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## (54) Electrical connector

(57) A connector (2) is provided with a safety element (70) that is pivoted over a release grip portion (76) of a latching arm (74). The safety element (70) prevents inadvertent uncoupling of the connectors. The connector is supplied with the safety element (70) in the secured position. Elasticity of the latch is sufficient to allow coupling of the connectors when the safety element blocks the release portion of the latch. The connector is thus easy to couple without requiring subsequent actuation of a safety element, yet prevents inadvertent release.

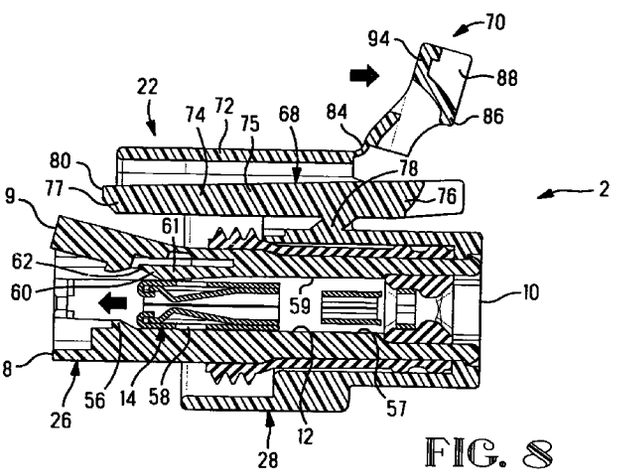


FIG. 8

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## Description

**[0001]** This invention relates to an electrical connector with a latch for securing to a complementary connector matable therewith.

**[0002]** It is known to provide electrical connectors with resilient latching arms that engage a complementary latching protrusion of a mating connector, whereby the latches engage automatically when the connectors are pressed together. It is also known to provide connectors having resilient latching arms , with a safety element inserted under the latch for preventing uncoupling of connectors. A disadvantage of conventional latching mechanisms with safety features is the need for additional parts and the requirement for an operator to effect a number of operations in order to ensure a secure fully coupled state. The need for a separate safety element and multiple operations adversely affects the reliability of the connector coupling. It would be desirable to provide a connector with a more reliable coupling mechanism. It would particularly advantageous to enable rapid and simple coupling of mating connectors with few operations whilst ensuring a secure coupling.

**[0003]** It is an object of this invention to provide a connector with secure and reliable coupling. It would be advantageous to enable simple and rapid coupling and uncoupling with few operations.

**[0004]** It would be advantageous to provide a connector that ensures correct insertion and locking of terminals in a housing thereof in a reliable and cost-effective manner.

**[0005]** It would be advantageous to provide an electrical connector that is effectively sealed, and that is simple and cost-effective to manufacture and assemble.

**[0006]** Objects of this invention have been achieved by providing the connector according to claim 1. Disclosed herein is a connector for mating with a complementary connector, comprising a housing, one or more terminals receivable in the housing, and a resilient latching member for securely engaging a complementary latch of the complementary connector in order to secure the connectors in the fully coupled position, the resilient latching member comprising a spring arm extending from an attachment portion where the latch is attached to the housing, to a locking portion having a locking shoulder for engaging a complementary locking shoulder of the complementary latch, wherein the latch further comprises a release extension connected to the spring arm and adapted to bias the latching portion out of engagement with the complementary latch when the release portion is actuated, the connector further comprising a safety element engaging the latch for preventing inadvertent disengagement thereof, wherein the safety element engages the release portion to prevent inadvertent disengagement, and the latch spring arm is provided with sufficient elasticity to enable coupling when the release portion is secured by the safety element.

**[0007]** Advantageously therefore, plugging of connectors is possible in a single operation whilst the safety element is in a secured position thereby preventing inadvertent release of the connectors. The connector can thus be supplied with the safety element in the secured position, whereby uncoupling of connectors can be easily effected by moving the safety element to an unsecured position and actuating the latch release portion.

**[0008]** The latch may advantageously be in the form of a cantilever beam attached to the housing at the attachment portion, the attachment portion forming substantially a pivot area of the latch. The latch spring arm and release portions may extend in opposite directions from the pivot mounting or attachment portion, the latch spring arm extending substantially in a direction of mating of the connector. The safety element may comprise an insert portion insertable between the latch release portion and the housing such that depression of the release portion towards the housing is blocked. The safety element may advantageously be pivotally mounted to the housing, for example with a hinge portion integrally moulded with the housing in the form of a thin web for cost-effective production of the connector. The safety element may comprise an insert portion that rotably inserts between the release portion and housing at a rear free end of the release portion.

**[0009]** Objects of this invention have been achieved by providing the connector according to claim 9. Disclosed herein is a connector for mating with a complementary connector, comprising a housing, one or more terminals receivable in corresponding cavities of the housing, each cavity provided with locking projections engageable in complementary locking recesses or cut-outs of the terminals, the connector further comprising a secondary locking member movable from an unlocked position where the terminals can be inserted into the cavities to a fully locked position where locking projections thereof engage in complementary recesses or cut-outs of the terminals thereby securing the terminals in the fully inserted position, wherein the locking projections in the cavity and on the secondary locking member respectively are substantially rigid and the connector is further provided with spring members having portions projecting into the cavity on an opposed side of the cavity to the locking protrusion thereof for biasing the terminals towards the cavity locking protrusion.

**[0010]** Advantageously, terminals are robustly secured in a reliable manner in the connector housing, whilst providing an operator with a tactile indication of complete insertion of the terminal.

