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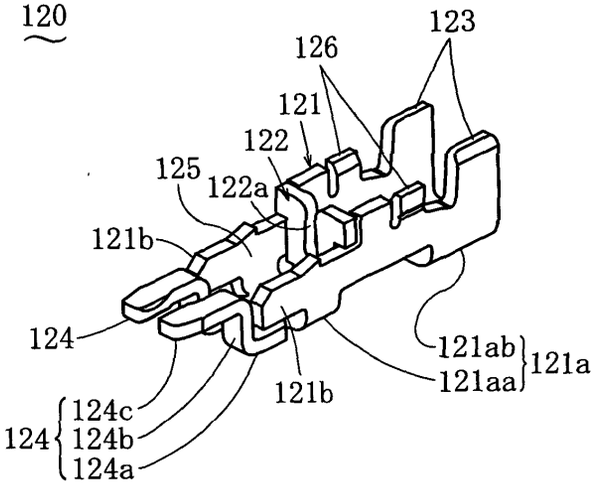
## (54) Socket contact

(57) A socket contact provides a reduction in thickness and downsizing of a socket connector. The socket contact (120) is for insertion into a wire insertion groove (115) of a socket housing (110) that is provided with the wire insertion groove (115) concaving from the bottom face (111). This socket contact (120) comprises a body (121) that has a bottom plate (121a), an insulation displacement plate (122) that rises from the bottom plate (121a), having a U-shaped slot (122a), and breaks the insulation of the wire (W) and makes a connection with the conductor thereof. An insulation barrel (123) rises from the bottom plate (121a) and grips the insulation of the wire (W) by bending inward, and a pair of contacting pieces (124) that lie side by side in the width direction and have base parts (124a), intermediate parts (124b) that form a receiving part (125) for receiving a redundant part (W1) of the terminal end of the wire (W) between themselves and the insulation displacement plate (122), and rear parts (124c) that contact a header contact (220).

F I G. 1

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## Description

**[0001]** The present invention relates to socket contacts for insertion into wire insertion grooves of socket housings.

**[0002]** Japanese Patent Publication 3262732 discloses an insulation displacement connector that comprises contacts to which wires are connected by insulation displacement connection and an insulative housing wherein contact receiving chambers that isolate and receive these contacts individually are separated from each other individually by partition walls, the top part and the rear end part of each contact receiving chamber are open for inserting the wire into it, and strain reliefs or fitting-on parts for the wire are provided on the partition wall parts on both sides of the rear end of the opening.

**[0003]** Japanese Patent Unexamined Publication 2003-163041 discloses an insulation displacement terminal wherein a connecting part that is to be connected to a counterpart terminal and an insulation displacement part that receives a wire and makes an insulation displacement connection are formed in this order from the front by punching and bending a conductive plate material, the insulation displacement terminal is so structured that the insulation displacement part is provided with a pair of insulation displacement blades, in front and in rear, the front insulation displacement blade is formed by cutting and raising a part of a bottom plate of the insulation displacement part and has a slot that can cut the insulation of the wire and make conductive connection with the conductor inside the wire, the rear insulation displacement blade is formed by bending one of right and left side plates that are formed by bending and raising on both sides of the bottom plate and has a slot that can cut the insulation of the wire and make conductive connection with the conductor inside the wire.

**[0004]** Japanese Utility Model Unexamined Publication Heisei 6-48190 discloses a female contact that has a pair of mutually opposing contacting pieces. This female contact is so arranged that these contacting pieces receive one end of a counterpart male contact between them to contact the counterpart male contact.

**[0005]** When a header connector that has header contacts comprising male contacts is mounted on a surface of a printed circuit board and a socket connector that has socket contacts comprising female contacts of insulation displacement type, the female contacts being connected to terminal ends of wires, is to be engaged with the header connector, the following problems will arise.

**[0006]** To enhance the strength against wire pulling-about that bends and deforms the wire, one possibility is to provide the socket connector with strain reliefs such as one disclosed in Japanese Patent Publication 3262732. However, in that case, strain reliefs will rise in the height direction from the tops of the partition walls of the socket housing, and the socket connector will be thicker; thus reduction in thickness can not be achieved.

**[0007]** To secure the wire holding force of the slot of the socket contact and ensure the contact reliability between the slot and the conductor of the wire, it is desirable, as disclosed in Japanese Patent Unexamined Publication 2003-163041, to provide two slots, thus doubling the number of wire holding points and the number of insulation displacement points in comparison with the case of single slot. This arrangement, however, means that slots are lined in the longitudinal direction and in turn the socket contact gets longer; thus it prevents downsizing of the socket connector.

**[0008]** Moreover, when the contacting part of a male header contact is formed into a plate shape or a rod shape, it is advantageous in terms of cost to make the contacting part of the socket connector that is to contact the former into a pair of mutually opposing contacting pieces as disclosed in Japanese Utility Model Unexamined Publication Heisei 6-48190. In that case, however, to secure the elasticity of the contacting pieces, it is necessary to secure a certain length for the contacting pieces and in turn the socket contact gets longer; thus it prevents downsizing of the socket connector.

**[0009]** Various aspects and features of the present invention are defined in the appended claims.

**[0010]** The present invention was made in view of the above points. Embodiments of the present invention can reduce the thickness of a socket connector by inserting a socket contact into a wire insertion groove and providing the socket contact with an insulation barrel so as to enhance the strength against pulling-about of the wire and in turn eliminate or at least reduce the need of providing a socket housing with strain reliefs, to downsize the socket connector by arranging side by side a pair of contacting pieces rather than making them oppose to each other and bending them so as to secure elasticity and shorten the socket contact, and to downsize the socket connector by securing the wire holding force with the insulation barrel and by forming a receiving part for receiving a redundant part of the terminal end of the wire between bending parts of the contacting pieces and an insulation displacement plate in which a slot is provided so as to secure contact reliability between the slot and the conductor of the wire and in turn reduce the number of slots to one and shorten the socket contact.

**[0011]** According to the present invention there is provided a socket contact which is to be inserted into a wire insertion groove of a socket housing having a depth direction, a width direction and a height direction all being perpendicular to each other wherein the wire insertion groove concaves from the bottom face being one end face in the height direction toward the top face being the other end face and also extends to the end face on the front side in the depth direction and to which the terminal end of a wire is to be connected so that the wire is led out of the socket housing frontward in the depth direction. This socket contact comprises a body that has a bottom plate facing in the height direction, an insulation displacement plate that faces in the depth direction, ris-

es on one side in the height direction from an intermediate part in the depth direction of the bottom plate, has an approximately U-shaped slot opening toward one side in the height direction, breaks insulation of the wire and makes connection with the conductor thereof, an insulation barrel that substantially faces in the width direction, rises toward one side in the height direction from at least one of both sides in the width direction of the end part on the front side in the depth direction of the bottom plate and grips the insulation of the wire by bending inward, and a pair of contacting pieces that lie side by side in the width direction and have base parts substantially facing in the height direction and extending from the bottom plate rearward in the depth direction, intermediate parts substantially facing in the depth direction and rising toward one side in the height direction from the top ends of the base parts to form a receiving part for receiving a redundant part of the terminal end of the wire between themselves and the insulation displacement plate and rear parts substantially facing in the height direction, extending from the top ends of the intermediate parts rearward in the depth direction to contact a header contact of a header connector by the end faces on the inner sides in the width direction.

**[0012]** This socket contact is inserted into the wire insertion groove of the socket housing in such an orientation that the slot opens toward the bottom face side of the socket housing and the insulation barrel rises toward the bottom face side of the socket housing. Then the terminal end of the wire extending in the depth direction is pushed, in the height direction, into the wire insertion groove so that the redundant part at the top end thereof is received in the receiving part, the wire is insulation-displacement-connected to the slot, and the insulation of the wire is gripped by the insulation barrel. Next, the socket connector is engaged with a header connector that is mounted on a surface of an object for mounting such as a printed circuit board, and the pair of contacting pieces of the socket contact are made to contact the contacting part of the header contact from both sides in the thickness direction thereof.

**[0013]** In this case, as the socket contact is inserted into the wire insertion groove and the insulation barrel grips the insulation of the wire, the strength against pulling-about of the wire is enhanced, and this in turn eliminates the need of providing the socket housing with strain reliefs; thus reduction in the thickness of the socket connector is realized. Moreover, as the pair of the contacting pieces do not oppose to each other but lie side by side in the width direction and their base parts, intermediate parts and rear parts are continuous, bending stepwise, when their developed lengths are set substantially equal to the lengths of the contacting pieces being straight, the socket contact will be shortened while maintaining elasticity in comparison with a case wherein the contacting pieces are used in the straight condition just like the case when the contacting parts are arranged to oppose to each other; thus the socket connector is downsized. Furthermore, as the wire holding force is secured by the insulation barrel and the redundant part of the terminal end of the wire is received between the bending parts of the contacting pieces and the insulation displacement plate, of the terminal end of the wire, the redundant part of which conductor might have been disturbed by cutting or the like is avoided and a portion of the wire of which conductor is intact will contact the slot, realizing a reliable insulation displacement connection; thus contact reliability between the slot and the wire conductor is assured. Accordingly, the socket contact is more shortened by using a single slot, and the socket connector is downsized. And as the pair of contacting pieces of the socket contact contact the contacting part of the header contact from both sides in the thickness direction thereof, the socket contact will contact the header contact at two points; thus the reliability of connection is enhanced. Moreover, as the binding strength between the socket contact and the wire is enhanced by the insulation barrel, no relative movements will be generated between the socket contact and the wire even when the wire is subjected to pulling-about or pulling-out forces; thus the reliability of connection between the slot and the conductor of the wire is enhanced.

