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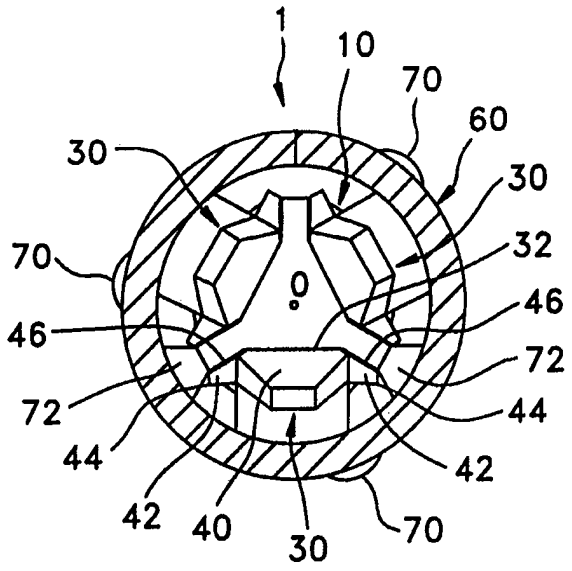

(57) Abstract

The present invention provides a ferrule–equipped female terminal in which the positional precision of anti–overstress projections formed on flexible contact arms is improved, and in which the flexible contact arms are securely protected from external foreign matter and forces. Female terminal (1) comprises a main body (10) which has a plurality of contact arms (30) extending toward a front end from a base member (26), and a cylindrical ferrule (60) which is disposed so that the ferrule (60) covers the contact arms (30). Anti–overstress projections (42) are located on both sides of contact points (32) of the contact arms in the same plane as the contact points. Even if the mating pin terminal is twisted during insertion into the female terminal (1), the edges (44) of the anti–overstress projections (42) engage the inside surface of the ferrule (60), so that no overstress is generated in the contact arms (30).

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FEMALE TERMINAL WITH PROTECTIVE SLEEVE

The present invention relates to a female terminal, and more specifically relates to a female terminal which is covered by a cylindrical ferrule.

Flat tab terminals and corresponding receptacle terminals, pin terminals with a round cross section (hereafter referred to as "round pin terminals") and corresponding socket terminals, and post terminals with a rectangular cross section and corresponding receptacle terminals, are universally known as examples of pairs of male and female terminals. Among these, tab terminals and corresponding receptacle terminals are widely used in the automotive industry because of advantages such as dimensional precision and high productivity. Furthermore, although round pin terminals and socket terminals involve some slight difficulty in obtaining true roundness, such terminals are superior in terms of ease of insertion into the connector housing, and are therefore widely used.

The socket terminal shown in Figure 6 is universally known as an example of such a round pin terminal and engaging socket terminal as disclosed in Japanese Patent Publication No. 62-198064. This terminal 100 includes a main body 104 which has two cantilever beam-form leaf springs 102 formed as integral parts of the main body 104, and a ferrule 106 which is fit over the tip end of the main body 104. The leaf springs 102 are thus protected from external forces by the ferrule 106.

However, in the terminal 100, no overstress preventing or anti-overstress means is provided in order to prevent excessive displacement of the leaf springs 102. Accordingly, in cases where the leaf springs 102 are twisted by the mating pin terminal (not shown), there is a danger that stress exceeding permissible limits will be generated in the leaf springs 102, thereby causing deformation of the leaf springs 102.

Terminals such as those shown in Figures 7 through 9 are known as female terminals which have anti-overstress means. The female terminal 110 shown in Figure 7 and

disclosed in Japanese Utility Model Publication No. 63-26979 is a receptacle terminal which electrically connects with a mating tab terminal 124. Here, a supporting member 120, which protrudes toward a base member 118, is located between the bent section 114 and peak section 116 of a flexible contact plate 112. Overstress generated in the bent section 114 can be prevented by this supporting section 120. However, since there is a relatively long distance between the peak section 116, which constitutes the engagement point with the tab terminal 124, and the supporting member 120, and between the peak section 116 and the free end 122, there is a danger that overstress will be generated in the flexible contact plate 112 between the supporting member 120 and the free end 122 as a result of twisting during insertion of the tab terminal 124. In addition, the precision of position of the lower end of the supporting member 120 depends on the cumulative total of the stamped and formed dimensional error of the supporting member 120, the bending error of the bent section 114 and the bending error of the supporting member 120 with respect to the flexible contact plate 112; accordingly, this precision is low.

