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(54) **Electrical connector assembly.**

(57) An electrical connection arrangement (10) comprises a heat sink (14) having a projecting terminal post (50) provided with a stepped opening (26) therein for receiving both a terminal (70) and a connector body (27) of an electrical high current cable assembly (20). In addition, the terminal post (50) is constructed with intersecting slots (48,50) and the connector body (27) of the electrical connector assembly has nibs (100) connected thereto which are received in one of the slots. If the connector

assembly (20) is properly mated to the heat sink (14), a U-shaped clip (30) can be snap fittingly connected to the connector body (27) by passing through the other of the slots (52). If it is not properly mated, the clip (80) engages the nibs (100) and cannot be connected to the connector body (27). The clip (30) serves the dual purpose of connecting an electrical cable assembly (20) to the heat sink (14) and serves as a connector position assurance (CPA).

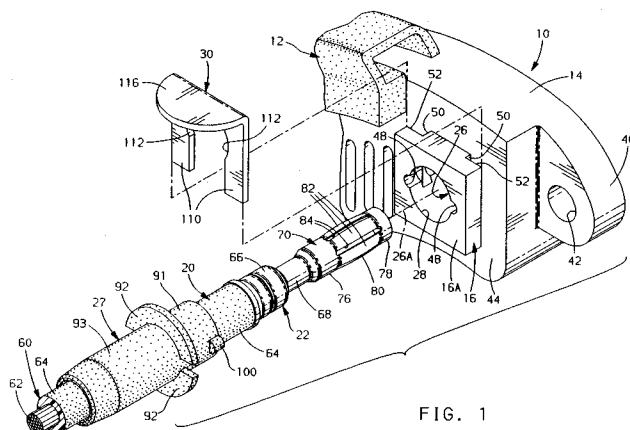


FIG. 1

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The present invention relates to an electrical assembly for example to a high current carrying capacity electrical connector assembly or arrangement for electrical devices such as an alternator or starting motor for automotive vehicles.

Cable assemblies for connection to electrical devices such as alternators or starting motors of automotive vehicles have to have a high current carrying capacity. It has been common to connect terminals of these cable assemblies to terminals on the electrical devices via threaded fasteners. While these connections have been highly satisfactory, this type of connection can cause problems if the connections are not properly made and/or become loose due to vehicle vibrations during usage of the vehicle. In either event, a loss of electrical power can result.

The present invention seeks to provide an improved electrical assembly.

According to an aspect of the present invention there is provided an electrical assembly as specified in claim 1.

A preferred embodiment involves a push-pull electrical connection arrangement or assembly for connection with a high current electrical device, such as an alternator or starting motor of an automotive vehicle. It includes a retention and connector position assurance (CPA) clip for both connecting a connector body of a cable of a cable assembly to the electrical device and for making sure that the cable assembly is properly mated or seated in the electrical device.

In a preferred embodiment, there is provided an electrical device having a heat sink including a projecting post having a stepped opening therein. It has a pair of diametrically spaced facing slots parallel with the opening and two slots in the post which are perpendicular to and intersect the first slots. The cable assembly has a barrel terminal at one end which biasingly and slidably engages the stepped opening along its smaller diameter portion when pushed into the opening to make good electrical contact. The cable assembly is housed within a connector body which is sealingly attached to the cable assembly at one end and which has a forward portion slidably engaged with the opening along its larger diameter portion. The connector body has a radial flange and a pair of diametrically opposite nibs at its forward end which are axially spaced from the flange. The nibs are slidably receivable within the first slots in the post and heat sink. If the connector body and cable assembly are properly mated to the electrical device, the nibs are located behind the second slots in the heat sink and the radial flange abuts the post. A bifurcated U-shaped metal clip has a pair of legs which are inserted through the second slots to snap fittingly connect the connector body to the electrical device

if the connector body is properly mated to the heat sink and terminal post. If the connector body is not properly mated to the heat sink and terminal post, the legs engage the nibs on the connector body and the clip cannot be connected.

The advantages of such a connector assembly or arrangement is that the clip can be readily attached and detached to enable the cable assembly to be readily connected to and disconnected from the terminal post and heat sink of the electrical device. Additionally, the cable assembly can serve both the function of connecting the cable assembly to the electrical device and as a connector position assurance (CPA) to ensure that the cable assembly has been properly mated to the electrical device.

