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(54) Guide assembly for facilitating the termination of a multiple conductor cable to an electronic component

(57) An apparatus is provided for facilitating the termination of an electrical cable (34) to an electronic component (48,50). The electrical cable (34) is comprised of a plurality of conductors. The apparatus is defined by a main body which includes a front portion (63), a rear portion (64), a bottom portion (66) and a top portion (68). The main body has a plurality of finger portions (74) which define a plurality of slots (70). The slots (70) define individual compartments which each receives an individual conductor of the electrical cable. The slots (70) are suitably dimensioned to be aligned with conductive portions of the electronic component. A plurality of apertures (72) are formed through the front portion (63) to the rear portion (64). Each aperture (72) receives an individual conductor.

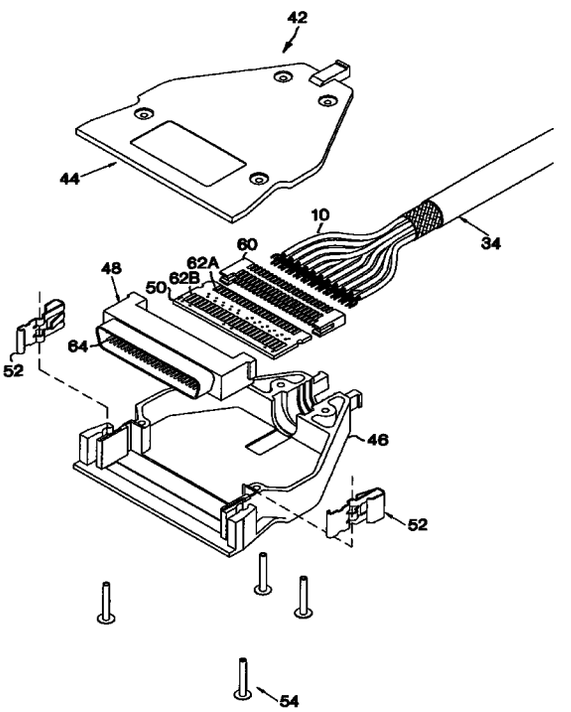

FIG. 1

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Description

This invention generally relates to electrical cables. More particularly, the present invention relates to an apparatus for facilitating the termination of a multiple conductor cable to an electronic component, and for providing strain relief during the assembly of such an electrical cable.

Electrical cables for data transmission are well known. One common data transmission cable is a coaxial cable. Coaxial cables generally comprise an electrically conductive wire surrounded by an insulator. The wire and insulator are surrounded by a shield, and the wire, insulator and shield are surrounded by a jacket. Coaxial cable assemblies may comprise multiple individual conductors that are individually insulated and surrounded by a common shield. Coaxial cables can transmit at much higher frequencies than a standard twisted pair wire and, therefore, have a much greater transmission capacity. Coaxial cables provide data transmission at raw data rates of up to 10 Mbit/sec (Mbps). In addition, coaxial cables have very little distortion, cross-talk or signal loss, and therefore, provide a very reliable medium for data transmission.

With the proliferation of high-speed, powerful personal computers and the availability of advanced telecommunications equipment, there is a need for cables that are capable of transmitting data at ever faster speeds. One such cable used for high speed data transmission between two points or devices is a parallel pair or twin axial cable. Parallel pair cable designs provide two separately insulated conductors arranged side by side in parallel relation, the pair being then wrapped in a shield. A cable assembly may be provided which is comprised of multiple parallel pair component cables.

Another cable particularly effective in high speed data transmission applications is a quad cable. Quad cable designs provide four separately insulated conductors arranged about a central axis at equal circumferential intervals. The insulated conductors are wrapped in a shield. For moderate data transmission speeds (i.e. less than 200 Mbit/sec), quad cables have been used by transmitting two differential pairs, each pair comprising two conductors, with each conductor oriented generally 180° apart from the other in the pair. A cable assembly may be comprised of multiple quad cable components.

