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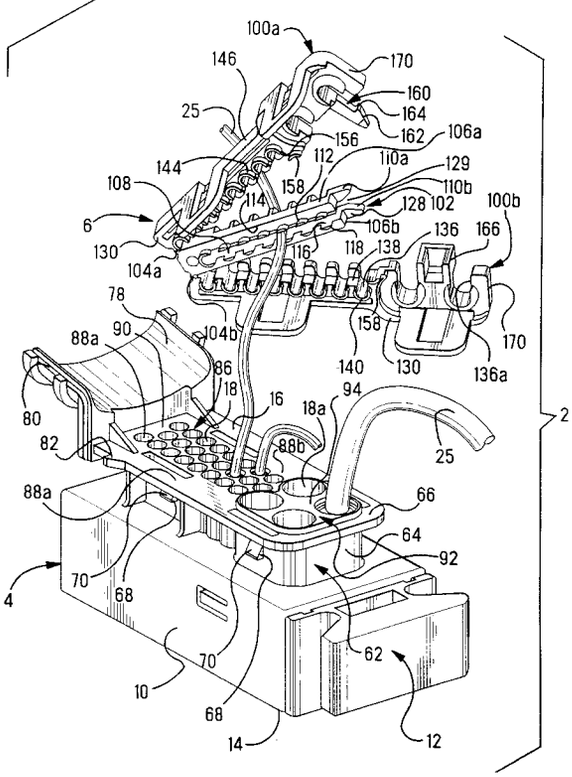
(54) Electrical connector having secondary locking member

(57) An electrical connector (2) comprises a connector body (4) having an array (86) of terminal receiving ports (18), an electrical terminal (20) within each terminal receiving port (18), and a secondary locking member (6) mountable to the connector body (4) and having a locked position for assuring retention of the electrical terminals (20). The secondary locking member (6) has two outer arms (100a,100b) with an inner locking arm (102) therebetween, each arm having a free end (110,170) and being interconnected opposite therefrom to the adjacent ends (110,170) by a web (104a,104b). The web (104a,104b) is flexible enabling the secondary locking element to be opened to receive wires (25) extending from the terminals (20). In addition, a cover (8) is provided for use with connectors incorporating a secondary locking member (6), that interferes with the locking member (6) unless the locking member (6) is fully seated, thereby preventing full assembly of the connector (2) without the secondary lock (6) being fully seated.

Fig. 1



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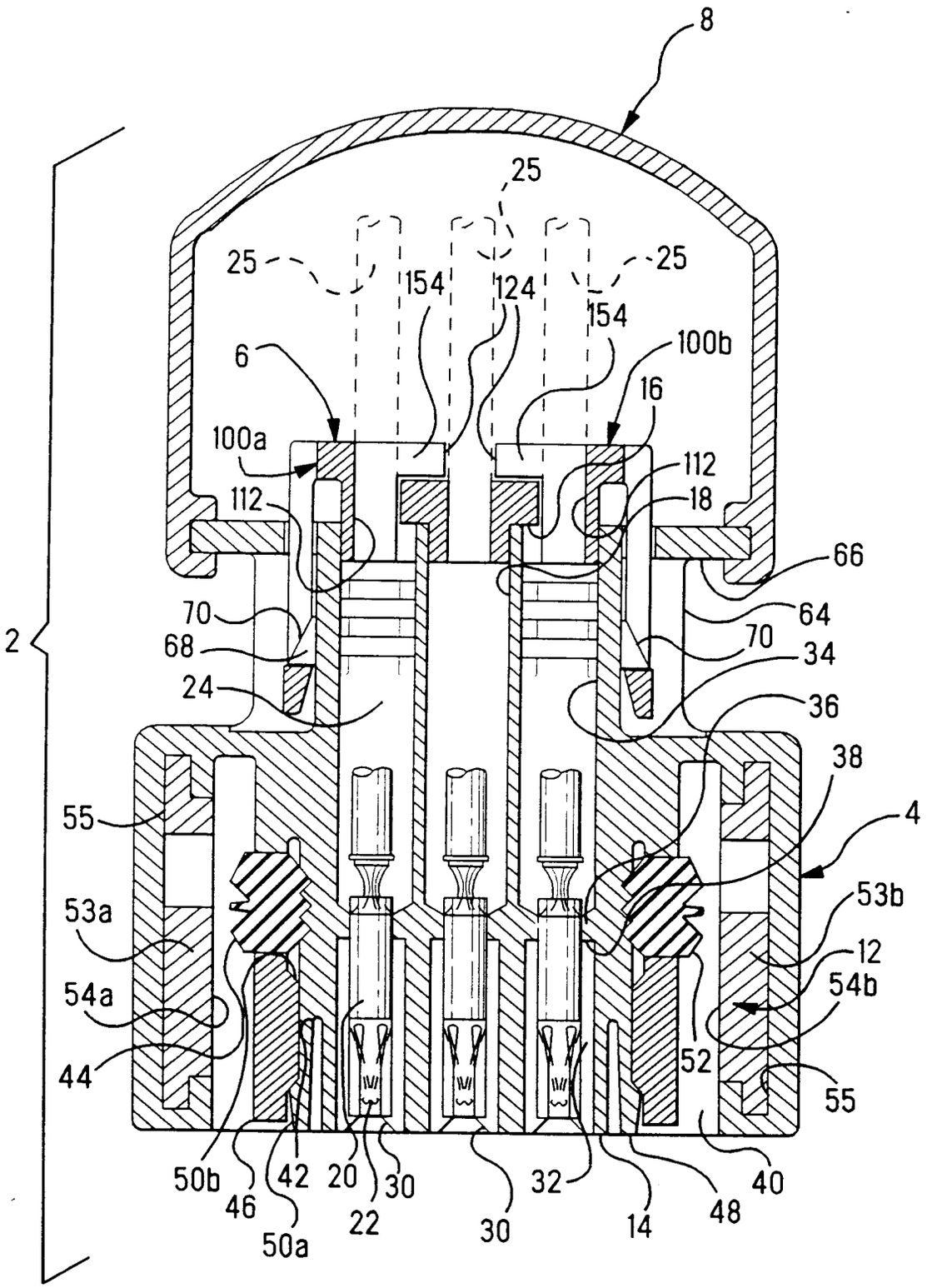
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55
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53a
53b
12
54a
54b
44
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50b
46
42
50a
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48
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2

Fig. 6

This invention relates to a connector which includes a secondary locking member for assuring that an electrical terminal contained therein is positively retained.