**[0011]** Objects of this invention have been achieved by providing the connector according to claim 12. Disclosed herein is a connector for mating with a complementary connector, comprising a housing, one or more terminals receivable in the housing, and sealing means comprising a connector seal portion and a wire seal portion, the connector seal portion for sealing between the

connectors, and the wire seal portion for sealing between conducting wires connected to the terminals and the connector housing, the wire seal portion arranged proximate a terminal receiving end of the housing and the connector seal portion arranged towards a mating end of the connector housing, wherein the connector seal portion and wire seal portion are integrally attached together via an intermediate section.

**[0012]** Advantageously, an effectively sealed connector is provided in a compact and cost-effective manner to produce.

**[0013]** Further objects and advantageous aspects of this invention will be apparent from the following description and drawings, or are set forth in the claims.

**[0014]** An embodiment of this invention will now be described by way of example with reference to the figures in which;

Figure 1 is a side view of a connector according to this invention and a complementary connector matable therewith;
Figure 2 is an isometric view towards a mating face of connector according to this invention;
Figure 3 is an isometric view of the connector viewed towards a terminal receiving face;
Figure 4 is a cross sectional view through line 4-4 of figure 2;
Figure 5 is an exploded isometric view of the connector;
Figure 6 is a further exploded isometric view of the connector showing the safety element in an unsecured position;
Figure 7 is an isometric view of a terminal receiving portion of the connector housing with a secondary locking member in an unlocked or open position;
Figure 8 is a cross sectional view through line 8-8 of figure 2;
Figure 9 is a view similar to figure 8 with a terminal of the connector shown in an almost fully inserted position;
Figure 10 is a cross sectional view through line 10-10 of figure 2, showing the terminal in a fully inserted position in a cavity of the housing;
Figure 11 is a cross sectional view similar to figure 10 showing the secondary locking member in the fully locked or closed position:

**[0015]** Referring first to figures 1-7, an electrical connector 2 for mating with a complementary connector 4 comprises an insulative housing 6 extending from a mating end 8 to a terminal receiving end 10 and has a plurality of cavities 12 extending therethrough for receiving electrical terminals 14 (see figure 11) of the connector. The connector further comprises a seal member 16 having a connector seal portion 18 for sealing between the connector 2 and complementary connector 4, and a wire seal portion 20 for sealing between incoming conductors such as wires extending through the wire receiving end 10 of the housing, and the connector 2. The connector further comprises a latching mechanism 22 for securing the connector to a complementary latch 24 of the complementary connector 4.

**[0016]** The housing 6 comprises a terminal receiving section 26 and an outer shroud section 28 within which the terminal receiving section 26 is received. The latching mechanism 22 is integrally formed with the housing 6, in this embodiment with the outer shroud section 28 thereof.

**[0017]** The wire seal portion 20 is received in a sandwich between a wire receiving end wall 30 of the shroud section 28 and a terminal receiving end 32 of the terminal receiving section 26. The terminal receiving section 26 is securely locked to the shroud section 28 by provision of latches or locking arms 34 that extend from the terminal receiving end 32 of the terminal receiving section 26. The locking arms 34 have locking projections 36 proximate ends thereof that engage with complementary locking shoulders 38 (see figures 6 and 3) formed in windows 40 of the shroud section end wall 30. Sandwiching of the wire seal 20 provides a spring force that biases the housing sections 26, 28 apart such that the latches 36, 38 therebetween are in tight engagement. The terminal receiving section latch arms 34 project through corresponding cavities in the wire seal portion 20. This provides for a particularly compact latching arrangement between the terminal receiving and shroud sections 26, 28. This arrangement also provides for a well protected and safely retained family seal for sealing between a plurality of wire conductors and the connector, the conductors inserted through sealing cavities 42 extending through the wire seal portion 20. The wire seal portion 20 further comprises radial sealing lips 44 that seal against an inner surface 45 of the shroud.

**[0018]** The wire seal portion 20 is integrally connected to the connector seal portion 18 by an intermediate section 46 in the form of a thin membrane that extends from the wire seal portion 20 to the connector seal portion 18 in a slightly outward tapered manner which enables easy insertion of the sealing member 16 over the terminal receiving section 26, with introduction of the seal initially over the terminal receiving end 32 thereof. The connector seal portion 18 comprises a radial seal having internal peripheral sealing lips 47, 48 respectively that seal the terminal section 26 to the complementary connector 4. The intermediate section 46 of the seal member 16 comprises windows 49 for receiving extensions 50 therethrough of the terminal receiving section 26. The extensions 50 may serve as guiding or polarising features slidably receivable in complementary guiding members in the form of grooves 52 in side walls of the shroud receiving section 28 to ensure correct positioning of the terminal receiving section within the shroud receiving section. The extensions 50 may further be provided with insertion limiting stops or shoulders 53 engageable against complementary shoulders 54 of the shroud guides 52 to prevent over insertion of

the terminal receiving section 26 therein. The integral forming of the wire seal section 20 and connector seal section 18 reduces the manufacturing handling and assembly costs of the connector whilst ensuring effective sealing thereof.