**[0014]** The socket contact of the present invention can reduce the thickness of the socket connector by eliminating the need of providing the socket housing with strain reliefs, downsize the socket connector by setting a pair of contacting pieces side by side and bending them so as to shorten the socket contact while securing elasticity, downsize the socket connector by securing the wire holding force, securing the contact reliability between the slot and the wire conductor and using a single slot so as to shorten the socket contact further, and enhance the contact reliability by making the socket contact contact the header contact at two points. Moreover, as no relative movements are generated between the socket contact and the wire, the reliability of connection between the slot and the wire conductor can be enhanced.

**[0015]** The socket contact of the present invention may be so arranged that the socket housing is provided with a receiving concaved part, which is located on the rear side in the depth direction of the wire insertion groove, is interconnected to the wire insertion groove and opened to the bottom face or the end face on the rear side in the depth direction of the socket housing and into which the header contact of the counterpart header connector is to be inserted, and the pair of contacting pieces are provided in the receiving concaved part.

**[0016]** With this arrangement, when the socket contact is inserted into the wire insertion groove of the socket housing, the contacting pieces will be received in the receiving concaved part. As a result, the contacting pieces will be protected by the socket housing and will not be deformed inadvertently by external forces.

**[0017]** Thus, the contacting pieces can be prevented

from being deformed inadvertently by external forces.

**[0018]** The socket contact of the present invention may be so arranged that the body comprises a bottom plate and side plates rising on one side in the height direction from both sides in the width direction of the bottom plate, the bottom plate is divided into a first bottom plate on the rear side in the depth direction and a second bottom plate on the front side, the contacting pieces are provided on the first bottom plate on the rear side in the depth direction and the insulation displacement plate is provided on the front side, and the insulation barrel is provided on the second bottom plate at least on one of both sides in the width direction thereof.

**[0019]** With this arrangement, as the first bottom plate and the second bottom plate are separated from each other, when the insulation barrel being provided on the second bottom plate is bent to grip the wire, stresses that are generated by this operation will not reach the first bottom plate, and neither the contacting pieces nor the insulation displacement plate will be deformed. Moreover, when the socket contact is formed by bending a single blank that is formed into a given configuration, as the blank will have a configuration that is symmetrical or symmetrical to some extent in relation to a line extending in the longitudinal direction of the bottom plates, unbalanced forces will be hardly exerted to the blanks when they are punched from a plate material by blanking or the like; thus the yield of the blanks is high. Furthermore, as neither the length nor the width of the blank is extremely greater than the other, blanks can be taken efficiently from the plate material.

**[0020]** Accordingly, the contacting pieces and the insulation displacement plate can be prevented or at least reduced from being deformed by stresses that are generated when the insulation barrel is bent to grip the wire. Moreover, the yield of blanks can be enhanced, and blanks can be taken efficiently from the plate material.

**[0021]** The socket contact of the present invention may be so structured that side plates are made to contact, with a contact pressure, protruding parts that protrude inward in the width direction near the opening to the bottom face of the wire insertion groove of the socket housing so as to accomplish inserting the socket contact into the wire insertion groove of the socket housing.

**[0022]** With this arrangement, as the movement in the height direction of the socket contact is strongly restrained by the bottom face and the protruding parts of the wire insertion groove, the strength against pulling-about of the wire in this direction is enhanced.

**[0023]** Accordingly, the strength against pulling-about of the wire in the height direction can be enhanced.

**[0024]** The socket contact of the present invention may be so structured that the socket connector engages with the header connector in the height direction, the header contact is of a blade type and has a plate-shaped contacting part facing in the width direction and when the socket connector engages with the header connector, the pair of contacting pieces will contact both end faces in the thickness direction of the contacting part of the header contact.

**[0025]** With this arrangement, as the socket connector is engaged with the header connector in the height direction, there is no need of providing the object for mounting with an open space for shifting the socket connector at the time of engagement, thus the area on the object for mounting, which is occupied by the socket connector and the header connector, is reduced. As the socket connector is reduced in thickness, the height from the surface of the object for mounting up to the surface of the socket connector is reduced, and reduction in the height of the connection structure comprising the socket connector and the header connector is realized. As the wire is led out of the socket housing frontward in the depth direction, even if an object, for example, a casing is arranged to oppose to the surface of the object for mounting, the wire will be hardly interfered by this casing or the like, thus the load to which the wire is subjected is reduced and the connection state is stabilized, and furthermore, reduction in the height of the connection structure of the socket connector and the header connector is enhanced.

**[0026]** Accordingly, the area of the object for mounting, which is occupied by the socket connector and the header connector, can be reduced, reduction in the height of the connection structure comprising the socket connector and the header connector can be realized by reduction in the thickness of the socket connector, the wire is hardly interfered by a casing or the like that is located to oppose to the surface of the object for mounting, the load to which the wire is subjected is reduced and the connection state can be stabilized, and reduction in the height of the connection structure of the socket connector and the header connector can be enhanced further.

**[0027]** In the following, some embodiments of the present invention will be described with reference to the drawings.

Fig. 1 is a perspective view of the socket contact of an embodiment.

Fig. 2 is a plan view of the socket contact of the embodiment seen from the opening side of a slot.

Fig. 3 is a side view of the socket contact of the embodiment seen in the width direction.

Fig. 4 is a front view of the socket contact of the embodiment seen from the rear in the depth direction.

Fig. 5 is a rear view of the socket contact of the embodiment seen from the front in the depth direction.

Fig. 6 is a sectional view along the line VI-VI of Fig. 2.

Fig. 7 is a plan view of the blank of the socket contact of the embodiment.

Fig. 8 is a perspective view of the socket connector of the embodiment.

Fig. 9 is a plan view of the socket connector of the

embodiment seen from the bottom face side of the socket housing.

Fig. 10 is a sectional view along the line X-X of Fig. 9.

Fig. 11 is a sectional view along the line XI-XI of Fig. 9.

Fig. 12 is a sectional view along the line XII-XII of Fig. 9.

Fig. 13 is a sectional view along the line XIII-XIII of Fig. 9.

Fig. 14 is a sectional view along the line XIV-XIV of Fig. 9.

Fig. 15 is a sectional view of the socket housing of the embodiment. The position of the section line is similar to that of Fig. 10.

Fig. 16 is a perspective view of the socket connector of the embodiment, which is connected to wires and seen from the bottom face side of the socket housing.

Fig. 17 is a perspective view of the socket connector of the embodiment, which is connected to wires and seen from the top face side of the socket housing.

Fig. 18 is a perspective view of the header connector of the embodiment.

Fig. 19 is a perspective view of the socket connector of the embodiment, which is connected to wires and then connected to the header connector of the embodiment.

Fig. 20 is a sectional view of the socket connector of the embodiment, which is connected to wires and then connected to the header connector of the embodiment. It is sectioned in a place facing in the width direction and seen in the width direction.

Fig. 21 is a sectional view of the socket connector of the embodiment, which is connected to wires and then connected to the header connector of the embodiment. It is sectioned in a plane facing in the depth direction and seen from the front in the depth direction.

**[0028]** An embodiment of the present invention will be described below. Fig. 1 through Fig. 6 show a socket contact 120 being an embodiment according to the present invention. This socket contact 120 is inserted into a socket housing 110 that is shown in Fig. 15, and a socket connector 100 that is shown in Fig. 8 through Fig. 14 is comprised of the socket housing 110 and the socket contacts 120. A depth direction, a width direction and a height direction all being perpendicular to each other are assumed, and these directions are used for description. In the case of this embodiment, with reference to Fig. 2, the left-right direction of the diagram is the depth direction, the left of the diagram is the rear in the depth direction, and the right is the front in the depth direction. A direction perpendicular to the paper plane of the diagram is the height direction, and the top-bottom direction of the diagram is the width direction. The socket housing 110 is formed of an insulative material, and the socket contacts 120 are formed of a conductive material. A counterpart header connector 200 comprises a header housing 210 that is formed of an insulative material and header contacts 220 that are formed of a conductive material and provided in the header housing 210. The socket connector 100 and the header connector 200 are of a two-pole type, and they are provided with two contacts 120, 220, respectively, which are arranged side by side, but the number of poles of the socket connector and the header connector of the present invention is not limited by this arrangement. The header connector 200 is placed on a surface of an object for mounting P such as a printed circuit board, the surface facing in the height direction. The object for mounting P is an object that has a plane surface facing in the height direction and also has conductors being to be connected with the header contacts 220. This object for mounting P includes, for example, printed circuit board, flat flexible cable such as FFC (flexible flat cable) and FPC (flexible printed circuit), and casing of electronic equipment. Here the printed circuit board means a board wherein a conductor pattern that is needed for connecting components is formed by printing according to the circuit design on the surface of an insulative board or on the surface and inside thereof. In the case of a casing of electronic equipment, an example is an insulator wherein conductors are formed on its surface by MID (molded interconnection device) technology that forms conductive plated layers. In the case of the present embodiment, the object for mounting P is a printed circuit board, and the header connector 200 is mounted on the surface of the printed circuit board being the object for mounting P.