An electrical connector typically includes electrical terminals retained within a connector body by way of an interference between a feature on the terminal and a feature of the connector body. As the size of the terminals decreases and the density of the interconnections increase, the magnitude of the retention forces due to the interference is limited. In these situations, and especially where the electrical connector is to be subjected to adverse conditions that may include high vibration, the integrity of an electrical interconnection is at risk. Even where connector halves are fully mated and locked relative to each other, it may still be possible for the electrical interconnection to be interrupted as the terminal may become dislodged within the connector body as a result of failure of the interference therebetween.

In order to prevent the dislodgement of the electrical terminal within the connector body it is known in the art to include a secondary locking member that is retained upon the connector housing and constructed to be movable into a locked position after the terminal has been inserted into the connector body so that, when in the locked position, the terminal may not be dislodged. There are numerous configurations of secondary locking members known in the art. One example of which is disclosed in United States Patent No. 5,199,902 which relates to a connector device including a locking feature for locking a receptacle contact in place, a positive locking system for guaranteeing that two connector halves are fully mated and will not inadvertently disconnect. In this patent, the locking feature is a secondary locking member having three legs joined at one end where each leg has a scalloped length therealong. The locking member is insertable through a side wall of the connector body to a first position where the contact may be inserted into the receptacle housing, and then further displaceable to a second position where the raised portion of the scalloped length is aligned with the contact and prevents the contact from becoming dislodged. The structural integrity of the assembled lock member is assured by having free ends of the three legs extend into apertures formed within the connector housing.

It is an object of this invention to provide a secondary locking member for positively locking terminals within a connector body.

It is another object of this invention to provide a secondary locking member that, when in the locked position, positively locks the terminals within the connector body and assures that the terminals are fully seated therein.

It is yet another object of the present invention to provide a cover for an electrical connector that assures a secondary latching member is in the fully locked position before the cover can be completely closed upon the connector body.

These objects are accomplished by providing a secondary lock member comprising two outer arms with an inner locking arm therebetween. Each arm has a free end and is interconnected to an adjacent arm opposite the free end by a web. The secondary locking member of this invention is characterized in that the web is flexible enabling the arms to be pivoted.

An embodiment of the present invention will now be described by way of example with reference to the accompanying drawings, in which;

Figure 1 is a partially exploded perspective view of an electrical connector according to this invention showing the secondary locking member in an open position;

Figure 2 is a perspective view of the electrical connector of Figure 1 showing the secondary locking member in a closed position;

Figure 3 is a perspective view of the electrical connector of Figure 1 showing the secondary locking member in a locked position thereupon;

Figure 4 is a partially broken-away, partially cutaway side view of the electrical connector of Figure 1 and a partially mated cover for use therewith;

Figure 5 is a partially broken-away, partially cutaway side view of the electrical connector of Figure 1 showing the cover of Figure 4 in a fully seated position;

Figure 6 is a sectional view taken along line 6-6 of Figure 5.

With reference first to Figures 1, an electrical connector is shown generally at 2. The electrical connector 2 comprises a connector body 4, a secondary lock member 6 and a cover 8 (shown in Figures 4 and 5). The connector body 4 comprises a housing 10 for mating with a complementary connector half (not shown) and a slide 12 for guaranteeing that two connector halves are fully mated and do not disconnect. Extending through the housing 10 are a plurality of terminal receiving ports 18 wherein terminals 20 are received (Figure 6). The ports 18 are open at a mating face 14 and a wire receiving face 16. The mating face 14 is configured to correspond to the complementary connector half (not shown) and the type of terminals 20 being interconnected.

Each terminal 20 (Figure 6) includes a mating portion 22 proximate the mating face 14 of the connector body 4. In the illustrated embodiment, the mating portion 22 comprises opposing contact beams that form a receptacle for receiving a tab-type terminal. It is envisioned that other terminal types may be used. Opposite the mating portion 22 of the terminal 20 is a wire engaging portion 24 constructed to engage the conductive core (not shown) of insulated wire 25. The wire engaging portion 24 may be config-

ured for any type of wire engagement, including solder attachment, crimp attachment or insulation displacement (IDC). The terminals 20 are inserted into the terminal receiving ports 18 from the wire receiving face 16 such that the mating portion 22 is proximate an inner face 30 of the mating face 14 within forward cavity 32. Locking lances (not shown) on the electrical terminal 20 would abut a shoulder 38 that is formed within the terminal receiving port 18 by constriction 36 between the forward cavity 32 and rear passage 34. The wire engaging portion 24 extends into the rear passage 34.

An annular groove 40 extends around the terminal receiving port interface 30 and is open to mating surface 14. The annular groove 40 defines an inner plug portion 42 about which a resilient seal 44 is seated. The seal 44 is retained in position by a retainer 46 that has an inner profile generally corresponding to the inner plug portion 42 overwhich it is located. The retainer 46 is held in position by latch arms 48 located at various intervals about the inner plug portion 42. The latch arms 48 include cam surfaces 50a and the retainer 46 includes cam surfaces 50b. The cam surfaces 50a,50b interact to deflect the latch arms 48 to enable the retainer 46 to be received upon the inner plug portion 42 such that a shoulder 52 of the retainer 46 abuts the seal 44, thereby maintaining the seal 44 in position upon inner plug portion 42 and extending into the angular groove 40. The angular groove 40 is further defined by the inner surfaces 54a,54b of the slide 12. As best seen in Figure 3, the inner surfaces 54a,54b of slide 12 include camming grooves 56 that are open to receive lugs of the mating connector half (not shown) such that transverse movement of the slide 12, when engaged with the locking lugs of the mating connector, draws the two connector halves into a fully mated condition. When the slide 12 is fully seated, tab 68 of the housing 10 is received within window 58 of the slide 12 to assure that the slide does not become dislodged, thereby loosening the connection of the mating connector halves. When in the fully mated condition, a shroud or hood of the mating connector is received within the angular groove 40 and interacts with the seal 44 to form a sealed pair of connector halves.

