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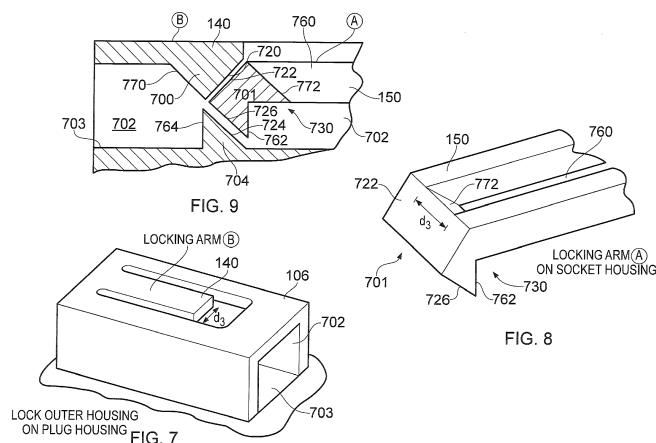
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(54) **ELECTRICAL CONNECTOR, HEADER AND SOCKET FOR THE SAME AND METHOD OF ASSEMBLY**

(57) An electrical connector (100) comprises a socket (104) for mutually engaging with a header (102) to provide electrical connection for one or more conductors of the socket (104) to one or more conductors of the header (102), the electrical connector including a locking mechanism to lock the header (102) to the socket (104). A housing of one of the header (102) and the socket (104) comprises a first locking arm (140) flexibly connected to the housing (122, 132), the first locking arm (140) including a first projection (700) having a first cam surface (720), and an adjacent housing surface (703) includes a second projection (704) having a second cam surface (724). A housing (122, 132) of the other of the socket (104) and the header (102) includes a second locking arm (150) comprising a head (701) having first and second engaging surfaces (722, 726), which are configured forward with respect to a first recess (760) and a second recess (730) formed in the second locking arm (150), the

first engaging surface (722) being configured to engage with the first cam surface (720) of the first projection (700) of the first locking arm (140), and the second engaging surface (726) being configured to engage with the second cam surface (724) of the second projection (704) as the socket (104) and the header (102) are being mated causing the first locking arm (140) to be displaced from a closed position against a biasing force provided by the flexible connection of the first locking arm (140) to the housing (122) to allow the head (701) of the second locking arm (150) to pass into a space between the first locking arm (140) and the adjacent housing surface (730), and the first projection (700) on the first locking arm (140) can be received in the first recess (760) on the second locking arm (150), and the second projection (704) can be received in the second recess (730) formed in the second locking arm (150) so that the first locking arm (140) can return to the closed position.



Description

Field of the Disclosure

[0001] The present disclosure relates to electrical connectors comprising a socket for mutually engaging with a header to provide electrical connection for one or more conductors of the socket to one or more conductors of the header.

[0002] Embodiments of the present technique can provide an electrical connector comprising a socket and a header which includes a locking mechanism between the socket and the header which can reduce an anti half mating possibility between the socket and the header.

Background of the Disclosure

[0003] The "background" description provided herein is for the purpose of generally presenting the context of the disclosure. Work of the presently named inventors, to the extent it is described in this background section, as well as aspects of the description which may not otherwise qualify as prior art at the time of filing, are neither expressly or impliedly admitted as prior art against the present disclosure.

[0004] Electrical connectors are known to provide an arrangement for providing electrical connection between electrical components and are used in a variety of electrical devices. Typically an electrical connector can comprise two parts in which one or more conductors from one part are arranged to be electrically connected to one or more conductors of the other part when the two parts are mated.

[0005] In some environments the electrical connection provided by an electrical connector can be compromised. For example, in automotive applications electrical components which are manufactured separately and then assembled on a production line must be provided with an electrical connector which allows those parts when assembled to be electrically connected. However a nature of automotive applications can mean that the electrical connector is subject to vibration and/or significant temperature changes as well as the presence of foreign bodies such as dirt and contamination. Therefore it is desirable to provide an arrangement in which an electrical connector can provide electrical connection between electrical components which ensures an increased reliability of the electrical connection provided by the electrical connector. Furthermore because the connection between two parts of the electrical connector may be made during assembly between two electrical components, and the assembly may restrict access to the parts of the electrical connector which must be mated at a point in the assembly process, it is also desirable to provide an arrangement in which a false mating of the two parts of the electrical connector is more easily detectable.

Summary of the Disclosure

[0006] Embodiments of the present technique can provide an electrical connector which includes a socket for mutually engaging with a header to provide electrical connection for one or more conductors of the socket part to one or more conductors of the header part. A housing of the socket and a housing of the header include locking arms, which together form a locking mechanism which is configured to provide an anti-half mating feature for the electrical connector. Anti-half mating is an expression which is used in the following description to describe an advantageous technical effect, in which it is easier to detect when the parts of the electrical connector have not mated correctly or completely in an engaged state although it may appear that they have been mated.

[0007] According to the present technique the housing of one of the header and the socket includes a first locking arm resiliently connected by a cantilever for example to the housing, the first locking arm including a first projection having a first cam surface, the first projection being arranged to project into a space between the first locking arm and an adjacent surface of the housing. The adjacent housing surface includes a second projection having a second cam surface, the second projection being arranged to project into the space between the first locking arm and the housing surface towards the first projection. The housing of the other of the socket and the header includes a second locking arm having first and second engaging surfaces, which are configured forward from a first recess and a second recess formed in the second locking arm. The first engaging surface is configured to engage the first cam surface of the first projection of the first locking arm, and the second engaging surface being configured to engage the second cam surface of the second projection of first locking arm as the socket and the header are advanced towards each other causing the first locking arm to be displaced from a closed position against a biasing force provided by the cantilever to an open position to allow the second locking arm to pass into the space between the first locking arm and the adjacent housing surface. After the second locking arm has passed into the space between the first locking arm and the adjacent housing surface the first projection on the first locking arm is received into the first recess on the second locking arm, and the second projection on the adjacent housing surface is received in the second recess formed in the second locking arm so that the first locking arm can return to a closed position. The second locking arm is thereby held by the first and the second projections by the first locking arm and the housing.

[0008] Various further aspects and features of the present disclosure are defined in the appended claims, which include an electrical connector, a header and a socket for electrical connectors, a method of assembling an electrical connector and a method forming an electrical connection using the electrical connector.

Brief Description of the Drawings

[0009] Embodiments of the present disclosure will now be described by way of example only with reference to the accompanying drawings in which like parts are provided with corresponding reference numerals and in which:

Figure 1 provides a three dimensional representation of an assembled electrical connector embodying the present technique, together with a three dimensional view illustrating an assembly of the electrical connector from its component parts;

Figure 2a is a three dimensional representation of a socket housing of the connector shown in Figure 1; Figure 2b is a retainer of the socket housing showing in Figure 1 and Figure 2c is a three-dimensional view of a header housing of the electrical connector shown in Figure 1;

Figure 3a is a side elevation of one of a plurality of terminals of the electrical connector shown in Figure 1 and Figure 3b is a top view of the terminal of the electrical connector shown in Figure 1;

Figure 4a is a side elevation one of a plurality of through pins of the electrical connector shown in Figure 1 and Figure 4b is a plan view of a through pin of the electrical connector shown in Figure 1;

Figure 5 is a diagram illustrating an assembly of the socket of the electrical connector shown in Figure 1 in three steps as well as a side elevation of the assembled socket;

Figure 6 is a diagram illustrating an assembly of the header of the electrical connector of Figure 1 in two steps together with a side elevation showing an engagement of the through pin;

Figure 7 is a diagram showing a three dimensional view of a tunnel locking chamber forming part of a locking mechanism of the electrical connector shown in Figure 1;

Figure 8 is a diagram showing a three dimensional view of a locking arm forming part of the locking mechanism of the electrical connector shown in Figure 1;

Figure 9 is a diagram showing a cross section of a pre-engaged view of the locking arm of Figure 8 within the locking chamber of Figure 7;

Figure 10 is a diagram showing a three dimensional representation of the locking mechanism provided on the electrical connector of Figure 1 in more detail,

together with an expanded view of a locking arm of the socket engaging with a locking arm of the header; and

Figure 11 is a diagram showing a side elevation of the electrical connector shown in Figure 1 together with four steps illustrating an arrangement in which the socket is locked in an electrical connection with the header by the locking mechanism according to the present technique.

Detailed Description of Example Embodiments

[0010] Figure 1 provides a three dimensional representation of an electrical connector according an example embodiment of the present technique. As shown in Figure 1, a three dimensional view of an assembled electrical connector 100 is shown, which is formed from a header 102 and a socket 104. According to the present technique the electrical connector 100 includes a locking arrangement or mechanism comprising a locking chamber 106 formed as part of the header which engages with a locking arm 150 formed on the socket 104. The header 102 includes a plurality of electrical conductors 108 which are formed by male through pins 130 as they project from a rear side of the header 102 to provide contact points for electrical connection for one or more components to which the header 102 is attached or forms part.

