(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 700 122 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
06.03.1996 Bulletin 1996/10

(51) Int. Cl.[6]: **H01R 13/115**

(21) Application number: **95113791.8**

(22) Date of filing: **01.09.1995**

(84) Designated Contracting States:
DE ES FR GB IT

(30) Priority: **02.09.1994 GB 9417702**

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(54) Electrical receptacle terminal

(57) An electrical receptacle terminal (2) comprising a conductor engaging end (4) for interconnecting to an electrical conductor, and a contact portion (6) connected thereto, the contact portion (6) having an outer protective shell (10) surrounding an inner contact structure (12) having plurality of resilient cantilevered contact arms (24a,b;26a,b;28a,b) each having contact surfaces (30a,b;32a,b;34a,b) thereupon respectively for electrically engaging a mating tab terminal, the receptacle terminal (2) being characterized in that adjacent contact arms have different stiffness, thereby advantageously assuring an adequate number of contact points are established between the receptacle terminal (2) and the mating tab terminal for signal transmission therebetween.

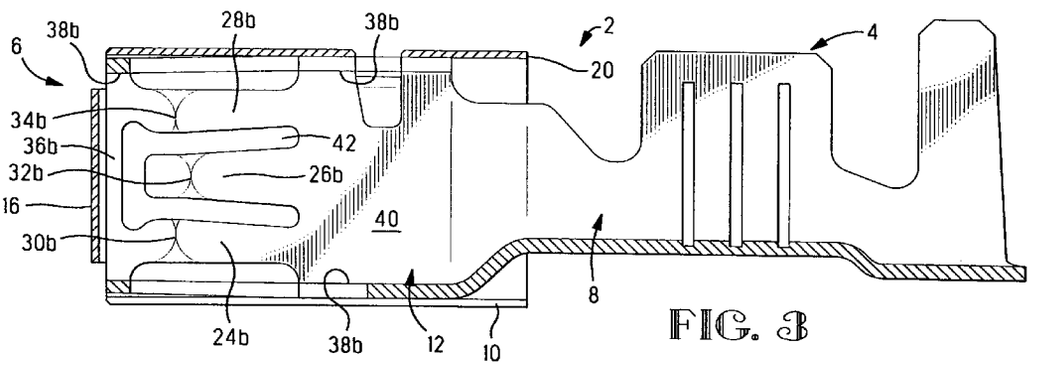

FIG. 3

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Description

This invention relates to electrical receptacle terminals requiring multiple points of engagement with a mating tab terminal.

In many instances it is necessary to have multiple points of engagement between contact surfaces of a receptacle terminal and the tab terminal inserted therein. The multiple contact points assure that adequate interconnection is established for transmitting the signal therebetween. Examples of where multiple contact points are advantageous are high power applications where the multiple contact points are necessary to transmit the power or where the interconnection between the mating terminals is likely to be misaligned so that not all of the contact points will be established for every insertion, in this case the multiple contact points provide sufficient redundancy to assure adequate signal transmission.

In high vibration environments, such as in vehicles or machines, it is necessary that the receptacle terminal exert sufficient normal force upon the tab terminal to maintain the electrical interconnection. However, it is also desirable to minimize the insertion forces required to mate the tab and receptacle terminals, as it is becoming more common to include multiple interconnections in a single connector unit. Furthermore, it is difficult to assure that all of the points of contact are established due to the commercial inaccuracies in manufacturing and the possibility of misalignment during assembly.

What is needed is an electrical receptacle terminal having provisions for multiple points of contact with a mating tab terminal that ensures reliable engagement of a sufficient number of the contact points to transmit the desired electrical signal. What is also needed is an electrical receptacle terminal that exerts sufficient normal force at the contact points to retain the mating tab terminal therein. What is further needed is that the receptacle terminal does not require so much insertion force that interconnection is difficult herein. Finally, the receptacle terminal must be economical to produce.

These and other objects are accomplished by providing an electrical receptacle terminal comprising a conductor engaging end for interconnecting to an electrical conductor, and a contact portion connected thereto, the contact portion having a plurality of contact arms having contact surfaces thereupon for electrically engaging a mating tab terminal, the receptacle being characterized in that adjacent contact arms have different stiffness.

