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(54) Connector position assurance device.

(57) An electrical connector has matable halves (110,118) having a position assurance device (150). The position assurance device (150) has locking arms (158) for latching the position assurance device (150) in first and second positions. The position assurance device cannot be fully advanced to the second position unless the matable halves (110,1218) are fully mated.

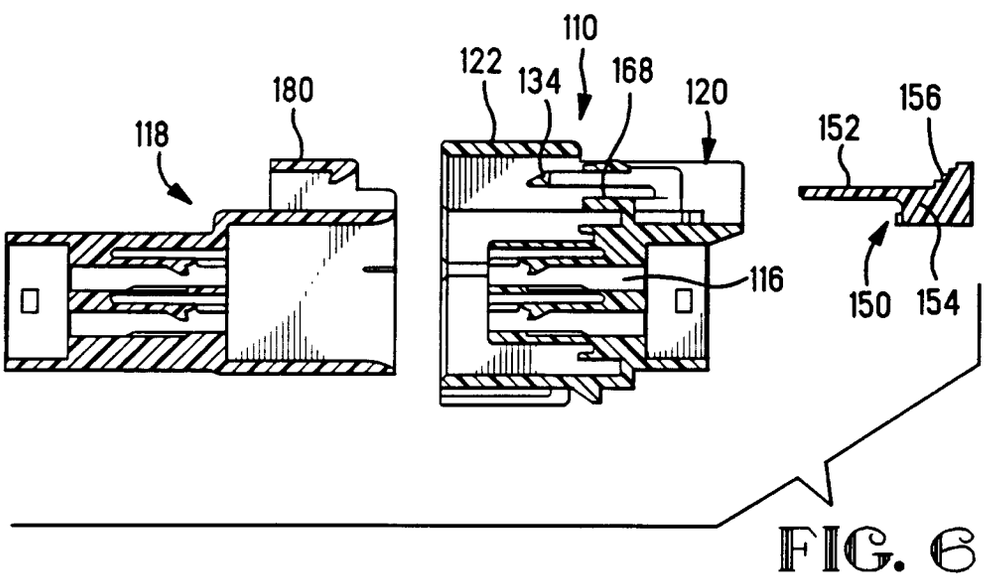

FIG. 6

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This invention relates to an electrical connector which is matable to another connector. In particular, the invention is directed to an electrical connector which has a connector position assurance device that can only be moved to a fully inserted position when the connectors are completely mated.

U.S. Patent 4,370,013 is directed to a lock member which is designed to assure that a pair of male and female electrical connectors, which are initially fully coupled and positively locked together by a manual assembly operation, remain locked by means of the lock member. The lock member avoids the problem of the electrical connectors being decoupled by vibration or some other environmental influence during subsequent use and, in effect, is intended to prevent, without disclosure of the fact, the disassembly of the connectors.

U.S. Patent 4,634,204 discloses two connectors, which when mated, have a connector position assurance and assist device inserted axially along a tracked slot. If the connectors are only partially interconnected, upon initial insertion of the connector position assurance and assist device though the connector it will assist the two connectors to become fully and rigidly mated, whereas if the device is improperly inserted into the connector it will refuse the further mating of the connectors.

U.S. Patent 5,120,255 teaches of a complete locking confirming device for confirming the complete locking of an electrical connector assembly. The device has a locking detector slider mounted on either housing so as to be positioned at an indicating position only when the housings are coupled completely.

The above references teach electrical connectors which have some type of connector position assurance member. However, it would be beneficial to provide electrical connectors with connector position assurance members which cannot be moved to the final position until a mating connector is mated to the electrical connector.

The invention is directed to a connector position assurance device for use with mating connectors. The connector position assurance device has a locking arm which extends from a body portion. The locking arm is stiff and is dimensioned to cooperate with a respective portion of a first mating connector. At least one latching arm cooperates with the mating connectors to movably maintain the connector position assurance device on a respective connector. The at least one latching arm being movable between a first and a second position.

The invention is also directed to an electrical connector which has a mating face which cooperates with a mating connector. A resilient primary latch is positioned on the electrical connector and is used to latch the mating connector to the electrical connector. The primary latch is provided proximate a connector position assurance receiving area of the electrical connector. The connector position assurance receiving area has barbs extending therein. A connector position assurance device is positioned in the connector position assurance receiving area, and has a locking arm and latching arms. The latching arms cooperate with the barbs to movably maintain the connector position assurance device in the connector position assurance receiving area. The latching arms cooperate with the barbs to movably maintain the connector position assurance device in the connector position assurance receiving area. The locking arm cooperates with the primary latch, when the locking arm is in a fully inserted position, to prevent the resilient movement of the primary latch.

Embodiments of the present invention will now be described by way of example with reference to the accompanying drawings in which:

FIGURE 1 is a rear perspective view of one embodiment of an electrical connector of the invention with a connector position assurance device exploded therefrom.

FIGURE 2 is an enlarged perspective view of the connector position assurance device of Figure 1.

FIGURE 3 is a front perspective view of the electrical connector shown in Figure 1 with the connector position assurance device provided in a fully inserted position.

FIGURE 4 is a front perspective view of a second electrical connector with an position assurance device exploded therefrom.

FIGURE 5 is a perspective cross-sectional view of the connector shown in Figure 4, with the connector position assurance device removed therefrom.

FIGURE 6 is a cross-sectional view of the connector assembly prior to the mating of the first and second connectors and prior to the insertion of the Connector position assurance device therein.

FIGURE 7 is a perspective cross-sectional view, similar to that of Figure 5, showing the connector position assurance device in a first position.

FIGURE 8 is a cross-sectional view, similar to that of Figure 6, showing the connectors partially mated together and the connector position assurance device in the first position.

FIGURE 9 is a perspective cross-sectional view, similar to that of Figure 7, showing the connector position assurance device in a second position.

FIGURE 10 is a cross-sectional view, similar to that of Figure 8, showing the connectors mated together and the connector position assurance device in the second position.

