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(54) Electrical connector with polarized terminals

(57) A connector (2) comprises an insulative housing (4) having a plurality of cavities (6) extending there-through for receiving stamped and formed terminals (8) therein. The terminals (8) have a U-shaped base section comprising a base wall (20) and side walls (22,24). One of the side walls comprises an upper polarizing extension (71) and the other side wall comprises a lower polarizing extension (72) disposed substantially diagonally from the upper extension. The diagonally opposed polarizing extensions (71,72) allow 0 or 180° polarization of the terminals (8) for insertion into the cavity (6). Due to posi-

tioning of the polarizing extensions proximate corners of the cavity, they abut against sturdier and less flexible corner wall sections of the housing when incorrectly inserted, and due to the use of two opposed extensions (71,72) the extensions can be made more compact. The latter also allows close centerline to centerline configuration of the terminals due to the rhombic shape of the cavities that allow maintenance of a minimum and substantially constant wall thickness (90) between adjacent cavities.

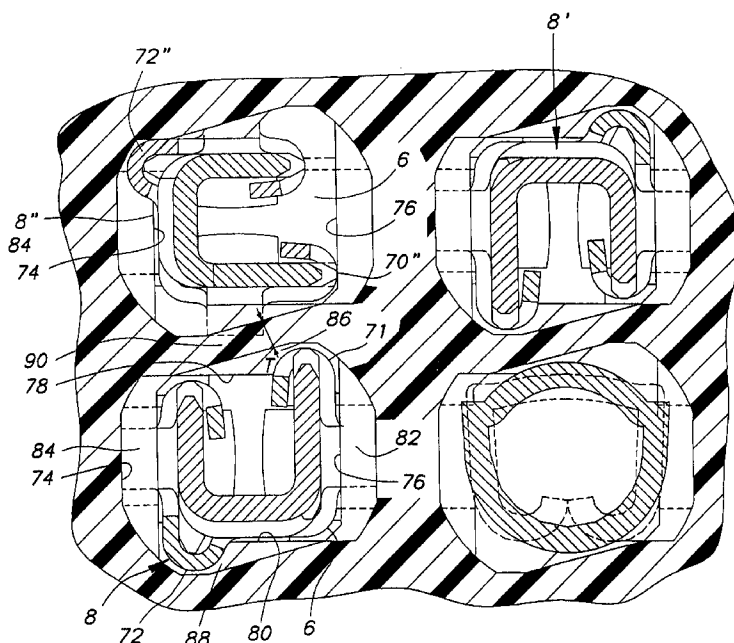


FIG. 7

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Description

This invention relates to an electrical connector having electrical terminals therein that are polarized with respect to the housing of the connector.

Many electrical connectors typically comprise an insulative housing having a plurality of cavities extending therethrough, in which are inserted electrical terminals having a connection end on one end for connection to conducting wires, and a complementary terminal mating end at the other end of the terminal. Some terminals, in particular small terminals for high density packing in an electrical connector, have roughly square or axi-symmetric shapes. Furthermore, because of the high density of terminals within the housing, the walls separating the terminals become rather thin and therefore quite flexible. Due to the latter two points, it has been possible in certain prior art designs to mistakenly insert the terminals with the wrong orientation within their corresponding cavities. Even though such terminals are not necessarily perfectly square in profile, the thin connector walls are flexible and sometimes allow insertion of the terminal with a 90° orientation with respect to its intended orientation. Such terminals may comprise a pair of opposed cantilever beam contact for mating to a complementary tab contact, such contacts therefore being unmatable to the male tab contact when orientated about their axis by 90° with respect to their correct coupling orientation. Such terminals however are matable even if orientated 180° as the cantilever beam contacts are thus once again aligned with the plane of the mating tab contact.

It is desirable to have connector assemblies with a high density of terminals whilst nevertheless preventing 90° false orientation of these terminals in a reliable manner.

It is therefore an object of this invention to provide a connector assembly with a high density of electrical terminals mounted therein, whereby the terminals cannot be inserted into a housing of the connector at a 90° orientation with respect to the intended orientation.

It is an object of this invention to provide a terminal having a roughly square or asymmetric cross-sectional profile, whereby the terminal is not insertable into a connector housing at an orientation 90° from its intended orientation, in a reliable, robust and cost-effective manner.

An object of this invention has been achieved by providing a connector comprising a stamped and formed electrical terminal having a U-shaped base portion extending between a connection section for connecting to conducting wires, and a mating section for electrical connection to a complementary terminal, whereby a side wall of the U-shaped base section extends upwards beyond a tip of an opposing side wall of the base section, and the opposing side wall has an extension directed downwards beyond a base wall of the U-shaped base section such that the terminal can be mounted in a cavity of an electrical connector in a first orientation or in a second orientation 180° with respect thereto, but not at 90°

with respect thereto, the connector having grooves therein to accommodate the side wall extensions.