**[0029]** As shown in Fig. 15, the socket housing 110 is provided with wire insertion grooves 115 that are concaved from the bottom face 111 being one end face in the height direction toward the top face 112 being the other end face and also extend to the end face 113 on the front side in the depth direction. On the rear side in the depth direction of the wire insertion grooves 115, the socket housing 110 is provided with receiving concaved parts 116, which are interconnected to the wire insertion grooves 115 and open to the bottom face 111 and the end face 114 on the rear side in the depth direction of the socket housing 110 and into which the header contacts 220 of the header connector 200 are to be inserted. This receiving concaved part may be arranged to open to either the bottom face or the end face at the rear in the depth direction of the socket housing. A pair of contacting pieces 124 of the socket contact 120 are provided in this receiving concaved part 116. When receiving concaved parts are not provided, the pair of contacting pieces of the socket contact are received in, for example, the wire insertion groove or made to protrude from the wire insertion groove rearward in the depth direction or in the height direction.

**[0030]** The socket contact 120 is inserted into the above-mentioned wire insertion groove 115, and the ter-

minal end of the wire W is connected to it so that the wire W is led out of the socket housing 110 frontward in the depth direction. This inserting is effected by setting dimensions so that, for example, the socket contact 120 and the wire insertion groove 115 fit together tightly. The socket contact 120 has a body 121. The body 121 is provided with a bottom plate 121a facing in the height direction and side plates 121b that rise on one side in the height direction from both ends in the width direction of the bottom plate 121a. It is sufficient for the body of the socket contact of the present invention that the body is provided with a bottom plate, and it does not matter whether the body is provided a side plate or not. The bottom plate 121a is provided with an insulation displacement plate 122, an insulation barrel 123 and a pair of contacting pieces 124.

**[0031]** The insulation displacement plate 122 is a plate piece that faces in the depth direction and rises on one side in the height direction from an intermediate part in the depth direction of the bottom plate 121a. The insulation displacement plate 122 is provided with an approximately U-shaped slot 122a that opens toward one side of the height direction, and the edges of the slot 122a are formed sharp to break the insulation of the wire W to make connection with the conductor thereof. When the wire W is pushed into this slot 122a in the height direction, the slot 122a will break the insulation, and the conductor inside the insulation will contact the slot 122a to make mechanical connection and electric connection between the slot 122a and the conductor of the wire W.

**[0032]** The insulation barrel 123 is a plate piece that substantially faces in the width direction and rises toward one side in the height direction from at least one of both sides in the width direction of the end part on the front side in the depth direction of the bottom plate 121a. It is arranged to grip the insulation of the wire W by bending inward in the width direction. In the case of this embodiment, two insulation barrels 123 rise in the height direction from both ends in the width direction of the end part on the front side in the depth direction of the bottom plate 121a.

**[0033]** The pair of contacting pieces 124 are plate pieces that are arranged side by side in the width direction. The pair of contacting pieces 124 together with the top end part of the bottom plate 121a form as a whole an approximately U-shaped portion when seen in the height direction. The contacting piece 124 comprises a base part 124a, an intermediate part 124b and a rear part 124c. The faces of the base part 124a substantially face in the height direction, and the base part 124a extends from the bottom plate 121a rearward in the depth direction. The faces of the intermediate part 124b substantially face in the depth direction, and the intermediate part 124b rises toward one side in the height direction from the top end of the base part 124a. The intermediate part 124b is so located to form a receiving part 125 between itself and the insulation displacement plate 122, the receiving part 125 being to receive a redundant part W1 at the terminal end of the wire W. The redundant part W1 is, of the terminal end of the wire W, a portion that is close to the top end and tends to be subjected to external forces by cutting operation or the like. The faces of the rear part 124c substantially face in the height direction, and the rear part 124c extends from the top end of the intermediate part 124b rearward in the depth direction. The rear part 124c is so arranged that it contacts the header contact 220 of the header connector 200 by its end face on the inner side in the width direction.

**[0034]** The bottom plate 121a of the body 121 of the socket contact 120 is divided into a first bottom plate 121aa that is on the rear side in the depth direction and a second bottom plate 121ab that is on the front side. The contacting pieces 124 are provided on the first bottom plate 121aa on the rear side in the depth direction, and the insulation displacement plate 122 is provided on the first bottom plate on the front side in the depth direction. Moreover, the insulation barrel 123 is provided on the second bottom plate 121ab at least on one of both sides in the width direction thereof. In the case of this embodiment, insulation barrels 123 are provided on both sides in the width direction of the second bottom plate 121ab.

**[0035]** As shown in Fig. 12, protruding parts 117 that protrude inward in the width direction are provided near the opening of the wire insertion groove 115 to the bottom face of the socket housing 110. It is so arranged that the side plates 121b of the body 121 of the socket contact 120 contact the protruding parts 117 with a contact pressure, and this accomplishes inserting of the socket contact 120 into the wire insertion groove 115 of the socket housing 110.

**[0036]** The socket contact 120 is provided with fitting-on pieces 126 that substantially rise in the height direction from both sides in the width direction thereof. The faces that constitute the wire insertion groove 115 of the socket housing 110 are provided with catching parts 118 that catch the fitting-on pieces 126 so as to prevent the socket contact 120 from shifting frontward in the depth direction. In the case of this embodiment, the fitting-on pieces 126 face substantially in the width direction and rise in the height direction from both ends in the width direction of the bottom wall. The catching parts 118 are provided by concaving the side faces of the wire insertion groove 115 outward in the width direction. First, the socket contact 120 is inserted into the wire insertion groove 115, then the fitting-on pieces 126 are bent a little outward in the width direction to fit the fitting-on pieces 126 into the catching parts 118. With this arrangement, if the socket contact 120 is made to move forward in the depth direction, its fitting-on pieces 126 will hit on faces of the catching parts 118, the faces facing rearward and being located on the front side in the depth direction, and the socket contact 120 will be prevented from shifting. The fitting-on pieces 126 may be so provided that they are tilted a little outward in the width direction, and when the socket contact 120 is inserted into the wire

insertion groove 115, the fitting-on pieces 126 are deformed elastically to fit the fitting-on pieces 126 into the catching parts 118.

**[0037]** The socket connector 100 is so arranged that it engages with the header connector 200 in the height direction. In the case of this embodiment, as shown in Fig. 18, the header housing 210 is provided with a receiving chamber 214 that penetrates it from a top face 211 being one end face in the height direction to a bottom face 212 being the other end face and also extends up to an end face 213 on the front side in the depth direction. On the other hand, the socket housing 110 is provided with a protruding part 119, which is formed at the rear end in the depth direction thereof and is to fit into the receiving chamber 214. The header contact 220 is of a blade type and has a contacting part 221 that is formed into a plate facing in the width direction. The header contacts 220 are so provided in the header housing 210 that their contacting parts 221 protrude from the rear in the depth direction into the receiving chamber 214. The header contact 220 is provided with a connecting part 222 in such a way that the connecting part 222 comes out of the bottom face 212 or its periphery of the header housing 210. The connecting part 222 is mounted by soldering, etc. onto a surface of an object for mounting P. The connecting part 222 may be soldered onto the surface of the object for mounting P or it may be inserted into a hole that is formed in the object for mounting P and then soldered. It does not matter whether this hole is through the object for mounting P or not. And they are so arranged that when the socket connector 100 is engaged with the header connector 200, the pair of contacting pieces 124 will contact both end faces in the thickness direction of the contacting part 221 of the header contact 220. The width of the receiving chamber 214 is narrowed at a location that is close to the end face 213 at the front in the depth direction of the header housing 210 to form a neck part. The header housing 210 is provided with fitting-on parts that protrude inward in the width direction to form this neck part, and these fitting-on parts prevent the socket connector 100 from coming off frontward in the depth direction. The protruding part 119 of the socket housing 110 and the constituent walls of the receiving chamber 214 of the header housing 210 are provided with locking mechanisms that enhance the strength of engagement when the protruding part 119 is fitted into the receiving chamber 214. To be more specific, the constituent walls of the receiving chamber 214 are provided with concaved parts as locking parts 215, and the protruding part 119 is provided with projecting parts as locking parts 119a so that when the protruding part 119 is fitted into the receiving chamber 214, the locking parts will engage together through the use of their flexibility. Conversely, the protruding part 119 may be provided with concaved parts and the constituent walls of the receiving chamber 214 may be provided with projecting parts.

**[0038]** The functions and effects of the socket contact 120 of this embodiment will be described. This socket contact 120 is inserted into the wire insertion groove 115 of the socket housing 110 by orienting the socket contact 120 so that the slot 122a opens toward the bottom face side of the socket housing 110 and the insulation barrel 123 rises toward the bottom face side of the socket housing 110. Then the terminal end of the wire W extending in the depth direction is pushed into the wire insertion groove 115 in the height direction so that the redundant part W1 at the top end is received in the receiving part 125, and the wire W is insulation-displacement-connected to the slot 122a, then the insulation of the wire W is gripped by the insulation barrel 123 (refer to Fig. 16 and Fig. 17). Next, the socket connector 100 is connected to the header connector 200 that is provided on a surface of an object for mounting P, and the pair of contacting pieces 124 of each socket contact 120 are made to contact the contacting part 221 of the header contact 220 from both sides in the width direction thereof (refer to Fig. 19 through Fig. 21).