Furthermore, the female terminal 130 shown in Figures 8A, 8B as disclosed in Japanese Utility Model Publication No. 7-42004 is a receptacle terminal which engages a mating tab terminal (not shown). In this terminal, a plurality of projecting members 134, 136, which prevent overstress in a flexible contact plate 132, are formed by being struck inwardly from side walls 138. Since the projecting members 136 support the flexible contact plate 132 in the vicinity of the contact point 140, there is almost no room for the generation of overstress in the flexible contact plate 132. However, since openings 142 are formed in the side walls 138 of the female terminal 130 as a result of the projecting members 134 and 136 being struck inwardly from the side walls 138, there is a danger that the flexible contact plate 132 will be damaged by foreign matter which enters via the openings 142.

Furthermore, the female terminal 150 shown in Figures 9A, 9B as disclosed in Japanese Utility Model Publication No. 1-112574 is a receptacle terminal which engages a mating tab terminal (not shown). Here, in order to prevent overstress in a flexible contact plate 154, which is separate from the terminal main body 152, lugs 160, which are disposed in apertures 158 formed in the side walls 156 of the terminal main body 152, are located on both sides of the flexible contact plate 154. In this female terminal 150 as well, there is a danger that the flexible contact plate 154 will be damaged by foreign matter entering via the apertures 158 formed in the side walls 156 of the terminal main body 152. Furthermore, since the electrical wire-connecting section (not shown) formed as part of the terminal main body 152 is a separate part from the flexible contact plate 154, the reliability of the connection is lowered by the interposition of an extra electrical connecting part between the mating tab terminal and the electrical wire-connecting section.

Accordingly, the object of the present invention is to provide a ferrule-equipped female terminal which has an anti-overstress means with high positional precision, and in which the flexible contact arms are securely protected from external foreign matter and forces.

A female terminal according to the present invention comprises a main body having a base member, contact arms extending forwardly from the base member and towards each other, and a ferrule disposed on the base member wherein the ferrule covers the base member and the contact arms, and anti-overstress projections on the contact arms are arranged so that the anti-overstress projections can engage an inside surface of the ferrule.

The female terminal of the present invention comprises a main body which has a contact member including a plurality of cantilever beam-form contact arms which extend from a base member, an electrical wire-connecting section, and a ferrule which surrounds the contact member, anti-overstress projections located on both sides of

contact points of the contact arms so that the anti-overstress projections are disposed in the same plane as the contact points, and the anti-overstress projections are arranged so that the projections can engage an inside surface of the ferrule. Furthermore, a much greater effect can be obtained if the angle formed by a line connecting one of the edges of an anti-overstress projection on an inside surface of the ferrule with the center of the ferrule, and a line connecting the other of the edges with the center of the ferrule, is set at less than 90 degrees.

The invention will not be described by way of example with reference to the accompanying drawings in which:

Figure 1 is a perspective view which shows an embodiment of a female terminal of the present invention.

Figure 2 is a cross-sectional view taken along line 2-2 in Figure 1.

Figure 3 is a plan view showing one of the contact arms of the female terminal in Figure 1 in an unrolled state.

Figure 4 is a cross-sectional view taken along line 4-4 in Figure 2.

Figure 5 is an explanatory diagram which illustrates the relationship between the anti-overstress projections and the ferrule.

Figure 6 is a partly-sectioned plan view which shows a conventional female terminal.