Advantageously, the diagonally opposed polarizing extensions allow for a more compact configuration whilst nevertheless providing a sturdy and reliable polarizing system which allows 0° or 180° polarization.

The preferred embodiment of this invention will now be described with reference to the figures, whereby;

- 10 Figure 1 is a top view of a top view of a terminal according to this invention;
- Figure 2 is a view in the direction of arrow 2 of Figure 1;
- Figure 3 is a view in the direction of arrow 3 of Figure 2;
- Figure 4 is a cross-section through lines 4-4 of Figure 2;
- Figure 5 is a cross-section through lines 5-5 of Figure 2;
- Figure 6 is a cross-sectional view through part of a connector housing comprising the terminal Figure 1;
- Figure 7 is a cross-sectional view through a housing comprising a plurality of terminals, whereby one of the terminals is shown in 90° false orientation;
- Figures 8-10 are bottom, side and top views respectively of an inner contact body of the terminal Figure 1;
- Figure 11 is a plan view of an edge stamped partially complete outer backup spring of the terminal Figure 1;
- Figure 12 is a view of the outer backup spring partially stamped and formed in a stage more complete than Figure 11;
- Figure 13 is a cross-sectional view through lines 13-13 of Figure 12; and
- Figure 14 is an edge stamped partially complete inner contact body of Figures 8-10.

Referring first to Figure 6, an electrical connector 2 comprises an insulative housing 4 having terminal receiving cavities 6 extending therethrough for receiving a stamped and formed electrical terminal 8. The terminal 8 comprises an inner contact body 10 (also see Figures 8-10) and an outer backup spring 12 (also see Figures 12 and 13).

Referring now to Figures 8-10, the inner contact body 10 is shown comprising a conductor connection section 14 extending axially into a transition section 16 which extends into a U-shaped body section 18 having a base wall 20 and side walls 22,24. A contact section 26 extends from the side walls 22,24 and comprises a pair of opposed cantilever beam contact arms 28 for receiving a mating tab terminal therebetween.

One of the side walls 22 comprises an upper extension 30 that projects beyond an upper edge 32 of the opposing side wall 24. An upper edge 34 of the upper extension 30 has a profile similar in shape to the upper edge 32 and comprises a central raised portion 36 flanked on either side by front and rear clinching edges

38,39 respectively for clinching of the outer backup spring thereto as will be described further on. The other side wall 24 similarly has front and rear clinching edges 41,43. Projecting from a lower edge 40, in a position substantially opposite the front clinching edge 41 is a lower extension 42 having a lower edge 44 that projects below the base wall 20. Referring to Figure 14, the inner contact body is shown in a partially stamped state prior to bending into a U-shape whereby the approximate plain of symmetry is shown by the dotted line 46.

Referring now to Figures 11-13, the outer backup spring 12 is shown in various stages of its stamping and forming process, whereby Figures 12 and 13 show the outer backup spring just prior to removal from the carrier strip 48 and clinching around the inner contact body 10. The outer backup spring 12 comprises a body section 50 for wrapping around the inner contact body section 18; and extending axially therefrom for positioning substantially parallel and against the cantilever beam contact arms 28, are cantilever beam spring arms 52 having arcuate projections 54 proximate their free ends for applying spring pressure against the inner contact body arms 28 for increased resiliency thereof. The body section 50 comprises a base wall 56, opposed side walls 57,58 and extending from upper edges 60 thereof, are front and rear clinching tabs 59,61,62,63 respectively. Locking lances 64 are stamped out of the side walls 57,58 and project obliquely rearwardly for locking the terminal 8 within the housing cavity 6 as shown in Figure 6.

The side walls 57,58 are mounted substantially against the inner contact side walls 24,22 respectively, whereby one side wall 58 of the outer backup spring extends further upwards than the other side wall such that the front and rear clinching tabs 62,63 thereof can be clinched over the clinching edges 38,39 respectively of the inner contact body sidewall 22. The latter is best seen in Figures 4 and 5 whereby the clinching arms 59,61,62,63 are clinched over their respective side walls 24,22 of the inner contact body in a similar manner except for the one side wall extending further than the other. The front and rear clinching arms 59,61 and 62,63 of each side wall 22,24 respectively are attached proximate their free ends with bridge portions 66 that are folded over the central raised portions 36 and against the side walls 22,24. Adjacent the bridging portion 66 is a cutout 68 to allow positioning of the upper edge protrusion 30,36 to fit between the front end rear clinching arms 59,61 and 62,63 respectively thus providing a secure retention means of the outer backup spring to the inner contact body.