Returning to Figures 1-3, incorporated into the connector body 4, opposite the mating face 14, is a rear pedestal 62 having a base portion 64 and an overlying platform 66 upon which the wire receiving face 16 is disposed. On opposite sides of the base portion 64 are a plurality of latching lugs 68, each of which have a cam surface 70, and are orientated below openings 74 (Figure 2) that extend through the platform 66. These lugs 68 are used for attaching the secondary lock 6 to the connector body 4 as will be described below. The pedestal 62 includes a half cable guide and strain relief bulkhead 78 at the rear thereof. The half cable guide and strain relief bulkhead 78 direct the exit of the wires 25 of an electrical cable (not shown) from the electrical connector 2 and provide an attachment point for incorporating a strain relief feature into the connector 2. In this embodiment, the half cable guide and strain relief bulkhead 78 are constructed for directing the wires 28 from the electrical connector 2 approximately perpendicular to the orientations of the terminals 20 within the terminal receiving ports 18. The half cable guide and strain relief bulkhead 78 includes a shoulder 80 and the platform 66 includes a locking latch 82 having a cam surface 84 (Figure 3) thereupon for retaining the cover 8, as will be described below.

In this particular embodiment, the connector body 4 includes a plurality of terminal receiving ports 18 of both large and small configurations. The smaller terminal receiving ports 18 are arranged in an array 86 having outer rows 88a,88b of at least one port 18. The array 86 may also include an inner row 90 of terminal receiving ports 18. The larger terminal receiving ports 18a are arranged in a second array 92 for receiving a different terminal and extend through a slightly raised surface 94 of the receiving face 16.

As best seen in Figure 1, the secondary locking member 6 includes a pair of outer arms 100a,100b that are similarly configured due to the symmetry of the connector housing 2. Located between the outer arms 100a,100b is an inner locking arm 102 that is interconnected with the adjacent outer arm 100a,100b by flexible webs 104a,104b. In this embodiment, the inner locking arm 102 is configured for retaining terminals 20 disposed within an inner row 90 of the array 86 of small terminal receiving ports 18 and includes a pair of inner arms 106a,106b are joined together at a bite 126 (Figure 2) and have free ends 110a,110b opposite thereof, thereby defining a U-shaped inner surface 108 therebetween. Extending downward from a lower surface 114 of inner arms 106a,106b are protrusions 112 that extend from a lower surface 114 and include an inner surface 116 that is part of the U-shaped inner surface 108 and an outer surface 118, opposite thereof, that corresponds to the respective rear passages 34 of the terminal receiving ports 18 to be slidably received therein.

Opposite lower surface 114 is an upper surface 120 which includes a plurality of partitions 122 that establish channels 124 corresponding to the protrusions 112. Opposite the bite 126, upon each of the inner arms 106a,106b, at the free ends 110a,110b are supporting lips 128 which have a slightly angled form creating a guide mouth 129 that is in communication with the opening defined by the U-shaped inner surface 108 for receiving wires 25.

The outer arms 100a,100b include a lower surface 130 that generally corresponds to the lower surface 114 of the inner locking arm 102. Opposite the lower surface 130 is an upper surface 132. These surfaces 130,132 are spanned by an inner scalloped

edge 134 that includes scallops 136 and an inner edge section 138 that is segmented by the scallops 136. Extending downward from the lower surface 130 are protrusions 140 that are configured similarly to protrusions 112 already described. The protrusions 140 include an inner surface 142 that forms part of the scallop 136 and an outer surface 144 which is contoured to be closely received within the terminal receiving port 18.

As seen in Figure 2, each outer arm 100a,100b includes an outer edge 146, located opposite the inner scalloped edge 134, from which tabs 148 extend downward, beyond the lower surface 130. These tabs 148 include an opening 150 defined in part by a latching surface 152 for engaging the latching lug 68 upon the base 64 to retain the secondary locking member 6 upon the connector body 4. The tabs 148 are configured to fit through openings 74 in platform 66. It is possible to assure proper assembly of the secondary locking member 6 with the connector housing by varying the sizing or location of the tabs 148 with respect to the openings 74.

Along upper surface 132 and extending outward over the scalloped inner edge 134 are tabs 154 arranged in a comb-like fashion. These tabs 154 are constructed to fit within the channels 124 of the inner arm 102, as shown in Figures 2-3. Seats 156 are formed along the upper surface 132 of each of the outer arms 100a,100b that correspond to the lips 128 at the free ends 110a,110b of the inner arms 106a,106b such that when the arms 100a,100b are closed the lips 128 are supported. Opposite the seats 156 are protrusions 158 that are receivable within one of the terminal receiving ports 18 of the inner row 90. These protrusions 158 correspond in function to the protrusions 112 of the interlocking arm 102.

The outer arms 100a,100b contain a clasp 160 and a catch 166 for holding the arms 100a,100b together in a closed position. The clasp 160 is a resilient member that includes a cam surface 162 and a barb 164 for engaging the catch 166 to lock the two outer arms 100a,100b together. The cam surface 162 passes over the inner surface of the catch 168 so that the barb 164 extends therebehind to hold the free ends 170 of the two outer arms 100a,100b together.