**[0039]** In that case, as the socket contact 120 is inserted into the wire insertion groove 115 and the insulation barrel 123 grips the insulation of the wire W, the strength against pulling-about of the wire W (the movements indicated by the imaginary lines and a continuous line arrow in Fig.20) is enhanced, and this in turn eliminates the need of providing the socket housing 110 with strain reliefs; thus reduction in the thickness of the socket connector 100 is realized. Moreover, as the pair of the contacting pieces 124 do not oppose to each other but lie side by side in the width direction and their base parts 124a, intermediate parts 124b and rear parts 124c are continuous, bending stepwise, when their developed lengths are set substantially equal to the lengths of the contacting pieces in the straight condition, the socket contact 120 will be shortened while maintaining elasticity in comparison with a case wherein the contacting pieces are used in the straight condition just like the case when the contacting parts are arranged to oppose to each other; thus the socket connector 100 is downsized. Furthermore, as the force for holding the wire W is secured by the insulation barrel 123 and the redundant part W1 of the terminal end of the wire is received between the bending parts of the contacting pieces 124 and the insulation displacement plate 122, of the terminal end of the wire, the redundant part W1 of which conductor might have been disturbed by cutting or the like is avoided and a portion W2 of the wire of which conductor is intact will contact the slot 122a, realizing a reliable insulation displacement connection; thus contact reliability between the slot 122a and the wire conductor is assured. Accordingly, the socket contact 120 is more shortened by using a single slot 122a, and the socket connector 100 is downsized. And as the pair of contacting parts 124 of the socket contact 120 contact the contacting part 221 of the header contact 220 from both sides in the thickness direction thereof, the socket contact 120 will contact the header contact 220 at two

points; thus the reliability of connection is enhanced. Moreover, as the binding strength between the socket contact 120 and the wire W is enhanced by the insulation barrel 123, no relative movements will be generated between the socket contact 120 and the wire W even when the wire W is subjected to pulling-about or pulling-out forces; thus the reliability of connection between the slot 122a and the conductor of the wire W is enhanced.

**[0040]** The pair of contacting pieces of the socket contact of the present invention may be provided in the wire insertion groove or may be made to protrude out of the wire insertion groove. However, in the case of this embodiment, the socket housing 110 is provided with a receiving concaved part 116, which is located on the rear side in the depth direction of the wire insertion groove 115, is interconnected to the wire insertion groove 115 and opens to the bottom face 111 or the end face 114 on the rear side in the depth direction and into which the header contact 220 of the counterpart header connector 200 is to be inserted, and the pair of contacting pieces 124 are provided in the receiving concaved part 116. With this arrangement, when the socket contact 120 is inserted into the wire insertion groove 115 of the socket housing 110, the contacting pieces 124 will be received in the receiving concaved part 116. As a result, the contacting pieces 124 will be protected by the socket housing 110 and will not be deformed inadvertently by external forces.

**[0041]** It is sufficient for the socket contact of the present invention that the socket contact is provided with a body having a bottom plate. The bottom plate of the socket contact of the present invention may be provided integrally without any division. However, in the case of this embodiment, the body 121 comprises a bottom plate 121a and side plates 121b rising on one side in the height direction from both sides in the width direction of the bottom plate 121a, the bottom plate 121a is divided into a first bottom plate 121aa on the rear side in the depth direction and a second bottom plate 121ab on the front side, contacting pieces 124 are provided on the first bottom plate 121aa on the rear side in the depth direction and an insulation displacement plate 122 is provided on the front side, and an insulation barrel 123 is provided on the second bottom plate 121ab at least on one of both sides in the width direction thereof. With this arrangement, as the first bottom plate 121aa and the second bottom plate 121ab are separated from each other, when the insulation barrel 123 being provided on the second bottom plate 121ab is bent to grip the wire W, stresses that are generated by this operation will not reach the first bottom plate 121aa, and neither the contacting pieces 124 nor the insulation displacement plate 122 will be deformed. Moreover, when the socket contact 120 is formed by bending a single blank C that is formed into a given configuration (refer to Fig. 7), as the blank C will have a configuration that is symmetrical or symmetrical to some extent in relation to a line L extending in the longitudinal direction of the bottom plate 121a, unbalanced forces will be hardly exerted to the blanks C when they are punched from a plate material by blanking or the like; thus the yield of the blanks C is high. Furthermore, as neither the length nor the width of the blank is extremely greater than the other, blanks C can be taken efficiently from the plate material.

**[0042]** The socket contact of the present invention may contact, with a contact pressure, any part of the constituent walls of the wire insertion groove, and its inserting form is not limited. However, in the case of this embodiment, side plates 121b are made to contact, with a contact pressure, protruding parts 117 that protrude inward in the width direction near the opening to the bottom face 111 of the wire insertion groove 115 of the socket housing 110 so as to accomplish inserting the socket contact 120 into the wire insertion groove 115 of the socket housing 110. With this arrangement, as the movement in the height direction of the socket contact 120 is strongly restrained by the bottom face and the protruding parts 117 of the wire insertion groove 115, the strength against pulling-about of the wire W in this direction is enhanced.

**[0043]** The socket contact of the present invention is so structured that the socket connector having this socket contact may engage with the header connector in any form, and the engaging form is not limited. Accordingly, the present invention includes an embodiment wherein the socket connector is arranged to be fitted with the header connector in the depth direction. However, in the case of this embodiment, the socket connector 100 engages with the header connector 200 in the height direction, the header contact 220 is of a blade type and has a plate-shaped contacting part 221 facing in the width direction and when the socket connector 100 engages with the header connector 200, a pair of contacting pieces 124 will contact both end faces in the thickness direction of the contacting part 221 of the header contact 220. With this arrangement, as the socket connector 100 is engaged with the header connector 200 in the height direction, there is no need of providing the object for mounting P with an open space for shifting the socket connector 100 at the time of engagement, thus the area on the object for mounting P, which is occupied by the socket connector 100 and the header connector 200, is reduced. This is advantageous when the header connector 200 is mounted on a surface of an object for mounting P, the surface having densely mounted components, and the socket connector 100 is to be connected to it. Moreover, when the header connector 200 is mounted on a surface of an object for mounting P, the surface having densely mounted components, and the socket connector 100 is to be fitted in it, the required operation will be pushing the socket connector 100 in the height direction, hence its workability will be significantly improved in comparison with an operation of pushing in a direction perpendicular to the height direction, such as the depth direction or the width direction. As the socket connector 100 is reduced in the height,

the height from the surface of the object for mounting P up to the top face 112 of the socket connector 100 is lowered, and in turn reduction in height of the connection structure comprising the socket connector 100 and the header connector 200 is realized. As the wires W are led out of the socket housing 110 forward in the depth direction, even if, for example, a casing or the like is placed to oppose to the surface of the object for mounting P, the wires W will hardly contact the casing or the like. Hence the loads that are exerted to the wires W are reduced and the state of connection is stabilized, and furthermore, the height of the connection structure of the socket connector 100 and the head connector 200 is reduced.

**[0044]** The present invention includes an embodiment of a socket connector wherein no fitting-on pieces nor catching parts are provided. However, in the case of the above-mentioned embodiment, the socket contacts 120 are provided with fitting-on pieces 126 that rise substantially in the height direction from both ends in the width direction, and the faces constituting the wire insertion grooves 115 of the socket housing 110 are provided with catching parts 118 that catch the fitting-on pieces 126 so as to prevent the socket contacts 120 from shifting forward in the depth direction. With this arrangement, as the catching parts 118 catch the fitting-on pieces 126 and the socket contacts 120 are prevented from shifting forward in the depth direction, the strength against pulling-out of the wires W is enhanced. Hence it is possible not to adopt the so-called lance structure wherein either the socket housing 110 or the socket contact 120 is provided with a fitting-on piece and the other is provided with a fitting-on hole in which the fitting-on piece is hooked. As a result, it becomes possible to eliminate from the socket housing 110 any fitting-on piece or hole that is formed to make a fitting-on hole, and to make the top face 112 of the socket housing 110 free of any hole, and in turn, it becomes possible to reduce the thickness of the socket housing 110.

**[0045]** Moreover, in the case of the above-mentioned embodiment, as the socket contacts 120 are inserted into the wire insertion grooves 115, the coupling strength between the socket contacts 120 and the socket housing 110 is high. When wires W are connected to the socket connectors 100 and this socket connector 100 is connected to the header connector 200 that is mounted on a surface of an object for mounting P, the wire insertion grooves 115 of the socket housing 110 will be blocked by the object for mounting P, and the peripheries of the slots 122a being the connecting parts of socket contacts 120 and wires W will be enclosed by the socket housing 110 and the object for mounting P. Accordingly, as shown in Fig. 20, the pulling-about forces of the wires W will be received by the socket housing 110 or the object for mounting P and will not reach the slots 122a; thus the strength against pulling-about of the wires W is enhanced. Moreover, as the insulation barrels 123 of the socket contacts 120 grip the insulations of wires W, even if the wires W are pulled in the extending direction of the wires W to move away from the socket connector 100 and the wires W are subjected to pulling-out forces, these pulling-out forces will be received by the insulation barrels 123 and will not reach the slots 122a; thus the strength against pulling-out of the wires W is enhanced.