In many electronic systems, the foregoing cables are terminated to an electronic component, such as a printed circuit board, for example. It is very common to have a plurality of individual conductors present at the point of termination. By way of example, in a main quad type cable assembly comprising ten component quad cables, a total of forty conductors must be correctly and precisely terminated to an electronic component, such as the printed circuit board. Heretofore, the termination of such a cable assembly to the electronic component has been accomplished manually, which has been a tedious, time consuming, and therefore costly manufacturing process.

An object of the present invention is to provide an apparatus for facilitating the automatic termination of a cable having multiple conductor components which all must be correctly and precisely terminated to an electronic component, such as a printed circuit board.

According to the present invention there is provided an apparatus for facilitating the termination of an electrical cable to an electronic component wherein the electrical cable is comprised of a plurality of conductors, the apparatus comprising:

a main body which includes a front portion, a rear portion, a bottom portion and a top portion, the main body having a plurality of finger portions which define a plurality of slots, the slots defining individual compartments, each compartment being adapted to receive an individual conductor of the electrical cable, the slots being suitably dimensioned to be aligned with conductive portions of the electronic component, wherein a plurality of apertures are formed through the front portion to the rear portion, each aperture being adapted to receive an individual conductor, wherein the apparatus facilitates the termination of the multiple conductor electrical cable to the electronic component.

The present invention provides a wire guide assembly for facilitating the termination of a multiple conductor cable to an electronic component by permitting an automated process to be accomplished for said termination.

Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is an exploded perspective view of an electrical cable connector assembly which incorporates the guide assembly of the present invention.

Figure 2 is a perspective view of the guide assembly of Figure 1.

Figure 3 is a rear elevational view of the guide assembly of Figure 2.

Figure 4 is a side elevational view of the guide assembly of Figure 2.

Figure 5 is a plan view of the guide assembly of Figure 2.

Figures 6-14 are sequential views illustrating utilization of the guide assembly in the termination of an electrical cable assembly to an electronic component.

Figure 15 is an enlarged cross-sectional view of an exemplary electrical cable which may be terminated using the guide assembly of the present invention.

Figure 16 is an enlarged cross-sectional view of an exemplary electrical cable which may be terminated using the guide assembly of the present invention.

The present invention is a wire guide assembly for

facilitating the termination of a multiple conductor cable to an electronic component. As used herein the term multiple conductor cable is any cable assembly comprising multiple conductors arranged within a common shield.

For purposes of illustration only, and without intending to limit the scope of the specification, examples of multiple conductor cables which may be terminated by employing the guide assembly of the present invention are illustrated in Figures 15 and 16. In Figure 15, a multiple differential pair cable is illustrated at 10 having an even numbered plurality of electrical conductors 12, 14, 16, 18. The electrical conductors form a plurality of differential pairs of electrical conductors with conductors 12 and 14 forming a first differential pair and conductors 16 and 18 forming a second differential pair. In this instance, the conductors 12-18 comprise multiple strand wires, but this present invention functions equally well using single strand wires. The cable differs from a pair of twin ax cables in that all of the conductors are all surrounded by a single shield 20 and are located within a single jacket 22.

As can be seen, the conductors 12, 14, 16, 18 are spaced apart in generally equidistant circumferential intervals and extend substantially parallel or helical with respect to each other over the length of the cable. The overall geometric shape of the cable is round. The conductors of each differential pair are generally spaced 180° apart from each other, which in a quad configuration, as shown, places the four conductors circumferentially spaced apart in approximately 90° intervals.

Each of the conductors is electrically insulated from each other and from the surrounding shield 20. This insulation can be accomplished by an independent insulation material separating the conductors from each other and another independent insulation material separating the conductors from the shield, or through the use of a single insulation layer that accomplishes both of these functions. As illustrated in Figure 15, each of the conductors 12, 14, 16, 18 is surrounded by its own insulation layer 24, 26, 28 and 30, respectively.

A center filler 32 may be provided to assist in maintaining the relative position between the conductors and shield within the cable 10. The center filler 32 may comprise a dielectric material that will not disrupt the electric properties within the cable. The center filler 36 may be circular in cross-section and is smaller in diameter than the insulating dielectrics 24-30 so that adjacent dielectrics contact each other. The center filler 36 may be constructed as a solid tube of material, a hollow tube, or a material with a cellular structure to reduce dielectric constant. The center filler 32 may be constructed of a foamed fluoropolymer, as that used for the insulating dielectrics, or an expanded polytetrafluoroethylene (ePTFE).