**[0019]** Referring to figures 7-11, the terminal receiving section 26 comprises a substantially rigid locking protrusion 56 in the terminal receiving cavity 12, engaging in a complementary locking recess or cut-out 58 of the terminal 14. The rigid locking protrusion 56 is provided on a first side 57 of the cavity 12, and on a second opposed side 59 of the cavity is a spring member 60 for biasing the terminal 14 towards the first side 57 during insertion of the terminal in the cavity 12. The spring member 60 is in the form of a cantilever beam spring arm with a protruding or enlargened portion 61 proximate a free end 62 thereof which is directed towards the mating end 8. The rigid locking protrusion 56 provides for a particularly robust retention of the terminal in the cavity 12 whilst the spring 60 ensures that the terminal 14 snaps into the fully inserted position, as shown in figure 10, thereby providing the operator with a tactile and audible indication of complete insertion, as well as ensuring securing of the terminal once fully inserted. Subsequent to full insertion as shown in figure 10, a secondary locking member 64, which is pivotally attached to the terminal receiving section 26 via a flexible hinge 66, is pivoted into the fully locked position as shown in figure 11. The secondary locking member 64 is provided with a locking protrusion 67 that engages in a complementary locking recess or cut-out 58` of the terminal 14. The locking protrusions 56, 67 on opposed sides of the terminals, are provided in a substantially rigid form thereby ensuring a particularly robust retention of the terminal in the housing. Closing of the secondary locking member 64 into the locked position as shown in figure 11 is not possible if the terminal is only partially inserted as shown in figure 9. Due to the rigid locking protrusion 56, closure of the secondary locking member 64 cannot bias the opposed locking protrusion 56, contrary to a situation where the locking protrusion would be elastic. The spring 60 thus enables the provision of rigid locking protrusions 56, 67 without foregoing the advantages of snapping the terminal into a locking position during insertion. As illustrated in figure 1, when the secondary locking member 64 is in the open or unlocked position, a mating end 9 thereof abuts a mating end 11 of the mating connector 4, thereby preventing coupling of connectors unless the secondary locking member is in the fully locked position. The provision of the secondary locking member 64 at the mating end 8 of the terminal section 26 provides easy accessibility for actuation thereof.

**[0020]** Referring now to figures 3-6, and 8-10, the connector latching mechanism 22 comprises a latch 68, a safety element 70 and a protective cover portion 72. The latch mechanism is integrally moulded with the housing, and in this embodiment with the shroud section 28 of the housing 6. The latch 68 comprises a resilient latching portion 74 and a release portion 76 extending in opposed directions from an attachment portion 78. The attachment portion 78 forms a pivotal support attachment of the latch 68 to the shroud section 28. The latching portion 74 comprises a spring arm 75 extending from the attachment portion 78 to a locking portion 77 proximate a free mating end 80. The locking portion 77, as best seen in figure 10, comprises a locking shoulder 79 for engaging a complementary locking shoulder 81 (see figure 1) of the complementary connector latch 24. The elastic flexibility of the spring arm 75 is sufficient to allow the locking portion 77 to bias over the latch protrusion 24 of the complementary connector during coupling, and subsequently reside behind the shoulder 81 without pivoting of the release portion 76. In other words, when the release portion 76 is blocked by the safety element as shown in figure 9, the connector 2 may still be coupled to the complementary connector 4 by merely pushing the connectors together until the latches snap into a fully locked condition. The connector can thus be supplied with the safety element 70 in the secured position shown in figures 9-11.

**[0021]** In figure 8 the safety element 70 is shown in the release or unsecured position, whereby an operator can depress the release portion 76, which is in the form of a cantilever beam extending from the attachment portion 78, thereby pivoting the latch portion 74 about the attachment portion 78. This causes the locking shoulder 79 of the latch portion 74 to bias over the complementary latch protrusion 24 of the complementary connector to enable uncoupling. The safety element 70 is integrally attached to the housing via a flexible hinge 84, which is in the form of a thin web extending between the safety element and the cover portion 72. The safety element 70 comprises an insert portion 86 that inserts between the release portion 76 and connector housing as seen in figure 9, thereby blocking biasing of the release portion 76 towards the housing. As best seen in figure 6, in this embodiment the safety element 70 is provided with a pair of insert portions 86 extending from sides 88 of the safety element whereby the release portion 76 comprises complementary blocking shoulders 89 on sides 90 for receiving the insert portion 86 thereunder. The release portion 76 extends to a wire receiving end 92 positioned beyond the blocking portions 89 to provide a sufficiently long finger grip extension 91 for actuation by an operator. In order to allow pivotal travel of the insert portions 86 of the safety element, sides 90' of the finger grip extension 91 are recessed with respect to the sides 90, the recess forming a substantially arcuate shoulder 93 joining the sides 90, 90' . Latches (not shown) between the safety element 70 and housing shroud section 28 may be provided to hold the safety element in the fully secured position.

**[0022]** The safety element 70 also forms a cover or cap including the side walls 88 and a top wall 94 that partially enclose the release portion 76 of the latch

thereby preventing access thereto by an operator when the safety element is in the fully secured position. In order to release fully coupled connectors 2, 4, an operator merely has to lift the safety element 70 which snaps open with a certain lifting force, to access the release portion 76 and pivotally lift the latch.

## Claims

1. A connector (2) for mating with a complementary connector (4), comprising a housing (6), one or more terminals (14) receivable in the housing, and a resilient latch (68) for securely engaging a complementary latch (24) of the complementary connector in order to secure the connectors in a fully coupled position, the resilient latch comprising a latching portion (74) with a spring arm (75) extending from an attachment portion (78) where the latch is attached to the housing (6), to a locking portion (77) having a locking shoulder (79) for engaging a complementary locking shoulder (81) of the complementary latch, wherein the latch (68) further comprises a release extension (76) connected to the spring arm (75) and adapted to bias the locking portion (77) out of engagement with the complementary latch (24) when the release portion (76) is actuated, the connector further comprising a safety element (70) engaging the latch (68) for preventing inadvertent disengagement thereof, characterised in that the safety element (70) engages the release portion (76) to prevent inadvertent disengagement, the latch spring arm (75) provided with sufficient elasticity to enable coupling when the release portion is secured by the safety element.