Figure 7 is a longitudinal cross-sectional view which shows another conventional female terminal.

Figure 8A is a longitudinal cross-sectional view, and Figure 8B is a cross-sectional view taken along line 8B-8B in Figure 8A of another conventional female terminal.

Figure 9A is a longitudinal cross-sectional view, and Figure 9B is a perspective exploded view of the parts prior to assembly of another conventional female terminal.

As shown in Figure 1, female terminal 1 of the present invention comprises a main body 10 which is formed by stamping and forming of a copper alloy plate, and a cylindrical ferrule 60 which is preferably formed by

stamping and forming of the same metal plate material as that used for the main body 10. The main body 10 has a contact section 14 which is formed at one end of a first base member 12 having a circular cross section, and which engages a mating round pin terminal (not shown). An electrical wire-connecting section 18 is formed at the other and of a second base member 16 extending in a direction perpendicular to the direction of extension of the base member 12. The electrical wire-connecting section 18 has a wire-crimping part 20 which is used to make electrical and mechanical engagement with the core wires of an electrical wire 3, and an insulation-crimping part 22 which is used to engage the insulating covering of the electrical wire 3. However, some other universally known connecting means may also be used. A pair of wire-pulling protective lugs 24 which face each other are formed on the second base member 16 in the vicinity of the base member 12; lugs 24 resist pulling of the electrical wire 3 by engaging with projections on a housing (not shown) in which the terminal is disposed.

Ferrule 60 is disposed on the contact section 14 of the main body 10 so that the ferrule 60 surrounds the contact section 14. Furthermore, dovetail projections 62 and 64, and dovetail grooves 66 and 68, are formed in the respective edges of the ferrule 60, when the ferrule is in an unrolled state, and opening of the ferrule 60 is prevented by the engagement of the dovetail projections 62 in the dovetail grooves 66 and the engagement of the dovetail projection 64 in the dovetail groove 68. In the present embodiment, three projections 70 with arcuate surfaces, (see Figure 4) which are used for engagement with the housing, are formed on the side surfaces of the ferrule 60. Furthermore, stopper members 72, which project inward between two parallel slits 74, 74, are formed in the side surface of the ferrule 60.

In Figure 2, the contact section 14 of the main body 10 has a plurality of contact arms 30 (three contact arms 30 in the present preferred embodiment) which extend

toward the front end in an axial direction (i. e., toward the right in Figure 2) and towards each other from the front end 27 of the cylindrical base part 26 forming a continuation of the base member 12. The front end 27 of the cylindrical base member 26 of the main body 10 engages stopper members 72 on the ferrule 60, and the rear end 28 of the cylindrical base member 26 engages second stopper members 76 on the rear end of the ferrule 60, so that the main body 10 is fastened inside the ferrule 60. The contact arms 30 converge toward the front ends thereof, and then spread outward beyond the contact points 32 which make electrical contact with a mating round pin (not shown) that is inserted via an opening 78 formed in the front end of the ferrule 60.

As is shown in Figure 3, each of the contact arms 30 has a relatively broad portion 34, which is connected with the cylindrical base member 26 (see Figure 2), a portion 36, which has a narrower width than the broad portion 34, a transitional portion 38 with a varying width, which is positioned between the portions 34 and 36, a contact point portion 32, which is positioned further toward the front end than the narrow portion 36, and a front end portion 40, which is positioned at the front end of the contact arm 30. Anti-overstress projections 42, which will be described later, are formed on both sides of the contact point portion 32.

As shown in Figure 4, the anti-overstress projections 42 are formed in positions that are extremely close to the contact point portions 32 of the contact arms 30. Accordingly, since the anti-overstress projections 42 can be formed with a high rigidity, the generation of overstress in the contact arms 30 can be reliably prevented. Furthermore, the anti-overstress projections 42 are positioned within the same plane (or more accurately, within the same curved plane) as the contact points 32, and are not bent toward the inside surface of the ferrule 60. Accordingly, the positional precision of the edges 44 of the anti-overstress projections 42, which engage the

ferrule 60, can be especially improved. Furthermore, the anti-overstress projections 42 are formed with beveled surfaces 46 in order to prevent mutual interference between the anti-overstress projections 42 of the respective contact arms 30. Moreover, when the edges 44 engage the inside surface of the ferrule 60, the front end portions 40 of the contact arms 30 do not engage the inside surface of the ferrule 60.

