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ABSTRACT

An electrical connector for making electrical connection to insulated conductors of an electrical cable, the conductors being separately covered with electrical insulation, and the insulated conductors being enclosed by an outer electrically insulative covering of the cable, the connector having a first connector part which has a lengthwise extending cable channel for receiving the cable and, within the cable channel, wire channels for receiving portions of the insulated conductors from which the outer covering of the cable has been removed; insulation displacement contacts for making separate electrical connections to the conductors when received in the wire channels, under relative movement between the insulation displacement contacts and the wires, laterally with respect to the directions of extent of the conductors, so that the insulation covering each one of said conductors is cut and the insulation displacement contacts make connections to the conductors; a second connector part relatively moveable with respect to the first part for effecting said relative movement; and restraining means for restraining said relative movement.

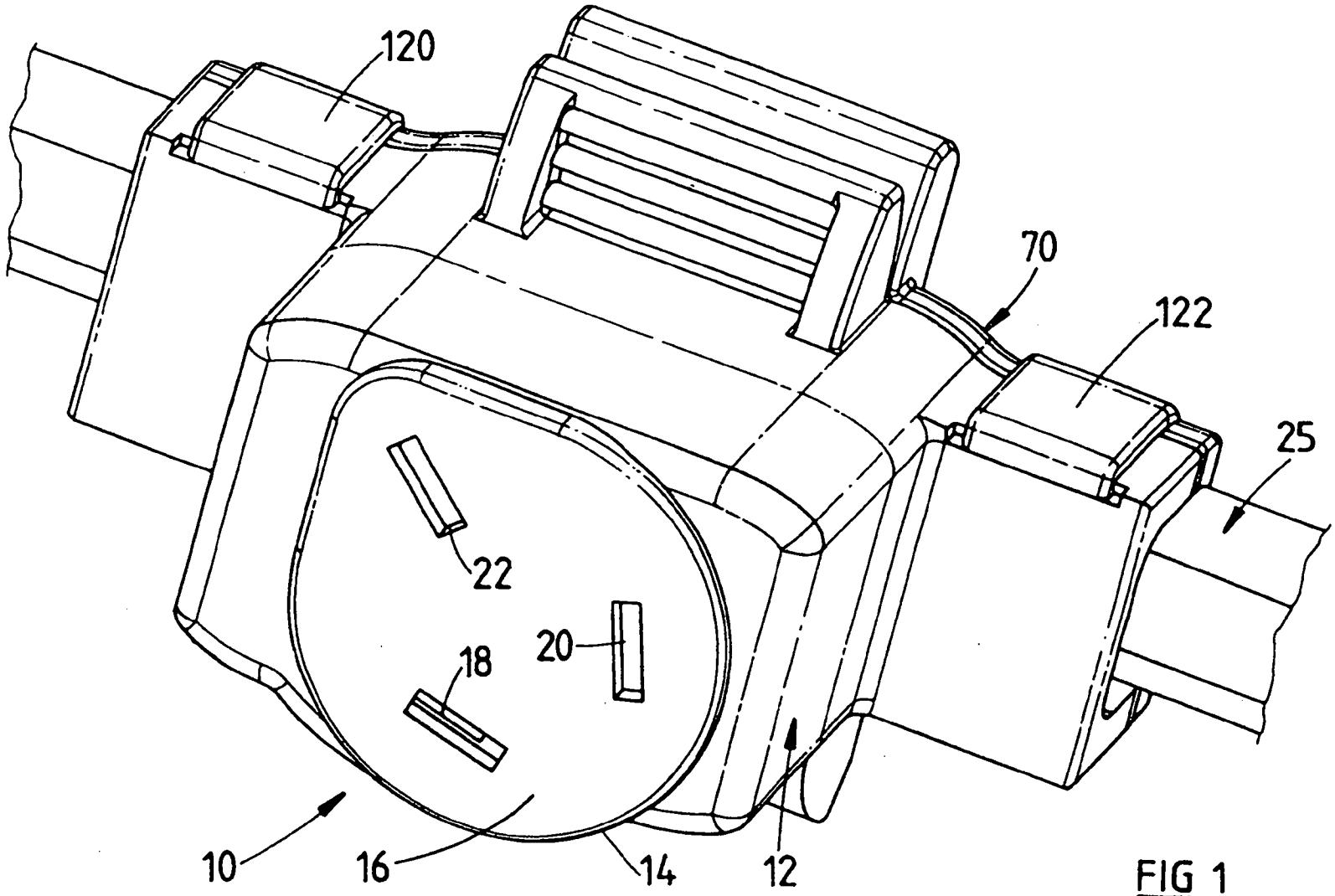

FIG 1

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P/00/011
Regulation 3.2

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COMPLETE SPECIFICATION

STANDARD PATENT

(ORIGINAL)

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Invention Title: **"Electrical connector with power socket"**

The following statement is a full description of this invention, including the best method of performing it known to us:-

ELECTRICAL CONNECTOR WITH POWER SOCKET

Field of Invention

This invention relates to an electrical connector with insulation displacement contacts.

Background of Invention

Electrical connectors useful in electrical power wiring usually employ screw contacts. These are somewhat inconvenient to use, requiring stripping of insulation from end portions of the wires, insertion of the wire end portions into receiving openings of the connector and thence screwing down of screws of the connector in order to make the connections. This is labour intensive, and inconvenient.

It is generally desirable to overcome or ameliorate one or more of the above described difficulties, or to at least provide a useful alternative.

Summary of Invention

In accordance with one aspect of the present invention, there is provided an electrical connector for making electrical connection to insulated conductors of an electrical cable, the conductors being separately covered with electrical insulation, and the insulated conductors being enclosed by an outer electrically insulative covering of the cable, the connector having:

(a) a first connector part which has a lengthwise extending cable channel for receiving the cable and, within the cable channel, wire channels for receiving portions of the insulated conductors from which the outer covering of the cable has been removed;

(b) insulation displacement contacts for making separate electrical connections to the conductors when received in the wire channels, under relative movement between the insulation displacement contacts and the wires, laterally with respect to the directions of extent of the conductors, so that

the insulation covering each one of said conductors is cut and the insulation displacement contacts make connections to the conductors;

(c) a second connector part relatively moveable with respect to the first part for effecting said relative movement; and

(d) restraining means for restraining said relative movement.

The restraining means may comprise a hinge, such as being formed by cooperating hinge components on the first and second parts, for constraining the parts for relative swinging movement with respect to each other. In one form, the wire channels are side-by-side, generally in common plane, and the restraining means is arranged to in use restrain the parts for relative swinging movement about an axis which is displaced to one side of the wire channels. The insulation displacement contacts may be carried by said first part or by the second part.

The second part may have projections for sequentially engaging said insulation displacement contacts during said relative movement.

The insulation displacement contacts may form parts of contact elements which form socket contacts of a socket formed on the first part, said socket being adapted to receive and make electrical connection of an electrical plug.

One of said parts may have pockets at interior spaces for receiving end portions of the insulated conductors. The parts may have divergent end portions, for example such that they are curved away from each other when the parts are in a closed condition. Reinforcing ribs may be provided on opposed surfaces of the parts.

Brief Description of the Invention

Preferred embodiments of the present invention are hereafter described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of an electrical connector;

Figure 2 is a perspective view of the connector of Figure 1 shown in an open condition;

Figure 3 is a view like Figure 2, but illustrating the way in which a cable is in use positioned in the connector;

Figure 4 is a side view of the connector of Figure 1 in a partially open condition and with a cable in position, the cable being shown partially sectioned.

Figure 5 is a perspective view of one part of the connector of Figure 1;

Figure 6 is a perspective view of another part of the connector;

Figure 7 is a perspective view of the connector of Figure 1 in a partly open condition;

Figure 8 is perspective view of a modified electrical connector;

Figure 9 is vertical transverse cross-section of the connector of Figure 8;

Figure 10 is a diagrammatic representation of two hinged connector parts, viewed transversely of the hinge axis and illustrating curvature of those parts which is limited by the construction of Figures 8 and 9;

Figure 11 is a cross-section approximately on the line 11-11 in Figure 9;

Figure 12 is a perspective view of a part of the connector of Figure 8 which is lowermost in Figure 8; and

Figure 13 is a perspective view similar to Figure 12, but with a portion of the connector part removed to show internal features.