The conductors 12-18 may be constructed of any electrically conductive material, such as copper, copper alloys, metal plated copper, aluminum or steel.

The insulation 24-30 may be formed from a generally crush resistant material to avoid significant changes in insulative properties of the dielectric upon the application of tensions and forces associated with handling the cable. In addition, the insulation may be constructed of a material that has a low dielectric constant. Suitable insulation materials include foamed polymers selected from the group consisting essentially of fluorinated ethylene propylene copolymer (FEP), perfluoroalkoxy copolymer (PFA), ethylene tetrafluoroethylene copolymer (ETFE), polyethylene, polypropylene, polyolefin copolymers, and polyallomers. Alternatively, it may be possible to construct the dielectric from certain non-foamed materials, such as expanded polytetrafluoroethylene polymer (ePTFE).

The outer jacket 22 that is circumferentially disposed about the shield 20, the insulating dielectrics 24-30 and the conductors 12-18, provides a number of useful properties. First, the jacket is useful for electrically insulating the shield 20, preventing contamination of the shield 20 and inhibiting the introduction of high dielectric contaminants, such as water, within the cable. The jacket 22 can also serve as a surface for marking or coding the cable 10. The jacket 24 may be constructed of polyvinylchloride (PVC), PVC compounds, FEP, or similar polymers and is generally between about 0.010 and 0.030 inches thick. The jacket 22 may be extruded over or otherwise positioned around the shield 20.

The shield 20 may be constructed of a plurality of interwoven, electrically conductive strands that surround the conductors 12-18 and the insulating dielectrics 24-30. The shield 20 prevents unwanted electromagnetic interference from causing significant signal losses and limits the amount of energy radiated from the cable 10.

Figure 16 illustrates a multiple conductor cable 34 which comprises a plurality of quad cable components 10. As can be seen, this cable comprises ten quad cable components thereby creating forty individual conductors which must all be precisely, effectively and efficiently terminated to an electronic component, such as a printed circuit board, for example. The quad cable components 10 may be arranged around a common center 36 and commonly shielded by a braided shield 38 and a jacket 40.

Figure 1 is an exploded perspective view of an electrical cable connector assembly, indicated generally at 42, which incorporates a guide assembly 60. The guide assembly 60 facilitates the termination of a multiple conductor cable to an electrical component. The electrical cable connector assembly includes a multiple conductor cable 34, first and second housing parts 44 and 46, an electronic component, and the guide assembly 60. Although the electronic component is illustrated as an electrically connected multi-pin assembly 48 and a printed circuit board 50, as should be understood, the guide assembly 60 may be employed to facilitate the termination of a multiple conductor cable to any electronic component, such as but not limited to an individual multi-pin assembly, an individual printed circuit board, or

an integral multi-pin assembly and printed circuit board, for example. Retention clips 52 and fasteners 54 may be employed to fixedly assemble the connector assembly 42 as an integral connector. The printed circuit board 50 includes conductive traces 62A and 62B. Individual conductors of the multiple conductor cable 34 are electrically connected to the conductive traces 62A by any suitable method, such as by soldering, for example. Additionally, the individual pins 64 of the multi-pin assembly 48 are terminated to respective conductive traces 62B. As should be understood, conductive traces 62A and 62B may be connected using multiple layers and vias to achieve a predetermined wiring scheme.

The guide assembly 60 is best understood by reference to Figures 2-5. The guide assembly 60 is defined by a main body which includes a front portion 63, a rear portion 64, a bottom portion 66 and a top portion 68. Slot portions 70 define individual compartments which receive the conductors of the multiple conductor cable 34. The slot portions 70 are dimensioned to be aligned with the conductive traces 62A in an assembled electrical connector assembly 42. A plurality of apertures 72 are formed through the guide assembly 60 from the front portion 63 to the rear portion 64. Each aperture is centered relative to an individual slot portion 70, and each aperture receives a respective individual conductor, as will be explained in further detail hereinafter.