In Figure 5, A indicates the contact location on the side of the ferrule 60 which can be engaged by the edge 44 of one of the anti-overstress projections 42 of one contact arm 30, B indicates the contact location on the side of the ferrule 60 which can be engaged by the other edge 44 of the same contact arm 30, O indicates the center of the ferrule 60, and θ indicates the angle formed by the line OA and the line OB. In the case of the present embodiment, the dimensions of the anti-overstress projections 42 are set so that $\theta < 90°$. Accordingly, the error y in the direction of displacement of the contact arm 30 (i. e., the vertical direction in Figure 5) is always less than the dimensional error x that is generated during the forming of the anti-overstress projections 42. Since the positional precision of the edges 44 of the anti-overstress projections 42 is high as was described above, the error in the direction of displacement of the contact arms 30 can be further reduced by setting θ at a value less than 90°. Accordingly, there is very little danger of excessive displacement and resulting overstress of the contact arms 30. Furthermore, in cases where $\theta' \geqq 90°$ (as indicated by the broken lines shown in Figure 5), the error y' in the direction of displacement of the contact arms is equal to or greater than the dimensional error x generated during the forming of the anti-overstress projections.

Since the anti-overstress projections 42 of the female terminal 1 can engage the inside surface of the

ferrule 60, there is no need to form cut-out and raised portions or holes in the ferrule 60 in order to prevent overstress of the contact arms 30. Accordingly, damage of the contact arms 30 caused by foreign matter entering from the sides of the female terminal 1 can be reliably prevented.

An example of the present invention has been described above. However, the present invention is not limited to such example described above; various modifications and alterations may be made as required. For example, the female terminal 1 described above is a so-called flag-type terminal in which the contact section 14 and the electrical wire-connecting section 18 are arranged in an L-shape; however, it would also be possible to arrange these parts on the same straight line.

In the female terminal described above, anti-overstress projections are disposed on both sides of the contact points of the contact arms in the same plane as the contact points, and these anti-overstress projections are arranged so that the projections can engage an inside surface of a ferrule. Accordingly, the positional precision of the edges of the anti-overstress projections which can engage the inside surface of the ferrule is improved, so that overstress in the contact arms can be reliably prevented. Furthermore, there is no need to form cut-outs and raised portions or holes in the ferrule in order to prevent overstress of the contact arms. Accordingly, the contact arms can be reliably protected from external foreign matter and forces.

Furthermore, in the female terminal described above, the positional precision of the edges of the anti-overstress projections which engage the inside surface of the ferrule is further improved.

CLAIMS

1. A female terminal comprises a main body (10) having a base member (12), contact arms (30) extending forwardly from the base member (12) and towards each other, and a ferrule (60) disposed on the base member (12), characterized in that,

the ferrule (60) covers the base member (12) and the contact arms (30), and anti-overstress projections (42) on the contact arms (30) are arranged so that the anti-overstress projections (42) can engage an inside surface of the ferrule (60).

2. A female terminal as claimed in claim 1, wherein the anti-overstress projections (42) are located on both sides of contact points (32) of the contact arms (30) so that the anti-overstress projections (42) are disposed in the same plane as said contact points (32).

3. A female terminal as claimed in claims 1 and 2, wherein the contact arms (30) converge toward the front ends thereof and then spread outward beyond the contact points (32).

4. A female terminal as claimed in claims 1, 2 and 3, wherein the anti-overstress projections (42) have edges (44) that engage an inside surface of said ferrule (60).