Detailed Description of Preferred Embodiments of the Invention

The connector 10 shown in Figure 1 is formed of two parts 12 and 70 which are hinged together so that the parts may be manipulated between the condition shown in Figure 1, at which the connector is in a closed condition for use, and the condition shown in Figure 2 at which the connector is in an open position, for connection to electrical conductors of an electrical cable.

Part 12 of connector 10 is formed of electrically insulate material. It has, at the exterior thereof, an electrical power socket 14 which has a generally planar surface 16 with three apertures 18, 20, 22 therein to receive conductive pins of an electric power plug (not shown). Within the part 12, there are provided three electrical contact elements 33, 35, 37, and these have end portions (not shown) which are located within part 12 behind the apertures 18, 20, 22 so that when the pins of the electrical power plug so pass through the apertures, they make electrical connection to the contact elements 33, 35, 37 respectively.

Part 12 has, at a face thereof opposite the socket 14, a cable channel 15 which is open to that opposite face, and which extends lengthwise from side-to-side of the part 12. Cable channel 15 has parts at the ends thereof which are sized so as to neatly accommodate spaced portions a double insulated electrical cable 25 which may be laid therein. The cable 25 has therewithin three wires 28, 30, 32 which each have inner conductors 34 and

outer surrounding insulation 36 (Figure 4). These wires are arranged side-by-side within an outer cover 38 of the cable 26. Prior to fitting the cable in the cable channel 15, part of the outer cover 38 is removed, over the length labelled "L" in Figure 3 so that, over this length "L", the three insulated wires 28, 30, 32 have no cover 38 over them, but the inner conductors 34 still retain their insulation 36.

Two upstanding walls 40, 42 are provided, upstanding from a base 45 of the cable channel 15. These extend parallel to the length of the cable channel 15, and are positioned at an intermediate part of the cable channel, along the length thereof. Wall 40 is adjacent to but spaced from an upstanding side wall portion 46 of cable channel 15, and wall 42 is adjacent to but spaced inwardly from an opposite side wall portion 48 of cable channel 15. The spacing between the side wall portion 46 and wall 40, that between walls 40, 42, and that between wall 42 and wall portion 48 is the same, and substantially equal to the diameter of the insulated wires 28, 30, 32. The side wall portions 46 and wall 40 define therebetween a wire channel 52. Walls 40, 42 define therebetween a wire channel 54, and wall 42 and wall portion 48 define therebetween a wire channel 56. At each end of each of the walls 40, 42, and at each end of the side wall portions 46, 48, there are disposed upstanding somewhat cylindrical posts 50 which diameter such that end portions of the wire channels 52, 54, 56 are of slightly reduced width so as to be of width slightly less than the diameter of the wires 28, 30, 32.

Disposed within the wire channels 52, 54, 56 are three insulation displacement contacts 58, 60, 62. These form parts of the contact elements 33, 35, 37. Each insulation displacement contact 58, 60, 62 is formed as a generally upstanding planar conductive portion of the respective contact element, being bifurcated so as to form two opposed upstanding contact portions 66 which are separated by an upwardly open space 68. The spacing between the contact portions 66 is such as to be slightly less than the diameter of the inner conductors 34 of the wires 28, 30, 32. The position of the contacts 58, 60, 62 are staggered in the direction of extent of wire channels 52, 54, 56, so that they are spaced apart in that direction.

Part 70 of the connector is formed of electrically insulative material and has an elongate somewhat planar form, shaped such that it can be positioned over the top of part 12 so as to close the cable channel 15 at the open side thereof. It thus has a generally elongate planar roof portion 72 with side rim portions 74 extending along opposed side-to-side edges thereof.

Restraining means, in the form of a hinge 75 is provided for pivotally coupling parts 12, 70 together. Thus, part 12 has two sidewardly extending lugs 76 between which extends a hinge pin 78. The axis of this hinge pin is arranged to be generally parallel to and to one side of the cable channel 15 and wire channels 52, 54, 56. Part 70 has at one side thereof a part-tubular elongate portion 80 of length only slightly less than the length of pin 78. This has a lengthwise extending part-tubular portion 82, of side-to-side width greater than the internal diameter of the part-tubular portion 80, and slightly less than the diameter of the pin 78. Portion 80 is of sufficient flexibility and resilience that it can be attached to the hinge pin 78 by aligning the opening 82 with the pin axis, and then pressing the portion 80 with respect to the pin 78 so that the pin resiliently sidewardly deforms the portion 80 with respect to the opening 82 to enter the pin into the interior of the portion 80. After this, due to natural resilience, the portion 80 reverts to its original, relatively more closed, form so that the pin 78 is captured in the portion 80 for rotation of the part 70 with respect to the part 12, about the axis of the pin 78. Figure 1 shows the parts 12, 70 in closed condition, and Figure 7 shows the parts in an almost closed condition.

At a central part of the roof portion 72, on the side thereof which is innermost when parts 12 and 70 are in the closed condition, there are three lengthwise extending projections 86, 88, 90. In the closed position, central portions of the projection 86, 88, 90, reckoned in the lengthwise direction of the cable channel 15, are brought to positions where they are adjacent respective ones of the three contacts 58, 60, 62, the latter being, as mentioned, arranged at different lengthwise locations with respect to the cable channel 15, as particularly shown in Figure 5. When the parts 12, 70 are hinged to the closed position, the projections 86, 88, 90 are likewise located above respective ones of the contacts 58, 60, 62.

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Roof portion 72 of part 70 has two transverse outstanding walls 92, 94. These are spaced apart in the direction of extent of cable channel 15. Two projections 96, 98 are provided adjacent wall 92. Two projections 100, 102 are also provided adjacent wall 94. In the closed condition of the connector, projections 96, 98 are in lengthwise alignment with the projections 86, 88 respectively, and projections 100, 102 are in lengthwise alignment with projections 88, 90 respectively.

To use the connector, the connector is first arranged in the position shown in Figure 2, that is in an open condition where the part 70 is swung clear of the cable channel 15. Then, the cable 25 having the portion of its outer cover 38 removed as above described, is laid in the cable channel 15 shown in Figure 3. Here, portions of the outer covering of the cable 25 adjacent the length "L" over which that covering has been removed are positioned within outer end portions of the cable channel 15 and the wires 28, 30, 32 are positioned so as to extend above the wire channels 52, 54, 56. The wires 28, 30, 32 are then lightly pressed between adjacent pairs of the posts 50 at either end of the wire channels 52, 54, 56 so as to grip the wires at portions thereof adjacent the respective ends of the wire channels, and so that the wires are maintained in position above the respective wire channels. Then, the part 70 is swung about the axis of the pin 78 so that it overlies and, at the projections 86, 88, 90, engages the wires 28, 30, 32 (Figures 4 and 7). Part 70 is then pressed fully down so that portions of the part 70 away from the hinge axis are firmly engaged with the part 12.

During the described closing action, the projections 86, 88, 90 so bear against portions of the wires 28, 30, 32 at locations on these above the insulation displacement contacts 58, 60, 62, to force the wires into the insulation displacement contacts so that the insulation of the wires is cut by the insulation displacement contacts, and the internal conductors are forced into electrically conductive connection with the insulation displacement contact. That is, the wires are pressed into the space between the upstanding contact parts 66 of the insulation displacement contacts, and are firmly engaged by these. Also during the above process, the projections 96, 98, 100, 102 and walls 92, 94 press down upon the wires to

further assist in locating these between the posts 50, and to hold the wires in position with respect to the connector.

The parts 12, 70 have respective outstanding lip portions 108, 110 which extend sidewardly at locations away from the hinge axis. As shown in Figure 7, as the part 12 is rotated to effect engagement thereof with the wires, the lip portions become adjacent and, by applying manual pressure to these, it is possible to apply some force so that the described forcing of the wires into position can be readily achieved. At the same time, the dimensions and sizing of the cable channel 15 and cooperating parts on part 70 may be such as to ensure firm gripping of the cable at the opposite ends of the connector. In order to further facilitate such holding, ribs 114 may be provided at each end of the cable channel 15. These are firmly pressed into engagement with the outer covering of the cable to partially deform and lock the cable in position.