[0011] As shown in Figure 1, the components of the electrical connector 100 are shown in an expanded view which illustrates an arrangement in which the components are assembled to form the electrical connector 100. As shown in Figure 1, the socket 104 comprises a plurality of female terminals 120 each of which provides electrical connection to a conductor on the socket side, and a socket housing 122. Optionally, the female terminals 120 are retained within the socket housing 122 by a retainer 110, although as explained below other arrangements can be used for retaining the female terminals 120 within the socket housing 122. An assembly of the socket is illustrated in Figure 1 by arrows 125, 127, in which the retainer 110 and female terminals 110, 120 are assembled into the socket housing 122 to form the socket 104.

[0012] Also illustrated in Figure 1 is an assembly of the header 102 from a plurality of through pins 130 and a header housing 132. As illustrated by an arrow 134 the header 102 is assembled by moving the through pins 130 into receiving holes 136 formed in the header 102.

[0013] According to an example embodiment of the present technique, the electrical connector 100 includes the locking chamber 106 which includes a first locking arm 140, which is formed as part of the locking chamber 106. The socket 104 includes a second locking arm 150 formed as part of the socket housing 122. As will be explained in the following paragraphs, the first locking arm 140 and the second locking arm 150 are arranged to mutually engage to lock the header 102 to the socket 104 to lock the electrical connection and to provide an anti-

half mating feature.

[0014] As shown in Figure 1 as the retainer 110 includes first and second displaceable securing arms 126, 128 each of which includes a receiving slot 129. As the socket 104 is assembled by pushing the retainer 110, the female terminals 120 and the socket housing 122 together, a securing projection 124 is arranged to deflect the first and second engaging arms 126, 128 before being received in the receiving slot 129 to retain the retainer 110 in engagement with the socket housing 122 to hold the female terminals 120 in place within receiving channels formed within the socket housing 122.

[0015] For the example shown in Figure 1, the retainer 110 is used to hold the female terminals 120 within the socket housing 122. However this is just one example and it will be appreciated that in other examples, different arrangements can be made for retaining the female terminals 120 within the socket housing 122, such as for example crimping the terminals onto the respective conductors and inserting the terminals into the housing.

[0016] As the socket 104 and the header 102 are mated together a mating section 180 of the socket 104 is received within a cavity formed within the header housing 132 to provide a more accurate alignment of the male through pins 130 and the female terminals 120 so that when mating occurs the male through pins 130 are coaxially located and received within the female terminals 120.

[0017] Figure 2a provides a more detailed view of the socket housing 122 in Figure 2a, the retainer 110 in Figure 2b and the header housing 132 in Figure 2c.

[0018] A more detailed example of the female terminals 120 shown in Figure 1 is shown in more detail as a side elevation in Figure 3a and a plan view in Figure 3b. As shown in Figure 3a and Figure 3b the female terminal 120 includes a receiving channel 200 for receiving the male through pin 130 through an opening 202. The male through pin 130 is engaged by upper and lower contact retaining flanges 204, 206 which are biased inwards so that they contact the male through pin 130 as the male through pin enters the receiving channel 200 and deflects the retaining flanges 204, 206. At an opposite end to the opening 202 of the receiving channel 200, the female terminal 120 includes circular conductor receiving elements 210 and a crimping section 212 which are arranged to receive and to fix a connecting wire or conductor within the female terminal 120. The female terminal 120 is configured to be mounted within the socket housing 122 and includes a locking tongue 220 for engaging with a recess in the socket housing to lock the female terminal 120 within the receiving channel (not shown) in the socket housing 122 further secured by the retainer 110.

[0019] An example of one of the male through pins 130 is shown in more detail as a side elevation in Figure 4a and a plan view in Figure 4b. As shown in Figures 4a and 4b, the male through pin 130 is arranged to be received and secured within a receiving channel of the header

housing 132 to project rearward 108 from the header 102. The male through pins 130 also project forward of the header housing 132 within a cavity formed by the header housing 132 facing the socket 104 for receiving the mating section 180. As mentioned above, the through or male pins 130 can be arranged to provide electrical connection to one or more components, for example which are mounted on a circuit board or in an automotive component of which the header 102 forms part. Thus as shown in Figure 4a a first section of the through pin 300 is configured to project forward of the header housing 132 within the cavity of the header housing 132 so that when the socket 104 and header 102 are mated together, the first section of the through pin 300 can be received within the receiving channel 202 of the female terminal 120. A second section 302 of the through pin 130 extends through the header housing 132 and protrudes rearward of the header housing 132 to form the rearward pins 108 for providing electrical connection to a component for which the electrical connector 100 is providing electrical connection.

[0020] A central section 304 is configured to include a profile which engages with a profiled receiving channel of the header housing 132 in order to fix the through pin 130 within the header housing 132. For example, the profile of the male through pin 130 also includes retaining projections 308 which embed within the walls of the receiving channel of the header housing 132. The central section 304 also includes a flange 306 which projects outwardly and perpendicular to an axis of the male through pin 130 in one plane for engaging with a slot within the profiled receiving channel of the header housing 132 which receives the through pin 130. The flange 306 can therefore provide a counter measure for over insertion of the male through pin 130 within the header housing 132.

[0021] Having regard to the description of the socket 104 provided above with reference to Figures 1 to 4b, Figure 5 provides an illustrative representation of the assembly of the socket 104. As shown in Figure 5 in a first step 500 the socket housing 122 is shown. In a second step 502, the female terminals 120 are inserted into receiving channels within the socket housing 102. In a third step 504 the retainer 110 is inserted behind the female terminals 120 so that the retaining arms 126, 128 ride over the securing projection 124 until they are secured within the receiving slots 129. As shown in step 506 the socket 104 is shown in its fully assembled state. A side elevation of the fully assembled socket 104 is also shown in Figure 5 in a cross-sectional view 508. As shown in the cross-sectional view 508, the locking tongue 220 shown in Figure 3a on the female terminal extends within a recess 510 within the socket housing 122 securing the female terminal 120 within a receiving channel 512 of the socket housing 122.

[0022] Figure 6 provides a corresponding diagram to that of Figure 5 illustrating the assembly of the socket 104. In a first view 600 the header housing 132 is shown.

In a first step 602, the male through pins 130 are inserted in receiving channels within the header housing 132 to form the header 102 shown in a third view 604. As shown in a side cross-sectional view 606 and a plan cross-sectional view 608 the male through pins 130 are inserted into the header housing 132 within receiving channels 610, which extend through the receiving channel 610 to protrude rearward of the header housing 132 within a section 612 to provide the connecting section of the pins 108.

[0023] As indicated above, the flange 306 formed in the middle section 304 of the male through pin 130 engages with side walls of a recess 620 within the receiving channel 610 which prevents the male through pin 130 being over inserted, so that the male through pin 130 extends a desired distance d_1 from the rearward side of the housing 132. The engagement of the flange 306 within the recess 620 also ensures that the first section 300 of the male through pin 130 (Figure 4a and 4b) extends a distance d_2 from the forward side of the header 102. As shown in Figure 6, a cavity 630 is formed within the header housing 132 into which the male through pin 130 protrudes the distance d_2 . The cavity 630 is configured to receive a mating section 180 of the socket. Accordingly, as the socket 104 and header 102 are mated together, the mating section 180 of the socket 102 passes into the cavity 130 as the male through pin 130 is received within the receiving holes 125 of the socket 104. Walls of the mating section 180 of the socket housing 122 therefore engage with walls of the cavity 630 to restrict lateral movement of the socket 104 with respect to the header 102 as they are advanced towards each other to ensure that the male through pin 130 is received within the receiving channel 200 through the opening 202 of the female terminal 120.

[0024] As shown in more detail within a box 640, the flange 306 is received by and engages within the recess 620 of the housing 132 so that the flange 306 is received within the recess 620. Furthermore the retaining projections 308 formed in the side of the male through pin 130 engage with the walls of the receiving channel 610 to ensure that the male through pins 130 are secured within the receiving channel 610.

[0025] Although in the above example the male through pins 130 are secured within the header housing 132 and the female terminals 120 are held within the socket housing 150, it will be appreciated that in other embodiments the male through pins 130 could be held by the socket housing 150 and the female terminals 120 could be held within the header housing 132. Indeed other terminal configurations are possible other than the specific examples of the male through pins 130 and female terminals 120 other than those presented in Figures 1 to 6.