5. A female terminal as claimed in claim 4, wherein when the edges (44) engage the inside surface of said ferrule (60), front end portions (40) of said contact arms (30) do not engage the insude surface of said ferrule (60).

6. A female terminal as claimed in claims 1-5, wherein an angle (θ) formed by a line (OA) connecting one of the contact areas on an inside surface of said ferrule (60), which can be engaged by the anti-overstress projections (42) of the contact arms (30), with a center (O) of said ferrule (60) and a line (OB) connecting another of the contact areas with said center (O) is less than 90 degrees.

7. A female terminal as claimed in claims 1-5,

wherein said ferrule (60) has stopper members (72, 76) between which said base member (12) is disposed to secure said base member (12) and contact arms (30) within said ferrule (60).

8. A female terminal as claimed in claims 1-5, wherein said anti-overstress projections (42) have beveled surfaces (46) to prevent mutual interference between the anti-overstress projections (42) of respective contact arms (30).

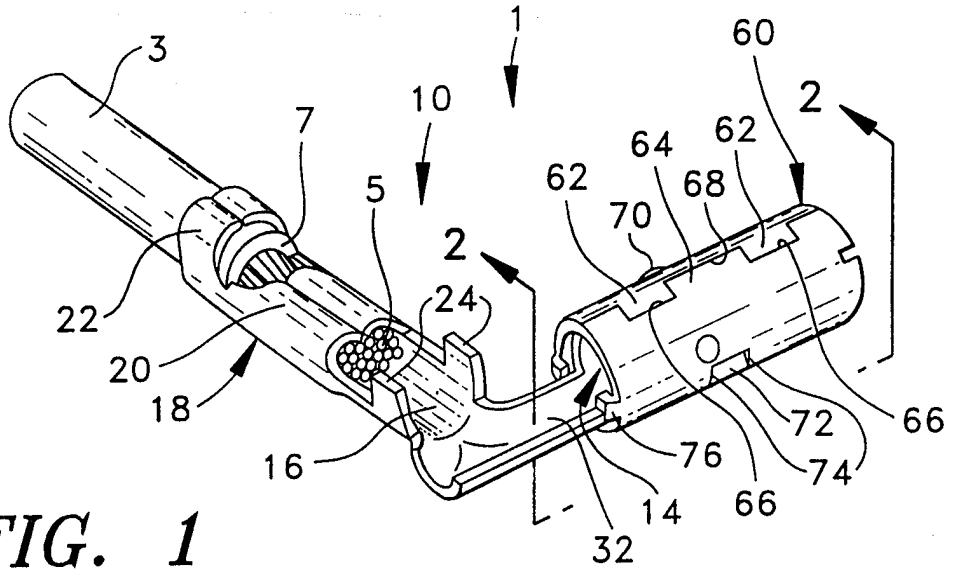

FIG. 1

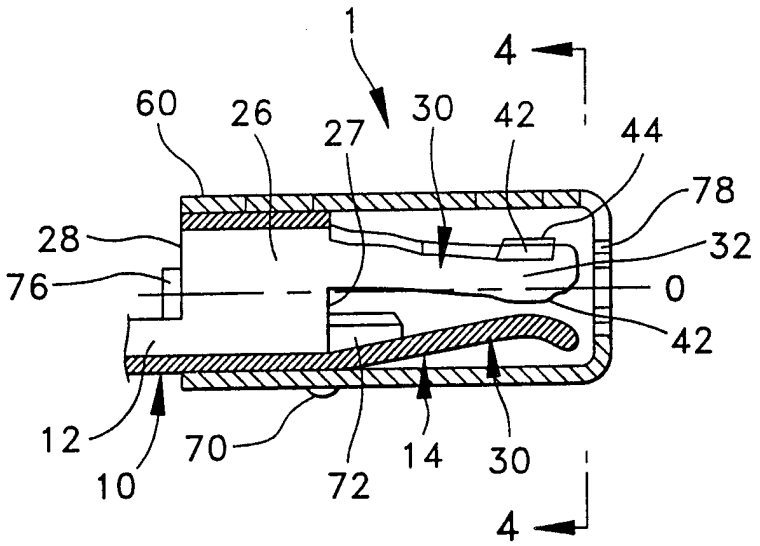

FIG. 2

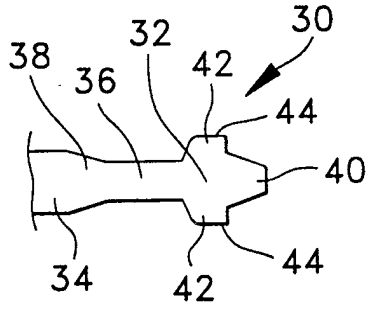

FIG. 3

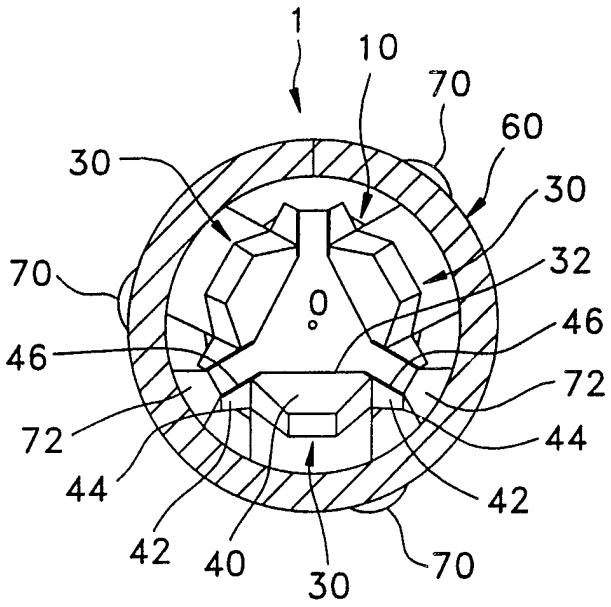
1
10
70
60
30
30
32
70
0°
46
46
72
72
44
44
42
42
40
30
70