As will be observed particularly from Figure 4, that because a rotary action about an axis offset from, but generally parallel to, the direction of extent of the cable 25 is used to bring the projections 86, 88, 90 into engagement with the wires for pressing these into the contacts 58, 60, 62, at least initially, contact between the projections 86, 88, 90 and the wires does not occur all at once. That is to say, at first the projection 86 is brought into contact with the wire 32, then the projection 88 is brought in to contact with the wire 30 and, lastly, the projection 90 is brought into contact with the wire 28. As a result, the wires are forced into the contacts 58, 60, 26 sequentially, and the forces which needs to be applied to effect the making of electrical connection to the contacts are also sequentially applied. By this, at any one time, it is sufficient to generally apply a force which would be enough to force only one wire at a time into position.

As shown in Figure 1, the parts 12, 70 may be latched in the closed position by resilient clips 120, 122 which releasably grip portions of the parts 12, 70, at either side of socket 14, and which portions are then adjacent each other.

The connector described is useful as a general purpose outlet for supply of electricity via contact elements 33, 35, 37 from cable 25 to electrical devices which may be plugged into the socket 14. However, the invention may be applied to other types of connector.

While, in the described connector, the parts 12, 70 are connected together for relative swinging movement by restraining means formed as a simple hinge having the hinge pin 78 and cooperating part tubular portion 80, other forms of restraining means may be employed. For example, the parts 12, 70 may be integrally moulded with a connecting flexible hinge element.

While it has been found useful to align the planes of the insulation displacement contacts 58, 60, 62 angularly with respect to the directions of extent of wire channels 52, 54, 56 (at 45° in the illustrated embodiment) this is not essential to the invention.

The electrical connector 120 shown in Figures 8 to 13 is generally similar to the electrical connector 10 shown in Figures 1 to 7, being formed of two parts 122, 124 hinged together and movable to effect connections between cables in the same fashion as in the connector 10. The connector 120 exhibits some differences as to design form. However, the parts 122, 124 of connector 120 function in a similar manner to the parts 12, 70 of connector 10. In Figures 8 to 13, integers of the connector 120 which are substantially the same as corresponding integers in the connector 10 are denoted by common reference numerals, and the following description is confined to differences as between the connectors 10 and 120.

In the connector 120, the outstanding lip portions 108, 122 are replaced by modified lip portions 130, 132. As most clearly shown in Figure 9, these are outwardly curved away from each other so as to diverge in the direction away from the axis of the hinge pin 78. By this, improved performance in clamping the wires of cable 25 may be achieved.

Figure 10 shows two beams 140, 142, which represent parts 12, 70 of the connector 10, these being hinged together at the hinge pin 78, and extending from that to adjacent free

outer ends. In this, the wires 28, 30, 32 and the contact elements 33, 35, 37 are not shown, but are located between the beams 140, 142, at locations between the ends of each beam. The effect on the beams of hinging these about the axis of the hinge pin, by application of mechanical force "F" at the free ends of the beams is to tend to cause the beams to outwardly bow as illustrated. Such bowing is undesirable, as it may render it impossible to properly force the wires properly into the contact elements. This arises because, once the free end portions are engaged with each other no amount of further force applied at the free ends will result in increased force against the wires 28, 30, 32. The formation of the parts 122, 124 such that they outwardly diverge away from the hinge axis is helpful in limiting such bowing, particularly if, as illustrated, they permit some degree of over over-travel in the hinging movement between them. In that regard, Figure 11 shows a normal closed position of the parts 122, 124. In this, the roof portion 138 of the part 124 is generally parallel to the adjacent surface of the part 122. Generally, it is sufficient to bring the parts 122, 124 directly to this condition in order to effect connections between the wires 28, 30, 32 and the connector elements 33, 35, 37. However, in some cases, due to the described flexing of the part 12 and/or part 72, the wires might not be fully entered into he connector elements. As shown in Figure 9, however, at this normal condition there is still some gap "G" between the free ends of the parts 122, 124, enabling these to be moved still closer together until the parts are brought into engagement at locations near the free ends.

Further protection against incomplete forcing of the wires into the contact elements may be achieved by increasing the rigidity of the parts 122, 124. For this purpose, the parts 122, 124 have, on the facing surfaces of these, respective ribs, 140, 142. These ribs extend in the direction normal to the hinge axis of the pin 78, and are spaced in the side to side direction, as shown in Figure 11. Particularly, the two ribs 140 on part 122 are disposed laterally with respect to the three ribs 142 on part 124, such that ribs 140, 142 can inter-fit, with ribs 140 fitting between ribs 142, as shown in Figure 11.

Although the connector 10 has been described as providing electrical connection to a cable 25 that extends through the connector, the cable may of course terminate inside the connector, where the connector is at the end of a cable run. The connector 120 is designed

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to facilitate such use. Particularly, the part 122 has at locations somewhat inboard of the ends of the cable channel 15, openings 150, 152, 154 through which free end portions of the insulated wires 28, 30, 32 of the cable of the may be passed into the interior of the part 122. At each such inboard location, there are defined, within the interior of part 122, at either lateral side of the cable channel, two pockets 156, 158 into the interior spaces 160, 160 of which the free end of the two outermost, neutral and active wires of the cable 25 pass when entered through openings 150, 154. The earth wire, when passed through opening 152, passes into an interior space in part 122 between the respective pockets 156, 158. By this, the interior spaces 160, 162, 164 receive the end portions of the wires 28, 30, 32 in a fashion which provides good insulation protection to the ends of these, at which the inner wire conductors are exposed.

The described arrangement has been advanced merely by way of explanation any many modifications may be made thereto without departing from the spirit and scope of the invention which includes every novel feature and combination of novel features herein disclosed.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

The reference to any prior art in this specification is not, and should not be taken as, an acknowledgment or any form of suggestion that that prior art forms part of the common general knowledge in Australia.

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THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1. An electrical connector for making electrical connection to insulated conductors of an electrical cable, the conductors being separately covered with electrical insulation, and the insulated conductors being enclosed by an outer electrically insulative covering of the cable, the connector having:
   (a) a first connector part which has a lengthwise extending cable channel for receiving the cable and, within the cable channel, wire channels for receiving portions of the insulated conductors from which the outer covering of the cable has been removed;
   (b) insulation displacement contacts for making separate electrical connections to the conductors when received in the wire channels, under relative movement between the insulation displacement contacts and the wires, laterally with respect to the directions of extent of the conductors, so that the insulation covering each one of said conductors is cut and the insulation displacement contacts make connections to the conductors;
   (c) a second connector part relatively moveable with respect to the first part for effecting said relative movement; and
   (d) restraining means for restraining said relative movement.

2. An electrical connector as claimed in claim 1, wherein the restraining means comprises a hinge.

3. An electrical connector as claimed in claim 2, wherein the hinge has cooperating hinge components on the first and second parts, for constraining the parts for relative swinging movement with respect to each other.

4. An electrical connector as claimed in any preceding claim, wherein the wire channels are side-by-side, and generally in a common plane, and the restraining means is arranged to in use restrain the parts for relative swinging movement about an axis which is displaced to one side of the wire channels.

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5. An electrical connector as claimed in any preceding claim, wherein the insulation displacement contacts are carried by said first part.

6. An electrical connector as claimed in any one of claims 1 to 4, wherein the insulation displacement contacts are carried by said second part.

7. An electrical connector as claimed in any preceding claim, wherein said second part has projections for sequentially engaging said insulation displacement contacts during said relative movement.

8. An electrical connector as claimed in any preceding claim, wherein said insulation displacement contacts form parts of contact elements which form socket contacts of a socket formed on the first part, said socket being adapted to receive and make electrical connection to an electrical plug.

9. An electrical connector as claimed in any preceding claim, wherein one of said parts has pockets defining interior spaces for receiving end portions of the insulated conductors.

10. An electrical connector as claimed in claim 2 or any one of claims 3 to 9 as appended directly or indirectly thereto, wherein said parts have divergent free end portions.