[0026] Embodiments of the present technique can provide an arrangement in which a locking mechanism secures a header 102 of an electrical connector 100 to a socket 104 which both secures the mating of the header

102 to the socket 104 and provides an anti-half mating feature. As indicated above, in harsh environments such as in automotive applications, vibrations and other conditions such as temperature variations can compromise the mating and therefore the electrical connection between the socket 104 and the header 102. Furthermore, the socket 104 and the header 102 are typically arranged to be connected to separately manufactured components, and for automotive applications, may be assembled on a production line where access to the header 102 and the socket 104 is not easy. Such automotive applications can make it difficult to mate the socket 104 and the header 102, so that a problem can arise in which a person performing the assembly considers that the socket 104 and header 102 have been engaged whereas in fact they have not been engaged. The socket 104 and the header 102 may therefore subsequently become detached, as a result of which the electrical connection fails. As will be explained shortly, the locking mechanism embodying the present technique includes a locking arm 150 forming part of a housing of one of the socket 104 and the header 102, which engages with another locking arm 140 forming part of a housing of the other of the socket 104 and the header 102 to secure a mating between the socket 104 and the header 102 and which also includes an anti-half mating aspect. According to the example embodiments shown in Figures 1 to 11, and with respect to the terminology and expressions used in the appended claims, a first locking arm 140 forms part of the housing 132 of the header 102, whereas a second locking arm 150 forms part of the housing 122 of the socket 104. However as will be appreciated the locking arms could be reversed and positioned on the other of the two parts of the connector.

[0027] According to the present technique therefore, the socket 104 and the header 102 may comprise first and second locking arms 140, 150 which form a locking mechanism for the electrical connector. An example illustration of a locking mechanism embodying the present technique is shown in Figures 6, 7 and 8.

[0028] Figure 7 shows a three dimensional representation of a tunnel style locking chamber 106, which includes a first locking arm 140. Figure 8 provides a three dimensional representation of a second locking arm 150 which is formed on the socket housing 122. A cross sectional view of the second locking arm 150 within the locking chamber 106 before engaging with the first locking arm 140 is shown in Figure 9.

[0029] The first and second locking arms 140, 150 may be arranged on either the socket 104 or the header 102 so that the locking chamber 106 may form part of the socket 104 whereas the second locking arm 150 may form part of the header 102.

[0030] As shown in Figure 9, the first locking arm 140 includes a first projection 700 which extends into a space 702 between the first locking arm 140 and a bottom of the locking chamber which also forms part of a surface of the housing 703 of the socket 104 or the header 102.

The surface of the housing 703 or the bottom section of the chamber 106 includes a second projection 704 which extends upward into the locking chamber 702 towards the first projection 700. Figure 9 shows a position of the first locking arm 140 in a closed position, in which the first locking arm 140 is substantially parallel to the surface of the housing 703 and the second locking arm is disengaged from the first locking arm 140 with a head 701 of the second locking arm 150 forward of the first and second projections 700, 704. The first projection 700 includes a first cam surface 720 for engagement with a first engaging surface 722 on the head 701 of the second locking arm 150. The second projection 704 includes a second cam surface 724 which is configured to engage with a second engaging surface 726 of the head 701 of the second locking arm 150.

[0031] As shown in Figure 8, the second locking arm 150 includes a cavity 760 which is configured to receive the first projection 700 and a space or void 730 configured to receive the second projection 704.

[0032] The receiving space 730 formed on a reverse side of the second engaging surface 726 of the second locking arm 150 for receiving the second projection 704, as the second locking arm 150 passes into the space 702. The first locking arm 140 is configured to be flexibly connected to the locking chamber 106 so that as the second locking arm 150 passes into the space 702 of the locking chamber 106, the first cam surface 720 engages with the first engaging surface 722 of the second locking arm 150 and the second cam surface 724 engages with the second engaging surface 726 of the second projection 704 causing the first locking arm 140 to be displaced against a biasing force provided by the flexible connection of the first locking arm 140 to the locking chamber 106. The flexible connection of the first locking arm 140 to the locking chamber 106 may be provided by a cantilever, resilient hinge or other arrangement which allows the first locking arm to move in a plane perpendicular to an axis of insertion. As the second engaging surface 726 of the second locking arm 150 engages with the second cam surface 724 of the second projection 704 the first locking arm 140 is caused to rise up by action of the first engaging surface 722 on the first cam surface 720. To this end, the second locking arm 150 may be flexibly mounted by a hinge, cantilever or other such arrangement to the housing of the socket 104 or header 102. Accordingly a position of the second locking arm 150 is displaced as the second cam surface 726 engages with the second engaging surface 724 causing perpendicular movement with respect to the movement of the socket 104 and the header 102 together.

[0033] As the second locking arm 150 passes into the space 702 of the locking chamber 106, rearward of the first and second projections 700, 704, the first projection 700 moves into a cavity or recess 760 formed in an upper surface of the second locking arm 150 so that the first projection 700 of the first locking arm 140 can be received within a space formed by the recess 760 behind the first

cam surface 722. At the same time the second projection 704 can be received within the recess 730 so that the first locking arm 140 can return to its closed position before the engagement with the second locking arm 150 in which it is substantially parallel to the surface of the housing 701.

[0034] According to some embodiments of the present technique, the second locking arm includes a locking surface 762 which is formed behind and rearward of the second engaging surface 726 which is configured to engage with a second locking surface 764 which is on the reverse side to the second engaging surface 724 of the second projection 704, thereby preventing the locking arm 150 from being retracted from the locking chamber 106, ensuring that the socket 104 is locked in position with respect to the header 102.

[0035] As will be appreciated therefore from the above description, the first locking arm 140 has a width indicated as d_3 which is the same or mutually adapted to a width of the recess or cavity 760 in the other surface of the second locking arm 150.

[0036] Advantageously, some embodiments of the present technique also provide a third cam surface 770 on the reverse side of the first projection 700 of the first locking arm 140 which is configured to engage with a third engaging surface 772 of the second locking arm 150. According to some embodiments, the second locking arm 150 is pivotally mounted on its housings, so that a biasing force can be applied to lift the second locking arm 150 within the locking chamber 106, which also raises the first locking arm 140 against the flexible coupling to its housing, so that the first locking arm 140 may pivot away from the surface of its housing, and away from the second projection 704. As a force is applied to retract the second locking arm 150 from the first locking arm 140 from within the locking chamber 106, the third cam surface 770 is caused to engage with the third engaging surface 772 as the second locking arm rises up and is retracted so that the first locking surface 762 of the second locking arm 150 becomes clear of the second locking surface 764 of the second projection 704. The second locking arm 150 therefore can be retracted from the locking chamber 106 and disengaged with the first locking arm 140.

[0037] Figures 10 and 11 provide a more detailed representation of an operation of the locking mechanism provided by the first and second locking arms 140, 150 in combination with the locking chamber 106. Figure 10 shows a three dimensional representation 800 looking rearward at the electrical connector 100 in which the socket 104 and header 102 are engaged, with the second locking arm 150 in a position in which the head 701 has passed behind the first and second projections 700, 704 and the first locking arm 140 is in the closed position substantially parallel to the header housing 132.

[0038] As shown in Figure 10 a box 802 shows in two expanded cross-sectional views 804, 806 of the first locking arm 140 before and after engaging with a second

locking arm 150. That is in the first view 804, the first and second locking arms 140, 150 are in a pre-insertion state. In the second view 806, the second locking arm 150 is shown to be engaged with the first locking arm 140. As shown in the first view 804 an arrow 808 represents the movement of the first locking arm 140 as it pivots about its flexible connection to the housing and as the first and second engaging surfaces 722, 726 of the second locking arm 150 engage with the first and second cam surfaces 720, 724 of the first and second projections 700, 704. An arrow 810 shows the direction of insertion of the second locking arm 150 with respect to the first locking arm 140 as the header 102 is mated with the socket 104.

[0039] As shown in the second view 806, as the first locking arm 140 engages with the second locking arm 150 as the head 701 of the second locking arm 150 moves into the space 702 between the first locking arm 140 and the header housing surface 703, a biasing force provided by the coupling of the first locking arm 140 to the header housing 132 in combination with the locking surfaces 762, 764 locks the header 102 and the socket 104 together.

[0040] Figure 11 shows a sequence of diagrams illustrating the insertion of the second locking arm 150 into the locking chamber 106 against the first locking arm 140 as the socket 104 and header 102 of the electrical connector 100 are mated. In a first view 900 an arrow 902 illustrates a direction of movement of the second locking arm 150 with respect to the first locking arm 140. The first view 900 illustrates a state in which the first and second cam surfaces 720, 724 of the first and second projections 700, 704 have engaged with the first and second engaging surfaces 722, 726 of the second locking arm 150 causing the first locking arm 140 to be displaced with respect to the header housing 132 and the head 701 moves upward from the second projection 704. In a second view 904 as the head 701 of the second locking arm 150 moves into the space 702 between the first locking arm 140 and the surface 703 of the header housing 132, the first locking arm 140 rises up and is shown in its most deflected position. In a third view 906 the third cam surface 770 of the first projection 700 engages with the third engaging surface 772 of the second locking arm 150 as the first locking arm 140 begins to return to its closed position. Finally, in view 908, the first locking arm 140 has returned to its closed position. In the state shown in the view 908 the first and second locking surfaces 762, 764 are configured to engage so that the head 701 of the second locking arm 150 engages with the second projection 704 to prevent the socket 104 and header 102 from being separated.