FIGURE 11 is a cross-sectional view of another alternative connector position assurance device positioned in the first position and the connector not mated to a mating connector.

FIGURE 12 is a cross-sectional view, similar to that of Figure 11, showing the movement of the connector position assurance device as the mating connector is mated to the connector.

FIGURE 13 is a cross-sectional view, similar to that of Figure 12, showing the movement of the connector position assurance device as the mating of the mating connector to the connector continues.

FIGURE 14 is a cross-sectional view, similar to that of Figure 13, showing the mating connector fully mated to the connector and the connector position assurance device fully inserted therein.

FIGURE 15 is partial enlarged view of the connector position assurance device positioned in a slot on the electrical connector.

Referring to Figures 1 and 3, a first electrical connector 10 is shown. The particular connector shown has a mating face 12 and a wire receiving face 14. Contact receiving cavities 16 extend from proximate the mating face to proximate the wire receiving face 14. The contact receiving cavities are dimensioned to receive contacts (not shown) therein. It should be noted that the configuration of the housing may vary according to the application.

A connector position assurance receiving area 20 is provided proximate a top surface of the first connector 10. The receiving area 20 has a shroud 22 provided proximate the mating face 12. The shroud is dimensioned to receive a portion of a mating connector (not shown) therein. The receiving area 20 has opposed side walls 24, 26 which extend rearward to proximate the wire receiving face 14. Each of the side walls has a cavity 28 provided therein. The cavities extend from the wire receiving face 14 toward the mating face 12, and are essentially parallel to the axis of the contact receiving cavities 16.

Provided between the side walls 24, 26 proximate the wire receiving face 14 is a primary latch 30. As is best shown in Figure 3, the primary latch 30 has two spaced apart resilient arms 32 which are joined at the free end thereof by a cross member (not shown). Intermediate the fixed ends and the free ends of the resilient arms 32 is an engagement member 36.

Extending inwardly from the side walls 24, 26, proximate the wire receiving face 14 are plastic retention barbs (not shown).

Connector position assurance device 50, as best shown in Figures 1 and 2, has a connector locking arm 52, a main body portion 54, an engagement portion 56, latching arms 58, and stabilization members 60.

In the embodiment shown in Figure 2, the latching arms 58 are provided on each side of the main body portion 54 and are positioned such that the longitudinal axis of the arms are essentially parallel to the longitudinal axis of the locking arm 52. The latching arms are spaced from the main body portion to allow the free ends 62 thereof to be resiliently deformed. Each latching arm 54 has a first angled surface 70 proximate the free end 62, a first locking shoulder 72, a second angled surface 74 and a second locking shoulder 76.

Stabilization members 60 extend in a direction which is essentially perpendicular to connector locking arm 52. The members 60 are cylindrical in configuration and have an enlarged free end portion 78. The enlarged free end portion has a larger diameter than the remainder of the stabilization member.

Referring to figures 4 through 10, an alternative embodiment is shown. Although the first electrical connector 110 is different than connector 10, the principals of the connector are essentially the same. The particular connector 110 has a mating face 112 and a wire receiving face 114. Contact receiving cavities 116 extend from proximate the mating face 112 to proximate the wire receiving face 114. The contact receiving cavities are dimensioned to receive contacts (not shown) therein.

A connector position assurance receiving area 120 is provided proximate a top surface of the first connector 110. The receiving area 120 has a shroud 122 provided proximate the mating face 112. The shroud is dimensioned to receive a portion of a mating connector 118 therein. The receiving area 120 has opposed side walls 124, 126 (Figure 4) which extend rearward proximate the wire receiving face 114.

Provided between the side walls 124, 126 proximate the wire receiving face 114 is a primary latch 130. As is best shown in Figure 4, the primary latch 110 has two spaced apart resilient arms 132 which are joined at the free end thereof by a cross member 134. Intermediate the fixed ends and the free ends of the resilient arms 132 is an engagement member 136.

Extending inwardly from the side walls 124, 126, proximate the wire receiving face 114 are plastic retention barbs 138.

Connector position assurance device 150, as best shown in Figures 5 and 6, has a connector locking arm 152, a main body portion 154, an engagement portion 156, and latching arms 158.

The latching arms 158 are provided on each side of the main body portion 154 and are positioned such that the longitudinal axis of the arms are essentially parallel to the longitudinal axis of the locking arm 152. Referring to Figure 5, the latching arms are spaced from the main body

portion to allow the free ends 162 thereof to be resiliently deformed. Each latching arm 154 has a first angled surface 170 proximate the free end 162, a first locking shoulder 172, a second angled surface 174 and a second locking shoulder 176.

The operation of the connector position assurance device is illustrated in Figures 5 through 10. Figures 5 and 6 show connector position assurance devices 150 prior to insertion into the first electrical connector 110.

The device 150 is inserted into the connector 110 and is maintained in an initial position, as shown in Figure 7. As this insertion occurs, the first angled surfaces 170 of the latching arms 158 cooperate with barbs 138 to cause the latching arms to deform resiliently inward. As the insertion continues, the latching arms continue to move relative to the barbs 138, causing the first locking shoulders 172 to move beyond the barbs. As this occurs, the latch arms 158 resiliently return to their unstressed position, thereby capturing the barbs 138 between the first locking shoulders 172 and the second angled surface 174. This defines the initial position.

As is shown in Figure 8, with the connector position assurance device in the initial position, the mating connector 118 can be mated to connector 110. As the mating connector 118 is moved into engagement with connector 110, a latch 180 of connector 118 cooperates with latch 130 of connector 110. A connector latch receiving end of latch 180 engages the cross member 134 of latch 130. This engagement causes the primary latch 130 to resiliently deform, as shown in Figure 8. The positioning of the device 150 in the first position aligns the device 150 with slots provided in the primary latch 130, thereby allowing the resilient movement of the latch.