As best seen by reference to Figures 1 and 2, the guide assembly 60 may include a plurality of fingers 74 which define the slot portions 70. The guide assembly 60 may also include a means for fixedly locating or removably mounting the guide assembly to the electronic component. In one embodiment of the present invention, projections 76 are formed on the main body of the guide assembly 60. These projections 76 interact with respective detents which are formed on the printed circuit board.

The guide assembly 60 may be formed from any suitable engineering grade thermoplastic material, such as but not limited to, polyester, polyphenylene sulfide, polyamide, acetyl, acetylene-butadiene-styrene terpolymer, polytetrafluoroethylene, polyvinyl chloride, polypropylene, polyethylene, polyethylene terephthalate (PET), polybutyline terephthalate (PBT), or liquid crystal polymer (LCP).

In operation, the present invention facilitates the termination of a multiple conductor cable, such as the cable 34 which is illustrated in Figure 16, to an electronic component, such as the multi-pin assembly 48 and/or the printed circuit board 50. Without intending to limit the scope of the present invention, the present invention may be better understood by referring to Figures 6-16 in conjunction with the following text.

The cable 34 is terminated by first loading the cable into a carrier assembly 80, as illustrated in Figure 6. The carrier assembly 80 supports the cable 34 which is comprised of a plurality of multiple differential pair assemblies 10, each having four electrical conductors 12, 14, 16 and 18. Typically, the multiple differential pair assemblies project from a first portion of the cable 34, at equal interval spacings, e.g. 0.100 inches. The evenly spaced multiple differential pair assemblies are stripped and prepared, thereby exposing the four electrical conductors 12, 14, 16 and 18 of each multiple differential pair assembly. The carrier assembly 80 is then loaded into a sorting fixture (not shown) having sorting combs 82 which define slots having predetermined centers, e.g. 0.050 inches. The individual conductors of each multiple differential pair assembly are sorted into the combs 82, as illustrated by Figure 7, in accordance with a predetermined wiring sequence. Color coding or electrical probing may be used to locate predetermined electrical conductors. Excess conductor length is trimmed by cutters 84 (Figure 8). Once the individual conductors have been sorted and trimmed, a guide assembly 60 is positioned above the individual conductors, as illustrated in Figure 9. (The guide assembly 60 may already have been attached to the printed circuit board 50 and the multi-pin assembly 48.) The guide assembly 60, printed circuit board 50 and the multi-pin assembly 48 are then positioned between the sorting combs 82 to a position wherein the slot portions 70 of the guide assembly 60 are aligned with the slots of the sorting combs (Figure 10). The carrier assembly 80 is then moved toward the guide assembly 60, which causes the individual electrical conductors to bend toward the guide assembly (Figure 11). A pair of positioning combs 86 are next employed to push the individual electrical conductors fully into their appropriate slot portions 70 of the guide assembly 60 (Figure 12). The carrier is then moved toward the guide assembly 60 in a manner to position the individual conductors through the apertures 72 and in contact with the electrical traces 62A (Figure 13). Finishing the operational steps, the positioning combs 86 are opened, thereby freeing the assembled apparatus for further process steps, such as electrical soldering for example.

Claims

1. An apparatus for facilitating the termination of an electrical cable (34) to an electronic component (48,50) wherein the electrical cable is comprised of a plurality of conductors, the apparatus comprising:

   a main body which includes a front portion (63), a rear portion (64), a bottom portion (66) and a top portion (68), the main body having a plurality of finger portions (74) which define a plurality of slots (70), the slots (70) defining individual compartments, each compartment being adapted to receive an individual conductor of the electrical cable, the slots (70) being suitably dimensioned to be aligned with conductive portions of the electronic component, wherein a plurality of apertures (72) are formed through the front portion (63) to the rear portion (64), each aperture (72) being adapted to receive an

individual conductor, wherein the apparatus facilitates the termination of the multiple conductor electrical cable (34) to the electronic component (48,50).

2. Apparatus as claimed in claim 1, further comprising a means for removably mounting the main body to the electronic component.

3. Apparatus as claimed in claim 2, wherein the removable mounting means comprises at least one projection (76) which interacts with at least one detent formed in the electronic component.