[0041] Finally, in a fifth view 920 a cross sectional view is provided with the socket 104 and header 102 mated and the first locking arm 140 in its closed position engaging with the second locking arm 150 in which the first projection 700 is positioned within the recess 760 in the upper side of the second locking arm 150 and the second projection 704 within moves into the recess 730 on the

reverse side of the second locking arm 150.

[0042] Embodiments of the present technique therefore provide an arrangement in which a positive biasing force must be provided to the second locking arm 150 to deflect the first locking arm 140 and because of the arrangement of the first and second cam surfaces 720, 724 and the first and second engaging surfaces 722, 726 of the first and second locking arms 140, 150 respectively, a resistive force is provided in a direction which is in a reverse direction to an insertion force being applied to mate the header 102 and the socket 104. An anti half mating feature is thereby provided by the locking mechanism between the socket 104 and the header 102 of the electrical connector 100 because a threshold force must be applied to deflect the first and second locking arms 140, 150 from their neutral or closed positions in their locked and dis-engaged states in order to mate the socket 104 and the header 102 and to lock the first and second locking arms 140, 150 together.

[0043] Various further aspects and features of the present technique are defined in the appended claims and various combinations of the features of the dependent claims may be made with those of the independent claims other than the specific combinations recited for the claim dependency. Modifications may also be made to the embodiments hereinbefore described without departing from the scope of the present technique. For instance, as explained above the positions of the first and second locking arms as well as the first and second cam surfaces and first and second engaging surfaces may be interchanged. Furthermore, although a feature may appear to be described in connection with particular embodiments, one skilled in the art would recognise that various features of the described embodiments may be combined in accordance with the present technique. As will be appreciated, although the example application has been given as that of automotive, embodiments of the present technique can be used in other applications and are not limited to the field of automotive technology.

[0044] The following numbered paragraphs define further example aspects and features of the present technique:

Paragraph 1. An electrical connector comprising a socket for mutually engaging with a header to provide electrical connection for one or more conductors of the socket to one or more conductors of the header, the socket comprising

a socket housing configured to hold one or more socket-side conducting terminals each of which is adapted and arranged mutually to engage with a corresponding header-side conducting terminal to provide electrical connection to the one or more conductors of the socket, and the header comprising

a header housing configured to hold one or more

of the header-side conducting terminals mounted within the housing to provide electrical connection to the one or more conductors of the header, each of the one or more of the header-side conducting terminals being configured mutually to engage with a corresponding one of the one or more socket-side conducting terminals when the socket is mated with the header, wherein the housing of one of the socket or the header includes

a first locking arm flexibly connected to the housing, the first locking arm including a first projection having a first cam surface, the first projection being arranged to project into a space between the first locking arm and an adjacent surface of the housing and the adjacent housing surface includes a second projection having a second cam surface, the second projection being arranged to project into the space between the first locking arm and the housing surface towards the first projection, and the housing of the other of the socket and the header includes

a second locking arm comprising a head having first and second engaging surfaces, which are configured forward with respect to a first recess and a second recess formed in the second locking arm, the first engaging surface being configured to engage with the first cam surface of the first projection of the first locking arm, and the second engaging surface being configured to engage with the second cam surface of the second projection as the socket and the header are being mated causing the first locking arm to be displaced from a closed position against a biasing force provided by the flexible connection of the first locking arm to the housing to allow the head of the second locking arm to pass into the space between the first locking arm and the adjacent housing surface, and after the head of the second locking arm has moved into the space between the first locking arm and the housing surface, the first projection on the first locking arm can be received in the first recess on the second locking arm, and the second projection can be received in the second recess formed in the second locking arm so that the first locking arm can return to the closed position.

Paragraph 2. An electrical connector according to paragraph 1, wherein the second projection includes a first locking surface adjacent to the second cam surface on the adjacent housing surface, and the second locking arm includes a second locking surface partly defining the second recess, the first locking surface being configured to engage the second locking surface to prevent the second locking arm

from being retracted from the space between the first locking arm and the adjacent housing surface.

Paragraph 3. An electrical connector according to paragraph 1 or 2, wherein the first locking arm is resiliently connected to the housing, the resilient connection allowing the first locking arm to be displaced in a plane perpendicular to a plane of insertion of the header to the socket by engagement of the first cam surface with the first engaging surface and the second cam surface with the second engaging surface as the header and the socket are mated.

Paragraph 4. An electrical connector according to paragraph 1, 2 or 3, wherein the second locking arm is resiliently connected to the housing, the resilient connection allowing the head of the second locking arm to be displaced in a plane substantially perpendicular to a plane of the first locking surface so that the second locking surface can be displaced away from the housing adjacent surface to dis-engage from the first locking surface, and the first projection includes a third cam surface and the head of the second locking arm includes a third engaging surface on an adjacent side to the first engaging surface, which engages with the third cam surface as the head of the second locking arm is displaced away from the housing adjacent surface, the third cam surface and the third engaging surface displacing the first locking arm as the second locking arm is displaced away from the housing adjacent surface and retracted from the first locking arm with the second locking surface displaced to be clear from the first locking surface allowing the second locking arm to be retracted from the first locking arm. Paragraph 5. An electrical connector according to any of paragraphs 1 to 4, wherein the housing of one of the header and the socket include a locking chamber, the first locking arm forming part of one side of the locking chamber and the housing adjacent surface forming an adjacent side of the locking chamber, the adjacent side including the second projection, and at least two adjacent walls of the locking chamber being configured to engage with corresponding walls of the second locking arm to constrain movement of the socket and the header in a plane perpendicular to the direction of mating between the conducting terminals of the header and the conducting terminals of the socket.

Paragraph 6. A method of assembling an electrical connector, the electrical connector comprising a socket and a header, the socket comprising a socket housing configured to hold one or more socket-side conducting terminals each of which is adapted and arranged mutually to engage with a corresponding header-side conducting terminal to provide electrical connection to the one or more conductors of the

socket, and

the header comprising a header housing configured to hold one or more of the header-side conducting terminals mounted within the housing to provide electrical connection to the one or more conductors of the header, each of the one or more of the header-side conducting terminals being configured mutually to engage with a corresponding one of the one or more socket-side conducting terminals when the socket is mated with the header, wherein the housing of one of the socket or the header includes

a first locking arm flexibly connected to the housing, the first locking arm including a first projection having a first cam surface, the first projection being arranged to project into a space between the first locking arm and an adjacent surface of the housing and the adjacent housing surface includes a second projection having a second cam surface, the second projection being arranged to project into the space between the first locking arm and the housing surface towards the first projection, and the housing of the other of the socket and the header includes

a second locking arm comprising a head having first and second engaging surfaces, which are configured forward with respect to a first recess and a second recess formed in the second locking arm, the first engaging surface being configured to engage with the first cam surface of the first projection of the first locking arm, and the second engaging surface being configured to engage with the second cam surface of the second projection as the socket and the header are being mated causing the first locking arm to be displaced from a closed position against a biasing force provided by the flexible connection of the first locking arm to the housing to allow the head of the second locking arm to pass into the space between the first locking arm and the adjacent housing surface, and after the head of the second locking arm has moved into the space between the first locking arm and the housing surface, the first projection on the first locking arm can be received in the first recess on the second locking arm, and the second projection can be received in the second recess formed in the second locking arm so that the first locking arm can return to the closed position, and the method comprises

inserting the header-side conducting terminals into the header housing,

inserting the socket-side conducting terminals

into the socket housing, and

mating the socket to the header so that the header-side conducting terminals engage with the socket-side conducting terminals, wherein the mating includes

advancing the second locking arm towards the first locking arm so that the head of the second locking arm causes the first locking arm to be displaced by action of the first engaging surface of the second locking arm engaging with the first cam surface on the first projection of the first locking arm and the second engaging surface engaging with the second cam surface of the second projection, the first locking arm being displaced until the head of the second locking arm can pass between the first projection on the first locking arm and the second projection on the adjacent housing surface, and

advancing the head of the second locking arm past the first and second projections (700, 704) into the space between the first locking arm and the housing surface allowing the first projection on the first locking arm to be received in the first recess on the second locking arm, and the second projection to be received in the second recess formed in the second locking arm so that the first locking arm can return to the closed position.