The side wall 57 has a lower U-shaped extension 70 that extends below the base wall 56 in such a manner as to fit around the lower extension 42 of the inner contact body side wall 24. The U-shaped lower extension 70 is thus disposed at a substantially opposing diagonal disposition with respect to the upper extension 30,60. As can be seen in Figures 4 and 5, the U-shaped lower extension 70 has substantially similar proportions and profile in mirror image to the U-shaped clinching arms

62,63 that are folded over the clinching edges 38,39 of the inner contact body side wall 22.

The diagonally opposed upper and lower extensions of the outer backup spring and inner contact body form polarizing extensions 70,72 respectively for the purpose hereafter described with reference to Figure 7. The housing cavity 6 has an almost square profile defined by opposed side faces 74,76 and extending therebetween opposed top and bottom faces 78,80 respectively. Tapered lead-in surfaces 82,84 serve to guide the contact arms and body section between the side walls 74,76. The side face 76 extends upwards beyond the side face 74 and extends into a substantially U-shaped corner that joins the top face 78 and forms a substantially U-shaped cavity section 86 for receiving either of the polarizing extensions 72,70 therein. Similarly, in a diagonally opposed manner the other side face 74 extends lower than the side face 76 and forms a substantially U-shaped cavity section 88 for receiving either of the polarizing extension 70,72 therein. Due to the diagonally opposed polarizing cavity sections 86,88, the general cavity cross-sectional profile is approximate rhombic. The latter allows close centerline to centerline positioning of cavities 6 stacked upon each other and which need to be separated by a wall section 90 that requires a minimum thickness for strength, manufacturability and other properties such as electrical resistance therethrough. As the polarizing extensions 70,72 have similar cross-sectional profiles, and similarly the corner cavities 86,88 are similarly profiled, the terminals 8 can be inserted into the cavities 6 in either a 0° disposition or 180° disposition with respect thereto as soon by the terminal 8' 90° disposition as shown by the terminal 8" must however be avoided as a mating tab terminal for insertion between the contact arms 88 is not possible in this disposition. The terminal 8" is shown positioned against one of the side wall 74 and whereby the upper polarizing extension 70" manages to insert into the cavity against the side face 76. The lower polarizing extension 72" however abuts the tapered lead-in surface 84 and prevents insertion of the terminal 8" into the cavity 6. Due to the use of opposingly projecting polarizing extension 70,72 they can extend only half the distance beyond the terminal in comparison to a terminal having only one polarizing extension. Furthermore, due to the positioning of the polarizing extensions 70,72 adjacent the side faces 74,76, the polarizing extension abut against corner sections of the housing cavity walls which are far sturdier and less flexible than a central portion of the cavity separating walls such as 90, whereby a polarizing extension positioned centrally may allow forcing of the terminal into the cavity 6 by deformation of the housing wall 90. Furthermore, as the polarizing extensions 70,72 and corresponding cavities 86,88 are diagonally opposed, terminals can be stacked in a compact configuration while maintaining a minimum wall thickness T of the wall 90 between adjacent cavities 6. A further advantage is the ability to insert the terminals in a 0 or 180° disposition which increases the assembly possibility thereof.

Advantageously therefore, the diagonally opposed polarizing extensions 70,72 allow for a more compact configuration whilst nevertheless providing a sturdy and reliable polarizing system which allows 0 or 180° polarization.

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Claims

1. An electrical terminal (8) with a roughly square or axi-symmetric cross-section of it's outer profile, having a contact body (10) comprising a connection section (14) for connection to a conducting wire, a contact section (26) for mating to a complementary terminal, and a U-shaped base section (18) extending therebetween, the base section (18) having a base wall (20) and first and second side walls (22,24) extending substantially orthogonally from edges of the base wall to upper free edges (34,32) respectively, characterized in that the upper free edge (34) of the first side wall (22) comprises an upper polarizing extension (30,71) that extends further outwards from the base wall (20) than the upper free edge (32) of the second side wall (24), and the second side wall (24) has a lower polarizing extension (42,72) projecting below the base wall (20) in a direction substantially opposed to the upper free edge (32), the upper and lower polarizing extensions being diametrically opposed and cooperable with a connector housing cavity (6) for allowing 0° or 180° polarization of the terminal therein, whilst preventing 90° or 270° polarization.
2. The electrical terminal of claim 1 characterized in that the projection of the upper polarizing extension (30,71) beyond the upper free edge (32) of the second wall is of substantially the same length as the projection of the lower polarizing extension (42,72) beyond the base wall (20).
3. The electrical terminal of claims 1 or 2 characterized in that the terminal comprises an outer back-up spring (12) mounted around and contiguous the base and side walls (20,22,24) and comprising upper clinching arms (59,61,62,63) folded over the upper free edges (32,34) for securely mounting the outer back-up spring (12) to the inner contact body (10).
4. The electrical terminal of claim 3 characterized in that the outer back-up spring (12) comprises a U-shaped lower extension (70) bent around the lower extension (42) of the contact body with a similar cross-sectional outer profiles to the upper clinching tabs (62,63) thereby providing similar polarizing protrusionS (71,72) for insertion at 0° or 180° orientation in the housing cavity (6) therefor.
5. The electrical terminal of claims 3-4 characterized in that the front and rear upper clinching tabs

(59,61,62,63) of each side wall (22,24) flank either side of retaining extension (36) of the contact body upper free edges (32,34) for retaining the back-up spring from axial movement with respect to the contact body.