2. The connector of claim 1 wherein the safety element (70) comprises an insert portion (86) insertable between the release portion (76) and the connector housing (6) for blocking movement of the release portion towards the connector housing.

3. The connector of claim 1 or 2 wherein the latch is substantially in the form of a beam pivotally attached at an attachment portion (78) to the housing (6), the attachment portion intermediate the release portion (76) and latching portion (74).

4. The connector of any one of the preceding claims wherein the latching portion (74) is substantially in the form of a cantilever beam extending from an attachment portion (78) where the latches attach to the housing (6), to a free mating end (80), the locking portion (77) provided proximate the mating end (80).

5. The connector of any one of the preceding claims wherein the safety element (70) is pivotally attached to the housing (6).

6. The connector of the preceding claim wherein the safety element is attached via a flexible hinge (84) integrally moulded with the housing.

7. The connector of any one of the preceding claims wherein the safety element is provided with side walls (88) and a top wall (94) that form a protective cover at least partially enclosing the release portion (76) for preventing access thereto.

8. The connector of any one of the preceding claims wherein the safety element is pivotally movable from an unsecured to a secured position proximate a wire receiving end (10) of the connector housing.

9. A connector (2) for mating with a complementary connector (4), comprising a housing (6), one or more terminals (14) receivable in corresponding cavities (12) of the housing, each cavity provided with locking projections (56) engageable in complementary locking recesses or cut-outs (58) of the terminals (14), the connector further comprising a secondary locking member (64) movable from an unlocked position where the terminals (14) can be inserted into the cavities (12) to a fully locked position where locking projections (67) thereof engage in complementary recesses or cut-outs (58') of the terminal thereby securing the terminal in the fully inserted position, characterised in that the locking projections (56, 67) in the cavity and on the secondary locking member respectively are substantially rigid and the connector is further provided with spring members (60) having portions (61) projecting into the cavity (12) on an opposed side of the cavity to the locking protrusion (56) thereof for biasing the terminals towards the cavity locking protrusion (56).

10. The connector of the preceding claim wherein the secondary locking member (64) is provided at a mating end (8) of the connector housing and is engageable against a portion (11) of the complementary connector (4) during coupling when the secondary locking member is in the unlocked position, in order to prevent coupling of the connectors unless the secondary locking member is in the fully locked position.

11. The connector of either of the two preceding claims wherein the secondary locking member (64) is integrally attached to the connector housing (6) via a thin flexible hinge (66), the secondary locking member extending therefrom in a mating direction to the mating end (8).

12. A connector (2) for mating with a complementary connector (4), comprising a housing (6), one or more terminals (14) receivable in the housing, and

sealing means (16) comprising a connector seal portion (18) and a wire seal portion (20), the connector seal portion (18) for sealing between the connectors (2, 4), and the wire seal portion (20) for sealing between conducting wires connected to the terminals (14) and the connector housing (6), the wire seal portion (20) arranged proximate a terminal receiving end (10) of the housing and the connector seal portion (18) arranged towards a mating end (8) of the connector housing, characterised in that the connector seal portion (18) and wire seal portion (20) are integrally attached together via an intermediate section (46).

**13.** The connector of the preceding claim wherein the connector housing comprises a terminal receiving section (26) and a shroud section (28) receiving the terminal receiving section therein, whereby the wire seal portion (20) is sandwiched between the terminal receiving section (26) and a terminal receiving end wall (30) of the shroud section (28).

**14.** The connector of the preceding claim wherein the terminal receiving section (26) comprises latch extensions (34, 36) projecting though the wire seal portion (20) and engaging a terminal receiving end wall (30) of the shroud section (28) for latching of the terminal receiving section thereto.