11. An electrical connector as claimed in claim 2 or any one of claims 3 to 10 as appended directly or indirectly thereto, wherein said parts have on opposed surfaces thereof reinforcing ribs.

12. An electrical connector as claimed in claim 11, wherein said ribs extend substantially normally to the hinge axis of said hinge.

13. An electrical connector as claimed in any one of the preceding claims, wherein the

restraining means is resiliently biased.

14. An electrical connector as claimed in claim 13, wherein the restraining means acts to separate the first connector part and the second connector part.

15. An electrical connector as claimed in claim 13 or claim 14, wherein the First connector part and the second connector part connector are adapted to be drawn together under a force applied by a pair of pliers.

16. An electrical connector as claimed in any one of the preceding claims, including indicia on an outer peripheral surface of the connector indicating a length to strip the outer covering of the cable.

17. An electrical connector as claimed in any one of the preceding claims, wherein the insulation displacement contacts are resiliently deformable and the connector is re usable.

18. An electrical connector as claimed in any one of the preceding claims, including one or more apertures that extend through the first connector part for receiving a fastener to secure the connector to another object.

19. An electrical connector claimed in claim 18, wherein the apertures extend through the first connector part and the second connector part.

20. An electrical connector claimed in claim 18 or claim 19, wherein the first connector part and the second connector part are coupled together by said fastener when so arranged.

21. An electrical connector as claimed in any one of the preceding claims, including interior spaces shaped to receive and electrically isolate end portions of the wires.

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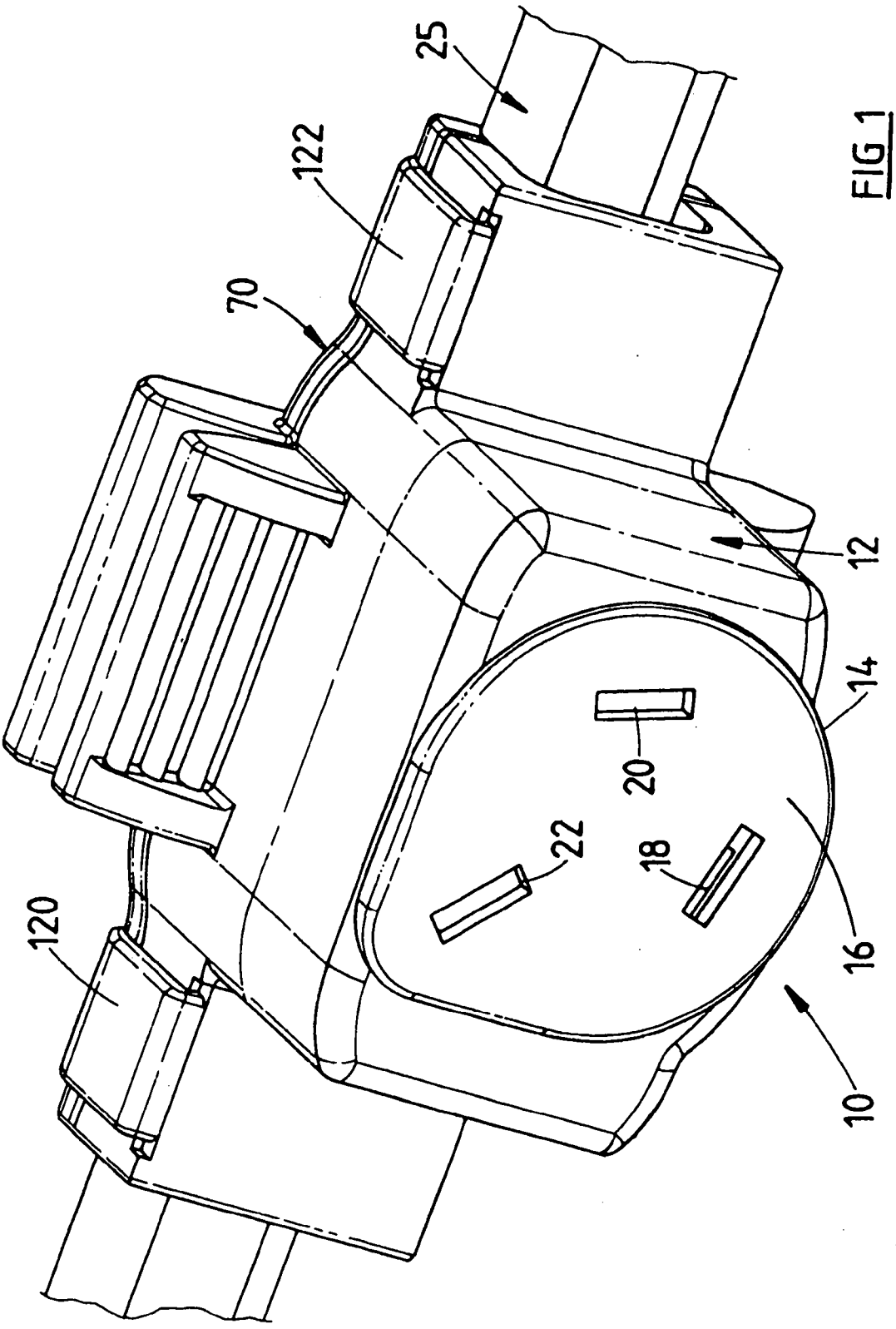

FIG 1

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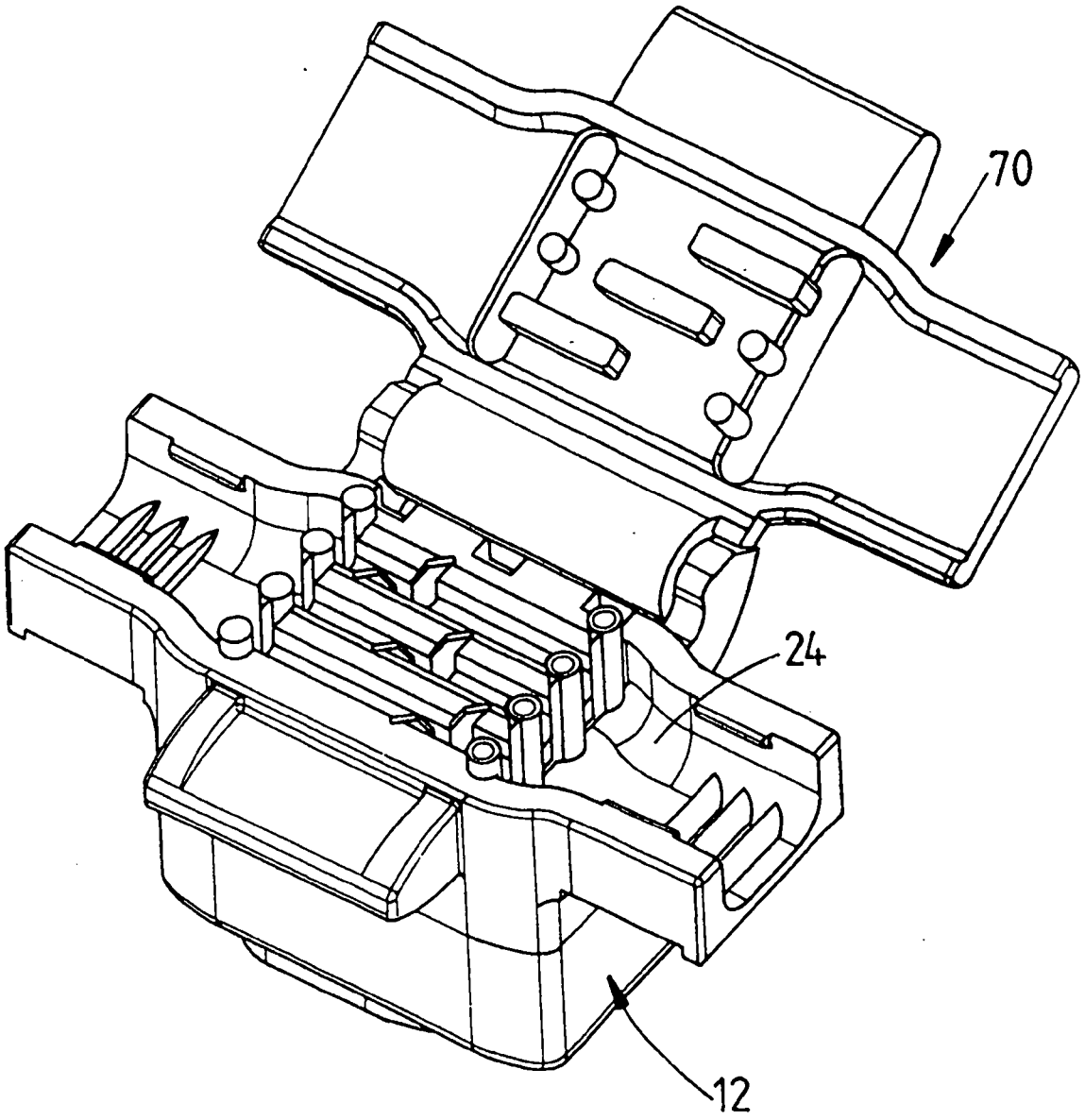