**[0046]** The present invention includes embodiments wherein features of the embodiments described above are combined.

## Claims

**1.** A socket contact (120), which is to be inserted into a wire insertion groove (115) of a socket housing (110) having a depth direction, a width direction and a height direction all being perpendicular to each other wherein the wire insertion groove (115) concaves from the bottom face (111) being one end face in the height direction toward the top face (112) being the other end face and also extends to the end face (113) on the front side in the depth direction and to which the terminal end of a wire (W) is to be connected so that the wire (W) is led out of the socket housing (110) frontward in the depth direction,

the socket contact (120) comprising

a body (121) that has a bottom plate (121a) facing in the height direction,

an insulation displacement plate (122) that faces in the depth direction, rises on one side in the height direction from an intermediate part in the depth direction of the bottom plate (121a), has an approximately U-shaped slot (122a) opening toward one side in the height direction, breaks insulation of the wire (W) and makes connection with the conductor thereof,

an insulation barrel (123) that substantially faces in the width direction, rises toward one side in the height direction from at least one of both sides in the width direction of the end part on the front side in the depth direction of the bottom plate (121a) and grips the insulation of the wire (W) by bending inward, and

a pair of contacting pieces (124) that lie side by side in the width direction and have base parts (124a) substantially facing in the height direction and extending from the bottom plate (121a) rearward in the depth direction, intermediate parts (124b) substantially facing in the depth direction and rising toward one side in the height direction from the top ends of the base parts (124a) to form a receiving part for receiving a redundant part (W1) of the terminal end of the wire (W) between themselves and the insulation displacement plate (122) and rear parts (124c) substantially facing in the height direction, extending from the top ends of the intermediate parts (124b) rearward in the depth di-

rection to contact a header contact (220) of a header connector (200) by the end faces on the inner sides in the width direction.

**2.** The socket contact (120) as recited in claim 1, wherein

the socket housing (110) is provided with a receiving concaved part (116), which is located on the rear side in the depth direction of the wire insertion groove (115), is interconnected to the wire insertion groove (115) and opened to the bottom face (111) or the end face (114) on the rear side in the depth direction of the socket housing (110) and into which the header contact (220) of the counterpart header connector (200) is to be inserted, and

the pair of contacting pieces (124) are provided in the receiving concaved part (116).

**3.** The socket contact (120) as recited in claim 1 or claim 2, wherein

the body (121) comprises a bottom plate (121a) and side plates (121b) rising on one side in the height direction from both sides in the width direction of the bottom plate (121a),

the bottom plate (121a) is divided into a first bottom plate (121aa) on the rear side in the depth direction and a second bottom plate (121ab) on the front side,

the contacting pieces (124) are provided on the first bottom plate (121aa) on the rear side in the depth direction and the insulation displacement plate (122) is provided on the front side, and

the insulation barrel (123) is provided on the second bottom plate (121ab) at least on one of both sides in the width direction thereof.

**4.** The socket contact (120) as recited in claim 3, wherein

the socket contact (120) is so structured that side plates (121b) are made to contact, with a contact pressure, protruding parts (117) that protrude inward in the width direction near the opening to the bottom face (111) of the wire insertion groove (115) of the socket housing (110) so as to accomplish inserting the socket contact (120) into the wire insertion groove (115) of the socket housing (110).

**5.** The socket contact (120) as recited in any one of claims 1 to 4, wherein it is so structured that

the socket connector (100) engages with the header connector (200) in the height direction.

the header contact (220) is of a blade type and has a plate-shaped contacting part (221) facing in the width direction and

when the socket connector (100) engages with the header connector (200), the pair of contacting pieces (124) will contact both end faces in the thickness direction of the contacting part (221) of the header contact (220).

FIG. 1

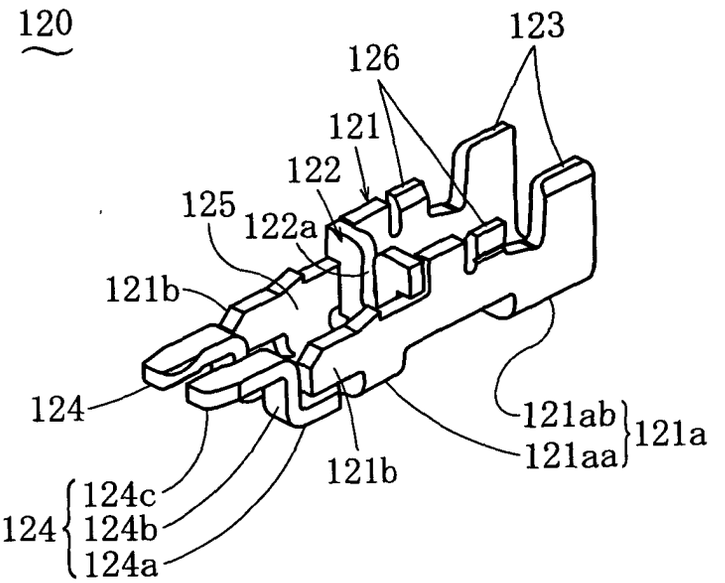
120
123
126
121
122
125
122a
121b
124
121ab
121aa
121a
121b
124
124c
124b
124a

FIG. 2

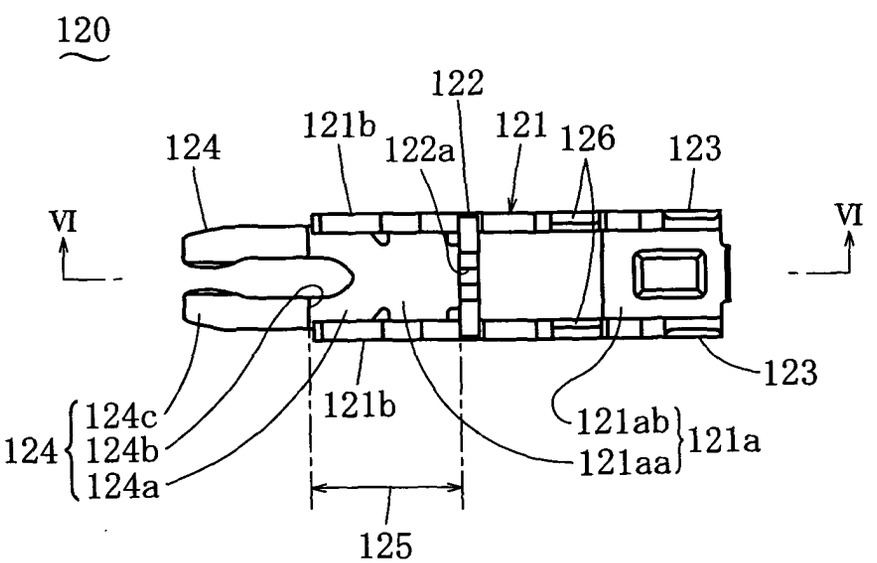
120
122
121b
121
126
123
124
122a
VI
VI
123
121b
121ab
121aa
121a
124
124c
124b
124a
125

FIG. 3

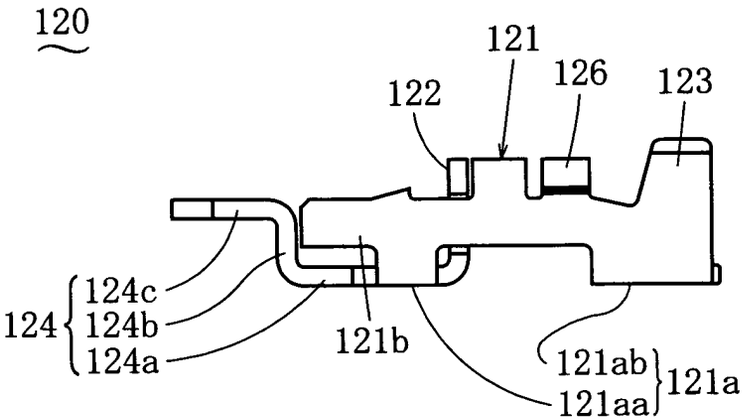
120
121
122
126
123
124
124c
124b
124a
121b
121ab
121aa
121a