After the mating connector 118 has been fully inserted into the connector 110, with shoulders of the latches 130 and 180 provided in locking engagement, as shown in Figure 10, the device 150 is moved to the fully inserted or final position. As shown in Figures 9 and 10, in the fully inserted position, the connector locking arm 152 is positioned under the cross member 134 of latch 130. The locking arm 152 is made of relatively thick plastic and therefore, does not have resilient characteristics. The locking arm 152 is also supported by a support member 168 of connector 110, to prevent the locking arm 152 from deforming downward. Consequently, the positioning of the locking arm under the cross member prevents the resilient movement of the latch 130 and ensures that the connectors 110 and 118 will be maintained in a mated position.

It is worth noting that if connectors 110, 118 are not fully mated, latch 130 will be deformed as shown in Figure 8, which prevents the movement of the device 150 to its final position. Consequently, if the connectors are not properly mated, the device 150 cannot be fully inserted, providing a visual indication that the mating is inadequate.

If the connectors 110 and 118 are to be unmated, the operator grasps the engagement portion 156 and pulls the contact position assurance device 150 in a direction opposed to the direction of insertion. As this occurs, the barbs 138 cause the latching arms 158 to deform resiliently inward. The force required to move the device 150 from the final position to the initial position is determined by the angle of the second locking shoulder 176 (i.e. the steeper the slope of the shoulder, the more force required). The removal of the device 150 continues until the latching arms return to the unstressed position, causing the first locking shoulders 172 to engage the barbs 138. As the shoulders 172 are essentially perpendicular to the longitudinal axis of the latching arms, the force required to remove the device beyond the initial position will damage the connector position assurance device.

The operation of the connector position assurance device 50 shown in Figures 1 through 3 is essentially the same as that described above. However, device 50 has stabilization members 60 which are positioned in cavities 28, as shown in Figure 3. The enlarged free end portions 78 are spaced apart a distance which is slightly greater than the distance between side walls 24, 26. The cooperation of the enlarged end portions 78 with side walls 24, 26 ensure that the connector assurance device 50 will be properly inserted, i.e. the device 50 will not be skewed or rotated as it is moved relative to the connector 10.

Figures 11 through 15 disclose another embodiment of a connector position assurance device 250. This embodiment has many of the same features as connector 150 described above. The locking arm 252 has an anti-overstress projection 290 which extends from proximate a free end thereof in a downward direction as viewed in Figures 11 through 14. As best shown in Figure 15, the width of projection 290 is less than the width of the locking arm 252.

Referring to Figures 11 and 12, when the locking arm 252 is in an unstressed position, the free end is offset in the direction from the fixed end. In the figures, the free end is upwardly offset from the fixed end. This offset can be accomplished in various ways including molding the locking arm in this "bent" configuration or bending the locking arm after molding to cause the locking arm to take a permanent set.

A slot 294 is positioned in the receiving area 220 of the connector 210. The slot is dimensioned to be slightly larger than projection 290, as is

shown in Figure 15.

As the connector position assurance device 250 is inserted into the connector 210, the anti-overstress projection 290 is positioned in the slot 294 and slides therein. The positioning of the projection in the slot provides a guide and centering means which ensures that the free end of the locking arm 252 will be properly positioned in the receiving area 220 of the connector 210. As the locking arm 252 is wider than the projection 290 and the slot 294, surfaces of the locking arm cooperate with the support member 268 to adequately support the locking arm.

The connector position assurance device 250 is maintained in the initial and final positions in the manner described above. However, the device 250 cannot be moved to the final position until mating connector 218 is fully mated to connector 210. As shown in Figure 11, if the device 250 is moved toward the final position before the mating connector is properly positioned, the offset free end of the locking arm 252 will engage the cross member 234 of the primary latch 230, thereby preventing the movement of the device 250 into the final position.

As the mating connector 218 is inserted into the connector 210, the latch 280 of the mating connector cooperates with the latch 230, as shown in Figure 12. A connector latch receiving end of the latch 280 engages the cross member 234, causing the primary latch 230 to resiliently pivot. The positioning of the device 250 in the first position aligns the device 250 with slots provided in the primary latch 230 as the latch pivots.

As the insertion of the mating connector 218 continues to the fully mated position, the latch 280 moves past the cross member 234, thereby allowing the primary latch 230 to return to its unstressed position. As this occurs, the latch 280 engages the free end of the locking arm 252 of the device 250. As the insertion continues, the locking arm 252 is moved downward to the position shown in Figure 13. In this position, the latch has deformed the locking arm 252.

With the mating connector 218 fully inserted and the locking arm deformed, the connector position assurance device is moved to the final position. The device 250 is able to move beyond the cross member 234 because the latch 280 maintains the free end of the arm 252 in a position below the cross member 234.

In the final position shown in Figure 14, the removal of the mating connector from the connector is prevented unless the connector position assurance device has been moved to the initial position. In the final position, the anti-overstress projection 290 will engage a top surface of the mating connector when a downward force is applied to the primary latch. As the height of the anti-overstress projection is approximately equal to the space provided between the latch and the top surface, the downward movement of the cross member 234 is essentially prevented, thereby preventing the removal of the mating connector 218 from the connector 210. Therefore, in order to remove the mating connector 218, the device 250 is moved to the initial position, the primary latch 230 is depressed, and the mating connector is removed. This prevents the unwanted removal of the mating connector due to harsh environments or operator error.

Claims

1. A connector position assurance device (150) for use with mating connectors, the connector position assurance device comprising:

   a locking arm (152) which extends from a body portion (154), the locking arm being stiff and being dimensioned to cooperate with a respective portion of a first mating connector (118); and

   at least one latching arm (158) which cooperates with the mating connectors to movably maintain the connector position assurance device (150) on a respective connector (110), at least one latching arm being movable between a first and a second position.

2. A connector position assurance device as recited in claim 1 wherein the locking arm (152) engages a section of the first connector (118) to prevent the movement of the connector position assurance device (150) from the first position to the second position unless the first mating connector (118) and a second mating connector (110) are properly mated together.