As shown in Figures 4 and 5, the cover 8 is formed as a shell-like member having an upper surface 180 and U-shaped side walls 182a,182b,182c defining an open cavity 184. The U-shaped side walls 182a,182b,182c, include a shoulder 186 therearound that has a groove 188 therein. The groove 188 is configured to receive the platform 66 of the rear pedestal 62 in a sliding fit, thereby enabling the cover 8 to be attached to the connector body 4. The cover 8 includes a half cable guide and strain relief bulkhead 190 that is complimentary to the half cable guide and strain relief bulkhead 78 of the connector body 4. A lip disposed about the half cable guide and strain relief bulkhead 190 of the cover 8 is constructed to mate with the shoulder 80 of the connector body. In this position, an opening (not shown), that is disposed along the groove 188 and extends through the wall 182a at a location that will correspond to locking latch 82 upon which the cover 8 is cammed over and engaged. A plurality of ribs 194 located at a nose of the cover 198 extend within the cavity 184 and define a radiused nose 196. When assembled, as shown in Figure 5, the radiused nose 196 and the rib 194 fits directly and closely over the secondary locking member 6.

The assembly of the electrical connector 2 will now be described with reference to the above described components and features. Insulated wires 25 are fixed upon electrical terminals 20. The terminals 20 are then inserted into the terminal receiving ports 18 of the connector body 4, such that the mating portion 22 of the terminal is received within the forward cavity 32 of the port 18 with the locking lances 26 of the terminal 20 interfering with the shoulder 38 to retain the terminals 20 therein. The wire engaging portion 24 of the terminal 20 is disposed in the rear passage 34 of the terminal receiving port 18 with the wires 25 extending outward of the wire receiving face 16 (Figure 1 and 6).

The secondary lock member 6 is shown in Figure 1 in an open position. Outer arms 100a,100b, of the secondary lock 6 are splayed from the interlocking arm 102 by way of flexible webs 104a,104b. With the secondary locking member 6 in the open position, the wires 25 extending from the wire receiving face 16 may be received therein. Wires 25 extending from the inner row 90 of the array of smaller ports 86 fit between the inner arms 106a,106b of the interlocking arm 102 along the U-shaped inner surface 108. Wires 25 extending from the outer rows 88a,88b are positioned between the respective outer arm 100a,100b and the inner locking arm 102 to fit within corresponding scallops 136 along the scalloped inner edge 134 of the outer arms 100a,100b, as best shown in Figure 2. Large wires 25a, extend through corresponding larger scallops 136a in each of the outer arms 100a,100b. By opening the secondary locking member in this scissor-like manner the wires 25 are easily received and positioned.

When all of the wires 25 have been seated within the secondary locking member 6, the outer arms 100a,100b are pushed together so that the clasp 160 engages and locks to catch 166 holding the wires 25 in their proper orientation, as best shown in Figure 2. In the drawings, a limited number of representative wires 25 are shown, with the others omitted for clarity. With the clasp 160 and catch 166 engaged, the outer arms 100a,100b are held together, whereby the secondary locking member 6 is positively retained upon the wires 26. In this position, best shown in Figure 2, the tabs 154 of the outer arms 100a,100b are re-

ceived within corresponding channels 124 of the inner arms 106a,106b respectively of the interlocking arm 102. Advantageously, as the tabs 154 overlie the inner arms 106a,106b of the interlocking arm 102, the inner locking arm 102 is supported and prevented from being displaced during assembly. Furthermore, the lips 128 of the free ends 110a,110b of the inner arms 106a, 106b are supported upon seat halves 156 of the outer arms 100a,100b, thereby preventing the interlocking arm 102 from being deflected downward. The support provided the inner locking arm 102 by the interaction with the tabs 154 and seat halves 156 of the outer arms 100a,100b support the resilient webs 104a,104b. By sizing the tabs 148 and the seat halves 156 relative to the channels 124 and lips 128, the interlocking arm 102 is provided with a limited range of float between the two outer arms 100a,100b as a result of the resilient webs 104a,104b. This float enables some alignment compliance with respect to the inner row 90 of the array of small ports 86.

With reference now to Figure 3 and Figure 6, the secondary locking member 6 is shown in a locked position upon the connector body 4. Tabs 148 of the secondary locking member 6 that extend downward from the outer edge 146 of the outer arms 100a,100b fit within openings 74 in platform 66 of the rear pedestal 62. The tabs 148 are sufficiently resilient, so that they are deflectable by cam surface 70 of latching lug 68 so that they pass thereover and are engaged upon locking surface 152. By receiving the tabs 148 within the openings 74 in the platform 66, the secondary locking member 6 is supported in the locked position without restricting the float of the interlocking arm 102.

As best seen in Figure 6, when the secondary locking member 6 is locked upon the connector body 4, the protrusions 112 of the interlocking arm 102 and the protrusion 140 of the outer locking arms 100a,100b extend into corresponding rear passages 34 of the terminal receiving ports 18 to abut the wire engaging portion 24 of the fully seated terminals 20. As the secondary locking member 6 is pressed upon the connector body 4, these protrusions are received within the terminal receiving ports and abut any terminals 20 that are not fully seated within the terminal receiving port 18. Further insertion of the secondary locking member 6 until the latching lugs 68 engage the latching surface 152 of tabs 148 results in terminals 20 being fully seated within the connector body 4, thereby assuring not only that the terminals 20 do not become dislodged within the connector body 4, but also that the terminals 20 are fully seated. Advantageously, as the tabs 154 that overlie the interlocking arm 102 where protrusions 112 extend, support is provided thereto in order to assure that the inner locking arm 102 is able to exert the necessary forces required to seat any terminals 20 that are not fully seated within the connector body 4 and to retain them therein.

With reference now to Figure 4 and Figure 5, a cover 8 is slidably received upon the platform 66 of the rear pedestal 62 of the connector body 4. As shown in Figure 4, if the secondary locking member 6 is not fully seated in the locked position, a free end 170 of the secondary locking member 6 interferes with an internal rib 194 of the cover 8. The interference prevents the cover 8 from being fully installed when the secondary locking member 6 is not properly seated. Where the secondary locking member 6 is close to being properly seated, the radiused nose 196 of the rib 194 will interact with the secondary locking member 6 and insertion of the cover 8 will force the secondary locking member 6 into the fully locked position.