FIG. 4

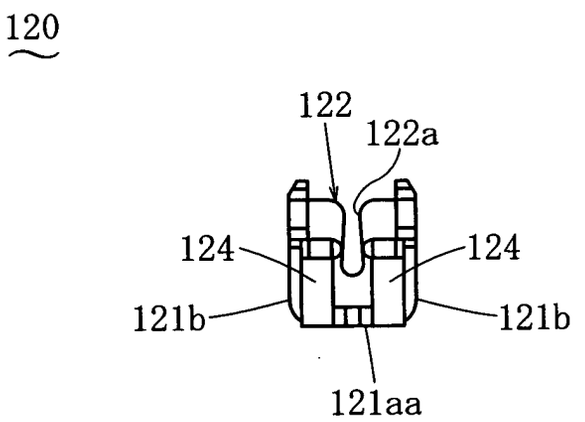
120
122
122a
124
124
121b
121b
121aa

FIG. 5

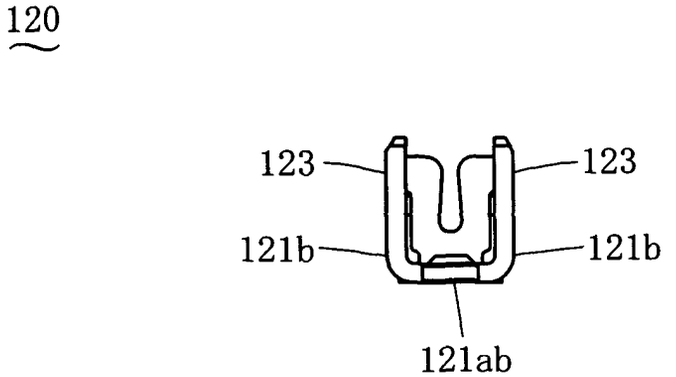
120
123
123
121b
121b
121ab

FIG. 6

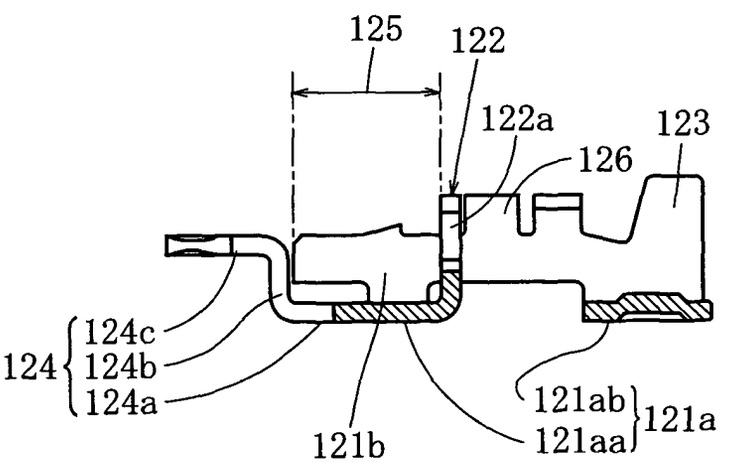
125
122
122a
123
126
124
124c
124b
124a
121b
121ab
121aa
121a

FIG. 7

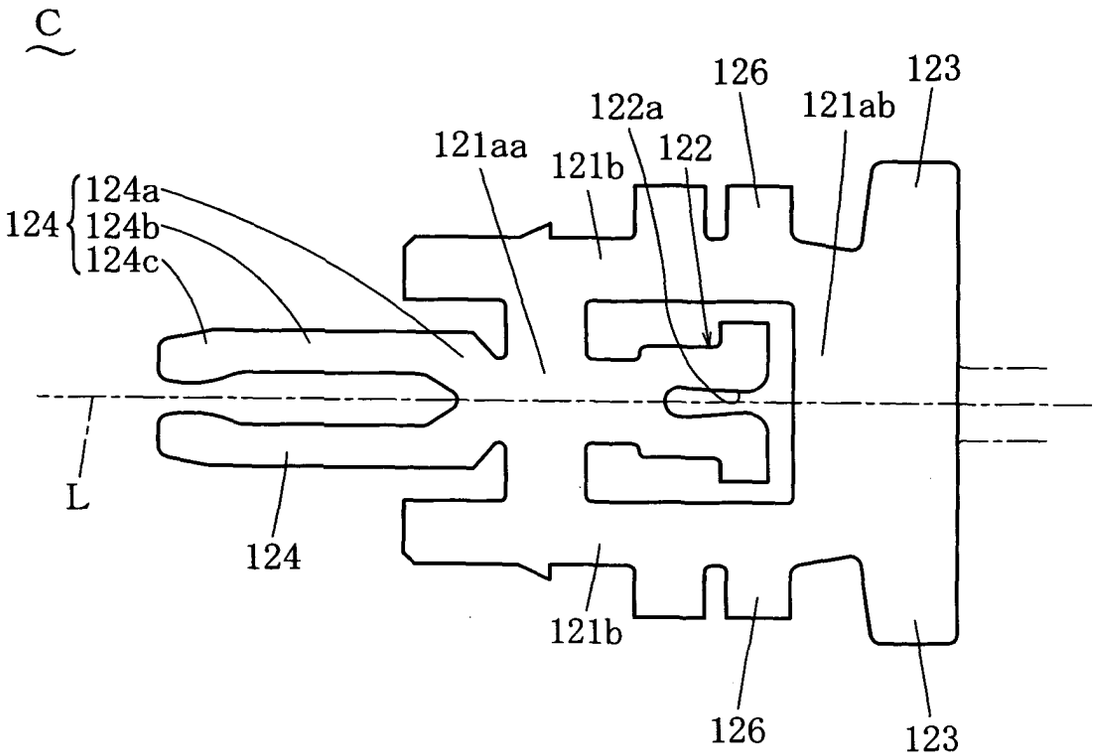
C
126
123
122a
121ab
121aa
121b
122
124
124a
124b
124c
L
124
121b
126
123

FIG. 8

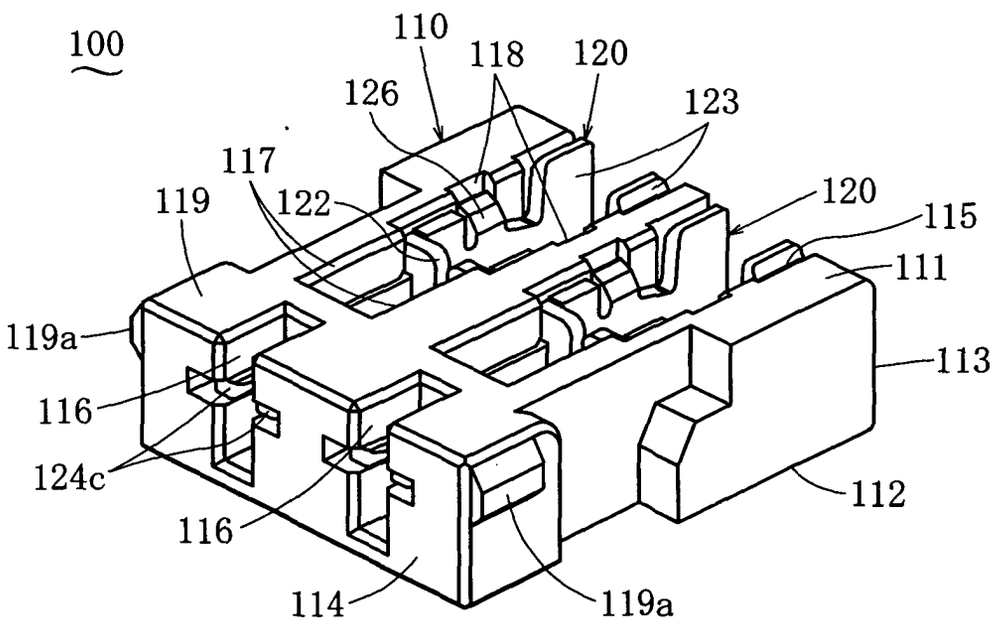
100
110
118
120
126
123
117
119
122
120
115
111
119a
113
116
124c
112
116
114
119a

FIG. 9

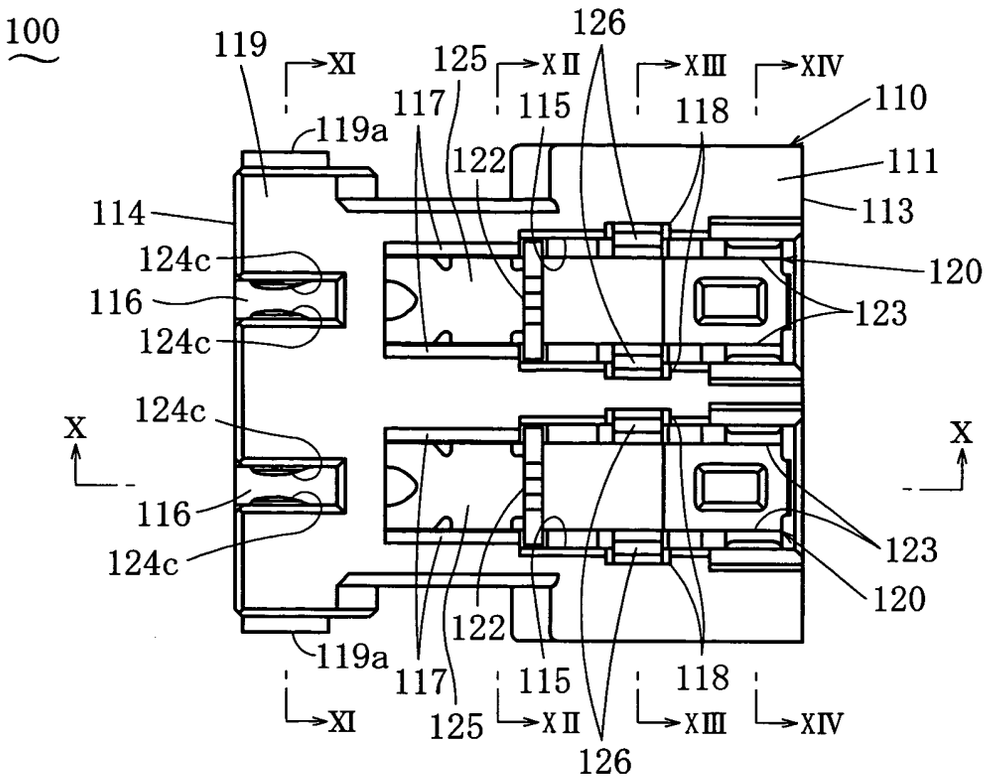
100
119
XI
125
XII
XIII
XIV
126
117
115
118
110
119a
122
111
114
113
124c
120
116
123
124c
124c
X
X
116
123
124c
120
122
119a
117
115
118
XI
125
XII
XIII
XIV
126