3. A connector position assurance device as recited in claim 1 wherein the at least one latching arm (158) is spaced from the body portion (154) to allow a free end (162) thereof to be resiliently deformed.

4. A connector position assurance device as recited in claim 3 wherein at least two latching arms are provided on the body portion (154), wherein the longitudinal axis of the latching arms (158) is essentially parallel to the longitudinal axis of the locking arm (152).

5. A connector position assurance device as recited in claim 4 wherein each latching arm (158) has first angled surface (170) proximate the free end, a first locking shoulder (172), a second angled surface (174), and a second locking shoulder (176).

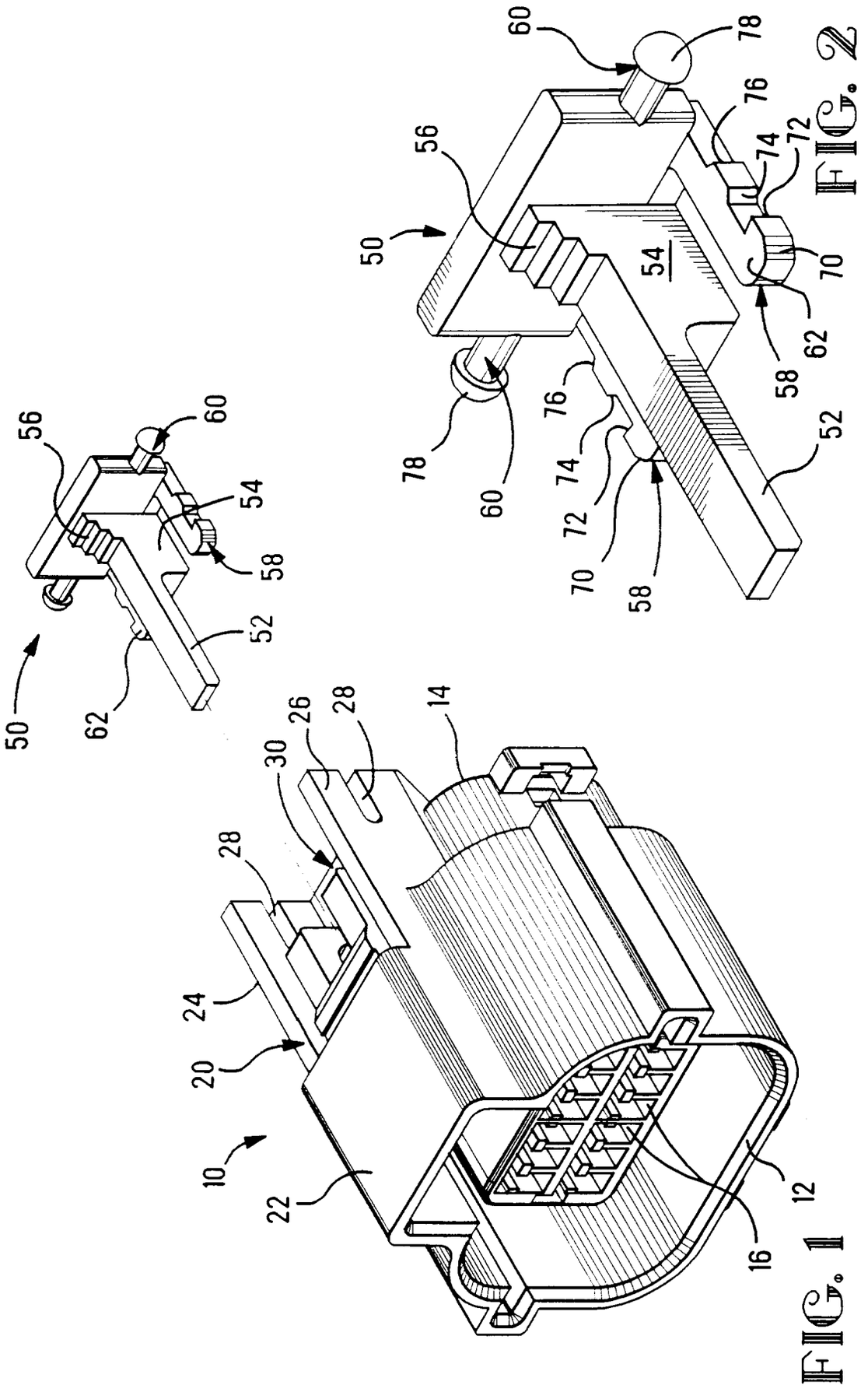

FIG. 1

FIG. 2

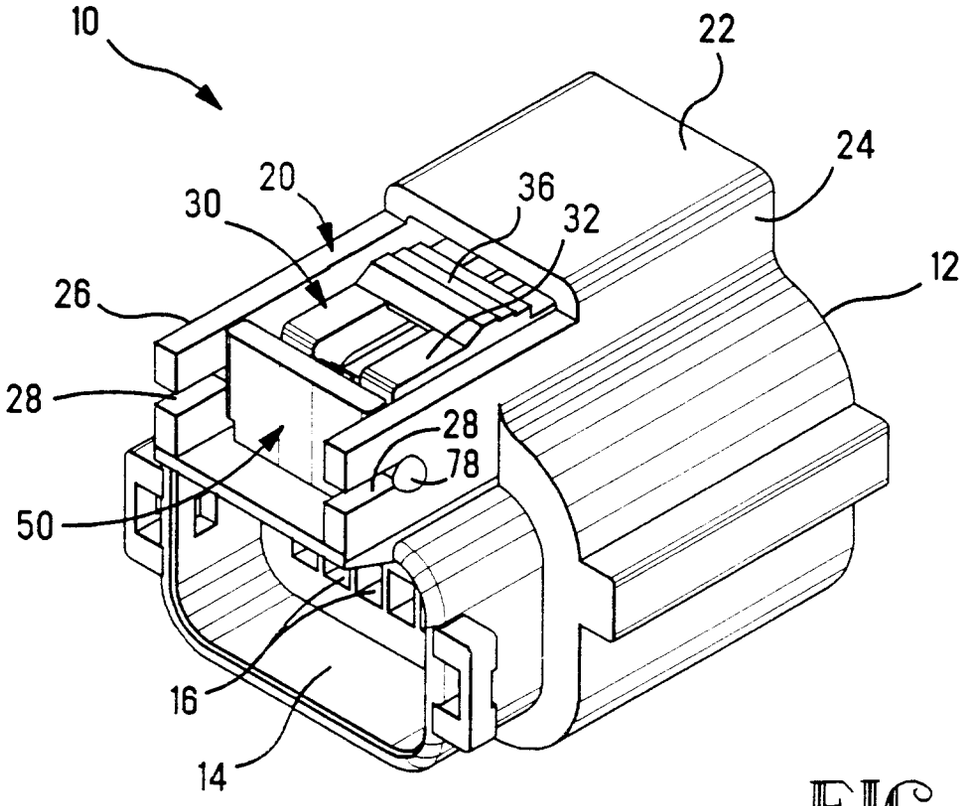
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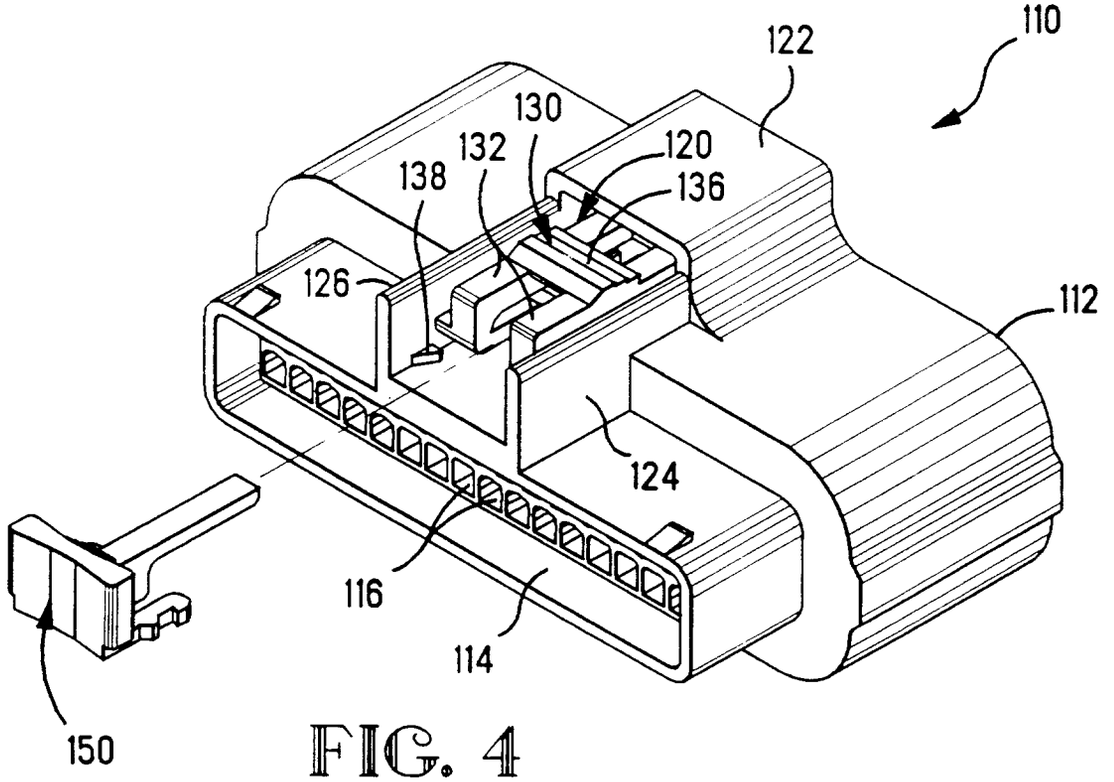
FIG. 3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150

FIG. 4

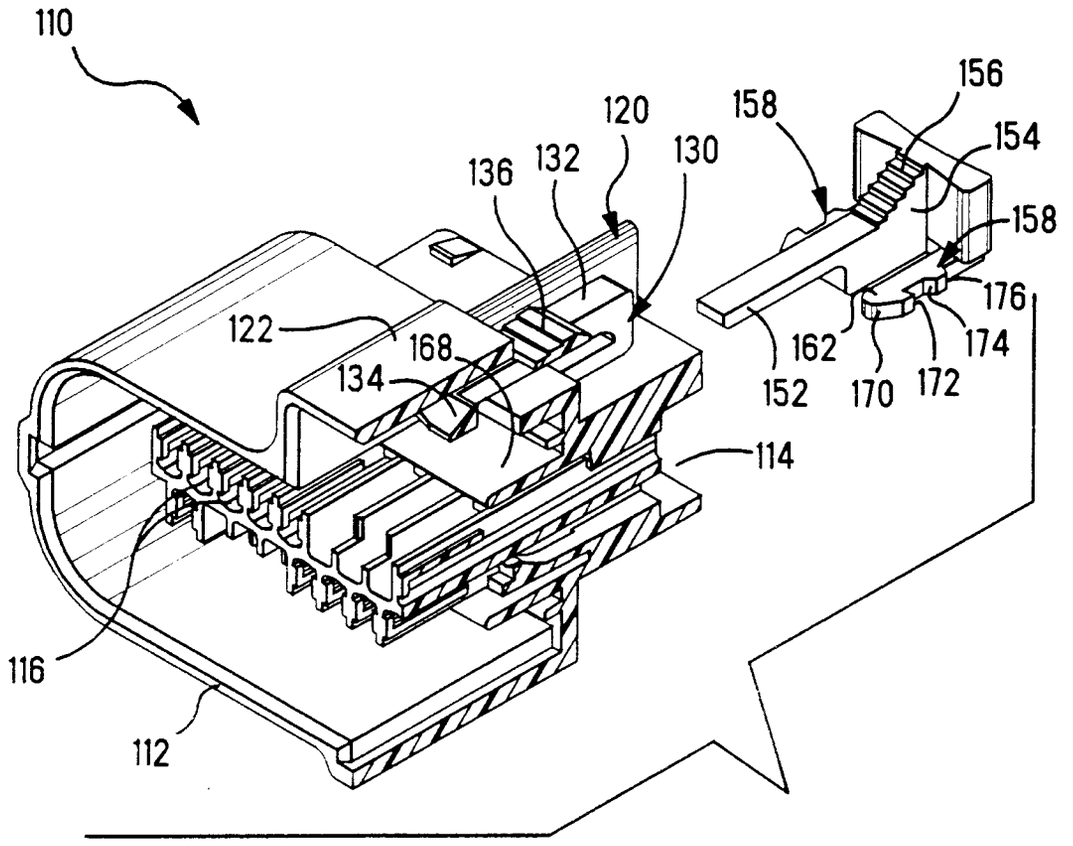
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FIG. 5