An embodiment of the present invention is described below, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is an exploded view of an embodiment of electrical connector arrangement;

Figure 2 is a fragmentary perspective view of the electrical connector arrangement of Figure 1 showing the parts thereof connected;

Figure 3 is an enlarged fragmentary cross-sectional view taken along line 3-3 of Figure 2; and

Figure 4 is a cross-sectional view taken approximately along line 4-4 of Figure 3.

Referring to the drawings, an electrical connector arrangement 10 broadly comprises an electrical device 12 having a heat sink 14 including an integral projecting post 16, a cable assembly 20 having a terminal 22 which is adapted to slidably engage a first diameter portion 24 of a stepped opening 26 in the post 16 and heat sink 14, an insulated conductor body 27 which is slidably received in a second diameter portion 28 of the stepped opening 26 and which abuts the post 16, and a connector clip 30 which serves both to connect the cable assembly 20 to the terminal post 16 and which serves as a connector position assurance (CPA) to make sure that the cable assembly 20 has been properly mated or seated within the electrical device 12.

The electrical device 12 could be any electrical device requiring a high current capacity. Preferably, the electrical device would comprise an alternator or starting motor of an automotive vehicle. The alternator or starting motor 12 could be of any suitable or conventional construction, except that the heat sink 14 shown in Figure 1 is of a somewhat modified construction in that the heat sink has a stepped opening 26 and the post 16 is slotted as hereinafter noted. Since in all other respects the alternator or starting motor 12 would be of a known or conventional construction, only the changes to the heat sink 14 and post 16 will be described herein.

The heat sink 14 would comprise a cast metal member, such as aluminium, and would have a pair of ears 40 (only one of which is shown) having openings 42 therethrough so that the heat sink 14 could be attached via bolts to the remainder of the alternator or starting motor 12. The heat sink 14 includes the outwardly projecting post 16. The post 16 is rectangular in shape and projects outwardly from the planar side face 44 of the heat sink 14. The post 16 has a planar outer surface 16A and the post 16 and the heat sink 14 have the stepped opening 26 therein. The large diameter portion 28 of the opening 26 extends from the outer surface 16A of the post to a step 45 at a location spaced inwardly from the side face 44 of the heat sink i.e. to the right of the side face 44, as viewed in Figure 3. The small diameter portion 24 extends from the step 45 of the opening 26 to a bottom (not shown) located inwardly into the heat sink 14 or to the right of the step 45, as viewed in Figure 3. The opening 26 has a central axis 26A and step 45 extends radially and perpendicular to the central axis 26A.

Co-extensive with the large diameter portion 28 of the stepped opening 26 are a pair of facing slots 48 at diametric opposite sides of the locations of the opening portion 28. That is, the slots 48 extend for the full length of the large diameter portion 28 of the opening 26 so that they extend into the heat sink 14. The slots 48 are parallel with the axis 26A of the opening 26 and are semicircular in shape. The post 16 is also provided with a second pair of slots 50 which extend perpendicular to the axis 26A of the opening 26 and which intersect the slots 48. The slots 50 are located between the face 44 of the heat sink 14 and a rearward surface 52 on the post 16. Both surfaces 44 and 52 are perpendicular to the axis 26A of the opening 26. The slots 50 thus intersect the slots 48 at a location immediately forward of the side face 44 of the heat sink 14.

The cable assembly 20 comprises a high current carrying capacity cable 60 having a conductive core 62 and an outer insulated sheath 64. The terminal 22 has a rearward cylindrical portion 66 which is crimped onto the electrically conducted sheath of the conductor cable 60, an intermediate cylindrical portion 68 which is crimped onto the conductive core 62 to make good electrical contact therewith and a forward terminal portion 70 which is adapted to be slidably received within the opening portion 24 of the stepped opening 26. To aid in retaining the rearward terminal portion 66 crimped onto the conductive sheath 64, the rearward terminal portion 66 is provided with a radially inwardly extending annular rib 72 which is received within an annular groove 74 in the conductive sheath 64. This greatly aids in axially retaining the rearward end portion of the terminal 22 onto the sheath 64.

The terminal 22 at its forward portion 70 is shaped like a barrel. The forward portion 70 has a rearward cylindrical section 76 a forward cylindrical section 78 and an intermediate section 80. The intermediate section 80 is bowed radially outwardly to define a plurality of circumferentially spaced springs 82 which are separated by axially extending slots 84. The forward section 70 is formed to provide the outwardly bowed springs 82 so that when the forward portion 70 is inserted into the small diameter opening portion 24 in the heat sink, the leaf springs 82 will be compressed radially inwardly and biasingly engage the annular wall defining the small diameter opening portion 24 so as to provide for good electrical contact with the heat sink 14.