FIG 2

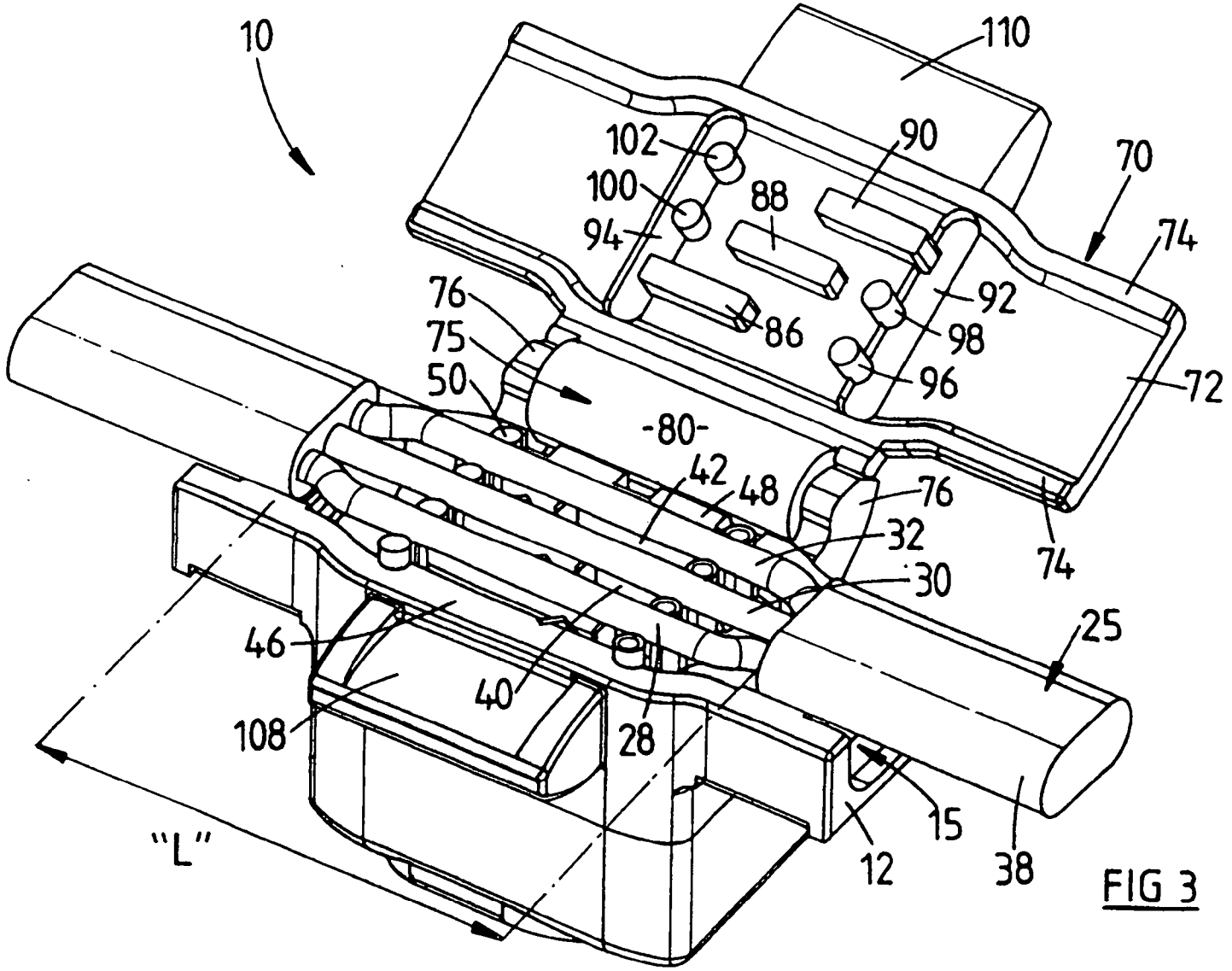
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FIG 3

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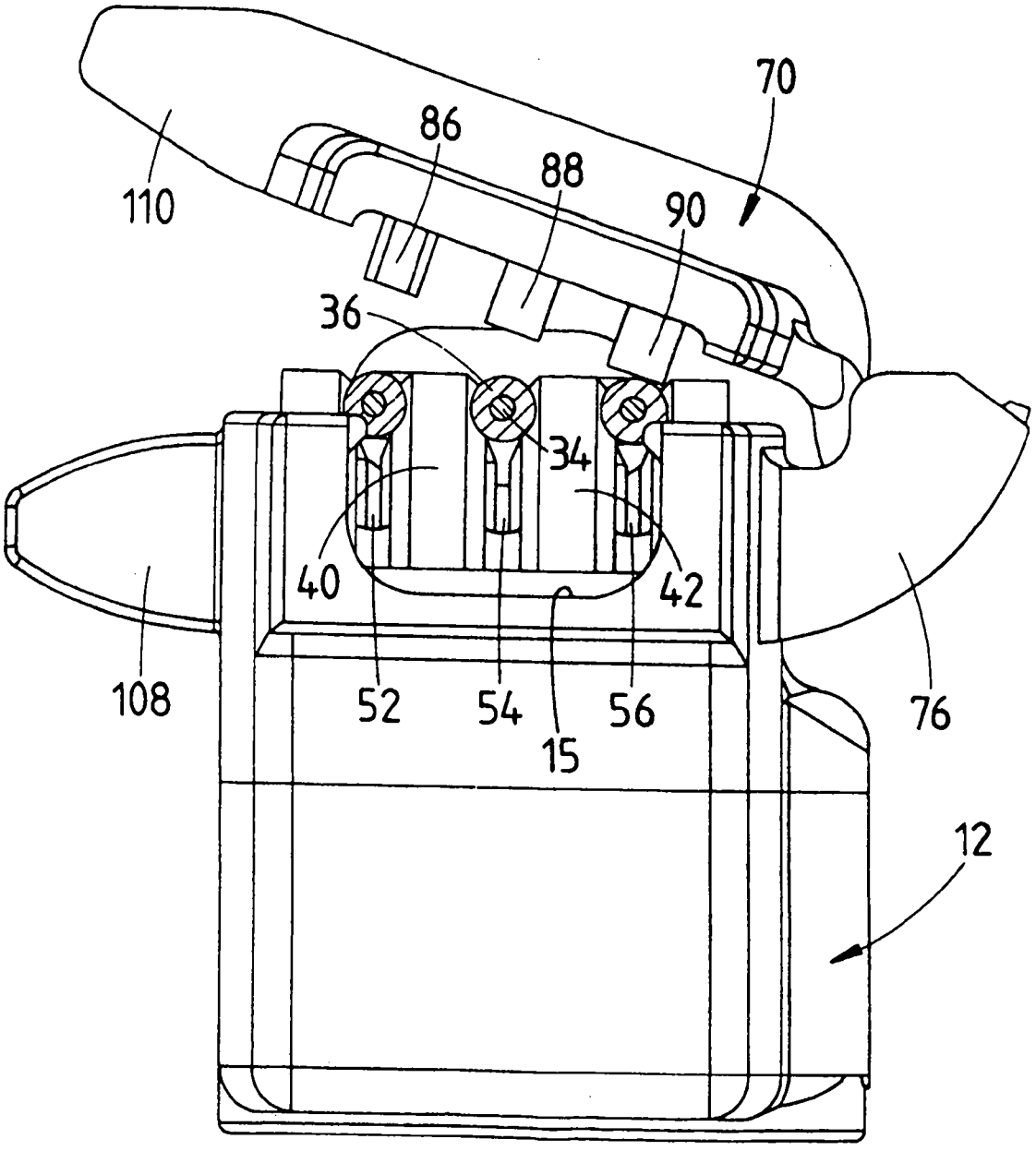