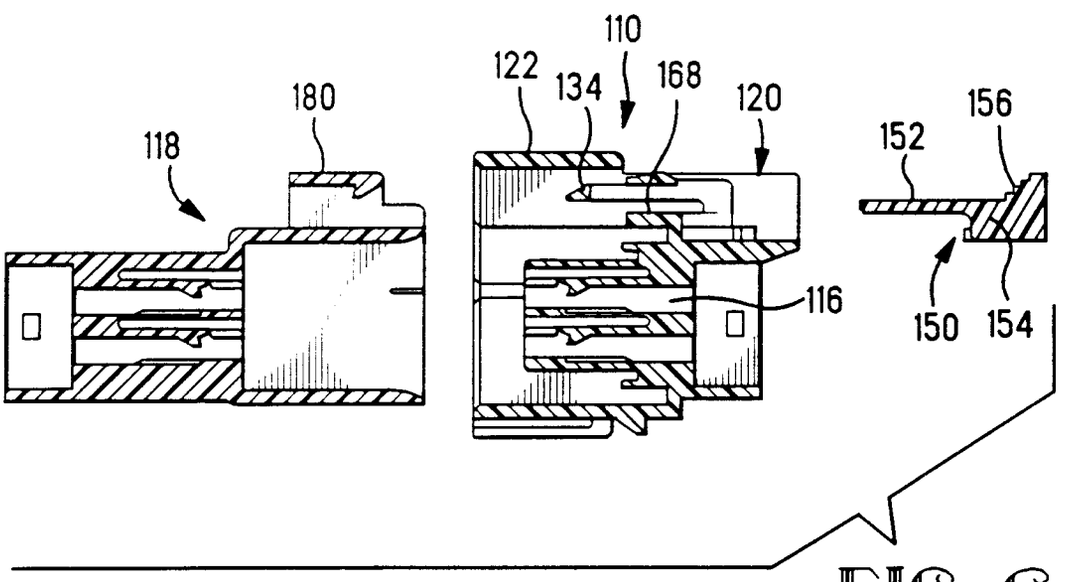
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FIG. 6

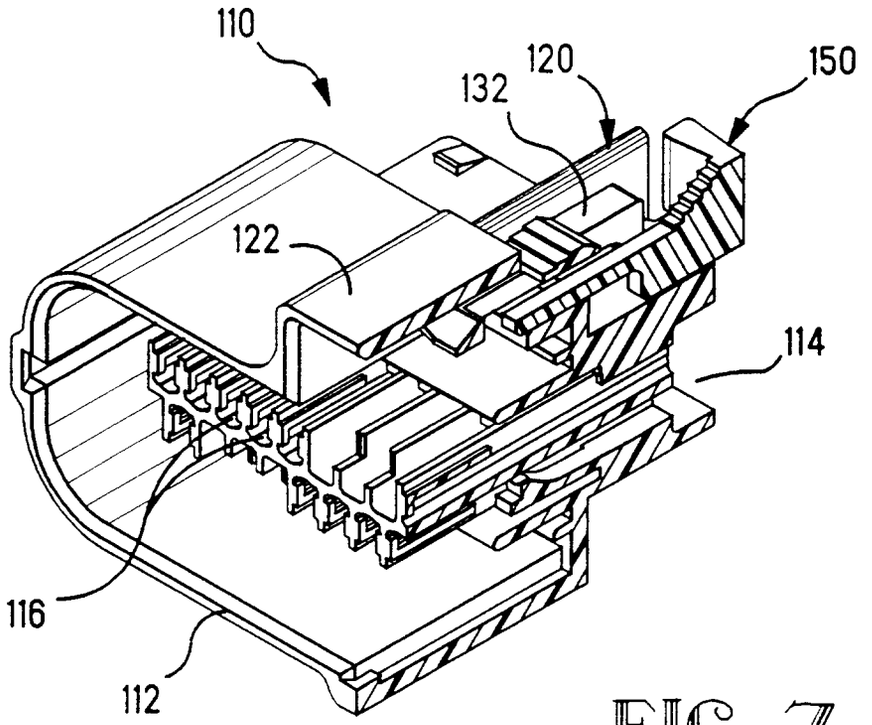
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FIG. 7