The cable assembly 20 further comprises a generally cylindrically shaped connector body 27 having a stepped through opening 87 defining a large diameter portion 88, a small diameter portion 89 and a radially extending step or shoulder 90. The connector body is made from a suitable memory plastic or elastomeric material which is pliable or semi-rigid, i.e., sufficiently resilient or pliable to enable it to be deformed somewhat. The connector body 27 has a forward cylindrical portion 91 which is adapted to be slidably received within the large diameter opening portion 28 of the opening 26, a pair of radially outwardly extending, generally semi-annular flanges 92 which are adapted to abuttingly engage the outer most end surface 16A of the terminal post 16 when connected thereto and a rearward cylindrical end portion 93 which is adapted to be snap fittingly connected to the outer sheath of the conductor 60. To this end, the conductor body 27 has a radially inwardly extending rib or flange 94 which is snap fittingly received within an annular groove 96 in the insulated sheath 64. The rearward portion 93 of the connector body 27 is radially expandable due to the engagement of the rib 94 with the sheath 64 as it is slid thereover, from left to right as viewed in Figures 1 and 3, until the rib 94 is aligned with the groove 96 whereupon it will snap into the groove due to the self-biasing forces of the pliable rearward portion 93 returning toward its normal free state position. When the connector body 27 is connected to the sheath 64, the leftmost end of the rear portion 66 of the terminal 22, as viewed in Figure 3, engages the annular shoulder 90 in the connector body 27 to ensure proper positioning of the connector body 27 onto the sheath 64.

In addition the connector body 27 has a pair of diametrically opposite, radially outwardly extending nibs 100 which are integral with the forward end of the cylindrical portion 91 of the connector body 27 and which are axially spaced forwardly from the radially outwardly extending flanges 92. The nibs

100 are shaped complimentary with the slots 48 of the opening portion 28 of the stepped opening 26 and are adapted to be slidably received within the slots 48.

The cable assembly 20 is connectable to the electrical device 10 or heat sink 14 by inserting the barrel end 70 of the terminal 22 into the opening portion 24 of the stepped opening 26 and the forward portion 91 of the connector body 27 into the enlarged diameter portion 28 of the stepped opening 26. When this occurs, the nibs 100 slide within the slots 48 and the connector body 27 is moved forwardly into the heat sink 14 until the arcuate flanges 92 thereof engage the outer surface 16A of the terminal post 16. When this occurs, the nibs 100 will be located wholly within the heat sink 14 at a location spaced inwardly from the outer surface 44 of the heat sink 14, i.e. to the right of surface 44, as viewed in Figure 3. The connector body 27 due to the close fit between the forward portion 91 and the opening portion 28 of the post 16 and the engagement of the flanges 92 against the post surface 16A also functions as a seal against the ambient environment.

The connector assembly 20 is adapted to be secured to the terminal post 16 and heat sink 14 of the electrical device 10 by the clip 30. The clip 30 is generally U-shaped and has a pair of spaced planar legs 110 provided with arcuate notches or cutouts 112 which face one another. The arcuate notches 112 lie on a circumscribed circle whose diameter is the same as or substantially the same as the outer diameter of the forward portion 91 of the connector body 27. The clip 30 also has an upper bight portion 114 which is integral with the legs 110 and integral with a tab 116 which is bent at right angles to the plane of the legs 110 so that the clip 30 can be manually grasped and manipulated. The clip 30 can be made either from metal or a high temperature resistant substantially rigid plastic material. The thickness of the planar legs 110 is slightly less than the width of the slots 50, i.e., the distance between the surfaces 44 and 52 as measured axially of the axis 26A of the opening 26.

In operation, after the connector assembly 20 is properly mated or connected within the terminal post 16 and heat sink 14, the legs 110 of the clip 30 are positioned within the slots 50 and moved vertically downward. The legs 110 will engage the outer surface of the forward end 91 of the connector body 27 and cause the same to be compressed or deflected inwardly somewhat until the slots 112 in the legs 110 are located diametrically opposite from the forward portion 91 whereupon the pliable forward portion, due to its self-biasing forces, springs outward to be received within the arcuate slots 112 of the legs 110 so that the clip 30 and

connector body 27 are connected with a snap fit.