FIG 4

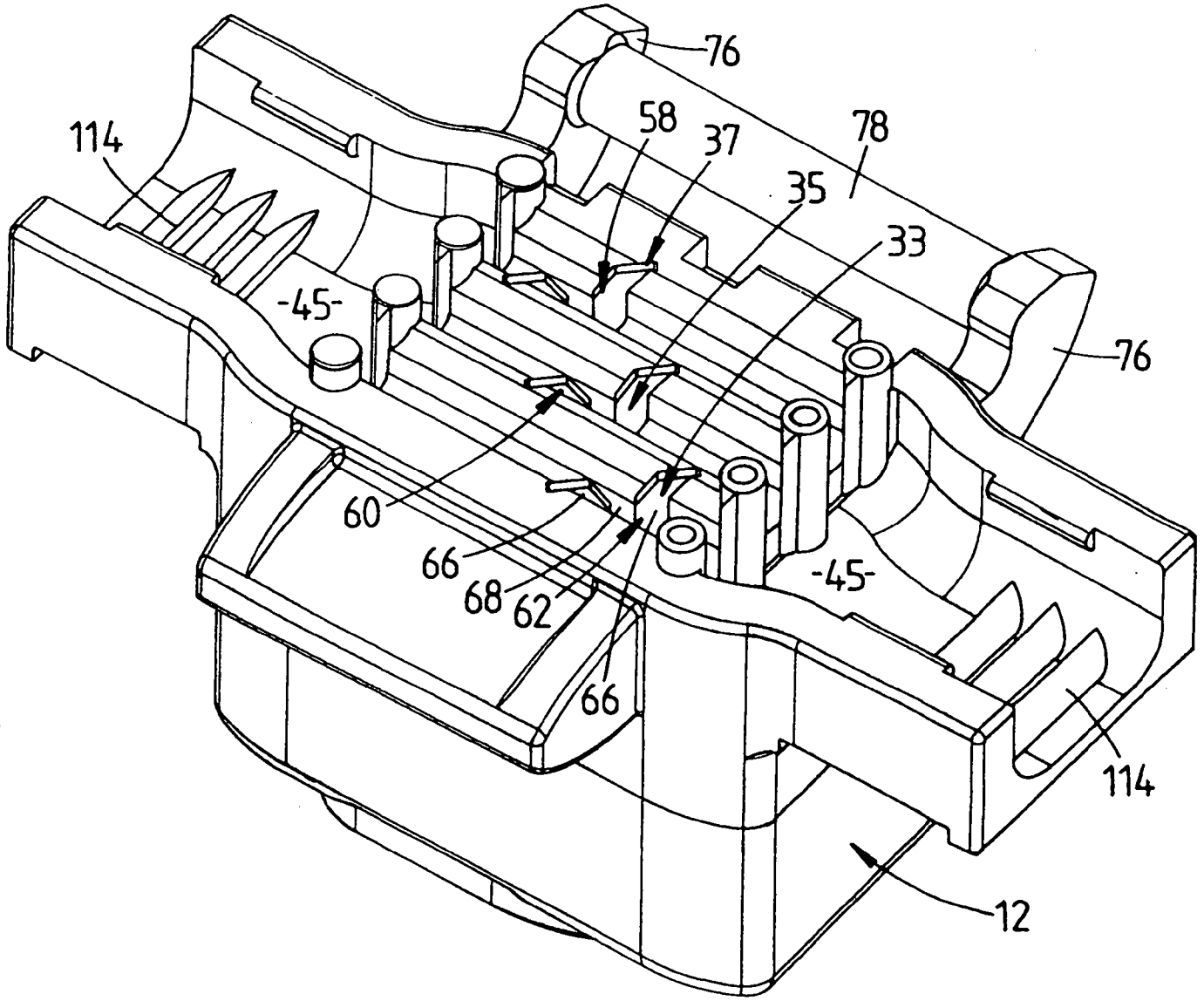

FIG 5

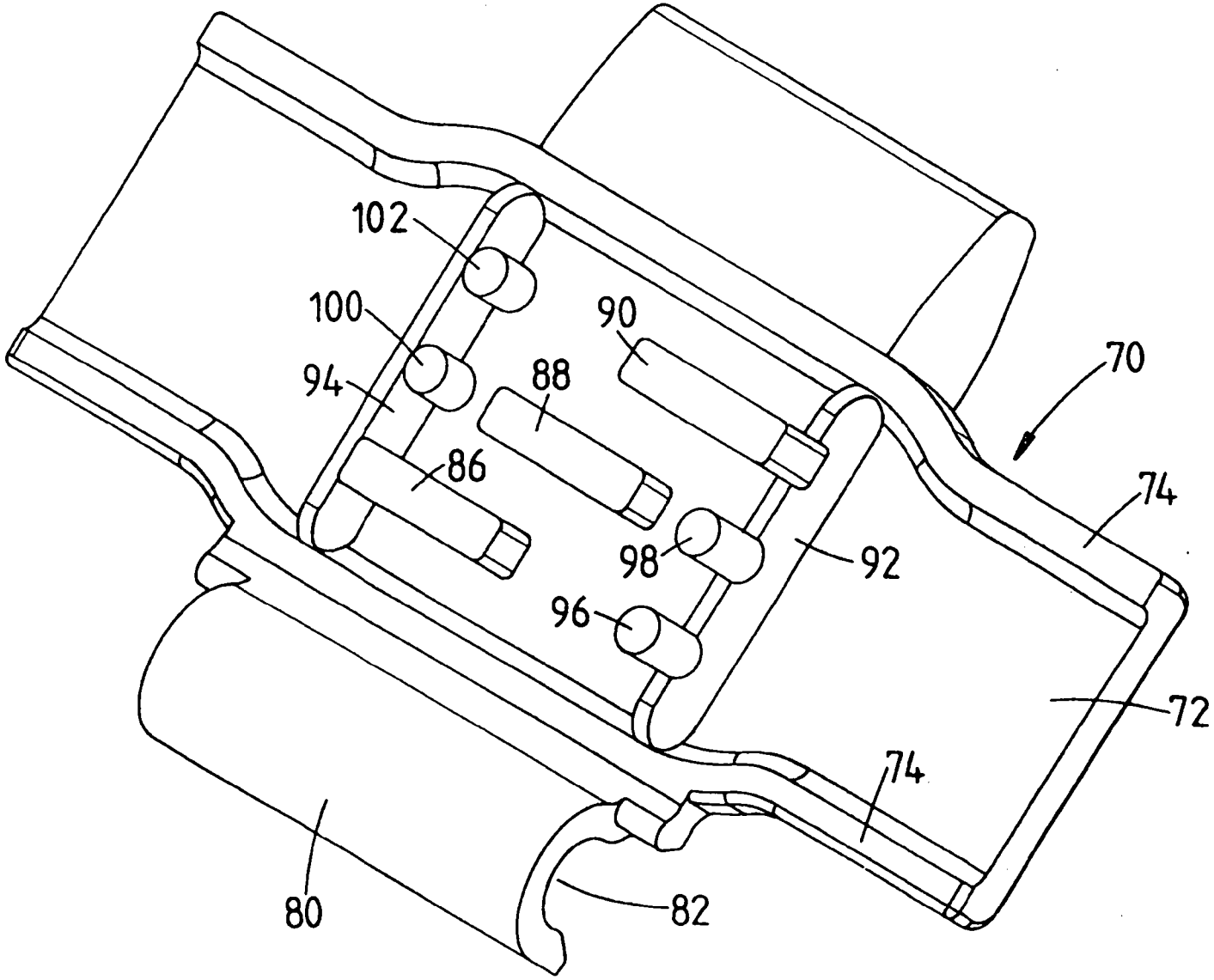

FIG 6