FIG. 10

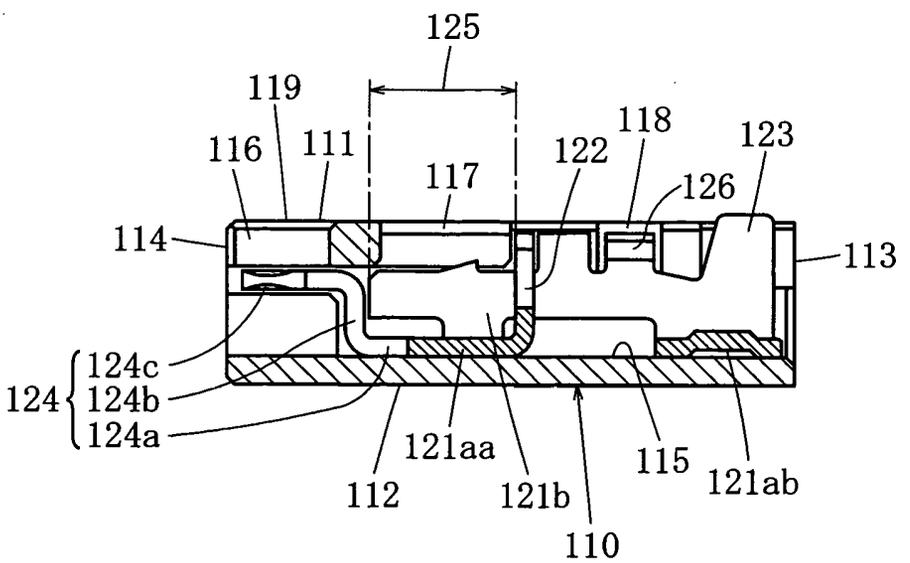
125
119
116
111
117
122
118
123
126
114
113
124
124c
124b
124a
121aa
115
121ab
112
121b
110

FIG. 11

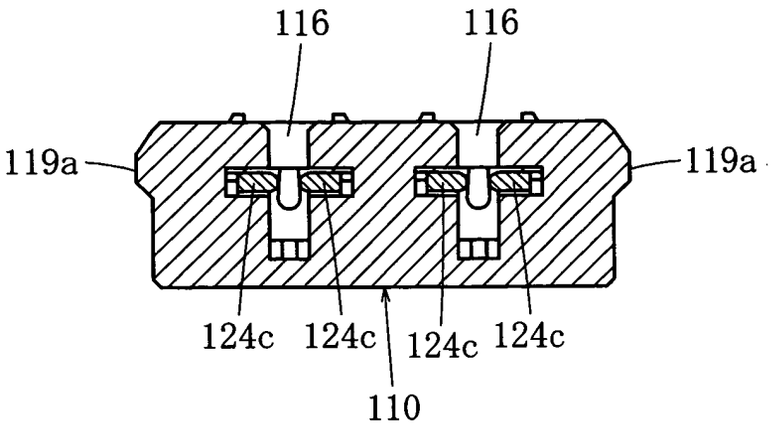
116
116
119a
119a
124c
124c
124c
124c
110

FIG. 12

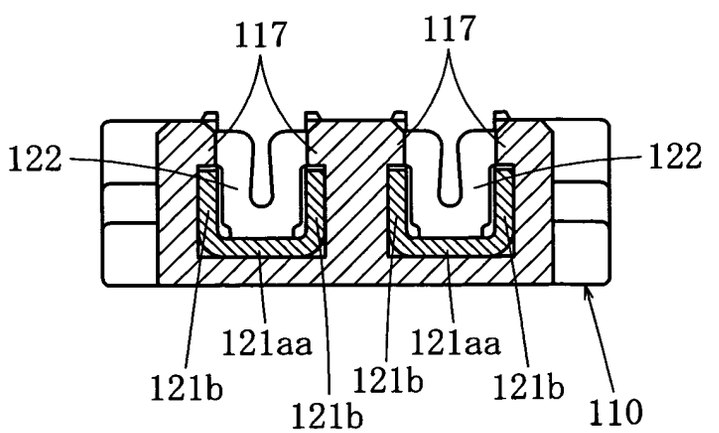
117
117
122
122
121aa
121aa
121b
121b
121b
121b
110

FIG. 13

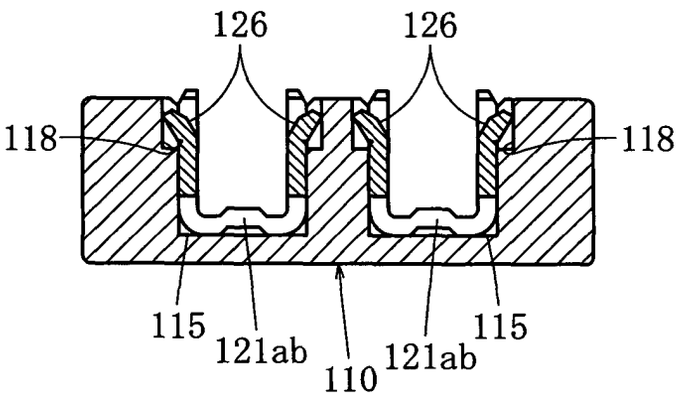
126
126
118
118
115
121ab
110
121ab
115

FIG. 14

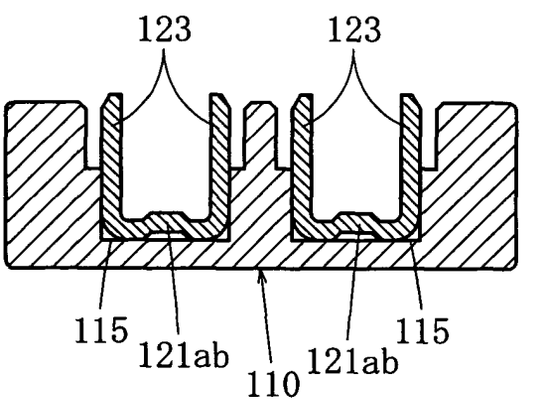
123
123
115
121ab
110
121ab
115

FIG. 15

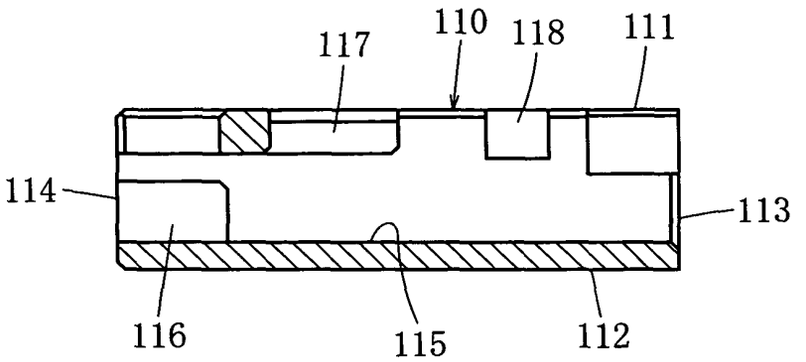
117
110
118
111
114
113
116
115
112

FIG. 16

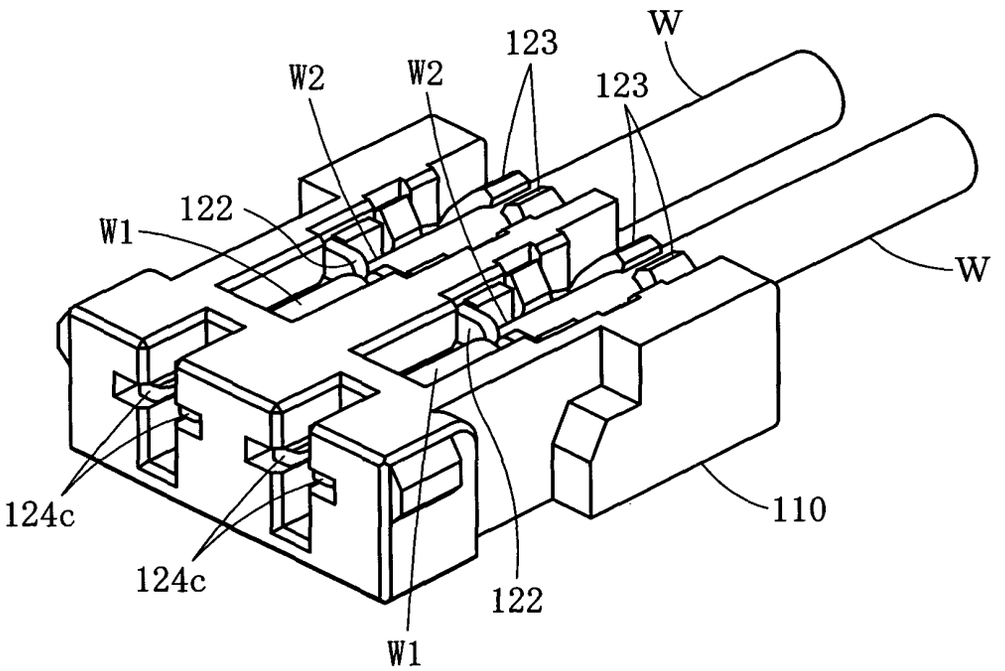
W
123
W2
W2
123
122
W1
W
124c
124c
122
W1
110