If the connector assembly 20 is properly mated to the post 16 and heat sink 14, the legs 110 will pass freely in front of the nibs 100 so that it can deflect the forward portion 91 of the connector body 27 to enable it to be snap fittingly connected thereto to retain the entire cable assembly 20 in place. The legs 110 serve to prevent removal of the cable assembly 20 from the electrical device 10, since the nibs 100 will engage the backside of the legs 110. The cable assembly 20 can only be removed by removing the clip 30 from the connector body 27.

If the cable assembly 20 is not properly mated or connected within the electrical device 10, the legs 110 will engage the nibs 100 and be prevented from being pushed downwardly to connect the connector assembly 20 to the electrical device 10. This informs the operator that the electrical connector assembly 20 has not been properly mated so as to allow him to properly push the connector assembly 20 all the way into the electrical device 10 so that the clip 30 can be mated to the connector assembly 20. Thus, the U-shaped clip 30 also functions as a connector position assurance (CPA).

From the foregoing it should be apparent that the described embodiment can provide a quick, electrical connect and disconnect arrangement in which a simple U-shaped clip functions both (1) to connect an electrical cable assembly to an electrical device and (2) to a connector position assurance (CPA) to ensure that the cable assembly has been properly electrically connected and mated to the electrical device.

The disclosures in United States patent application no. 08/199,919, from which this application claims priority, and in the abstract accompanying this application are incorporated herein by reference.

Claims

1. An electrical assembly including an electrical device (10) comprising connection means (16) including a stepped central opening (26) providing first and second diameter portions (26,28); at least one first slot (48) in communication with said opening along said first diameter portion (28); at least one second slot (52) in said connection means intersecting said first slot, a high current cable assembly (20) including a conductor (62) and a metal terminal (70) projecting from one end of the conductor and which is slidably receivable in the connection means (16) along said second diameter portion (26) of said opening; a hollow pliable connector body (27) attached to said cable

assembly and including a first portion (91) which is slidably receivable within said first diameter portion (28) of said opening, abutment means (92) abutable against said connection means of said electrical device and at least one nib (100) shaped complementary with said first slot and slidable in said first slot to a position beyond said second slot; and a clip (20) for removably securing said cable assembly to said connection means, said clip including at least one leg (110) receivable in said second slot so as to be located so as to prevent the removal of the nib from the connector body and thereby to prevent removal of the cable assembly, said leg engaging said nib if the connector body is not fully seated in the connection means.

2. An electrical assembly according to claim 1, wherein the connection means (16) includes a pair of first slots (48) on opposing sides of said opening, and a pair of second slots (52) each intersecting a respective first slot, the connector body (27) including a pair of nibs (100) each slidable within a respective slot to a position beyond the respective second slot, the clip (30) being a bifurcated clip and including a pair of spaced legs (110) each receivable in a respective second slot.
3. An electrical assembly according to claim 1 or 2, wherein the or each first slot extends substantially parallel with the first diameter portion (28) of the opening.
4. An electrical assembly according to claim 1, 2 or 3, wherein the or each second slot (52) extends substantially perpendicularly to the or its respective first slot (48).
5. An electrical assembly according to any preceding claim, wherein the electrical device includes a heat sink (14) provided with a projecting post (50) terminating in an outer end surface (16A), the projecting part providing the connection means (16), the abutment means (92) of said connector body including a radial flange abutable against the outer end surface of the post (50).
6. An electrical assembly according to claim 5, wherein the or each nib (100) is axially spaced from said radial flange.
7. An electrical assembly according to any preceding claim, wherein the or each leg (40) of said clip (30) is provided with an arcuate notch (112) having a diameter substantially the same

as a diameter of the first portion (91) of the connector body, the or each leg being operative to deform the first portion (91) of said connector body until it is aligned with the notch or notches.

8. As electrical assembly according to any preceding claim, wherein said clip (30) includes a bight portion (114) between at one end of the or each leg and a tab (116) extending at an angle to said bight portion.