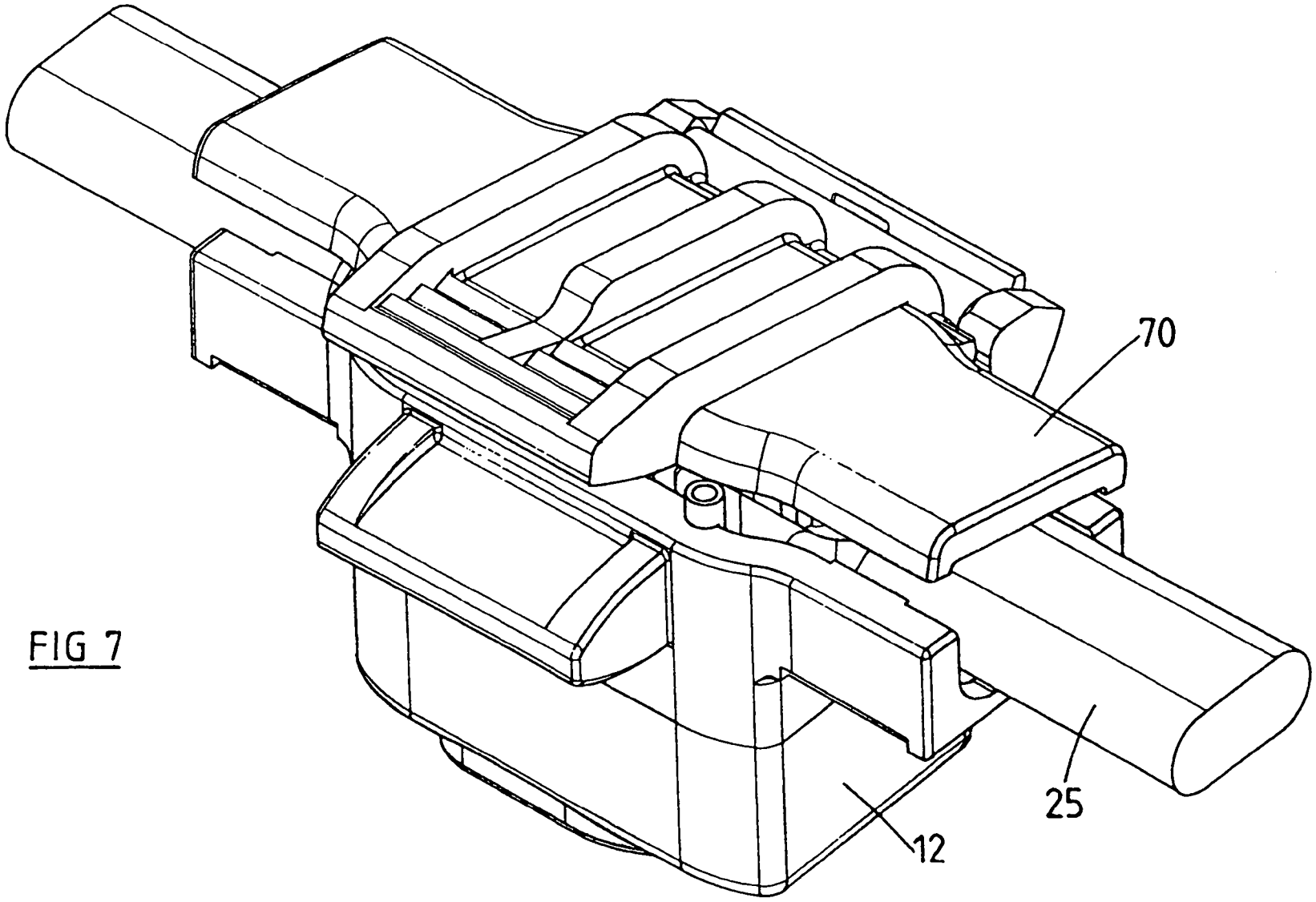

FIG 7

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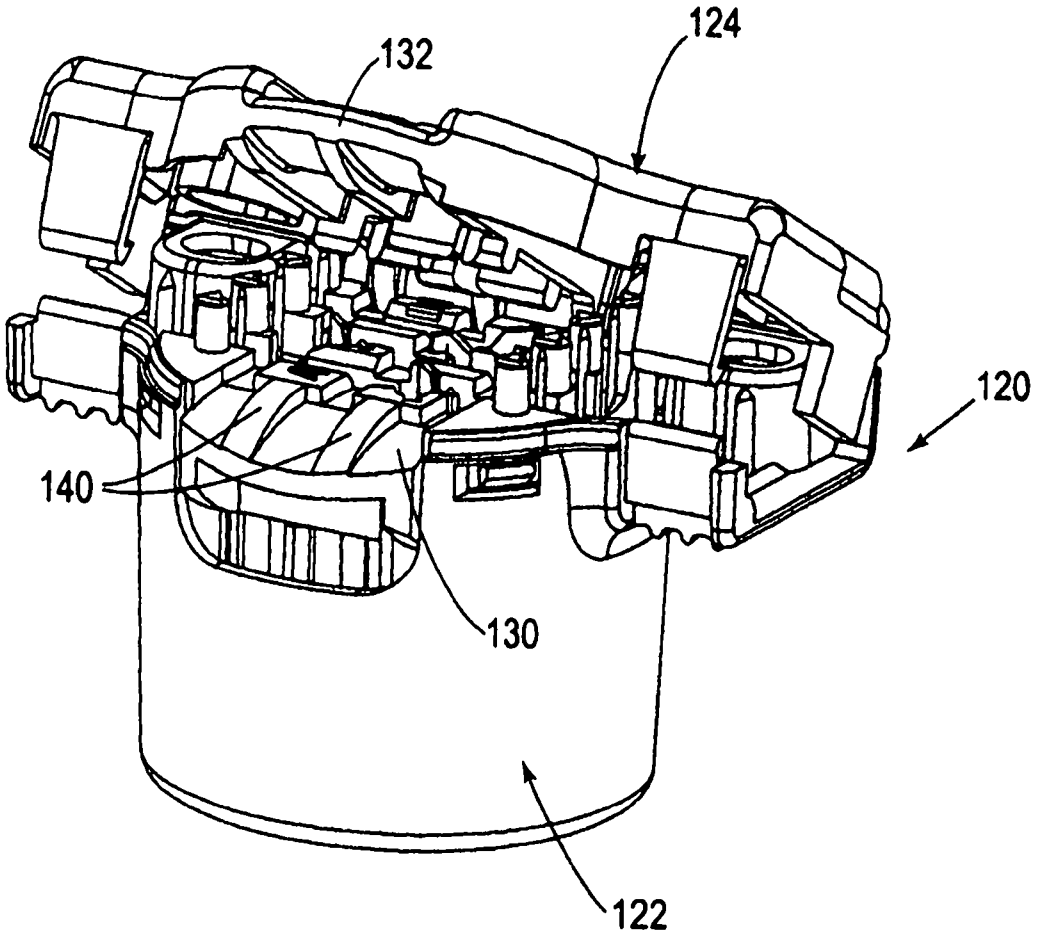