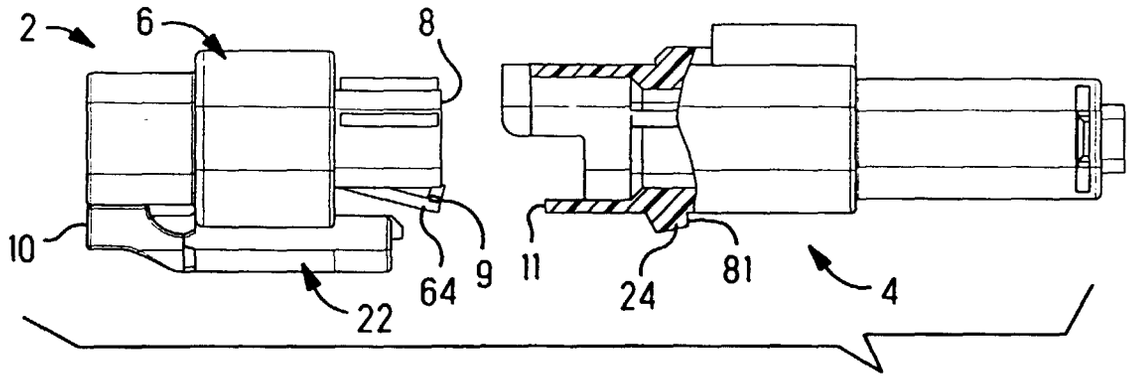


FIG. 1

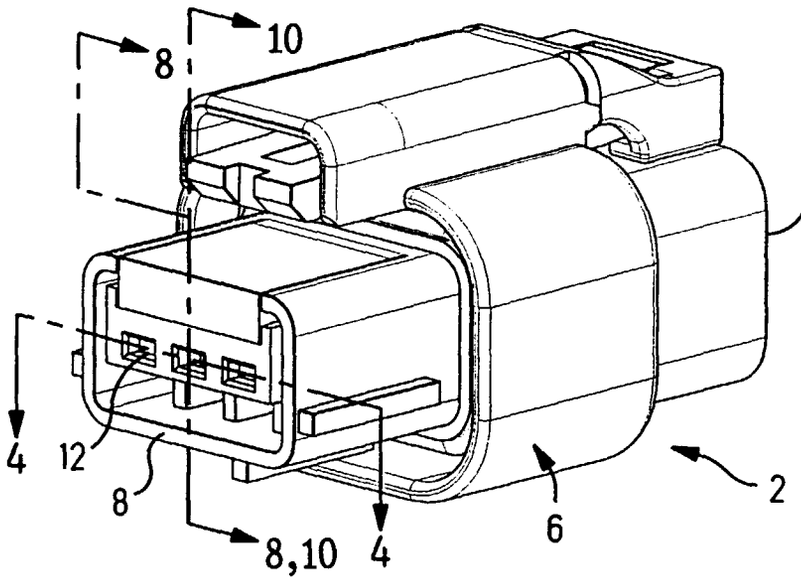


FIG. 2

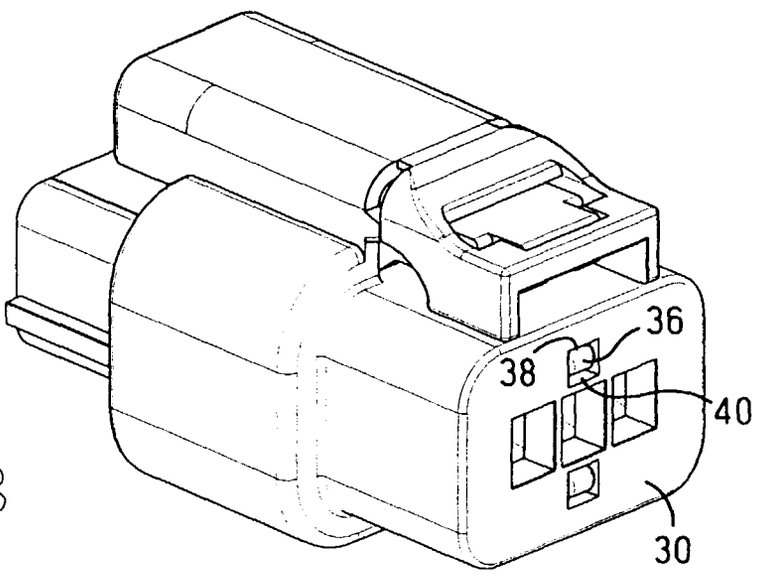


FIG. 3

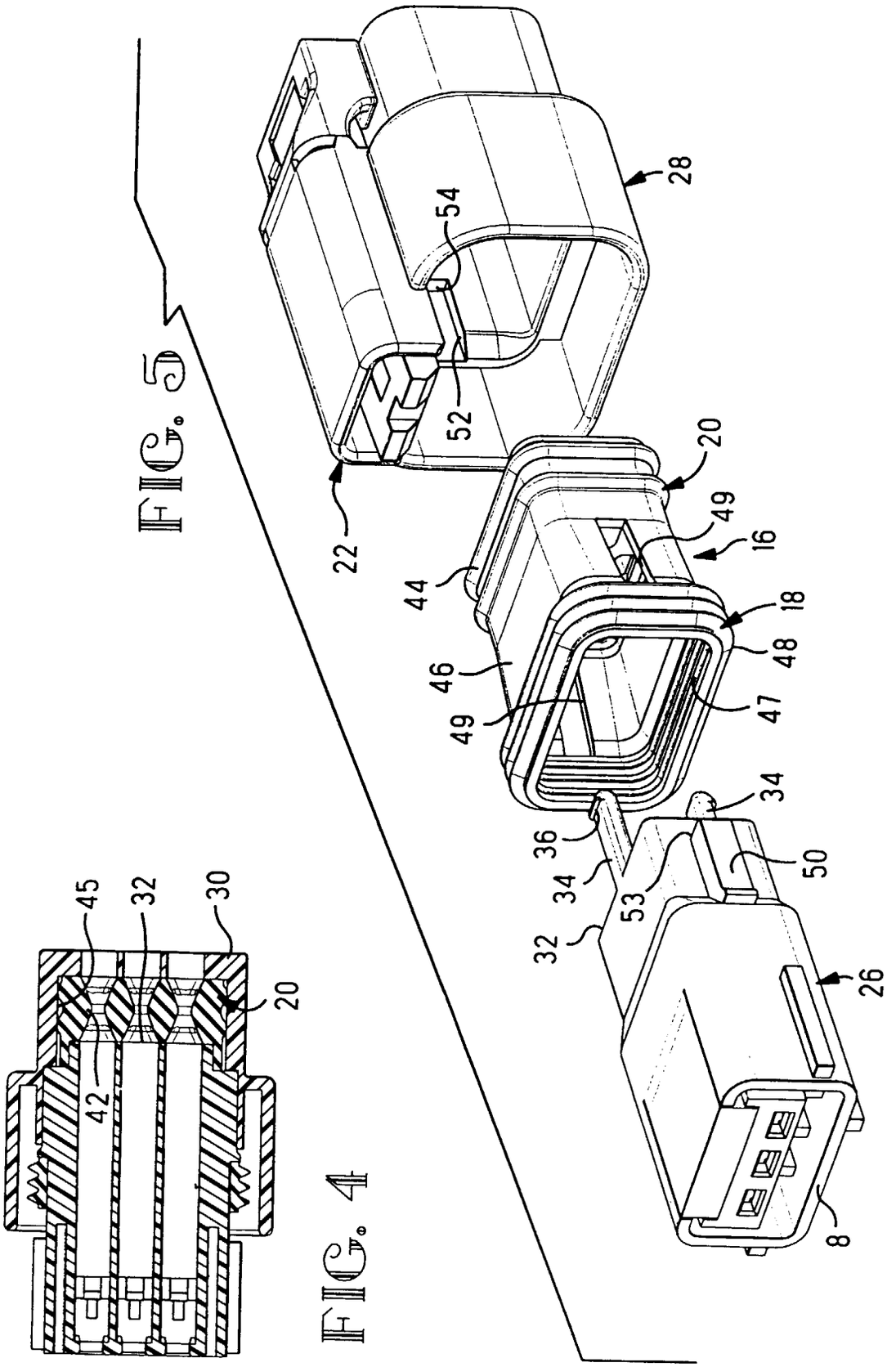
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FIG. 5