4. Apparatus as claimed in any preceding claim, wherein the apparatus is formed of a thermoplastic polymer material.

5. Apparatus as claimed in claim 4, wherein the thermoplastic polymer material consists essentially of polyphenylene sulfide, polyamide, acetyl, acetylene-butadiene-styrene terpolymer, polytetrafluoroethylene, polyvinyl chloride, polypropylene, polyethylene, polyethylene terephthalate, polybutyline terephthalate, or liquid crystal polymer.

6. Apparatus as claimed in claim 4 or 5, wherein the thermoplastic material is an engineering grade thermoplastic.

7. Apparatus as claimed in any preceding claim, comprising:

an electrical cable having more than two conductors;
the electronic component is an electrical connector; and
the apparatus forming a guide assembly for facilitating termination of the electrical cable to the electrical connector.

8. Apparatus as claimed in claim 7, further including a housing portion which encloses the guide assembly and the electrical connector.

9. Apparatus as claimed in claim 7 or 8, wherein the electrical connector is defined by a printed circuit board (50).

10. Apparatus as claimed in claim 7 or 8, wherein the electrical connector is defined by a printed circuit board (50) and a multi-pin connector assembly (48).

11. Apparatus as claimed in claim 7 or 8, wherein the electrical connector is defined by an integral printed circuit board (50) and multi-pin connector assembly (48).