Advantageously, a secondary locking member is provided for an electrical connector that assures that the electrical terminals within a connector body are retained therein. Furthermore, the secondary locking member may include protrusions that assure that the terminals are fully seated within the connector body. In addition, the resilient webs that interconnect the outer arms to the interlocking arm of the secondary locking member, enable the outer arms to pivotably open for receiving the wires extending from the electrical terminals to aid in installation. Finally, it is possible to use the secondary locking member described above, or another type of secondary locking member, as part of an electrical connector that incorporates a cover having a rib therein that interferes with the secondary locking member unless the secondary locking member is fully seated. In this embodiment, as the full latching of the secondary locking member assures that all of the terminals are fully seated within the connector body, assembly of the cover upon the connector body assures that complete seating of the electrical terminals has occurred and that the terminals will be retained within the connector body.

Claims

1. A secondary locking member (6) for assuring retention of electrical terminals (20) attached to wires (25) within respective terminal receiving ports (18) of an electrical connector (2), the secondary locking member (6) comprising two outer arms (100a,100b), each arm having a free end (170) and being interconnected opposite thereof by a web (104), characterized in that the web (104) is flexible enabling the outer arms (100a,100b) to pivot open to receive the wires (25) and closed to prevent the terminals (20) from passing.

2. The secondary locking member (6) of claim 1, characterized in that the outer locking arms

(100a,100b) include scallops (136) along an inner surface thereof that correspond to the wires (25).

3. The secondary locking member (6) of claim 1 or claim 2, characterized in that the outer arms (100a,100b) include protrusions (140) extending therefrom, said protrusions (140) being configured to be received in the terminal receiving ports (18) and abut seated terminals (20) therein when the secondary locking member (6) is seated upon the connector housing (4), such that when the secondary locking member (6) is fully seated the protrusions (140) assure the terminals (20) are also fully seated.

4. The secondary locking member (6) of any one of claims 1-3, characterized in that the outer arms (100a,100b) include a clasp (160) and a catch (166) for locking the outer arms (100a,100b) together.

5. The secondary locking member of any one of claims 1-4, characterized in that an inner locking arm (102) is disposed between the outer arms (100a,100b) and joined therewith at the web (104a,104b).

6. The secondary locking member (6) of claim 5, characterized in that the inner locking arm (102) includes opposing inner arms (110a,110b) separated by a wire receiving opening (108) for receiving wires (25) therein such that the secondary locking member (6) receives wires (25) between each of the outer arms (100a,100b) and the inner locking arm (102) and within the wire receiving opening (108).

7. The secondary locking member (6) of any one of claims 5 or 6, characterized in that the outer arms (100a,100b) include a seat (156) for supporting a free end (110a,110b) of the inner locking arm (102).

8. The secondary locking member (6) of any one of claims 5-7, characterized in that the outer locking arms (100a,100b) include tabs (154) extending oppositely therefrom and the inner locking arm (102) includes channels (124) corresponding to the tabs (154) such that when the secondary locking member (6) is in the closed position the tabs (154) are received within the channels (124) to support the inner locking arm (102).

9. The electrical connector (2) for terminating a wire (25), the connector (2) comprising a housing (4) having a wire receiving face (16) and a mating face (14) with a terminal receiving passageway (18) extending therethrough, a contact (20) that is connected to the wire (25) and seated within the terminal receiving passageway (18), a secondary locking member (6) having a seated position at the wire receiving face (16) to prevent the contact (20) from being displaced from the terminal receiving passageway (18), and a cover (8) fixable to the housing (4) to cover the wire receiving face (16) thereof, the connector (2) being characterized in that the cover (8) includes a secondary lock seating assurance member (194) that interferes with the secondary lock (6) unless the secondary lock (6) is fully seated and prevents full assembly of the connector (2) as attachment of the cover (8) to the housing (4) is prevented.

10. The electrical connector (2) of claim 9, further characterized in that the cover (8) is a shell-like member received transversely to the terminal receiving passageways (18) upon the housing (4), where the secondary lock seating assurance member is a rib (194) within the shell (8) and extending therefrom so that a nose (196) thereof abuts the secondary lock (6) unless the secondary lock (6) is fully seated.