It is an advantage of this invention, that a sufficient number of contact points may be established between the receptacle and mating tab terminal to transmit the desired signal, in spite of misalignment and/or dimensional variations. It is another advantage of this invention that sufficient normal forces are exerted at some of the contact points to retain the tab terminal therein without the receptacle requiring excessive insertion forces to mate with the tab terminal. It is yet another advantage of this invention that this electrical receptacle terminal is simple to manufacture.

The invention will now be described by way of example with reference to the following drawings, in which;

Figure 1 is a side view of an electrical receptacle terminal according to the present invention;
Figure 2 is an end view of the terminal of Figure 1;
Figure 3 is a sectional view of the electrical receptacle terminal of Figure 1 taken along line 2.2 of Figure 2; and
Figure 4 is another sectional view of the electrical receptacle terminal of Figure 1 taken along line 4.4 of Figure 2.

With reference now to Figure 1, an electrical connector according to the present invention is shown generally at 2. The electrical connector 2 includes a conductor engaging end 4 and a contact end 6 interconnected by an intermediate portion 8. The conductor engaging end 4 of the present embodiment is adapted for crimp engagement of an insulated conductor by what is commonly known as an F-crimp. The conductor engaging end 4 could take on any desired configuration depending upon the type of conductor to be engaged and the physical characteristics required of the engagement. Possible configurations would include, for wire, an insulation displacement contact (IDC) for engaging an insulated wire, different crimp structures, or solder structures, while it would be also possible to incorporate structure for direct engagement of pads on a printed circuit board or another connector structure.

The contact end 6 includes an outer shell 10 that generally surrounds an inner contact 12. The outer shell 10 is a stamped and formed sheet metal component joined together along seam 14 by conventional techniques, such as laser welding, to form a protective box about the inner contact 12. At the front end of the outer shell 10 extend forwardly a pair of opposing guide tabs 16 that are folded backwards and inwardly to define a mouth 18 therebetween for receiving the mating tab terminal (not shown). The guide tabs 16 act to assist in blind mating and to protect the inner contact 12 during insertion of the tab terminal (not shown). At the opposite end of the outer shell from the guide tab 16 is a rear end 20 which extends out over the intermediate portion 8 to define side receiving regions 22. These side receiving regions 22 may receive a secondary locking member (not shown) of a connector housing (not shown) in order to provide positive retention of the terminal within the housing, as is well known in the art. In addition, it may be desirable to incorporate a locking lance folded outward of the outer shell 10 that would interfere with the connector housing in order to provide primary terminal retention. Furthermore, it would also be possible to produce the electrical receptacle terminal according to the present invention without an outer shell 12.

With reference now to Figure 2, the inner contact 12 includes three pairs of opposed contact arms at 24a,b; 26a,b; 28a,b including respectively thereupon contact surfaces 30a,b; 32a,b; 34a,b. Correspondingly disposed

contact arms of the outer pairs 24a,28a; 24b,28b are advantageously, although not necessarily, interconnected at their forward end by a tie bar 36a,36b respectively. Each tie bar 36a,36b is integrally formed with opposing side rails 38a,38b that act to stiffen the corresponding contact arms 24a,b;28a,b as will be described below.

With reference now to Figure 3, one side of the terminal 2 will be described in detail and the description is further applicable is applicable to the opposing side due to the symmetry of the terminal 2. It is important to note that the receptacle terminal need not be formed of opposing pairs of contact arms and it is envisioned that the receptacle structure could include an opposite side that is a seat with contact surfaces thereupon having no or different resiliency characteristics than the side illustrated here in Figure 3 incorporating the present invention. The contact arms 24b,26b,28b and the oppositely opposed side rails 38b extend from a common base portion 40b. The outer contact arms 24b,28b and the opposing side rails 38b are interconnected at the tie bar 36b. The side rails 38 are folded normal to the plane from which the contact arms 24b,28b are formed disposed transversely to act as stiffening members for re-enforcing the cantilevered nature of the contact arms 24b,28b. The side rails 38b provide additional stiffness beyond what would be realized if the contact arms 24b,28b were simply cantilevered from the base 40. Furthermore, as tie bar 36b interconnects corresponding contact arms 24b,28b, when forces resulting from the insertion of a tab terminal are exerted upon one of the contact arms 24b,28b, the tie bar 36b transmits at least a portion of reactionary forces through to the opposite contact arm 24b,28b and side rail 38b.