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FIG. 4

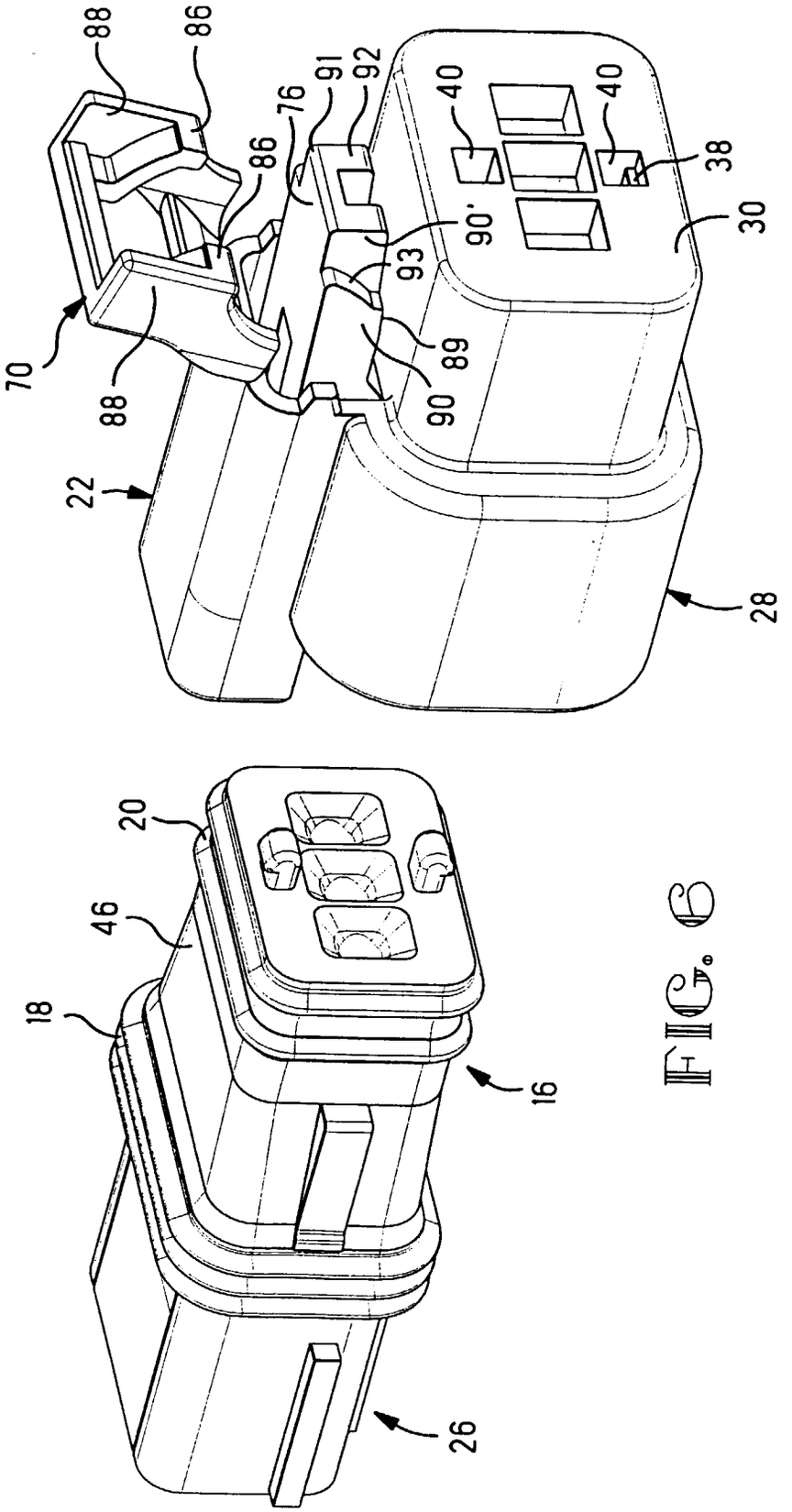


FIG. 6

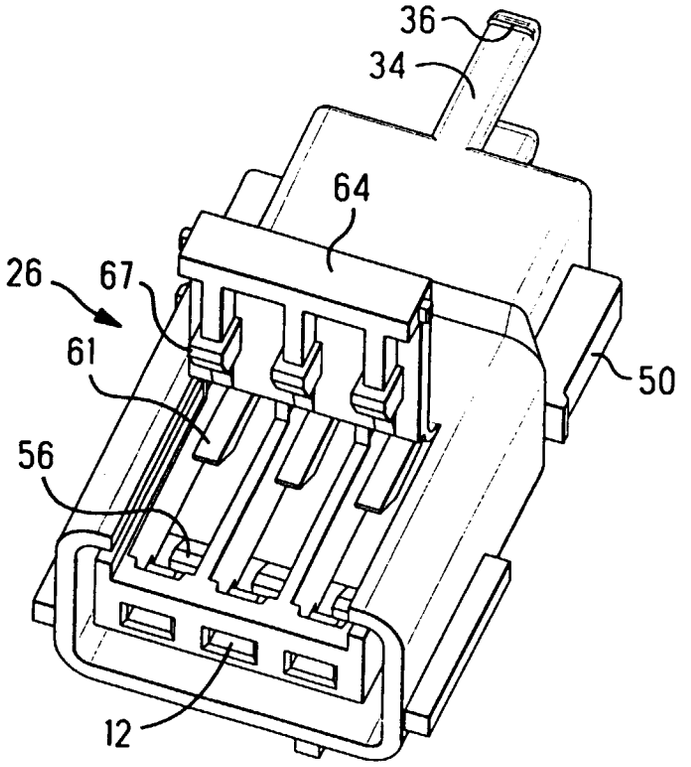
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FIG. 7