Fig. 1

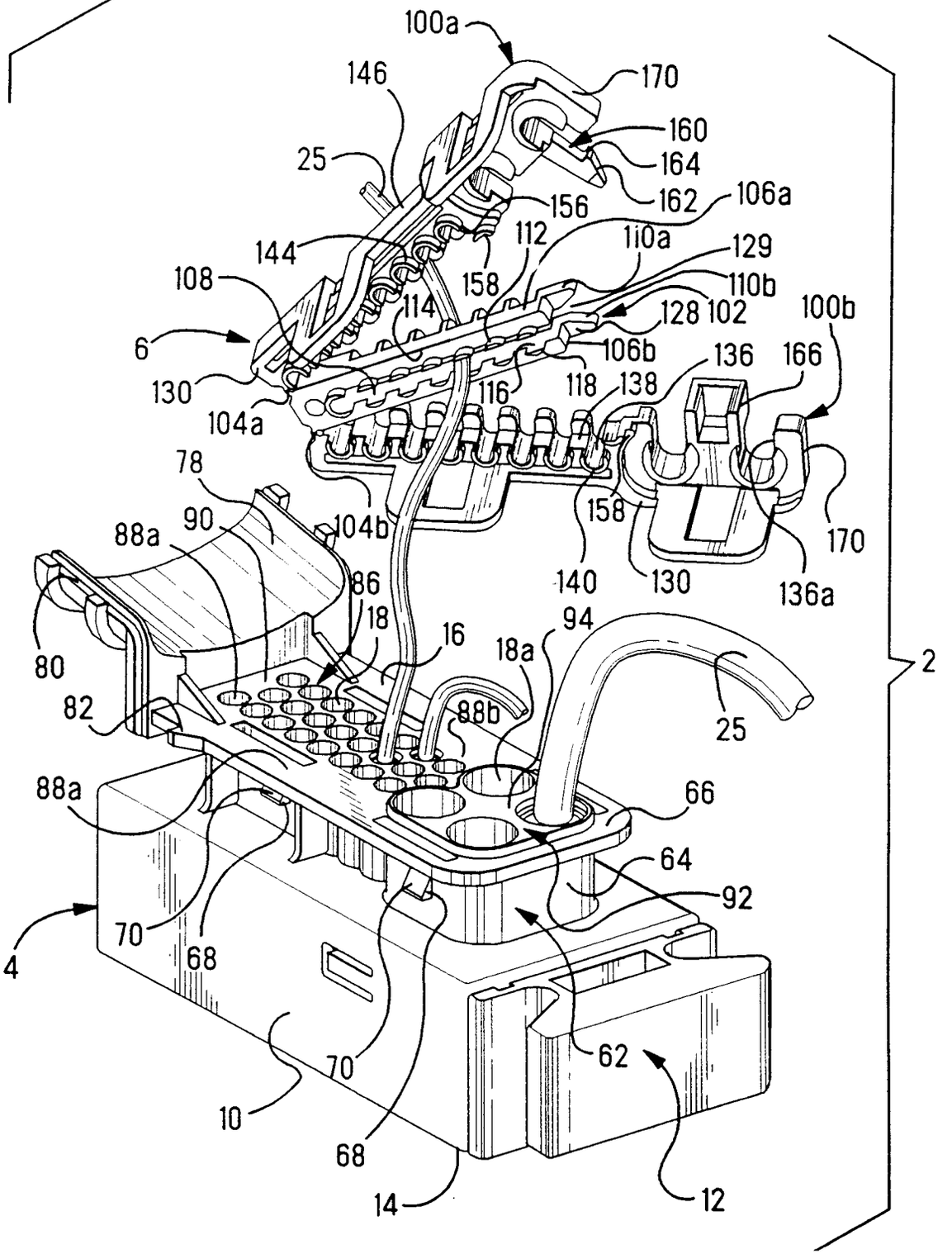
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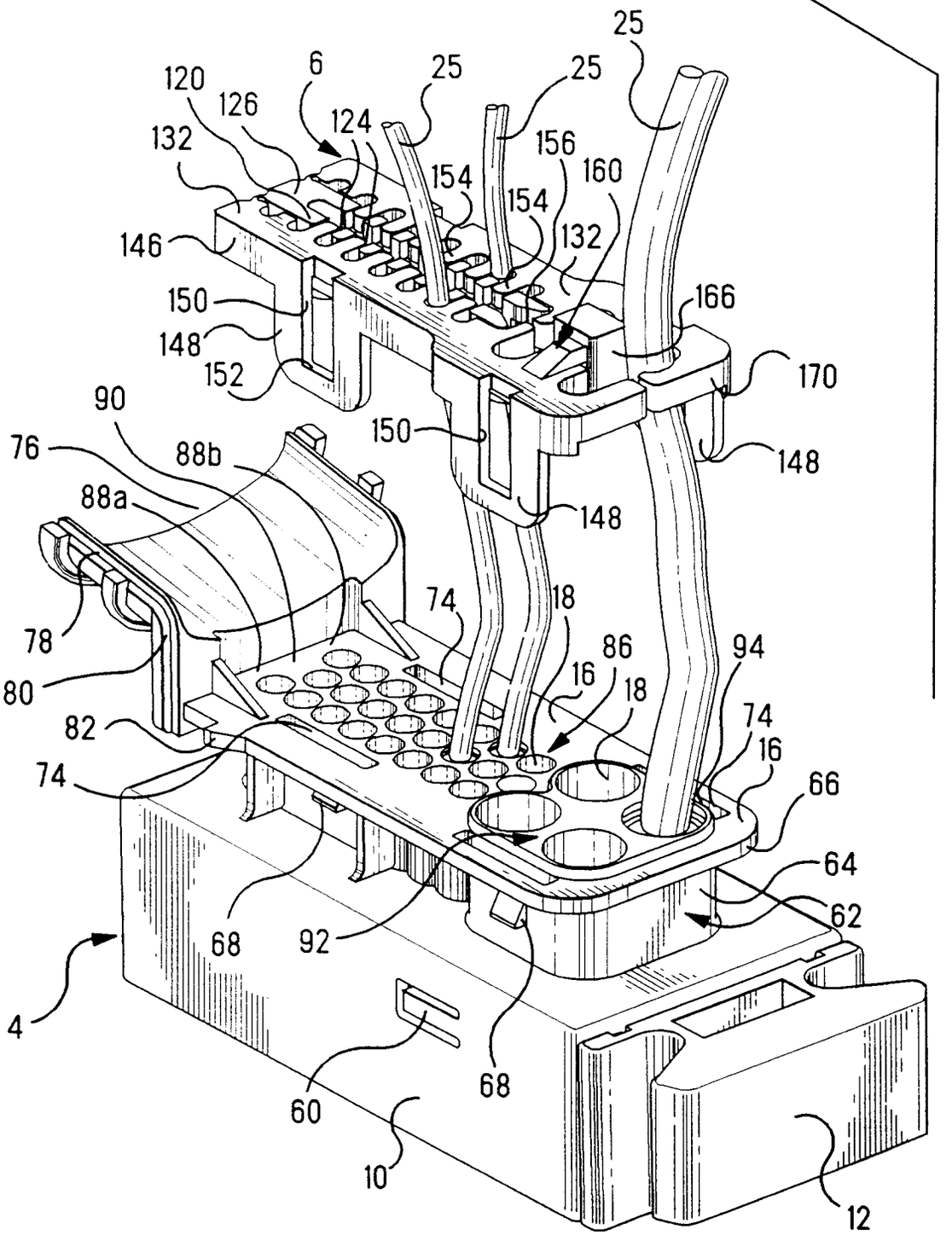
Fig. 2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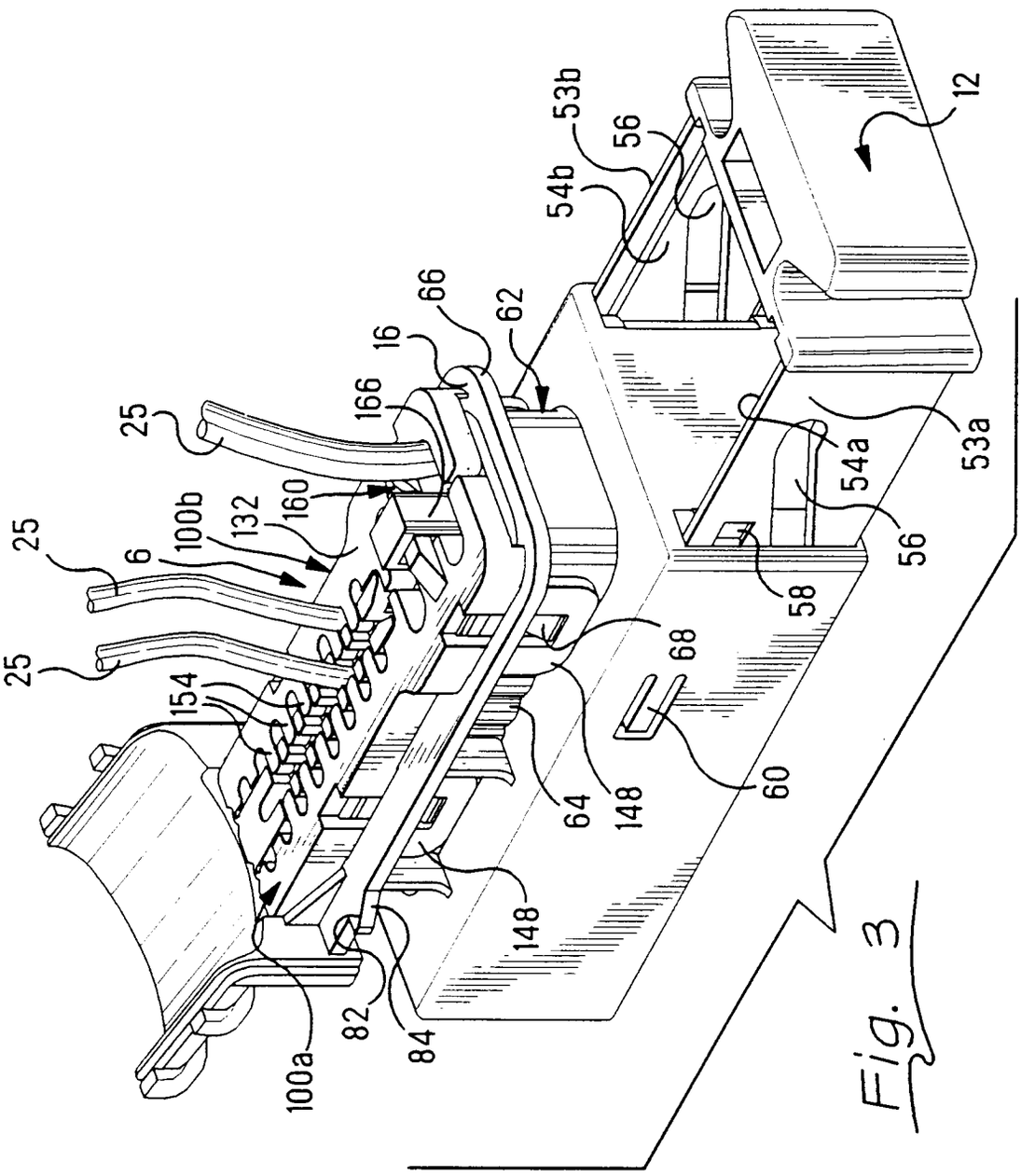
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Fig. 3