The centre contact arm 26b is located between the outer contact arms 24b,28b in a freely cantilevered manner extending forwardly from the base 40. This contact arm 26 is defined by a U-shaped opening 42 that defines a free end 43 of the contact arm 26b.

With reference now to Figure 4, the outer contact arms 24a,b;28a,b extend forwardly from the base 40 and converge towards the opposing arm of the pair to define a first receiving region 44 between the opposed contact surfaces 30a,b and 34a,b of the respective contact arms before diverging outwardly. The first contact receiving region 44 is forward a second receiving region 46 defined by the contact surfaces 32a,b of the middle pair of contact arms 26a,b which converge and diverge in a manner similar to that described with respect to the outer contact arms. Additionally, the contact surfaces 30a,b;34a,b of the outer pairs of contact arms 24a,b;28a,b are spaced further apart, thereby defining a larger first receiving region than the contact surfaces 32a,b of the middle contact arms. It may be desirable in some instances to have the opposing contact surfaces 30a,b;34a,b and 32a,b that define the first and second receiving regions 44,46 respectively in contact with each other prior to insertion of the mating tab terminal.

When a tab terminal (not shown) is inserted into the mouth 18 the tab terminal will enter the first receiving region 44 and come into contact with the outer pairs of contact arms 24a,b;28a,b. Upon further insertion, the tab terminal acts against the contact arms 24a,b;28a,b which are supported by their respective side rails 38a,b. The insertion force must overcome the stiffness of the contact arms 24,28 and the frictional forces being exerted thereupon. Once the contact arms 24,28 are fully separated so that the tab terminal is fully inserted into the first receiving region 44 only the frictional forces resist further insertion until the tab terminal enters into contact with the middle pair of contact arms 26 at the second receiving region 46. At this point further insertion results in the separation of the middle contact arms 26a,b which are freely cantilevered so that they offer less resistance as they are less stiff so they separate easier enabling the tab terminal to be inserted. The tab terminal will now undergo only sliding frictional resistance as it is inserted to its final position.

As further seen in Figure 4, by having the second receiving region 46 slightly smaller than the first receiving region 44 is may be assured that these contact arms 26 will engage the tab terminal and the amount of normal forces generated. In addition, with the central pair of contact arms 26 being freely cantilevered they have a greater elastic range enabling these arms to compensate for misalignment of the mating tab terminal. Advantageously, in this embodiment, these arms are located at the centre position where the minimal amount of displacement occurs if the tab terminal is misaligned, thereby assuring that at least two points of contact will be formed on each side of the tab terminal.

While in the embodiment shown in the figures, the stiffer outer contact arms 24a,b;28a,b are reinforced by side rails, it is envisioned that other stiffening structure could be used, for example: a back up spring; forming techniques, such as coining or stamping; or alternative structural configurations that would enable stiffening of a contact arm from its freely cantilevered stiffness characteristic. Furthermore, in some applications it may be desirable to incorporate more or less contact arms or to orient the stiffer contact arms differently with respect to the more resilient contact arms, such as having the middle pair be the stiff arms and the outer pairs be the more resilient.

Advantageously, a receptacle terminal is produced that is especially suited for ensuring that multiple points of contact are established with a mating tab terminal, in order to enable adequate signal transmission, even where the mating tab terminal is misaligned. The receptacle terminal has good insertion force characteristics in relation to the number of contact points. The receptacle terminal generates sufficient normal force to retain the mated tab terminal therein.

Claims

1. An electrical receptacle terminal (2) for mating with a tab terminal comprising a conductor engaging end (4) for interconnecting to an electrical conductor, and a contact portion (6) connected thereto, the contact portion (6) having a plurality of contact arms (24a,b;26a,b;28a,b) having contact surfaces (30a,b;32a,b;34a,b) thereupon for electrically engaging the mating tab terminal, the receptacle being characterized in that adjacent contact arms have different stiffness.