FIG. 4

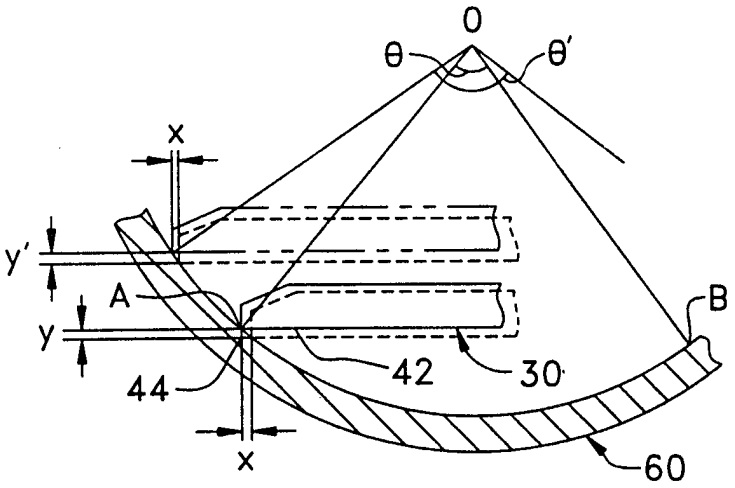
0
θ
θ'
x
y'
A
y
B
44
42
30
x
60

FIG. 5

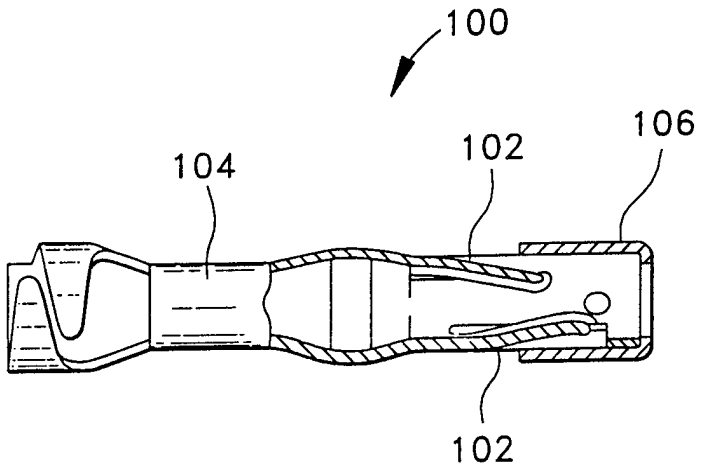

FIG. 6

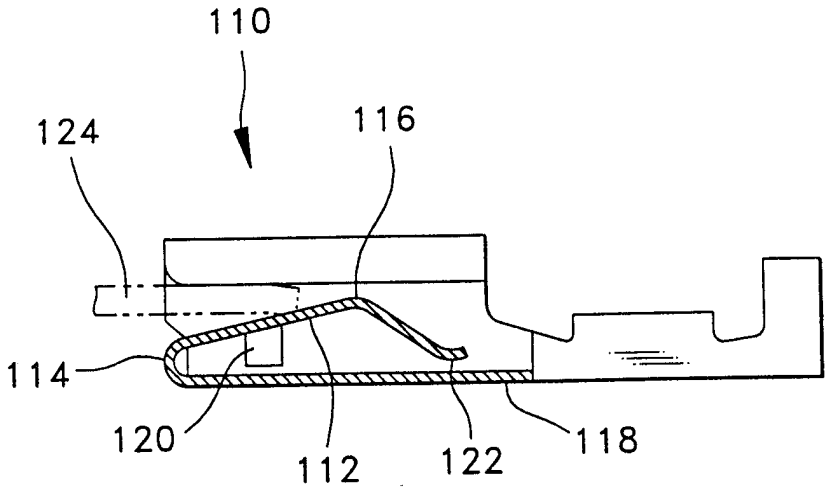

FIG. 7

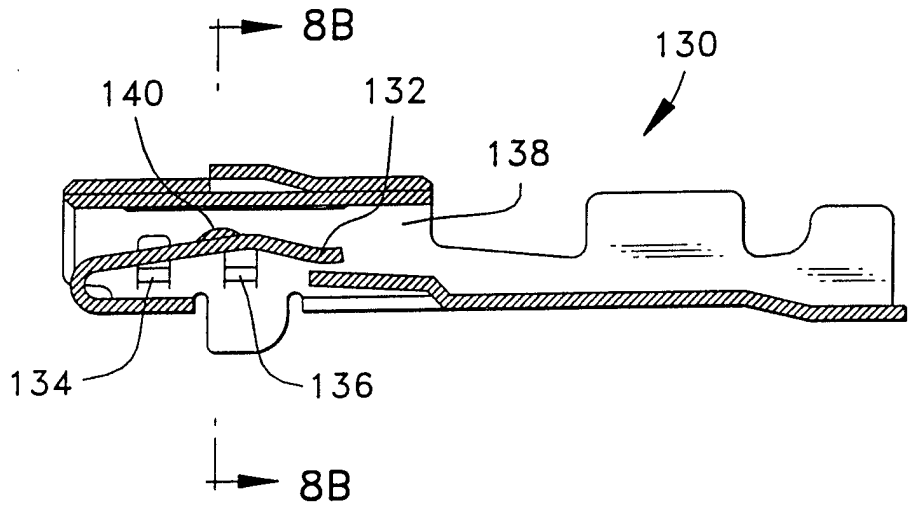

FIG. 8A

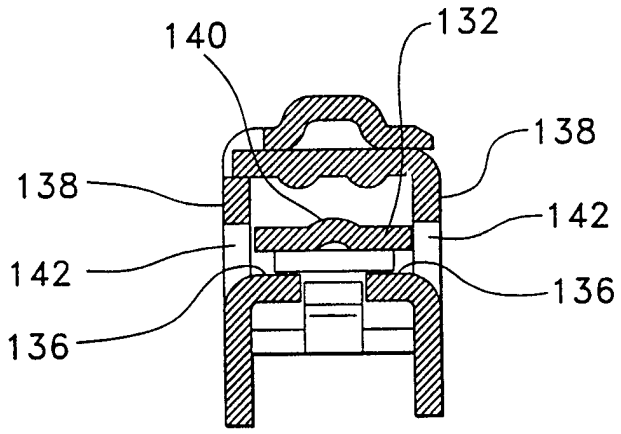

FIG. 8B

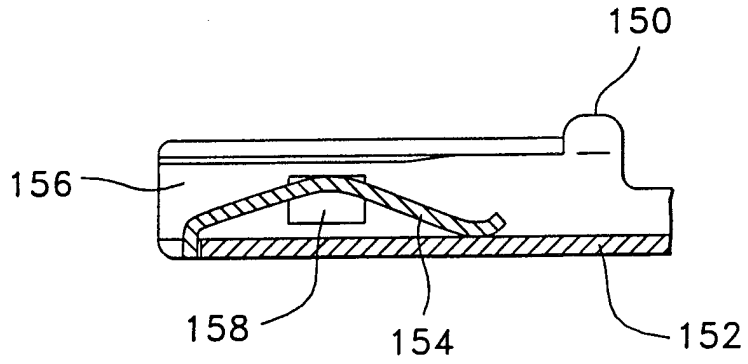

FIG. 9A

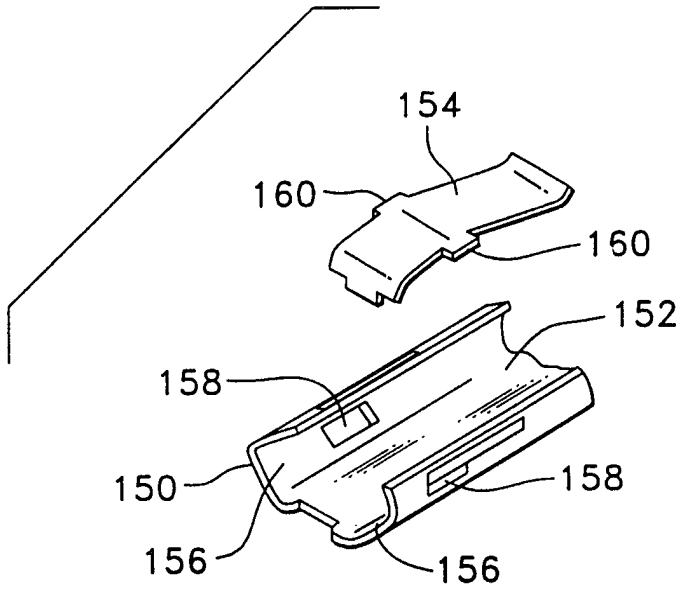

FIG. 9B

INTERNATIONAL SEARCH REPORT

Interna .al Application No
PCT/US 97/19074

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H01R13/115

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0 681 344 A (WOODHEAD) 8 November 1995 see column 5, line 33 - line 43 see column 6, line 21 - line 47; figures 6-9	1
Y A	EP 0 268 356 A (DU PONT DE NEMOURS) 25 May 1988 see column 3, line 40 - line 45; figures 9-11	1 2
A	US 4 657 336 A (R.E.JOHNSON ET AL) 14 April 1987 see column 3, line 48 - line 64; figures 3-6	1,3
A	EP 0 060 770 A (BENDIX) 22 September 1982 see page 4, line 28 - line 33; figure 5	1,7

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1

Date of the actual completion of the international search	Date of mailing of the international search report
16 February 1998	25. 02. 98

Name and mailing address of the ISA	Authorized officer
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Information on patent family members

Interna..al Application No
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