Claims

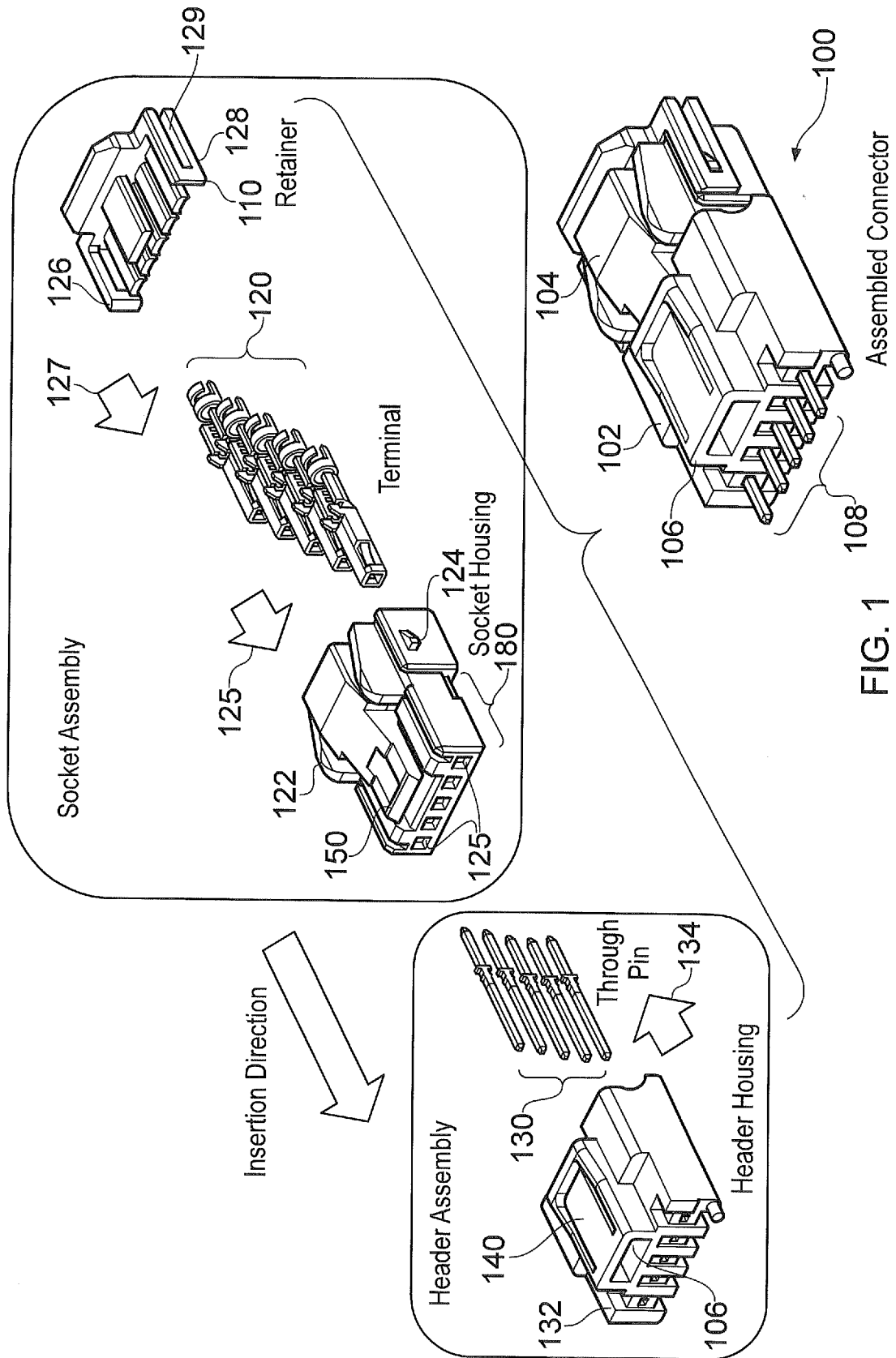
1. An electrical connector (100) comprising a socket (104) for mutually engaging with a header (102) to provide electrical connection for one or more conductors of the socket (104) to one or more conductors of the header (102), the socket (104) comprising a socket housing (122) configured to hold one or more socket-side conducting terminals (120) each of which is adapted and arranged mutually to engage with a corresponding header-side conducting terminal (130) to provide electrical connection to the one or more conductors of the socket (104), and the header (102) comprising a header housing (132) configured to hold one or more of the header-side conducting terminals (130) mounted within the housing (132) to provide electrical connection to the one or more conductors of the header (102), each of the one or more of the header-side conducting terminals (130) being configured mutually to engage with a corresponding one of the one or more socket-side conducting terminals (120) when the socket (104) is mated with the header (102), wherein the housing (122, 132) of one of the socket (104) or the header (102) includes

a first locking arm (140) flexibly connected to the housing (122, 132), the first locking arm (140) including a first projection (700) having a first cam surface (720), the first projection (700) being arranged to project into a space between the first locking arm (140) and an adjacent surface (703) of the housing (132) and the adjacent housing surface (703) includes a second projection (704) having a second cam surface (724), the second projection (704) being arranged to project into the space between the first locking arm (140) and the housing surface (703) towards the first projection (700), and the housing (122, 132) of the other of the socket (104) and the header (102) includes

a second locking arm (150) comprising a head (701) having first and second engaging surfaces (722, 726), which are configured forward with respect to a first recess (760) and a second recess (730) formed in the second locking arm (150), the first engaging surface (722) being configured to engage with the first cam surface (720) of the first projection (700) of the first locking arm (140), and the second engaging surface (726) being configured to engage with the second cam surface (724) of the second projection (704) as the socket (104) and the header (102) are being mated causing the first locking arm (140) to be displaced from a closed position against a biasing force provided by the flexible connection of the first locking arm (140) to the housing (122, 132) to allow the head (701) of the second locking arm (150) to pass into the space between the first locking arm (140) and the adjacent housing surface (703), and after the head (701) of the second locking arm (150) has moved into the space (702) between the first locking arm (140) and the housing surface (703), the first projection (700) on the first locking arm (140) can be received in the first recess (760) on the second locking arm (150), and the second projection (704) can be received in the second recess (730) formed in the second locking arm (150) so that the first locking arm (140) can return to the closed position.

2. An electrical connector (100) as claimed in Claim 1, wherein the second projection includes a first locking surface (764) adjacent to the second cam surface on the adjacent housing surface (703), and the second locking arm (150) includes a second locking surface (762) partly defining the second recess, the first locking surface (764) being configured to engage the second locking surface (762) to prevent the second locking arm (150) from being retracted from the space between the first locking arm (140) and the adjacent housing surface (703).
3. An electrical connector (100) as claimed in Claim 1 or 2, wherein the first locking arm (140) is resiliently connected to the housing (122, 132), the resilient

connection allowing the first locking arm (140) to be displaced in a plane perpendicular to a plane of insertion of the header (102) to the socket (104) by engagement of the first cam surface (720) with the first engaging surface (722) and the second cam surface (724) with the second engaging surface (726) as the header (102) and the socket (104) are mated.