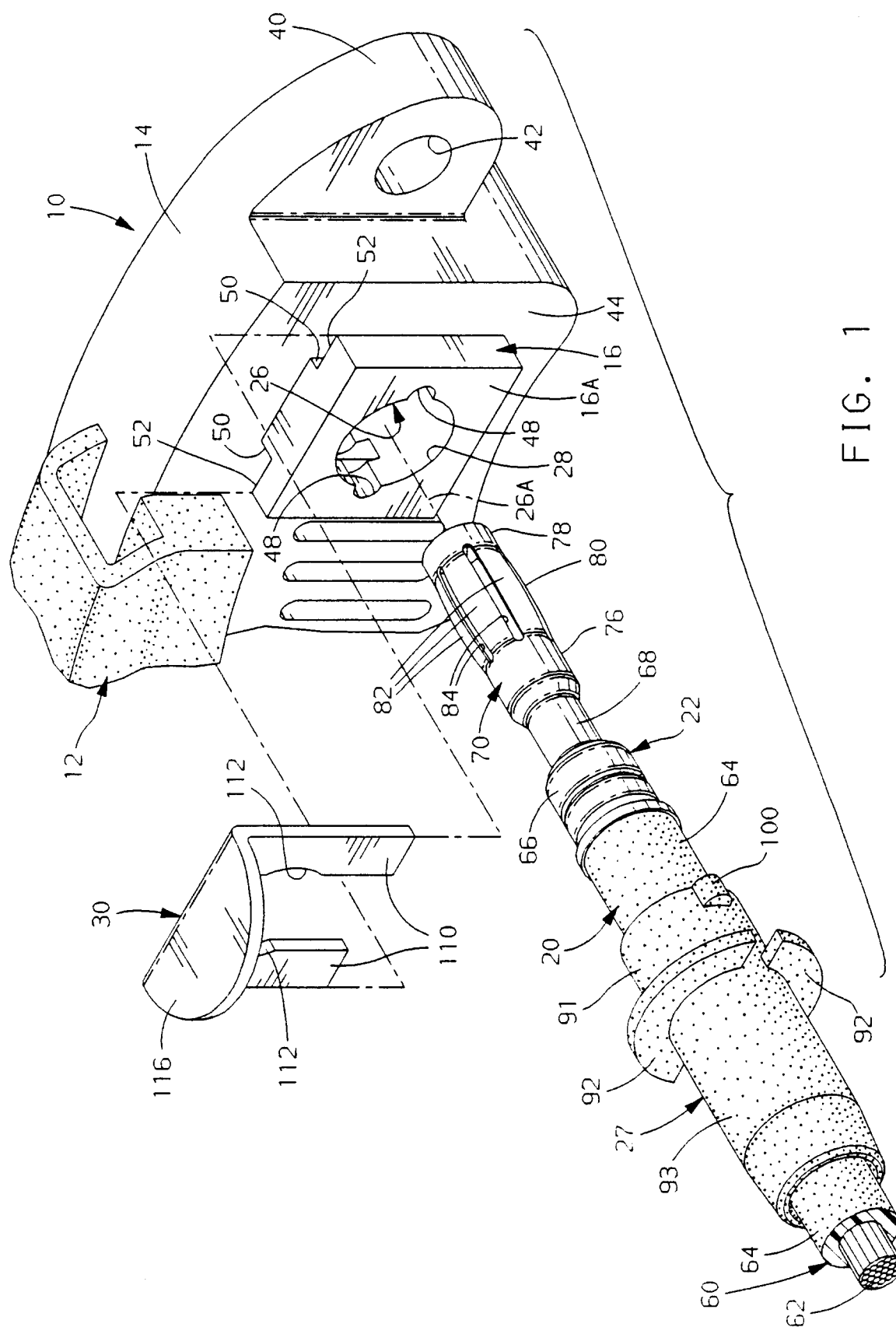


FIG. 1

