conductive portion to electrically connect the male snap protrusion inserted into said receiving hole.

7. The belt connector according to claim **5**, wherein the connecting portion includes a conductive connector that passes through or above said receiving hole, or the connecting portion is an end portion of the wire of the electrode belt that passes through or above said receiving hole.

8. The belt connector according to claim **5**, wherein the connecting portion includes a conductive foil connector configured to electrically connect the wire of the electrode belt to the first snap portion of the snap connector.

9. The belt connector according to claim **8**, wherein connecting portion is provided such as to be between the frame and the biometric device.

10. The belt connector according to claim **1**, wherein the connecting portion includes a conductive connector configured to connect the wire of the electrode belt to the first snap portion of the snap connector.

11. The belt connector according to claim **1**, wherein the connecting portion one or more contact members configured to connect the wire of the electrode belt to the first snap portion of the snap connector.

12. The belt connector according to claim **1**, wherein the connecting portion includes an electrically conductive connector configured to connect the wire of the electrode belt to the first snap portion of the snap connector.

13. The belt connector according to claim **1**, wherein the connecting portion includes an electrically conductive portion that pass through or above said receiving hole.

14. The belt connector according to claim **1**, wherein the frame includes a front side configured to face toward the biometric device and a rear side configured to face away from the biometric device, and

wherein the connecting portion is arranged on the rear side the frame.

15. The belt connector according to claim **1**, wherein the connecting portion includes an electrically connecting portion provided such as to be between the frame and the biometric device.

* * * * *

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外部链接	Espacenet USPTO		

摘要(译)

提供一种电极带连接器，用于将电极带的导体电连接到构造成连接到生物测定装置的按扣连接器电极的第一按扣部分。电极带连接器包括框架和导电部分。框架限定相应的第二卡扣部分，该第二卡扣部分构造成与卡扣连接器电极的第一卡扣部分配合。电极带连接器还包括连接部分，该连接部分构造成将电极带的导体电连接到按扣连接器电极的第一按扣部分。