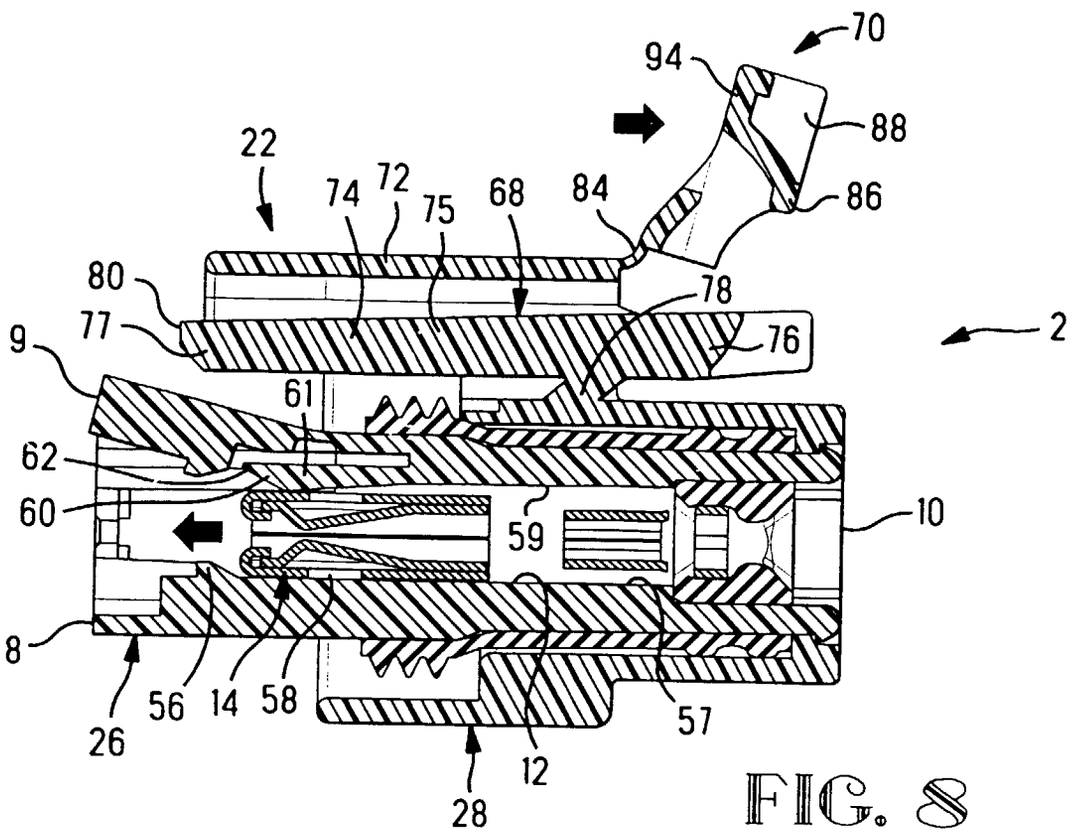
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FIG. 8

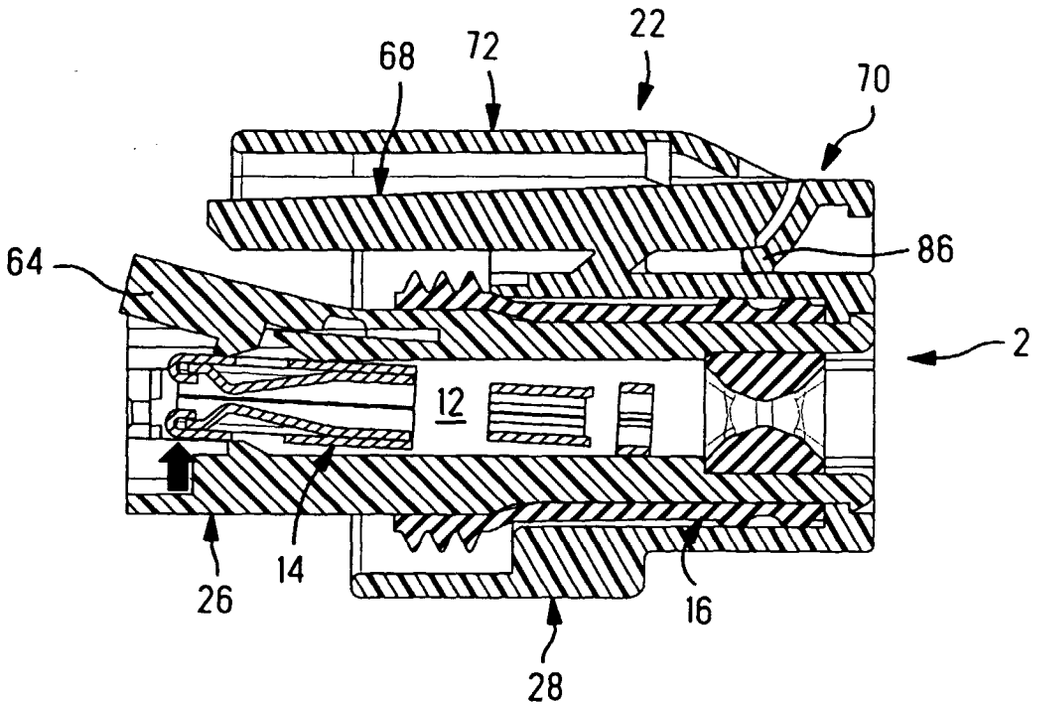
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FIG. 9