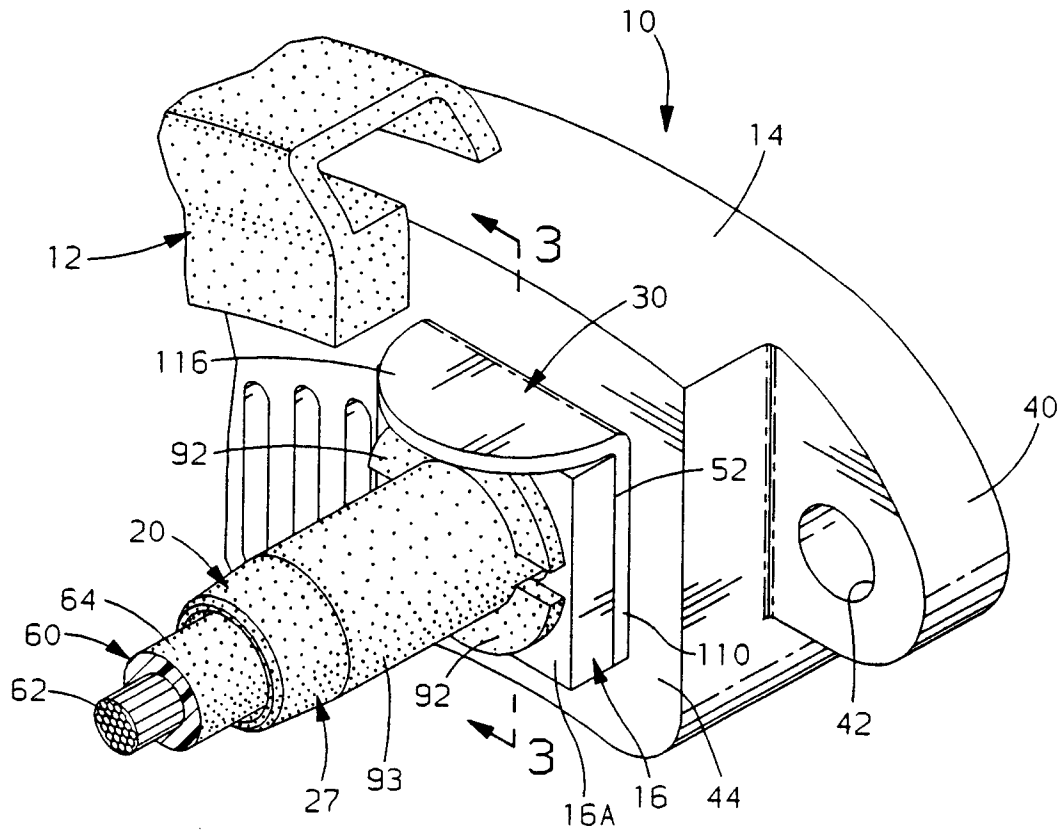


FIG. 2

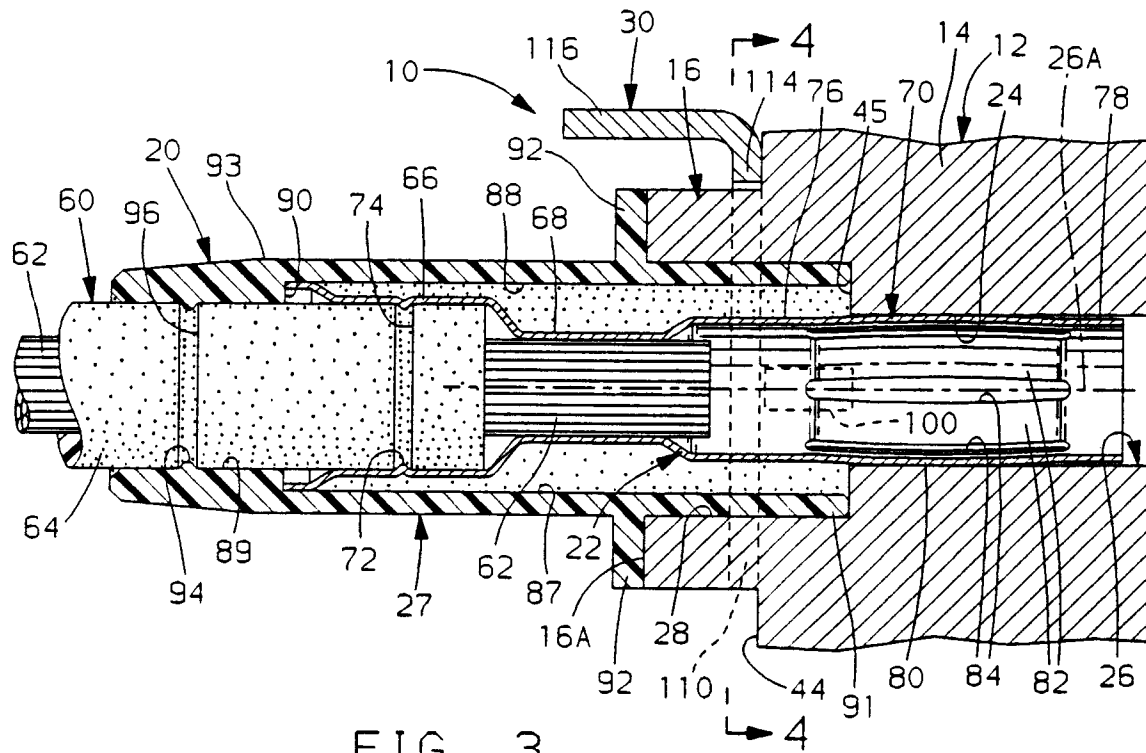