6. The terminal of claim 5 characterized in that the U-shaped clinching tabs (59,61,62,63) are joined proximate their free ends by a bridging portion (66) for reinforcement of the terminal.
7. An electrical connector comprising a plurality of terminals as claimed in any of claims 1-7, the connector further comprising an insulative housing (4) having a plurality of terminal receiving cavities (6) extending therethrough, the cavities (6) disposed in one or more rows, the cavities (6) comprising a pair of diametrically opposed upper and lower polarizing grooves (86,88) adjacent opposing side surfaces (76,74) of the cavities (6), for receiving the upper and lower polarizing extensions (71,72).
8. The connector of claim 7 characterized in that adjacent cavities (16) are separated by walls (90) disposed at an angle that is non-perpendicular to the direction of the row of cavities, whereby the upper polarizing groove (86) of the preceding cavity and the lower polarizing groove (88) of the subsequent cavity are substantially interleaved for a very compact disposition.
9. The connector of claims 7 or 8 characterized in that the terminal upper and lower polarizing extensions (71,72) are disposed proximate opposing side walls (74,76) of the cavity (6) respectively, to ensure rigid abutment of the terminal extensions against corner sections of cavity separating walls of the housing when inserted in the false (90° or 270°) orientation with respect thereto.

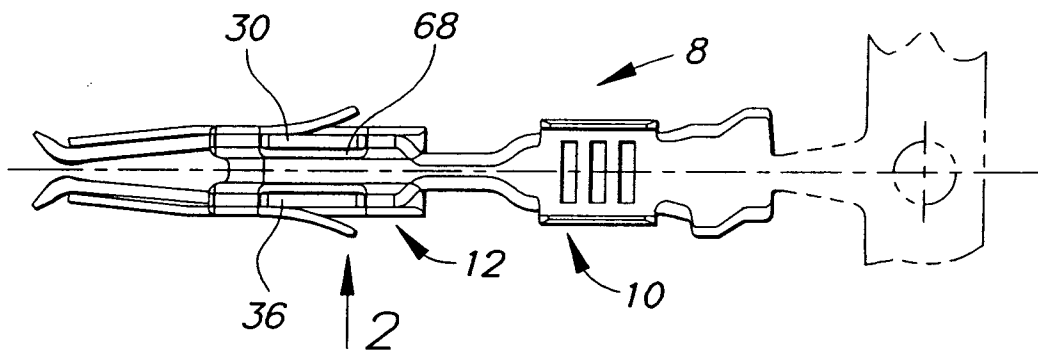


FIG. 1

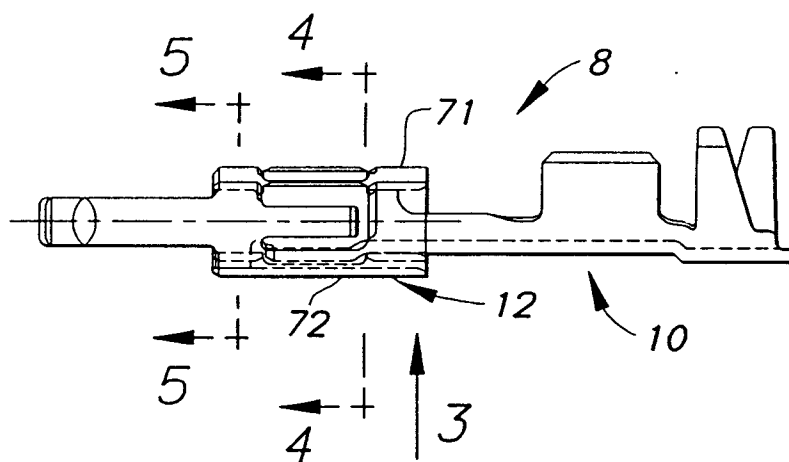


FIG. 2

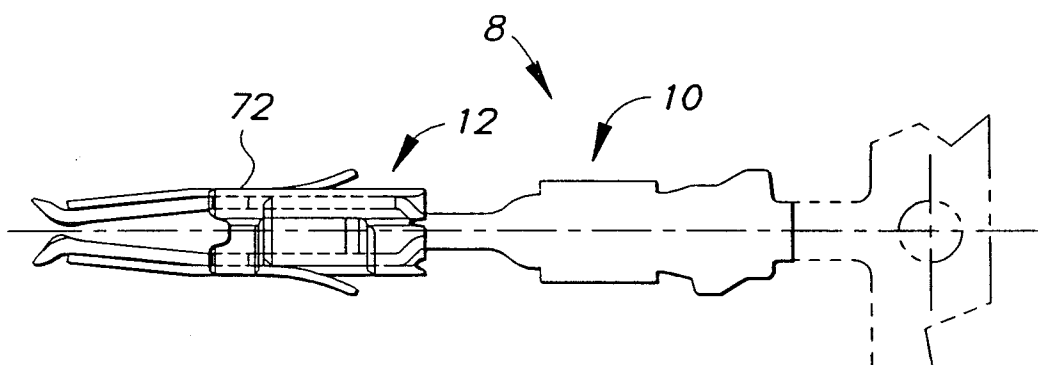


FIG. 3

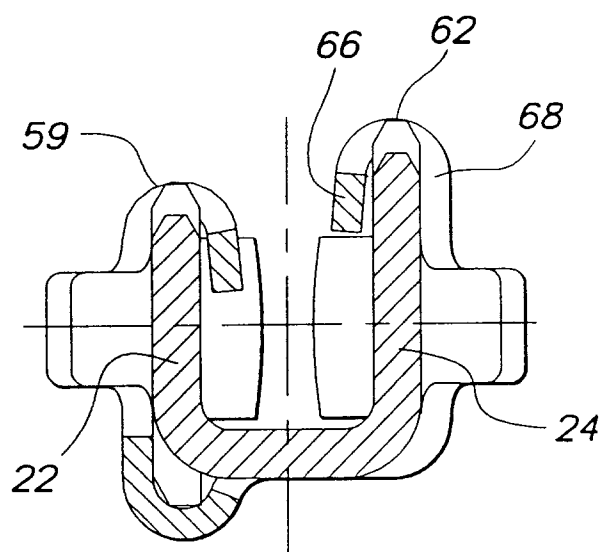


FIG. 4

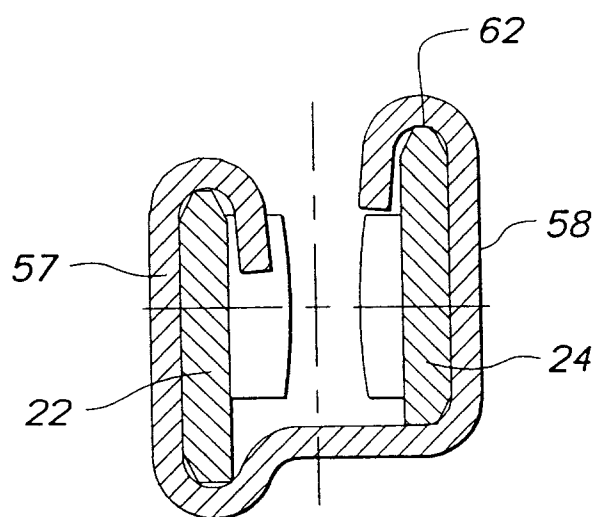


FIG. 5

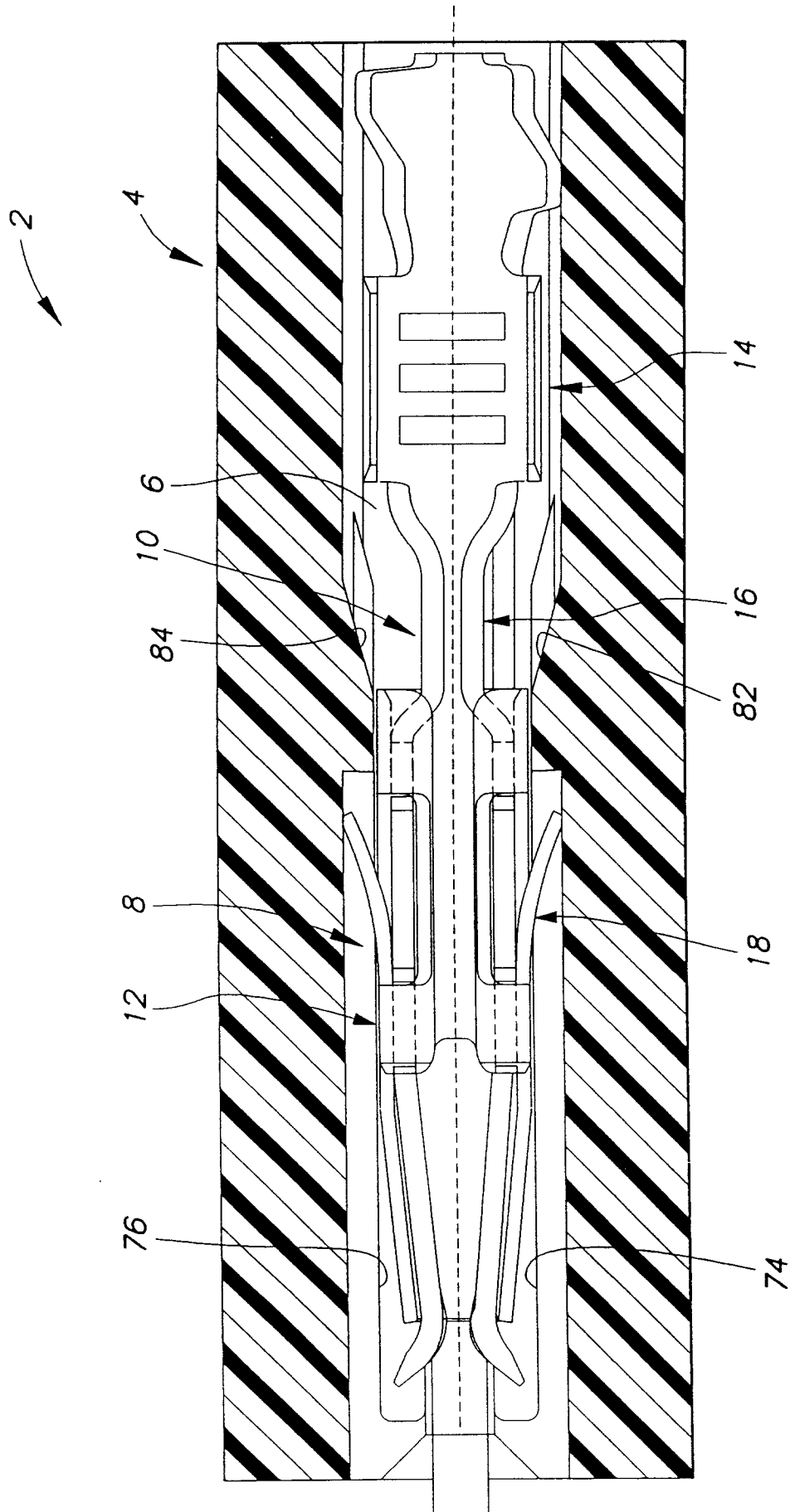