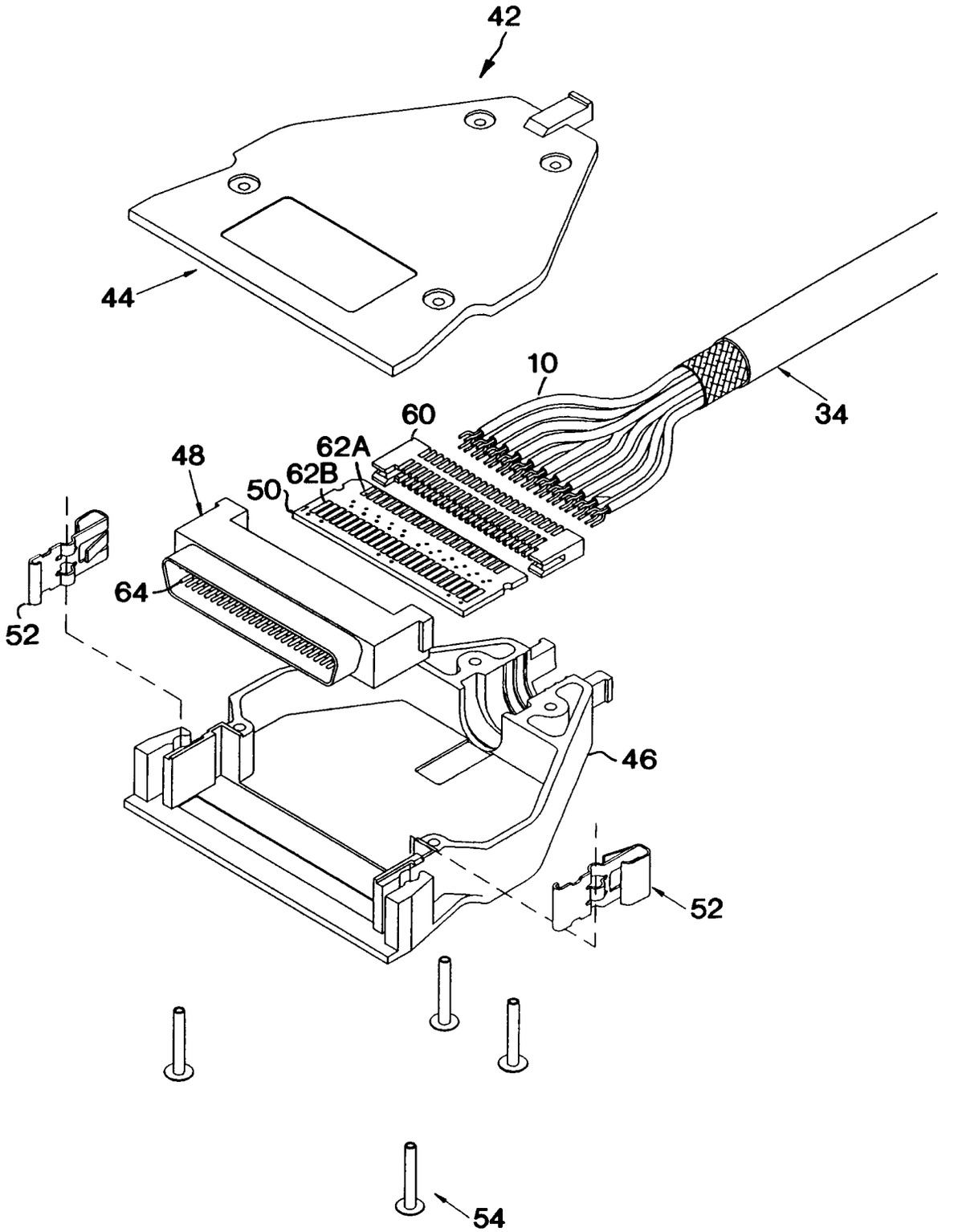

FIG. 1

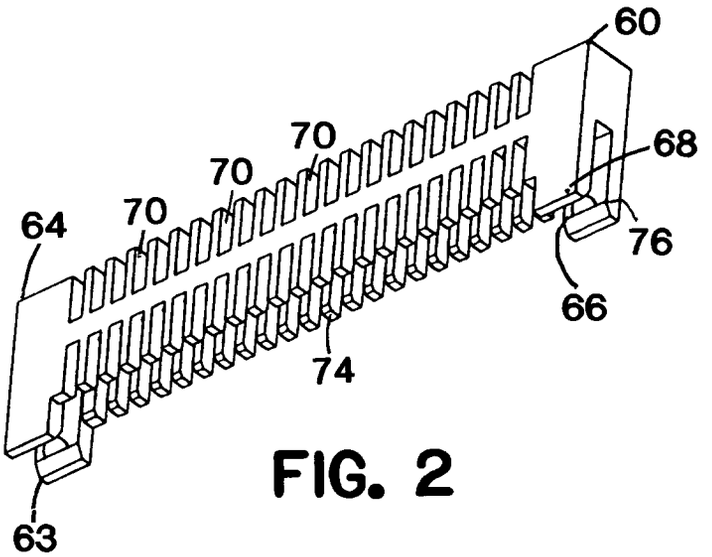

FIG. 2

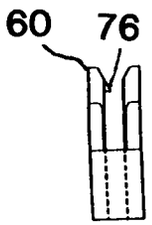

FIG. 4

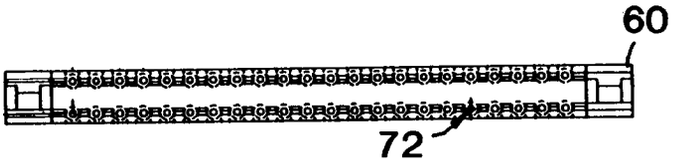

FIG. 3

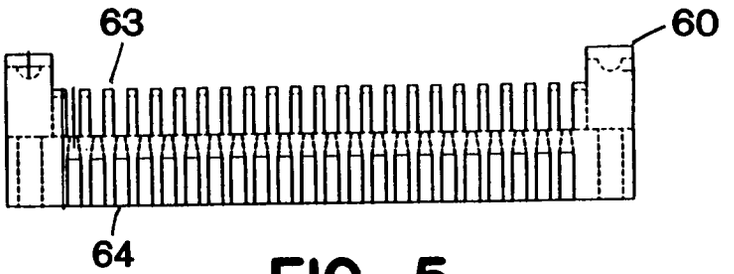

FIG. 5