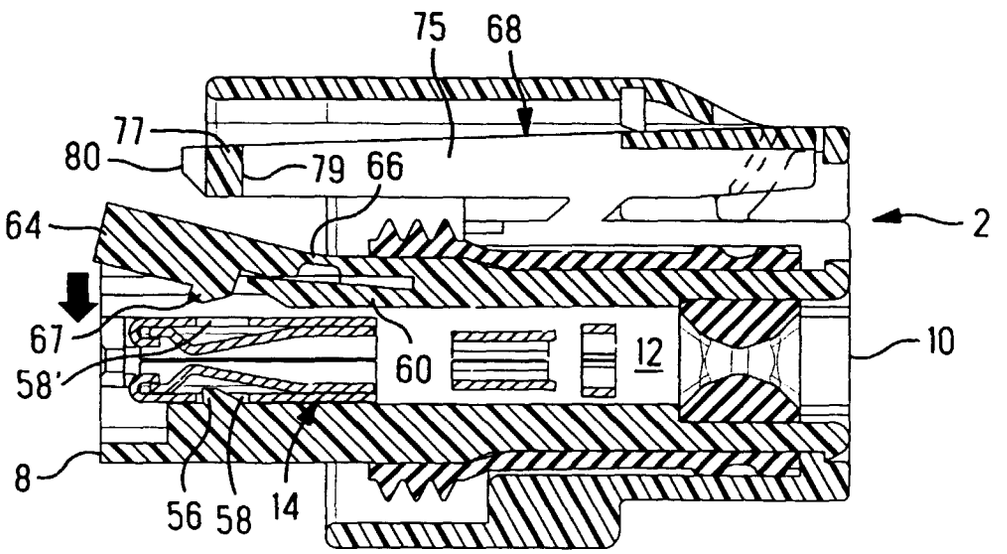
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FIG. 10

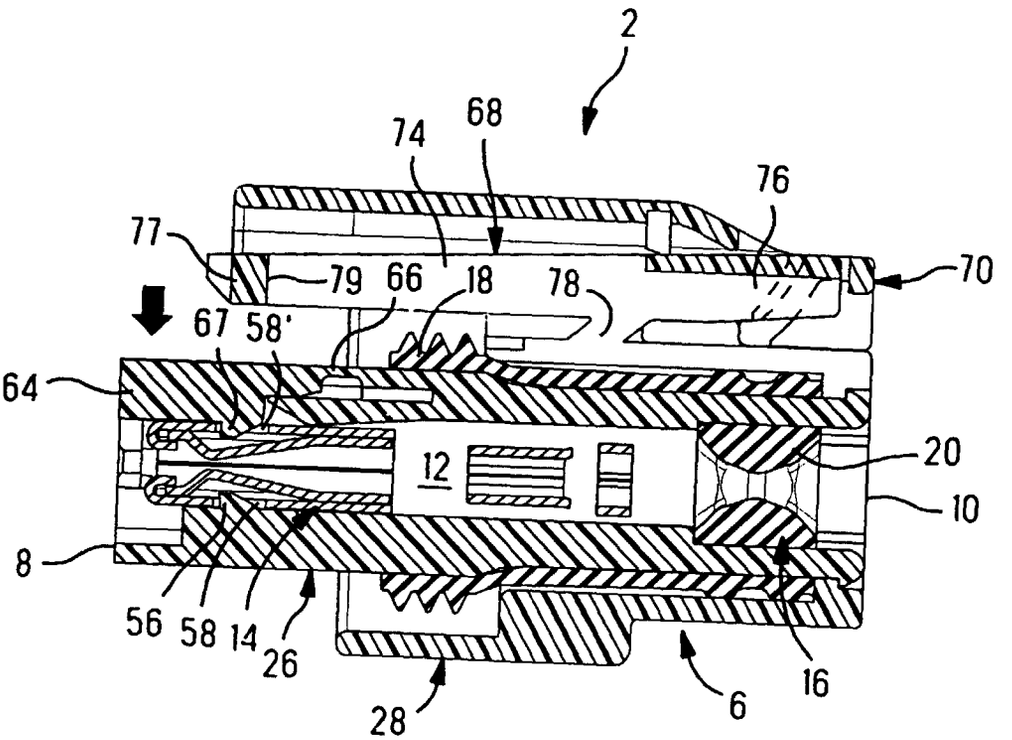


FIG. 11