FIG. 8

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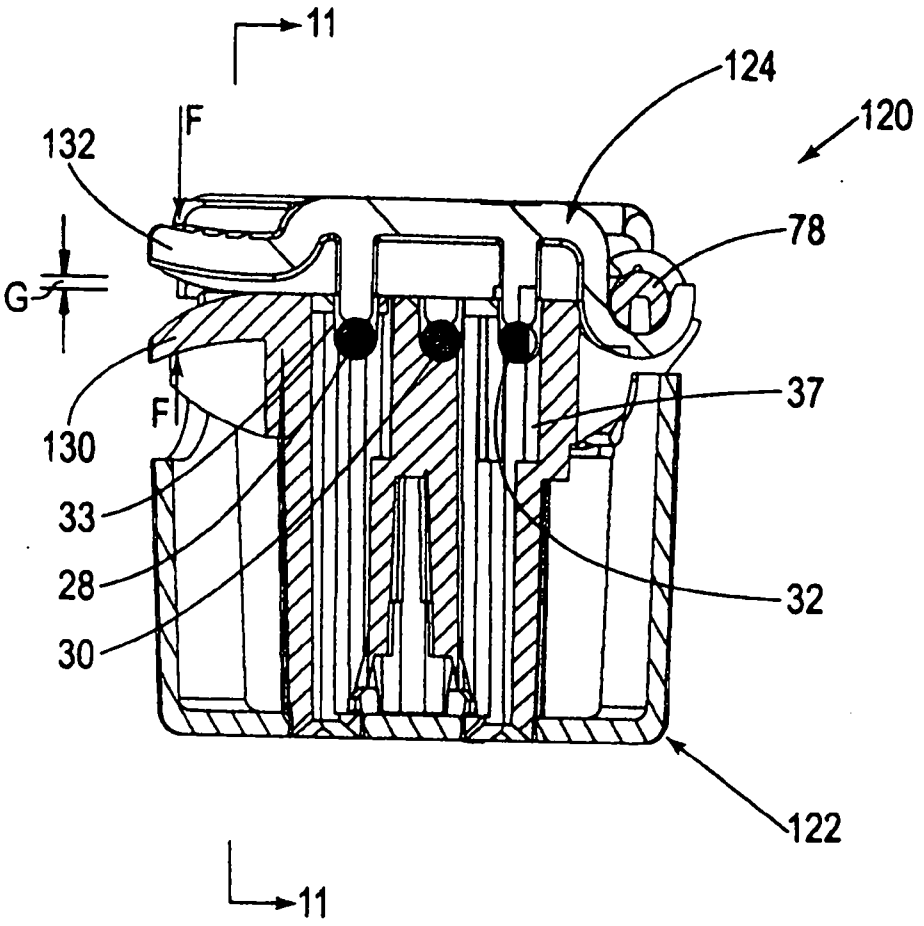

FIG. 9

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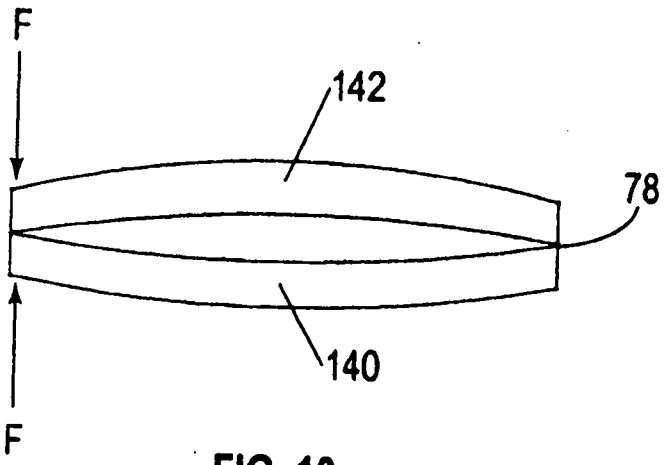

FIG. 10

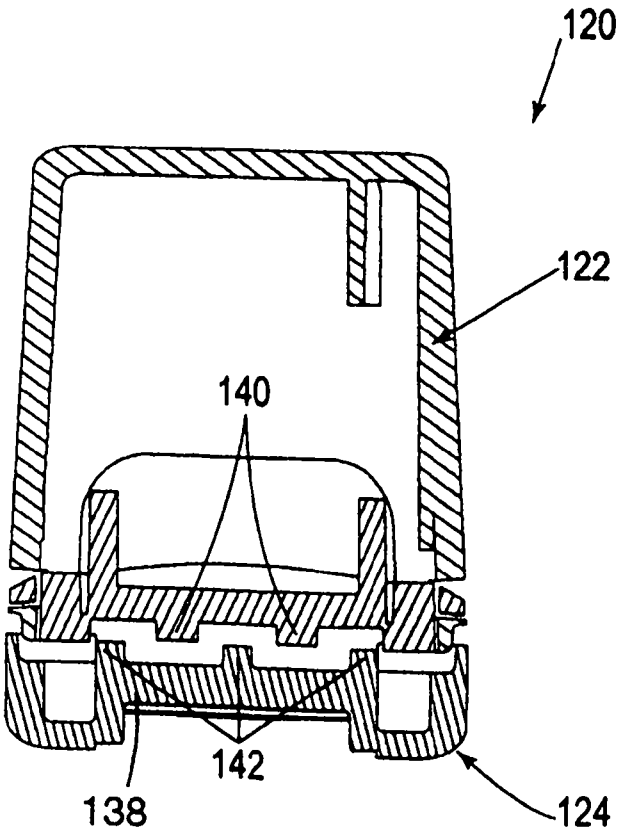

FIG.11

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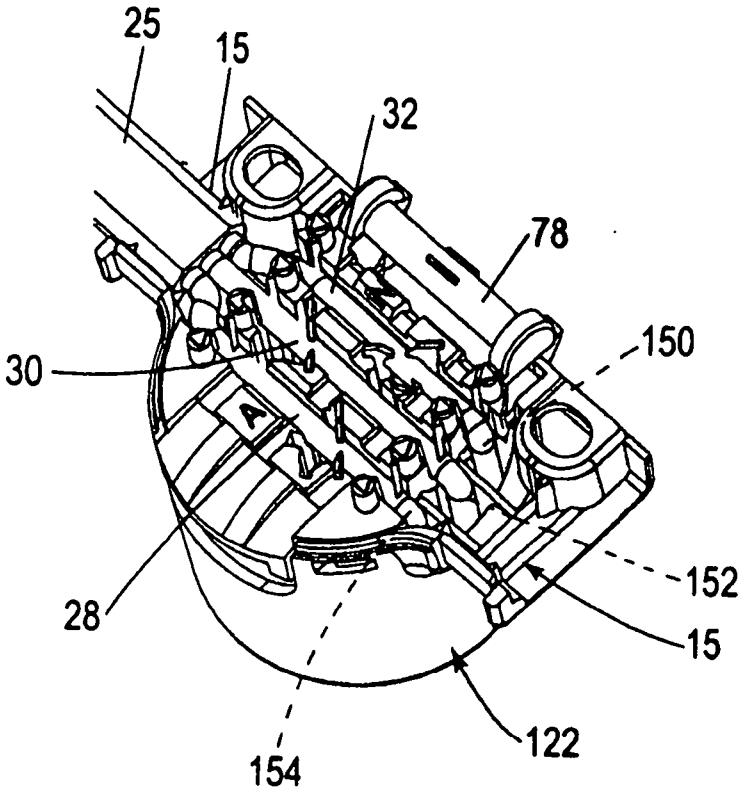

FIG. 12

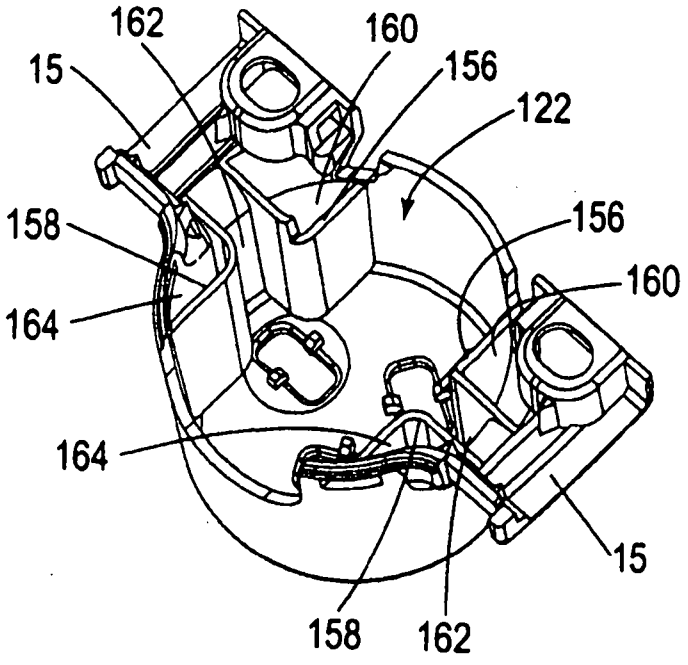

FIG. 13