FIG. 6

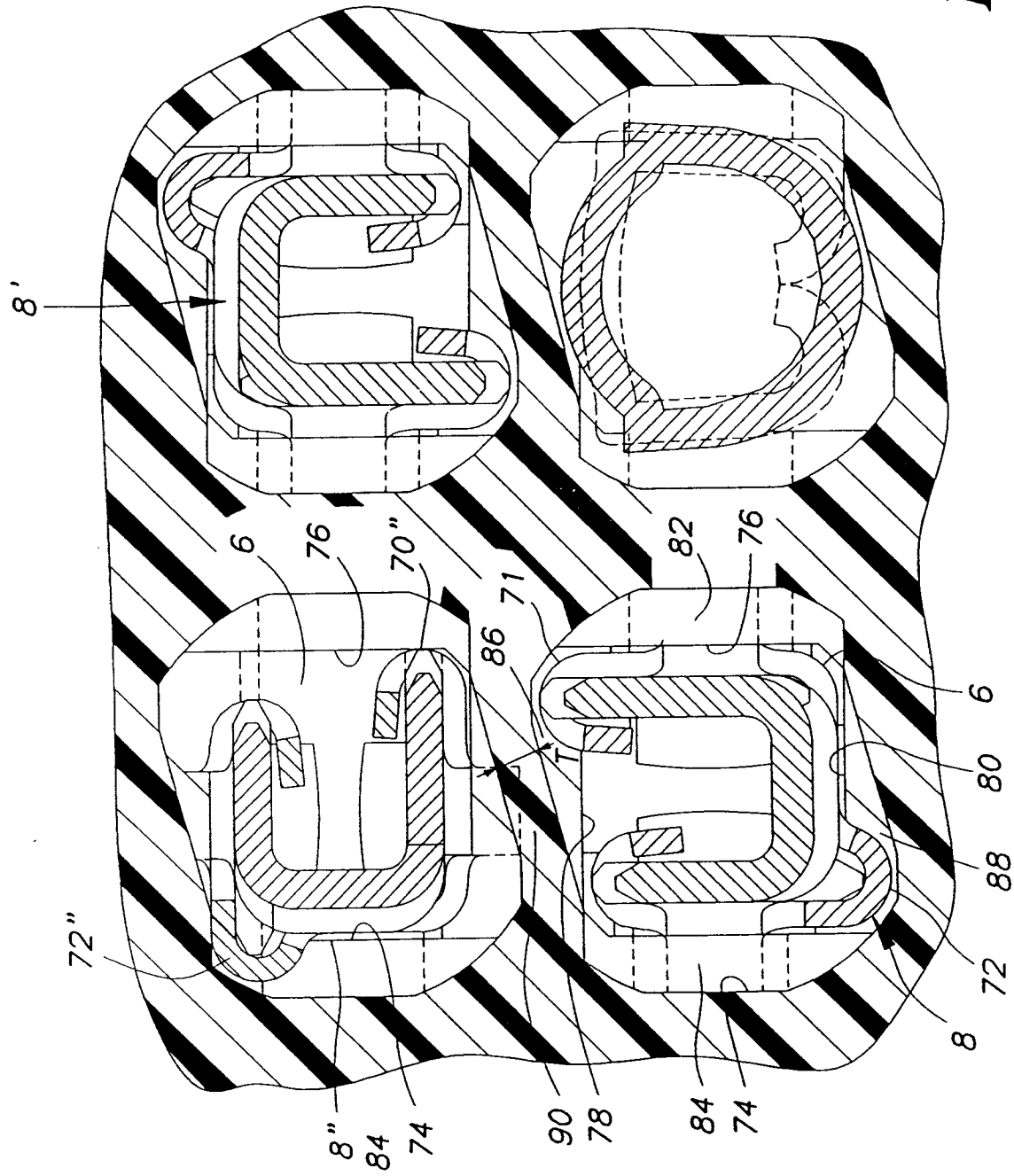


FIG. 7

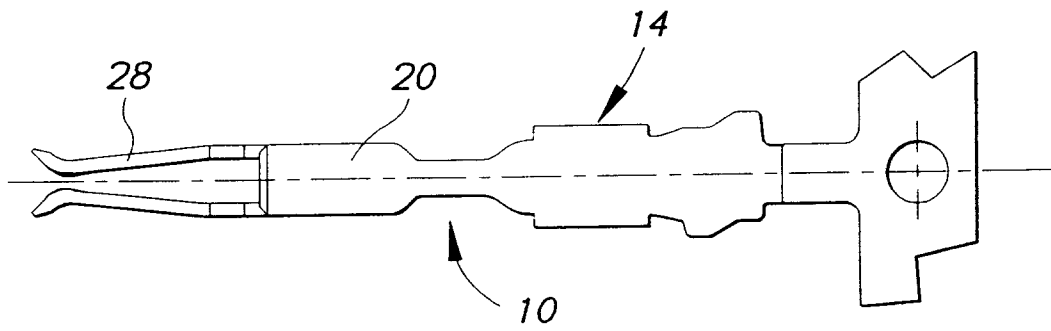


FIG. 8

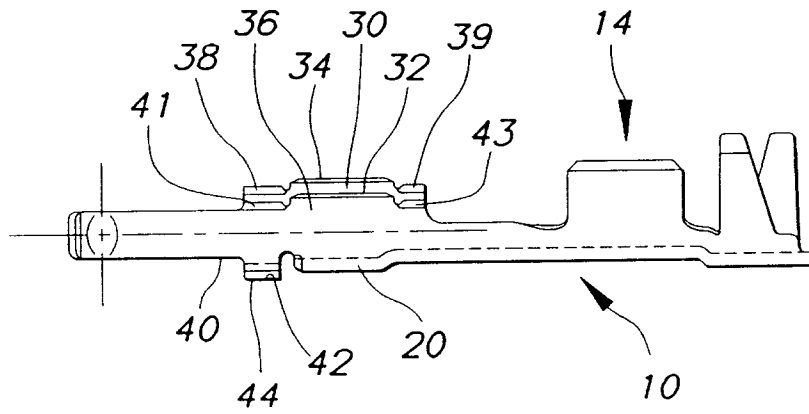


FIG. 9

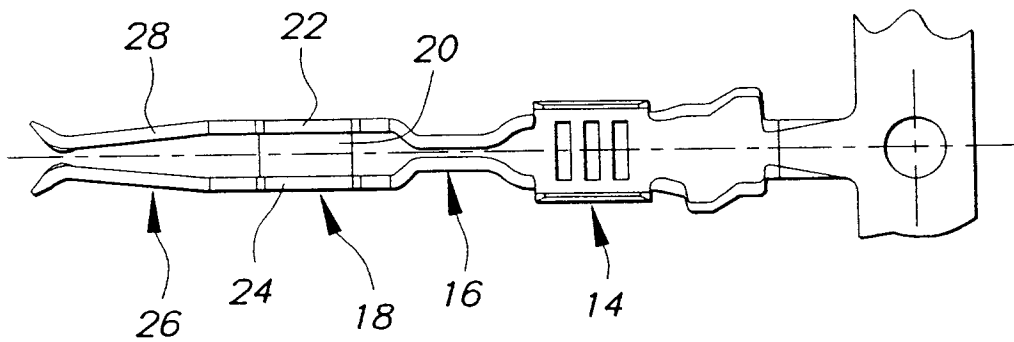


FIG. 10

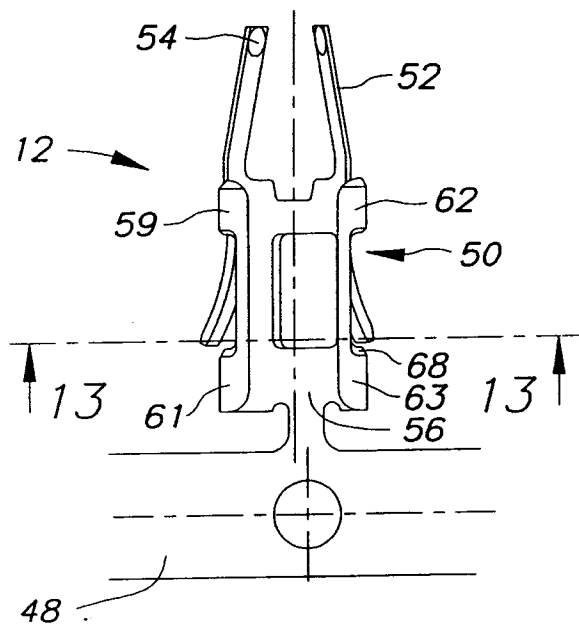


FIG. 12

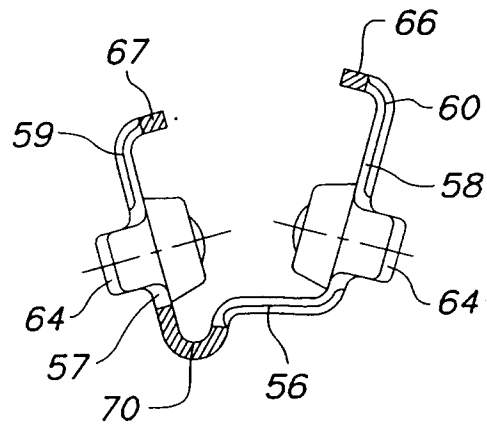


FIG. 13

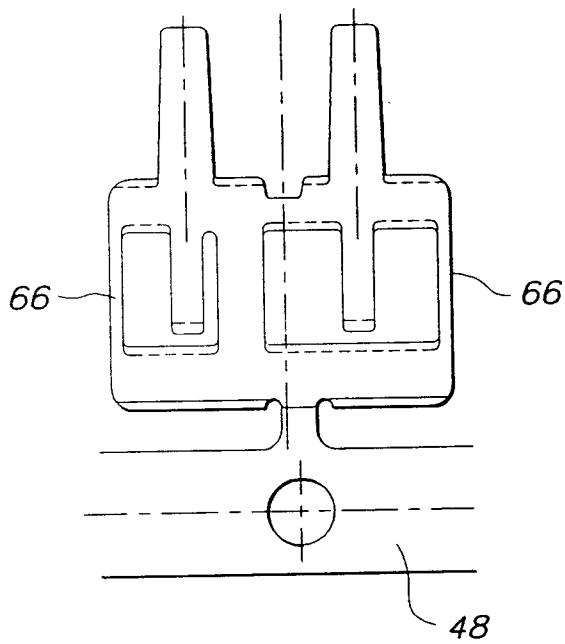


FIG. 11

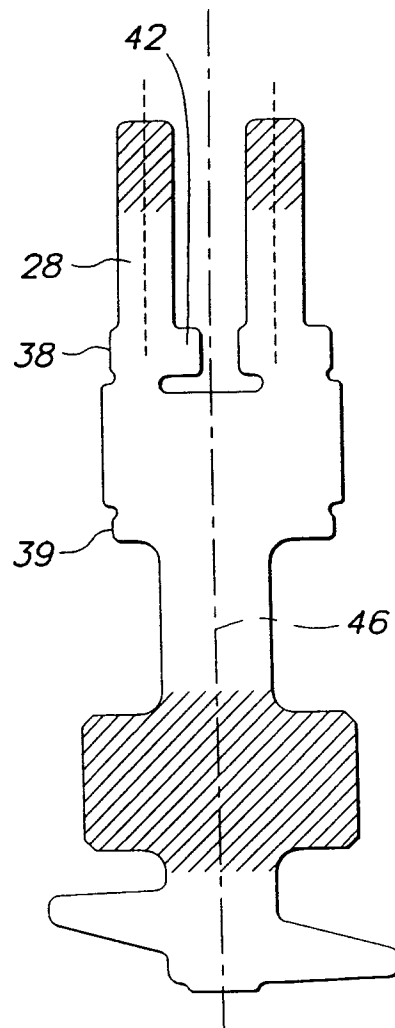


FIG. 14