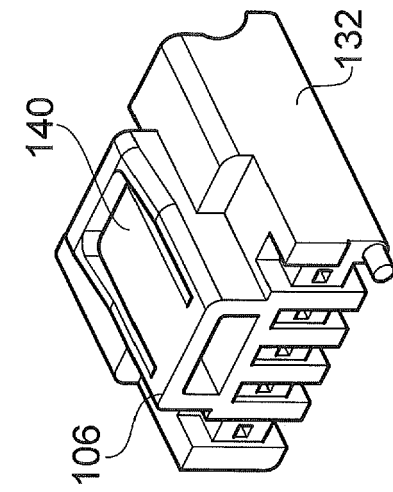


FIG. 2c

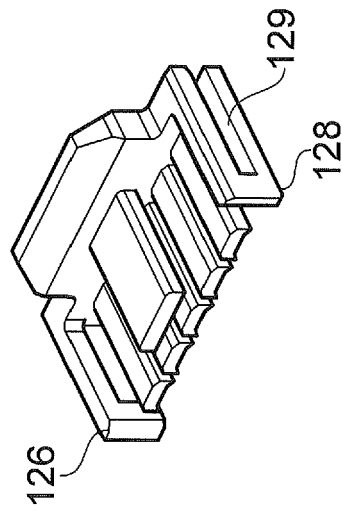


FIG. 2b

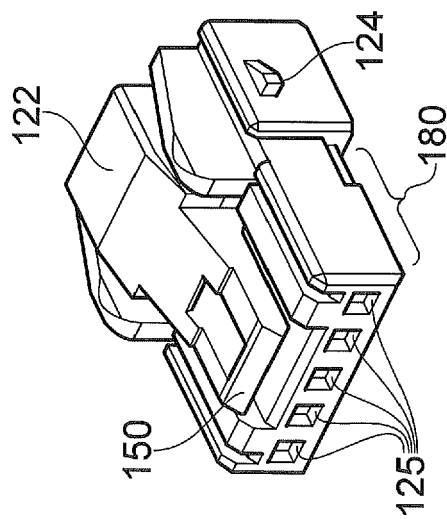
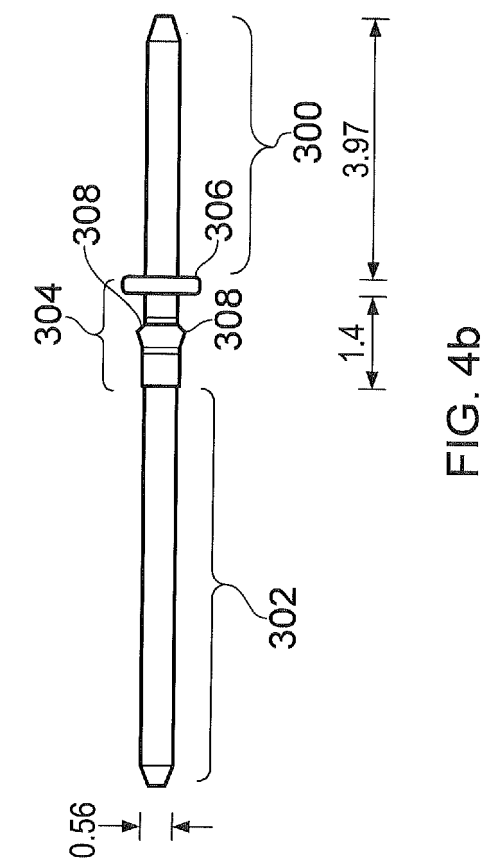
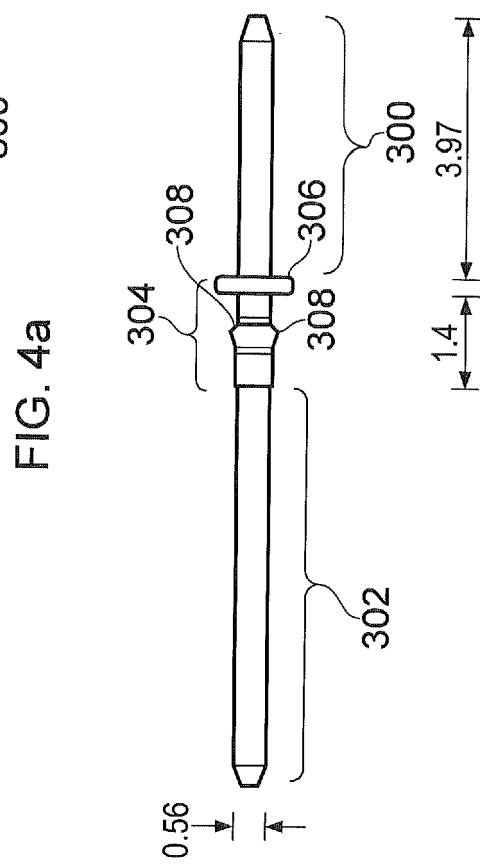
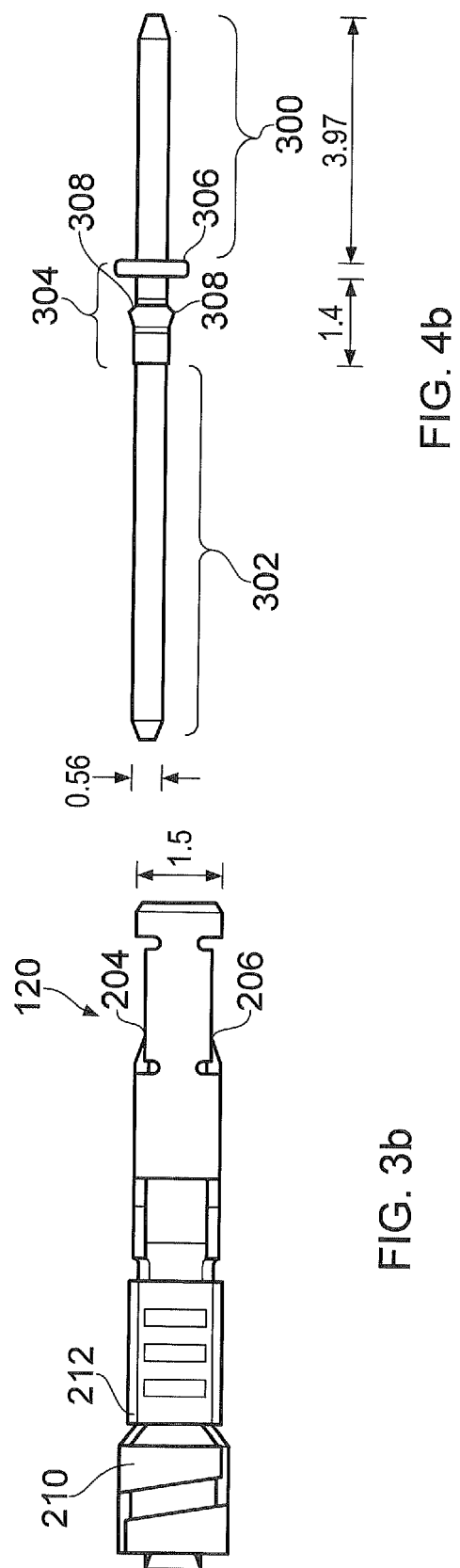
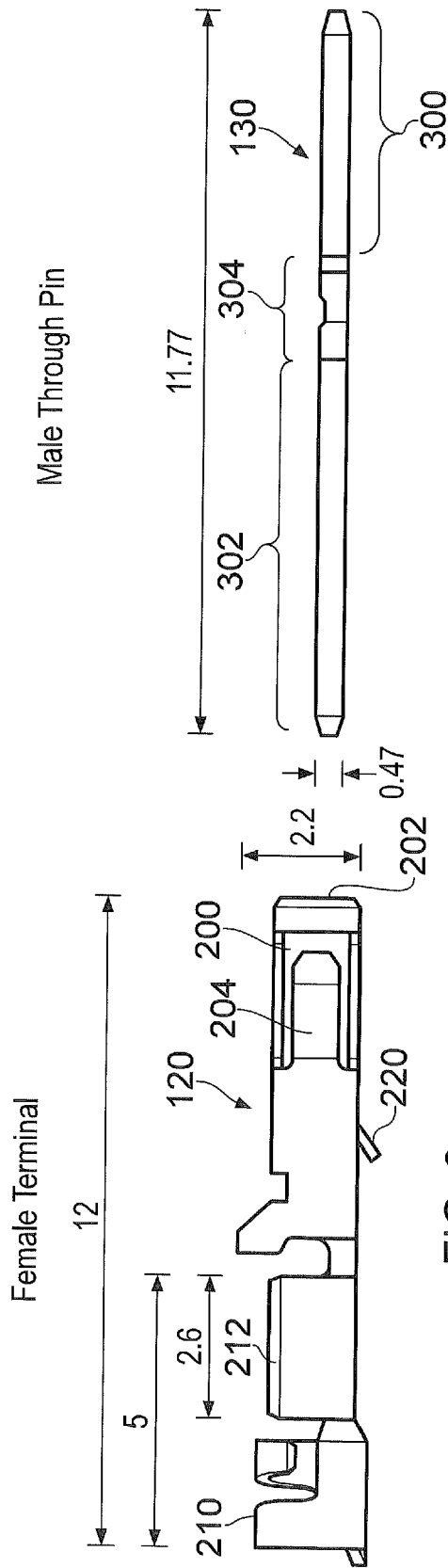
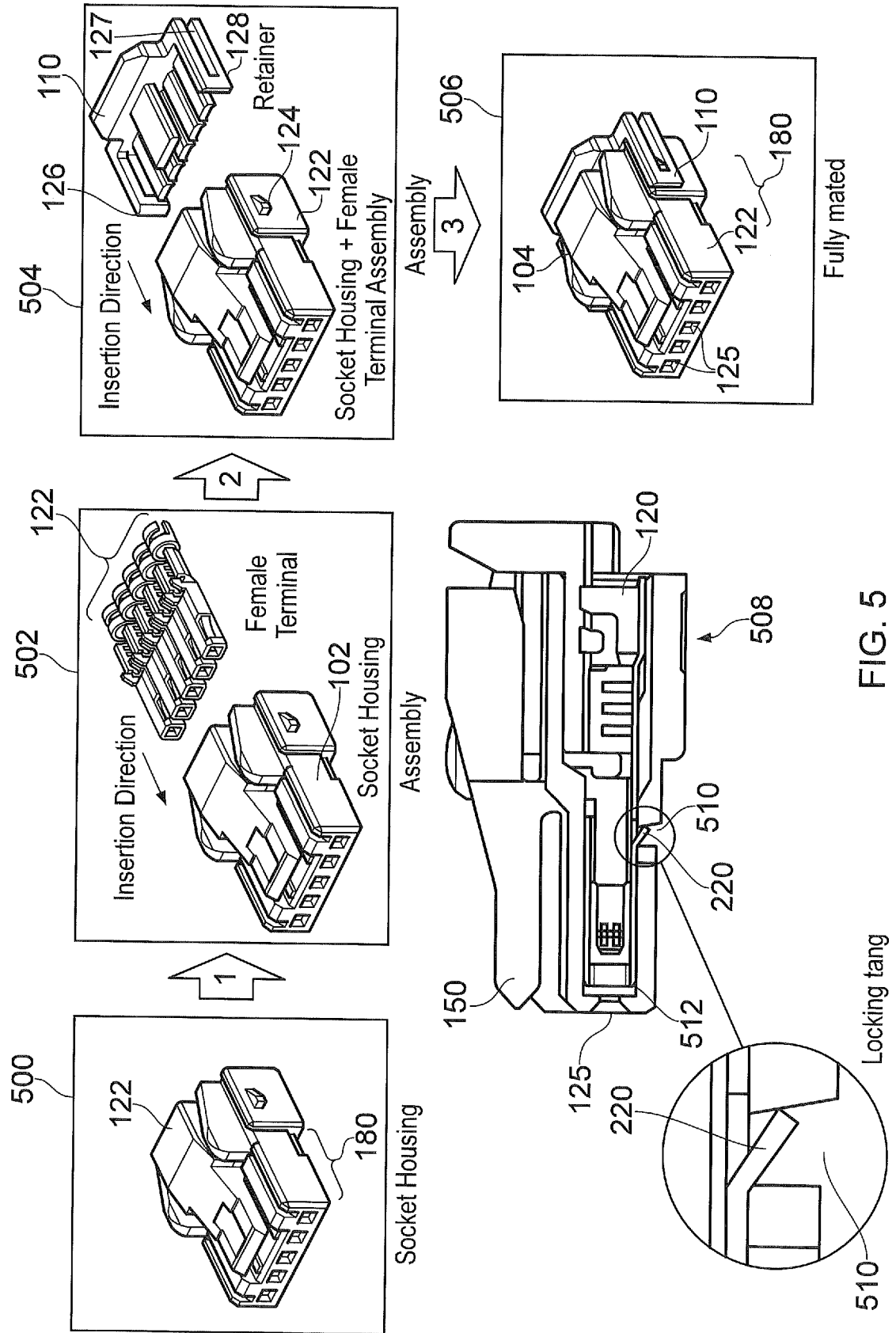