2. The electrical receptacle terminal of Claim 1, further characterized in that the contact portion includes three contact arms (24a,b;26a,b;28a,b) and the middle contact arm (26a,b) is less stiff than at least one of the outer contact arms (24a,b;28a,b).

3. The electrical receptacle terminal of Claim 2, further characterized in that the middle contact (26a,b) is less stiff than both of the outer contact arms (24a,b;28a,b).

4. The electrical receptacle terminal of any one of the preceding claims, further characterized in that the contact portion includes opposed pairs of contact arms.

5. The electrical receptacle terminal of any one of the preceding claims, further characterized in that the stiffer contact arms are interconnected and supported by a side rail (38a,b).

6. The electrical receptacle terminal of claim 2, further characterized in that the outer contact arms (24a,b;28a,b) are interconnected by a tie bar (36a,b).

7. The electrical receptacle terminal of any one of the preceding claims, further characterized in that the stiffer contact arms define a first contact receiving region (44) by their contact surfaces while the less stiff contact arm (26a,b) defines a second contact receiving region (46) and second contact receiving region (46) is smaller than the first contact receiving region.

8. The electrical receptacle terminal of any one of the preceding claims, further characterized in that the less stiff contact arm (26) undergoes a greater deflection upon engagement of the tab terminal.

9. The electrical receptacle terminal of any one of the preceding claims, further characterized in that the stiffer contact arms (24a,b;28a,b) define a first contact receiving region (44) by their contact surfaces while the less stiff contact arms (26a,b) define a second contact receiving region (46) that is offset in the direction of insertion of the mating tab from the first contact region (44).

10. The electrical receptacle terminal of claim 9 further characterized in that the receptacle terminal includes two opposing pairs of stiff contact arms (24a,b;28a,b) with a pair of less stiff arms (26a,b) positioned therebetween.

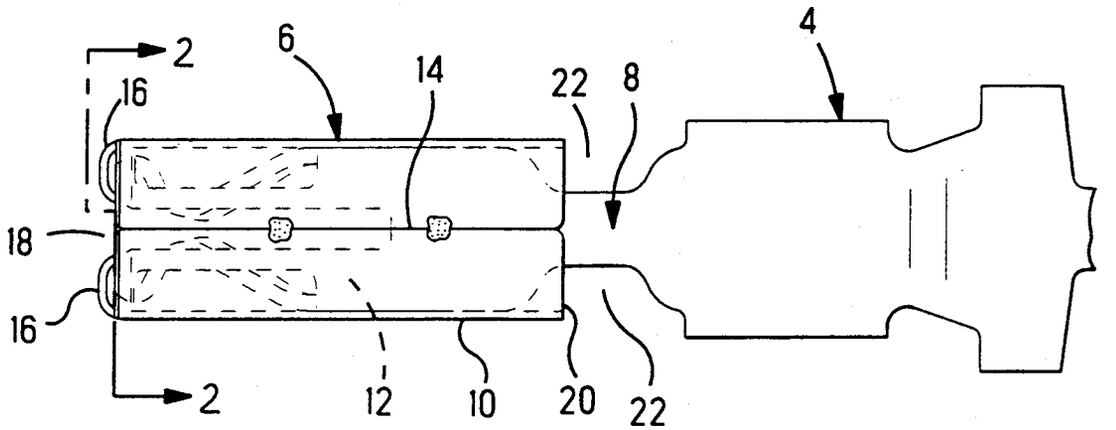
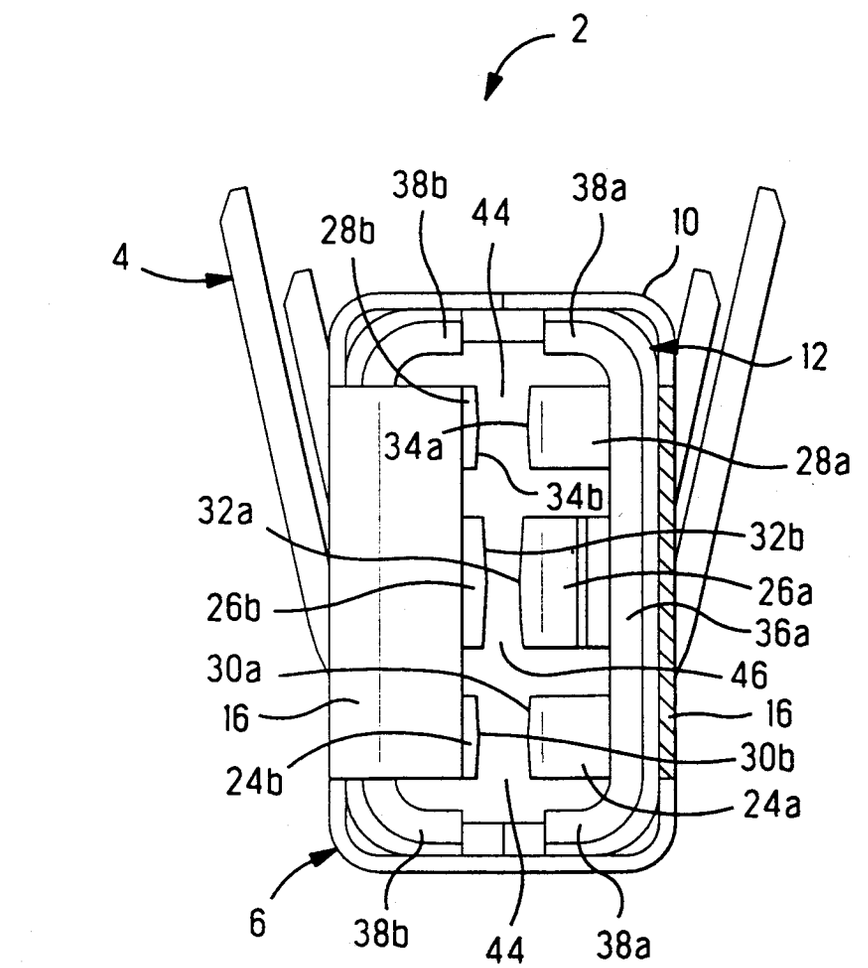