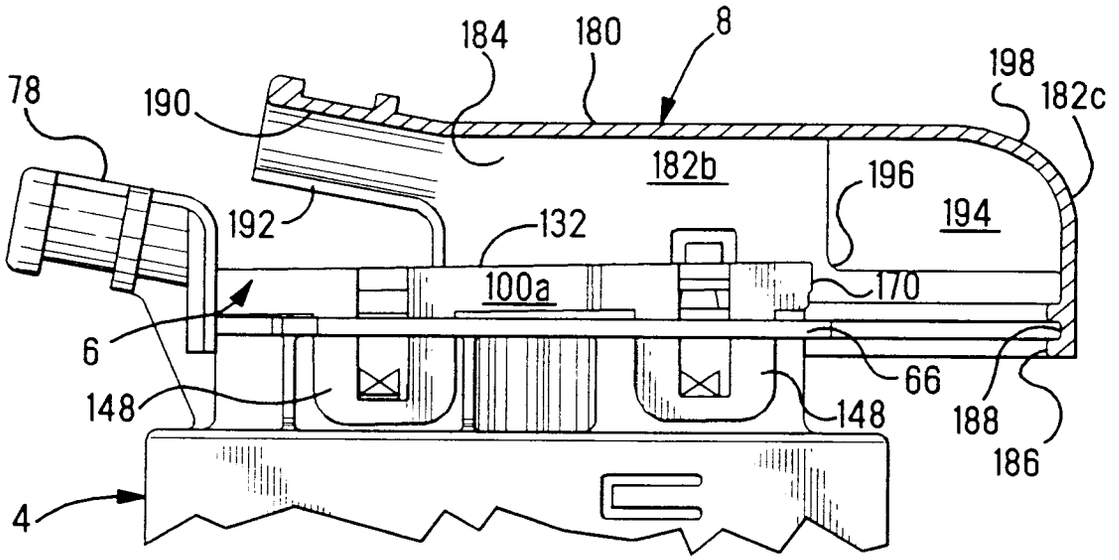
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Fig. 4