FIG. 17

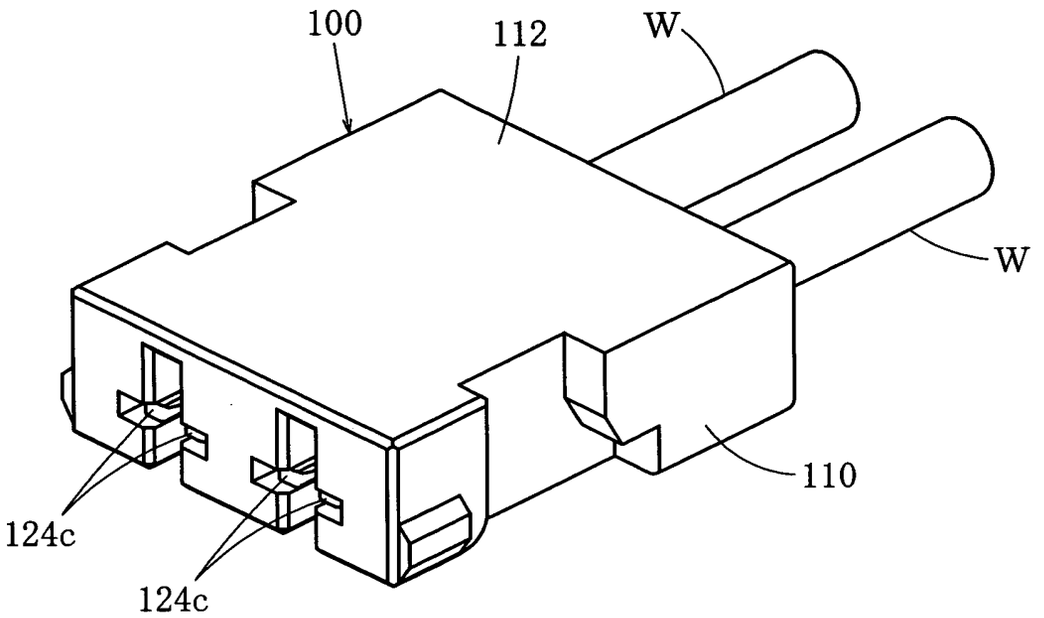
100
112
W
W
110
124c
124c

FIG. 18

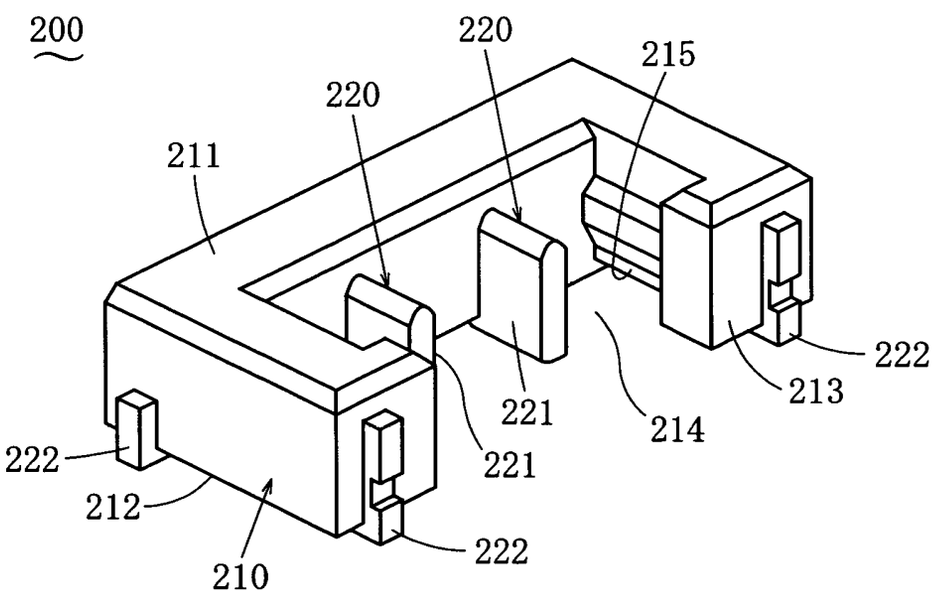
200
220
215
220
211
222
213
221
214
221
222
212
210
222

FIG. 19

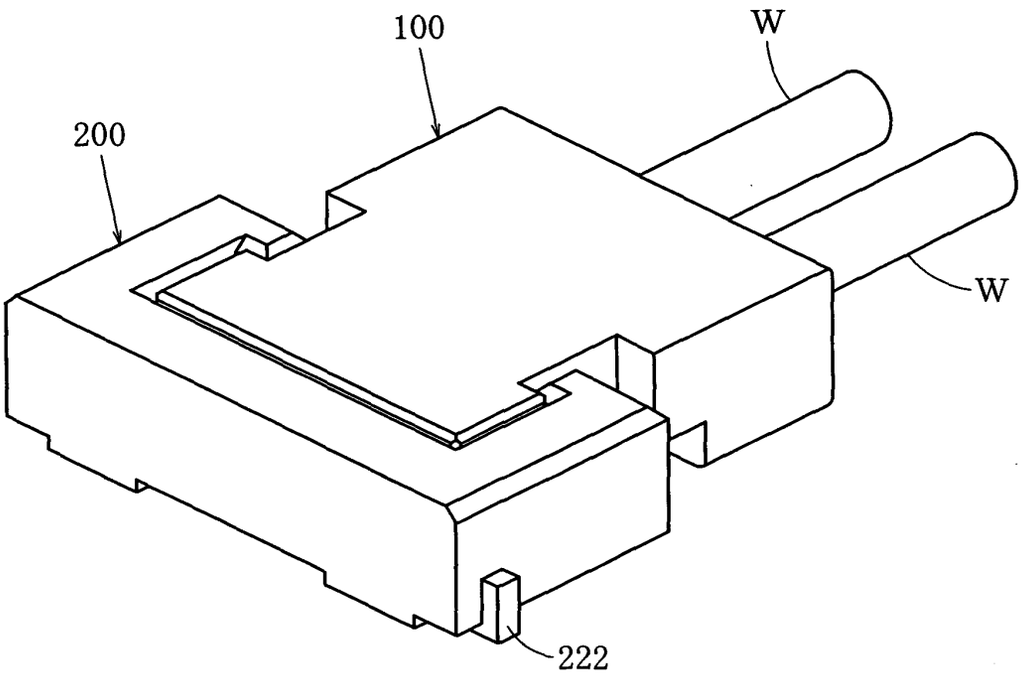


FIG. 20

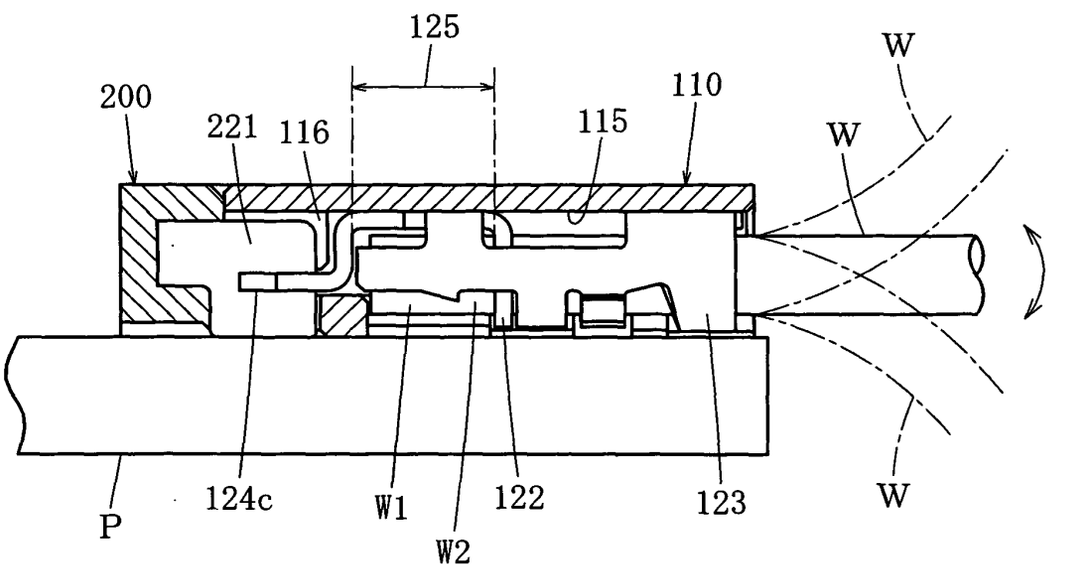

FIG. 21