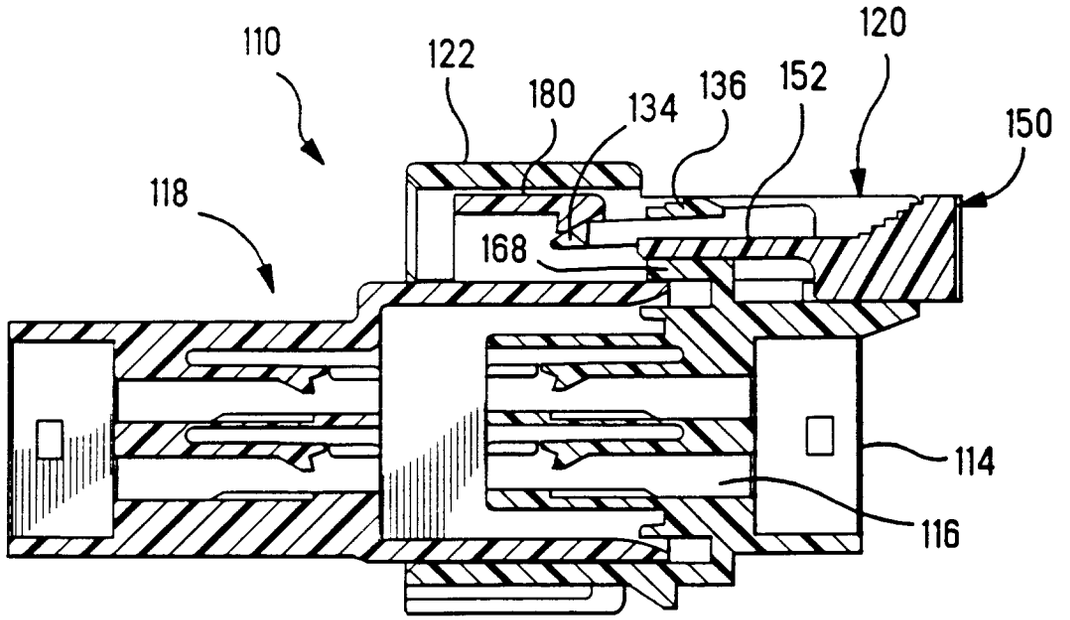
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FIG. 8