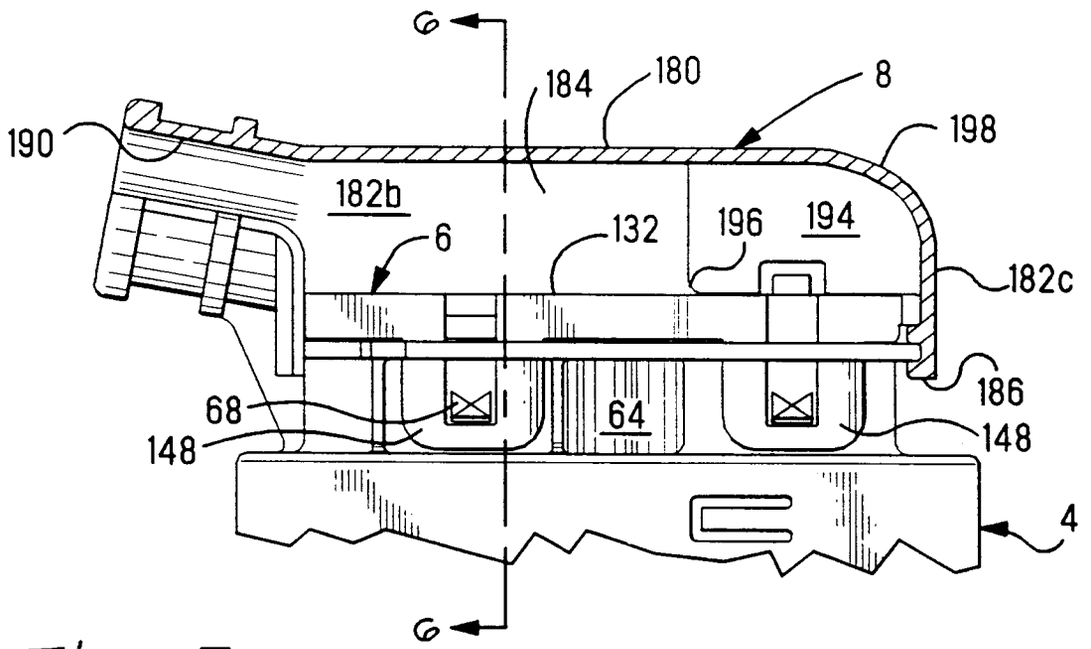
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Fig. 5

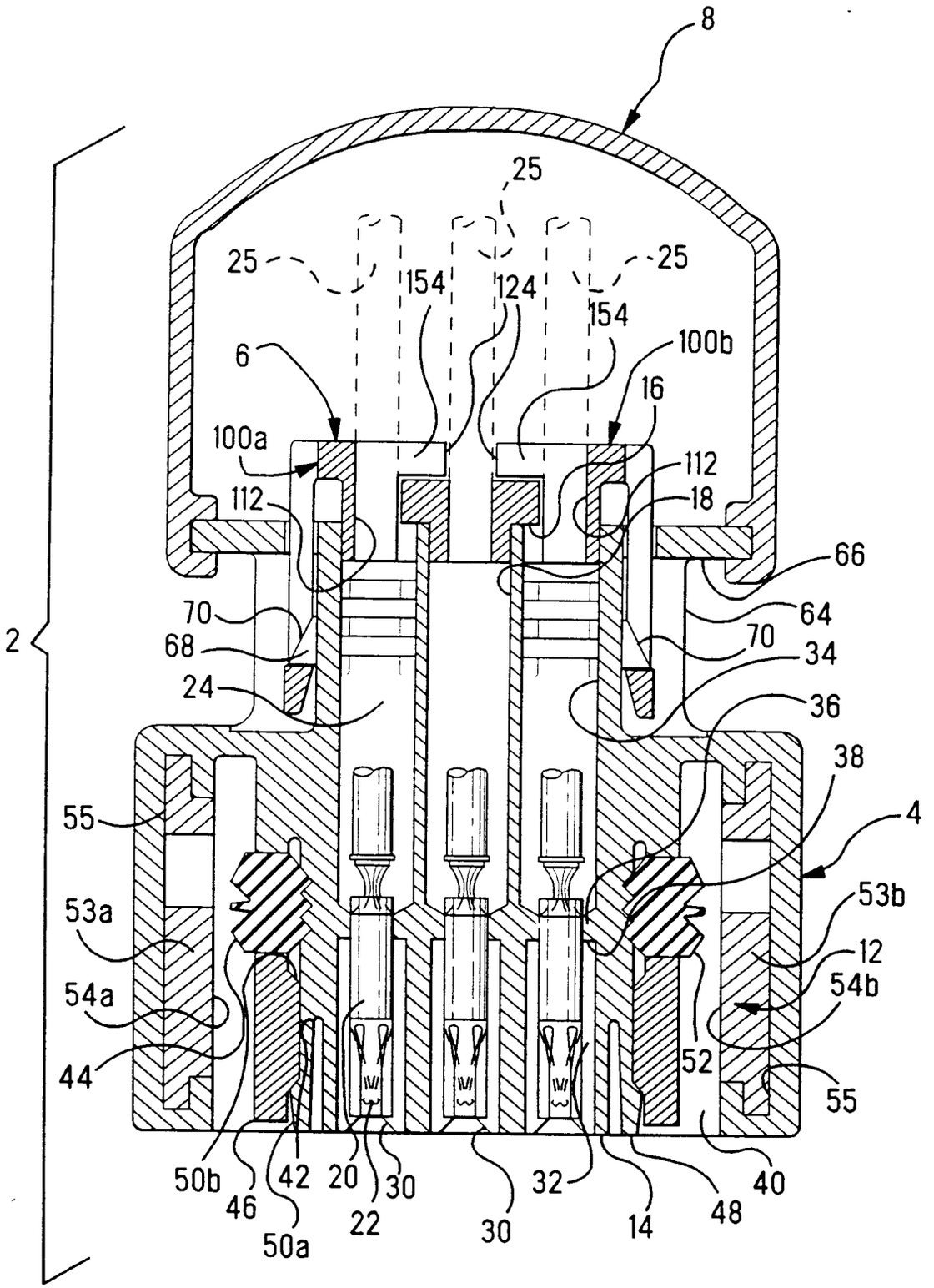
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Fig. 6