FIG. 2a





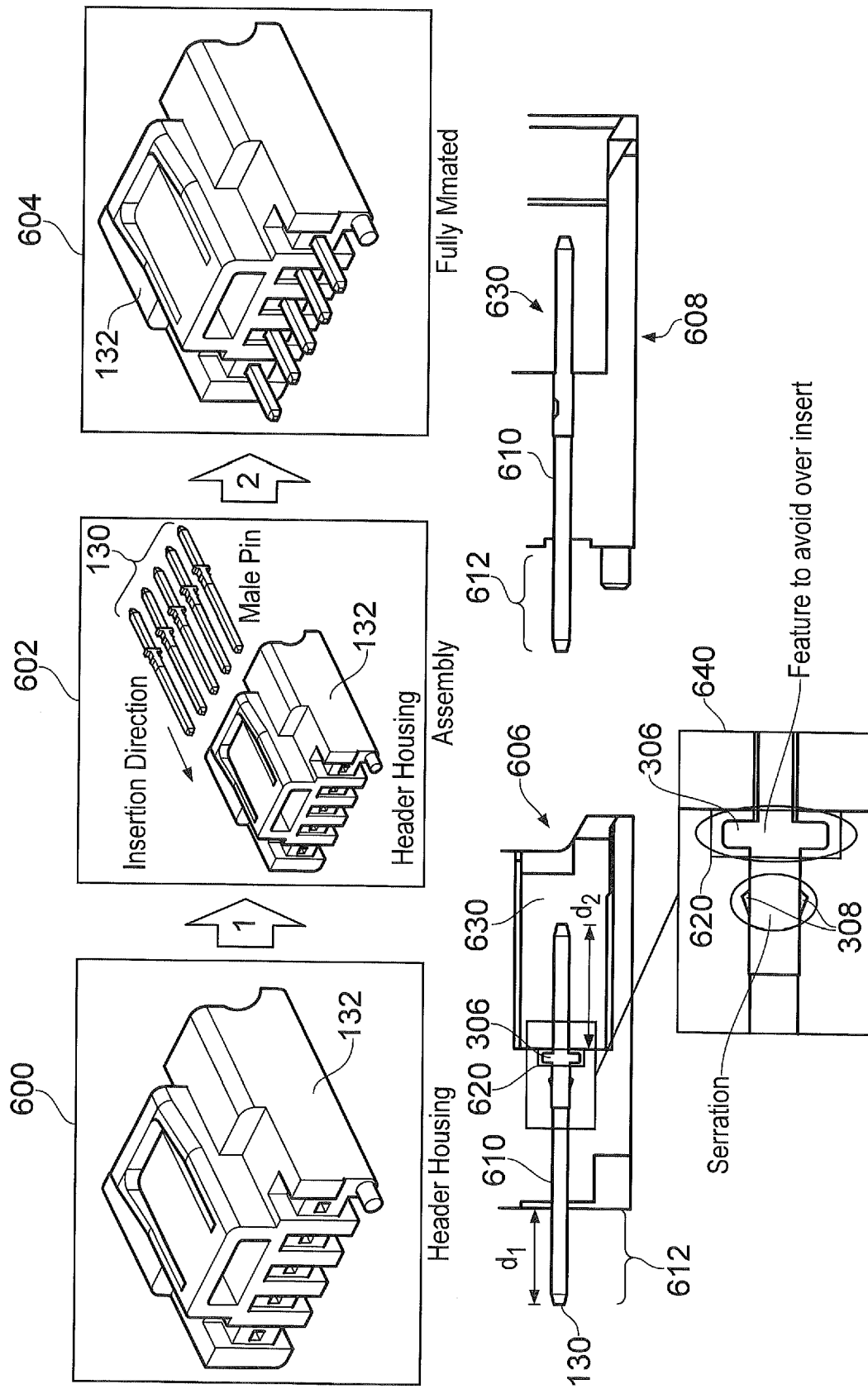
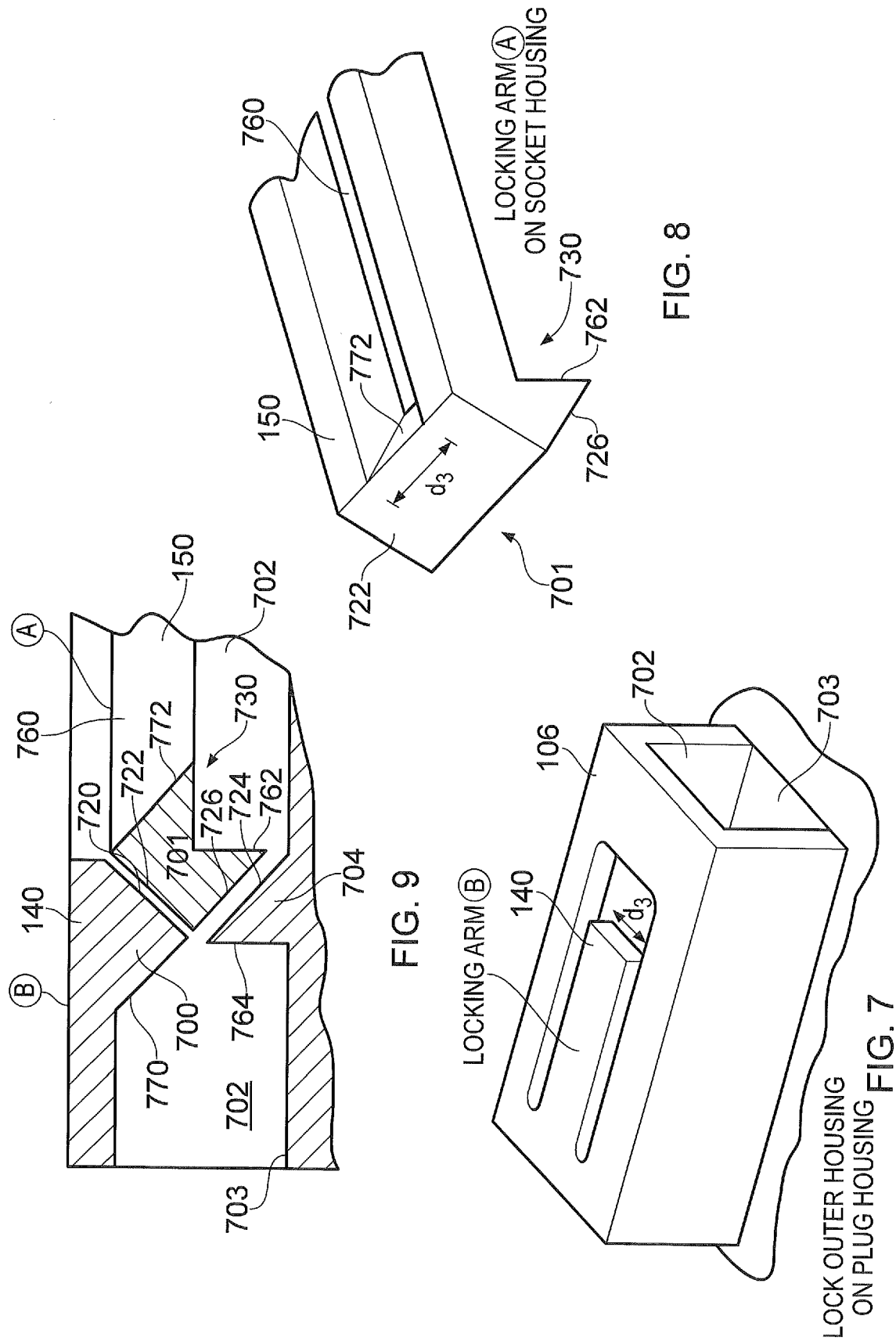
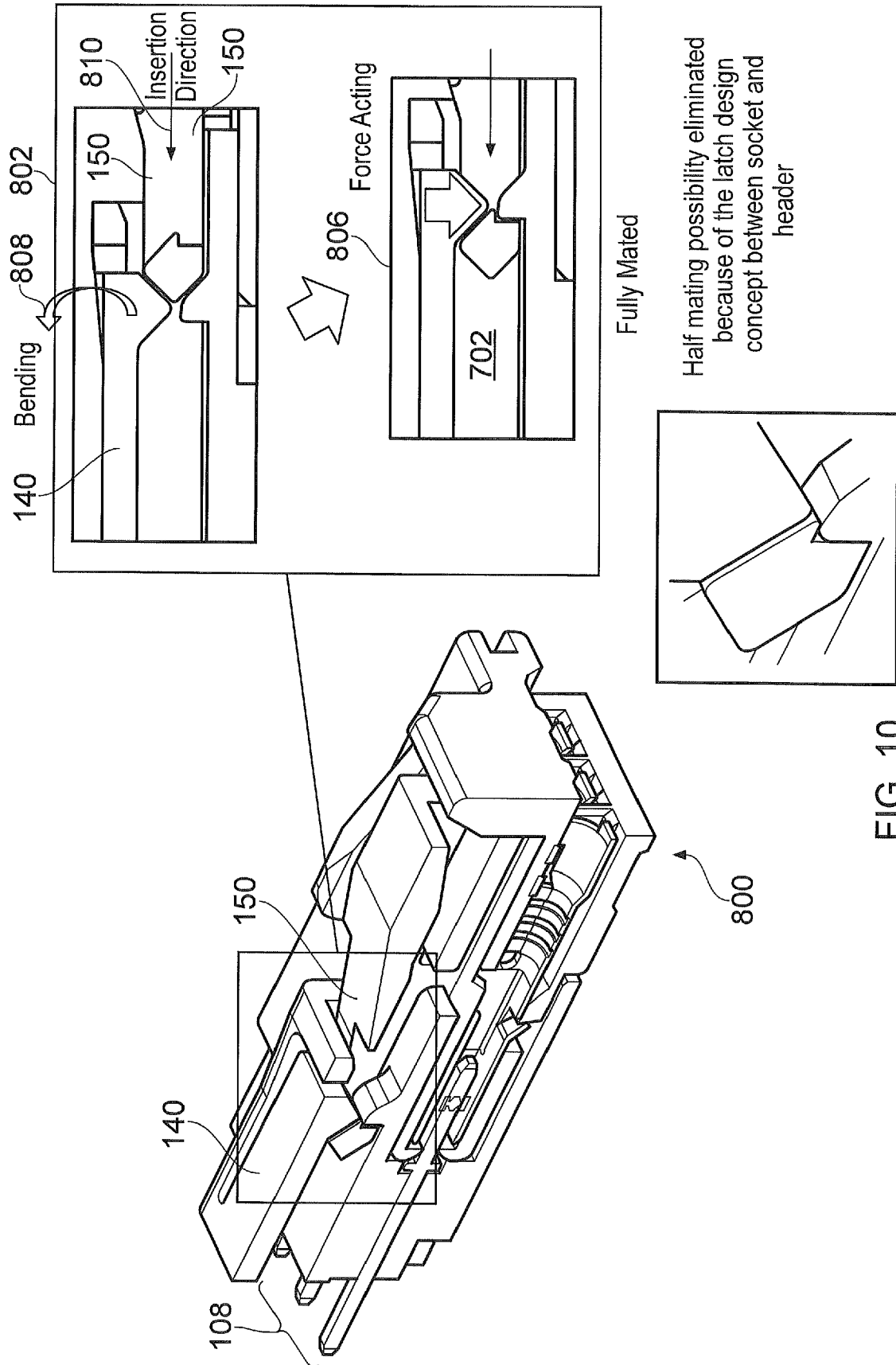