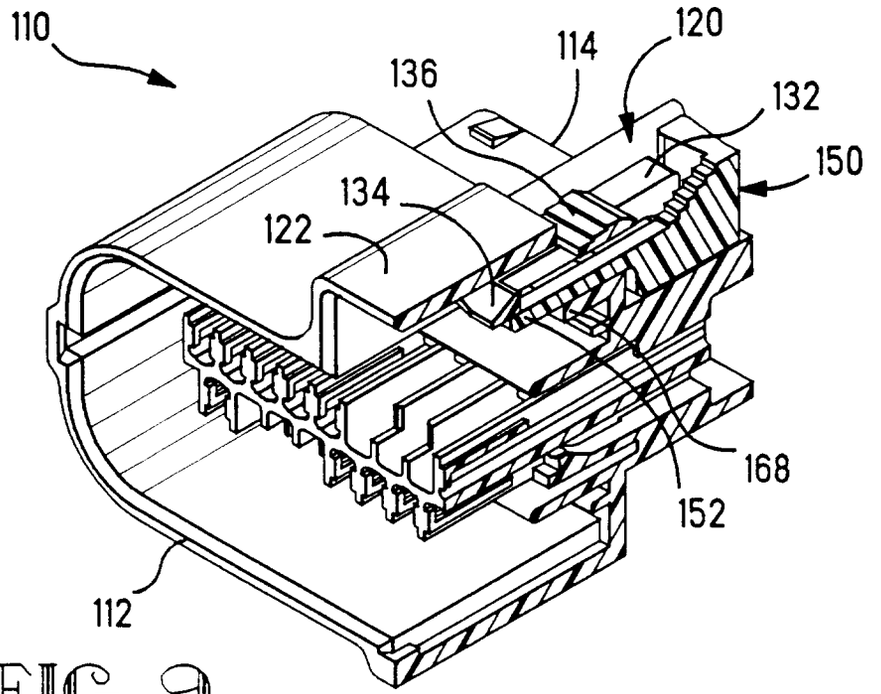

FIG. 9

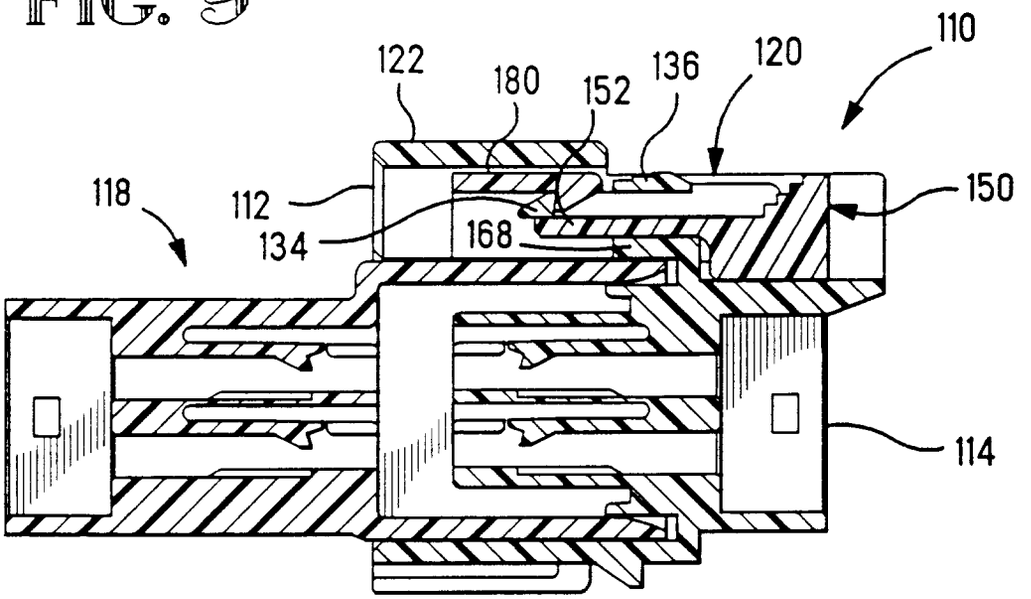

FIG. 10

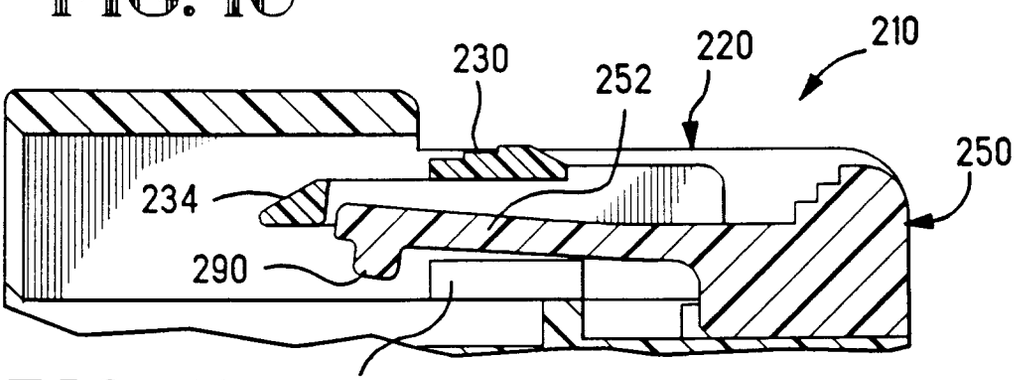

FIG. 11

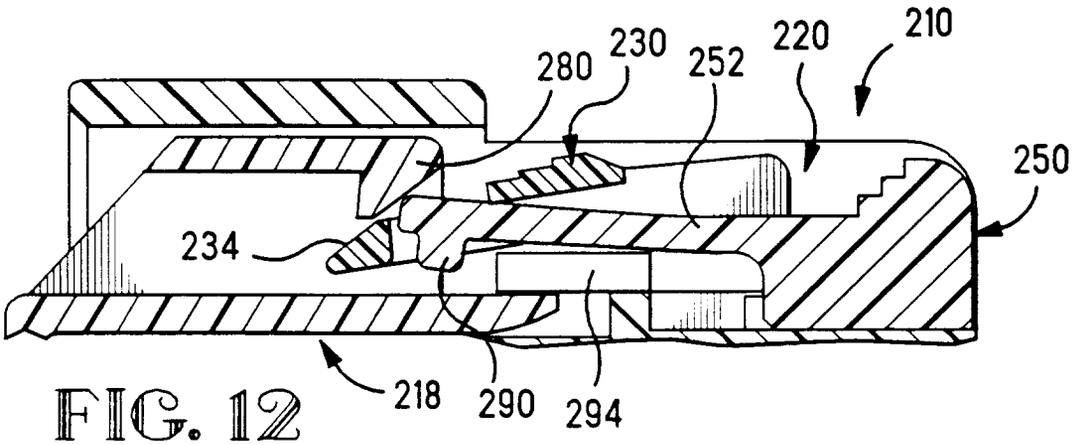

FIG. 12

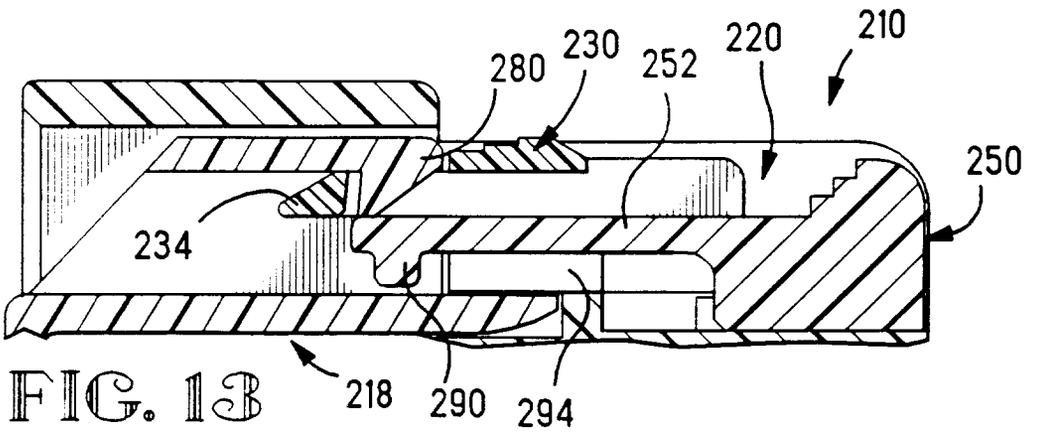

FIG. 13

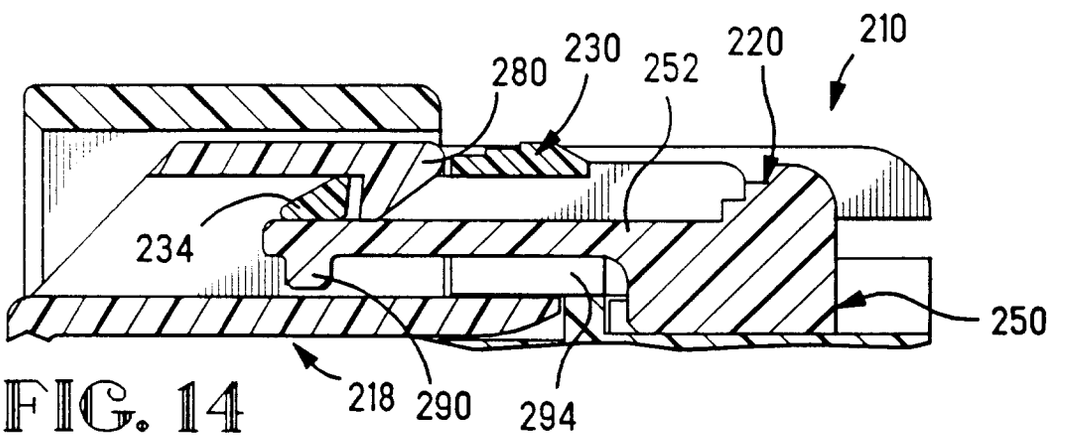

FIG. 14

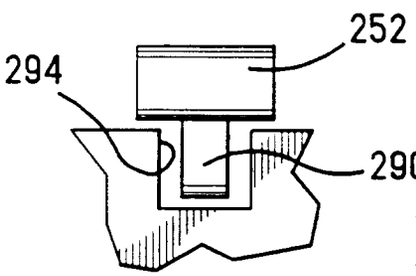

FIG. 15