2
6
14
22
8
4
16
18
16
2
12
10
20
22

FIG. 1


2
38b
44
38a
28b
10
4
12
34a
28a
34b
32a
32b
26b
26a
36a
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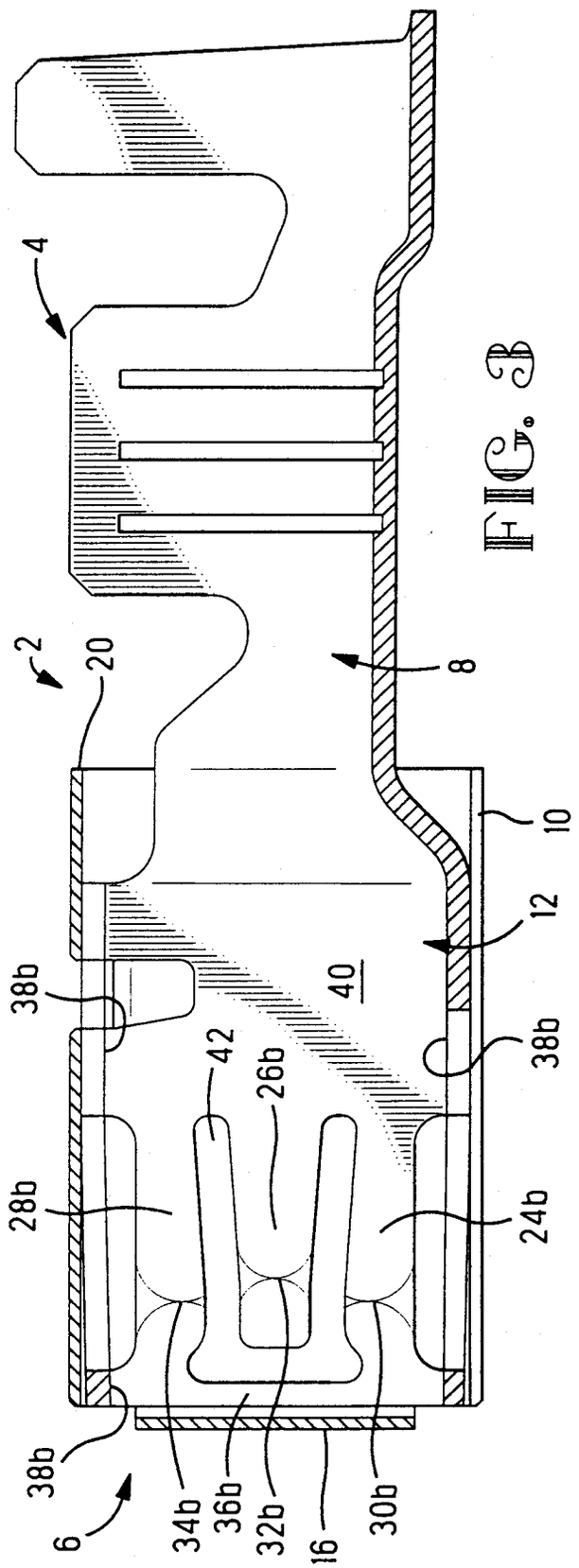
46
16
16
30b
24b
24a
6
38b
44
38a