FIG. 6





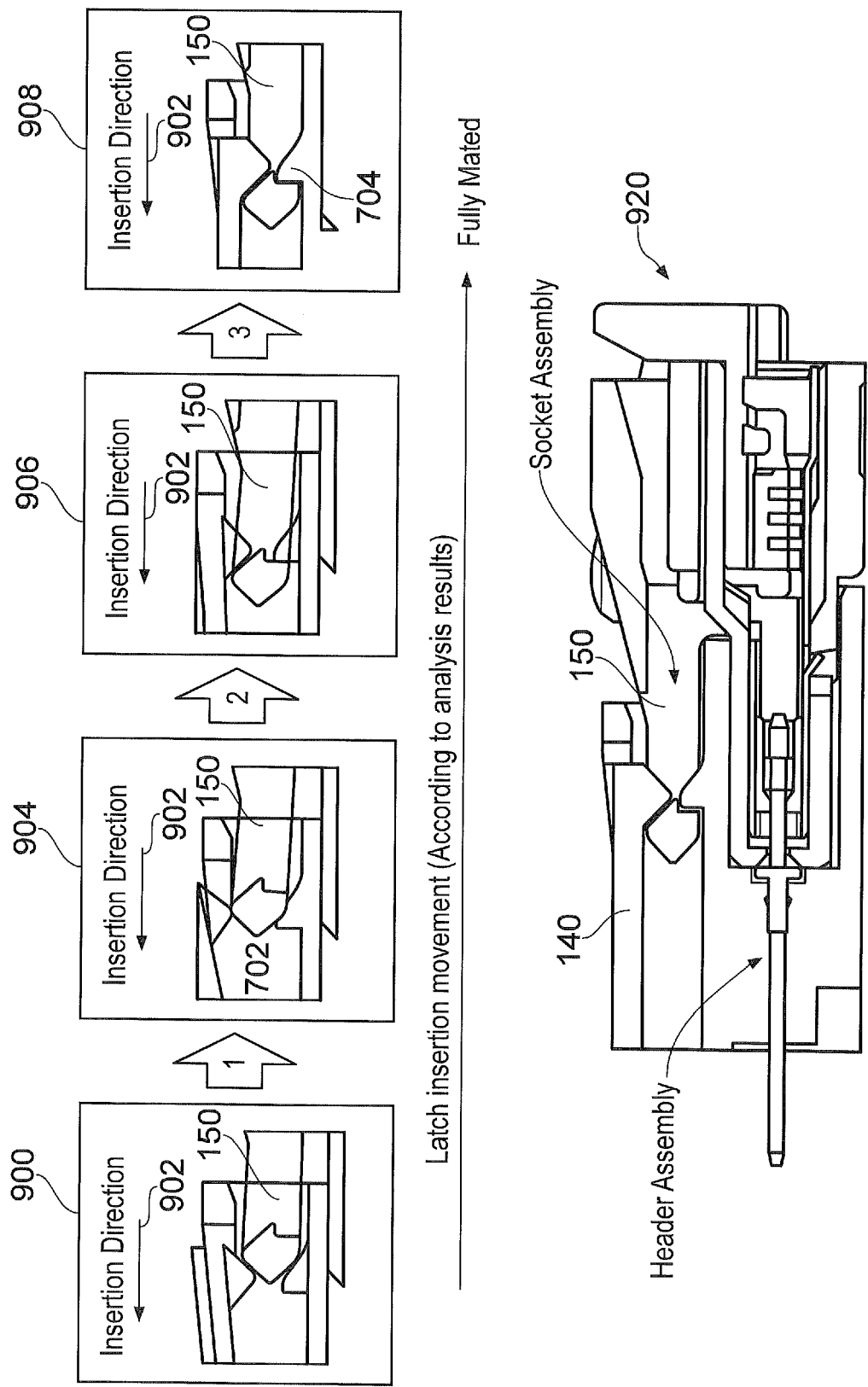


FIG. 11



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Application Number
EP 16 18 4728

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