FIG. 3

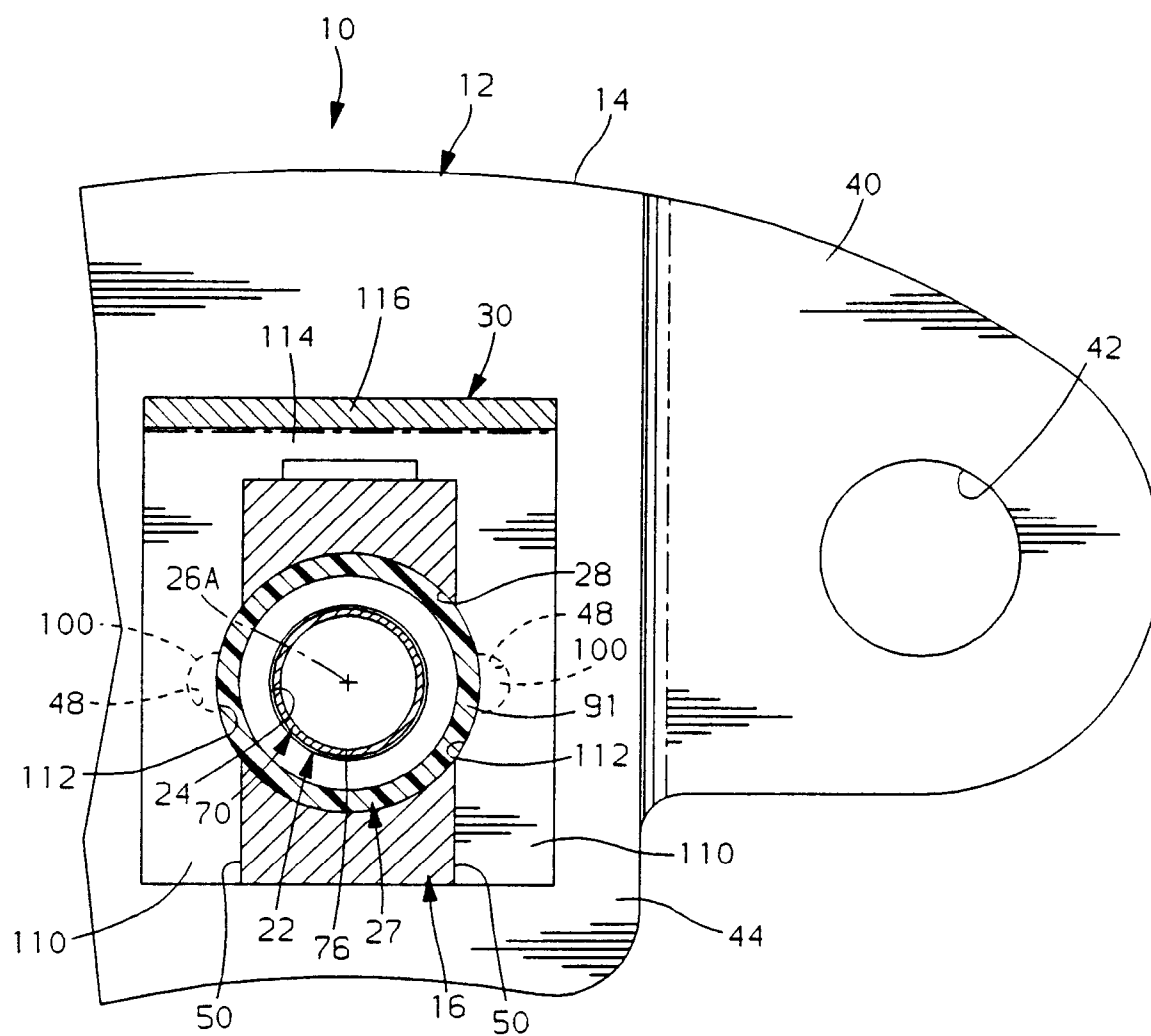


FIG. 4