FIG. 2


4
2
20
8
10
12
38b
40
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26b
28b
24b
38b
38b
6
34b
36b
32b
16
30b

FIG. 3B

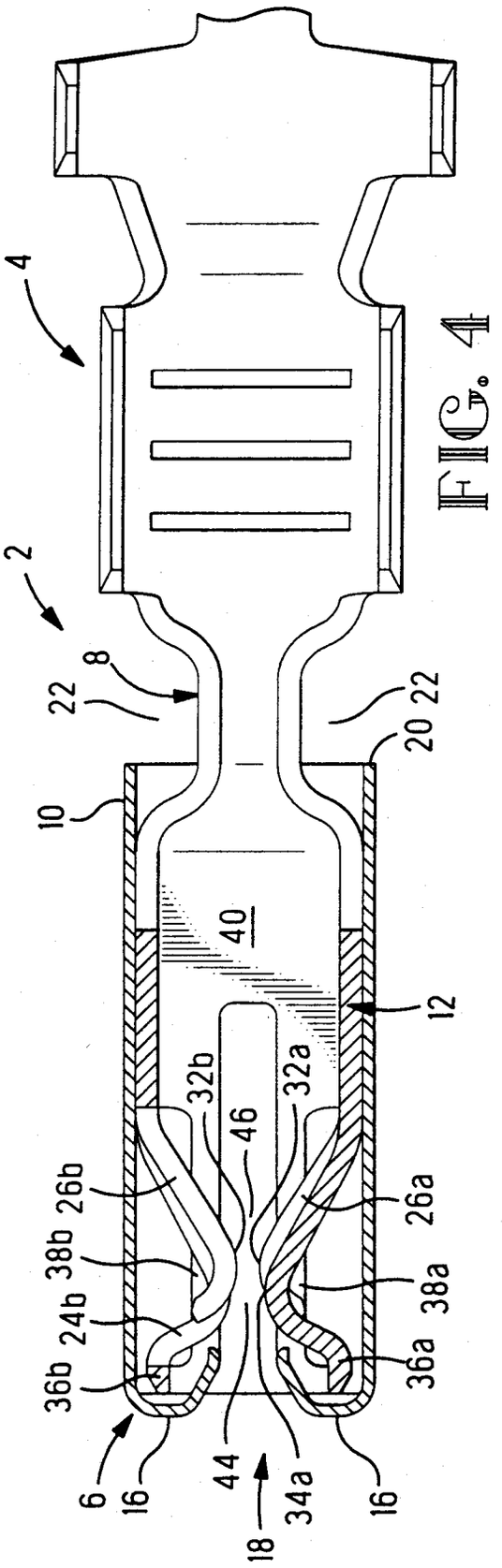
4
2
8
22
20 22
10
40
12
32b
46
32a
26b
26a
38b
38a
24b
36b
36a
6
16
44
18
34a
16

FIG. 4