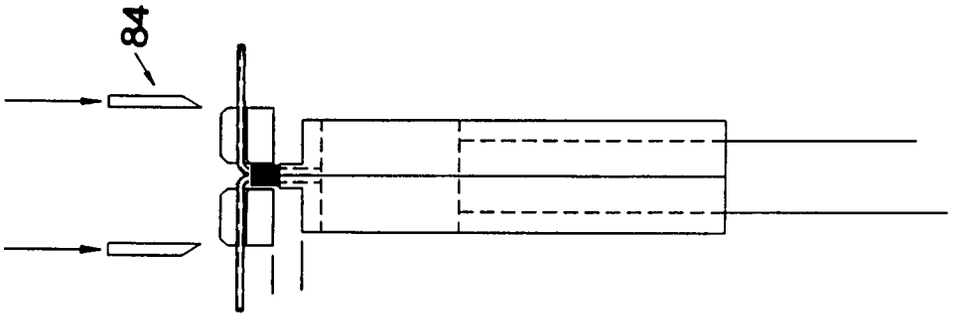

FIG. 8

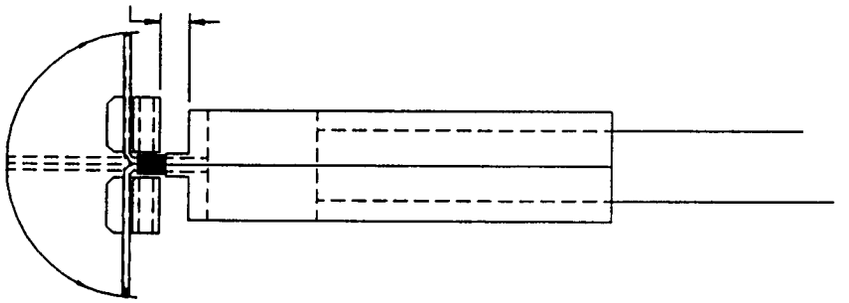

FIG. 7

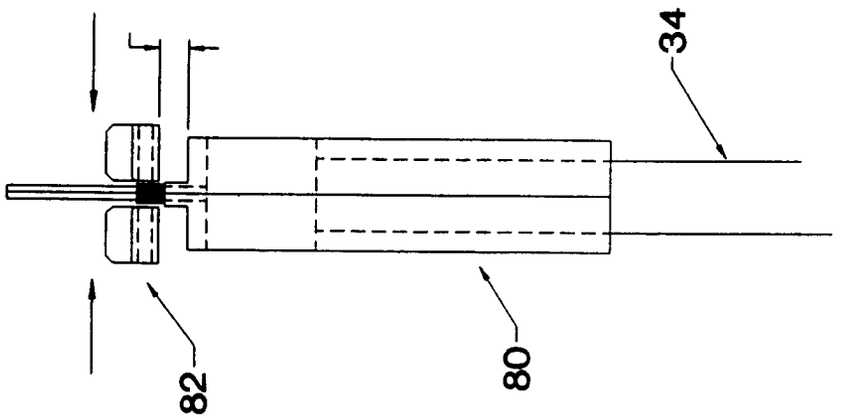

FIG. 6

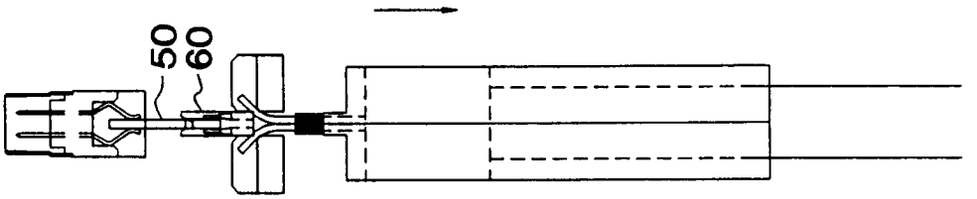

FIG. 11

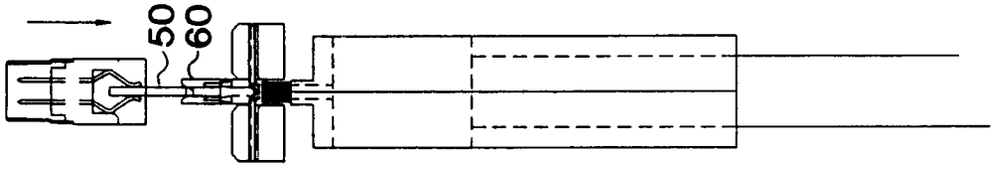

FIG. 10

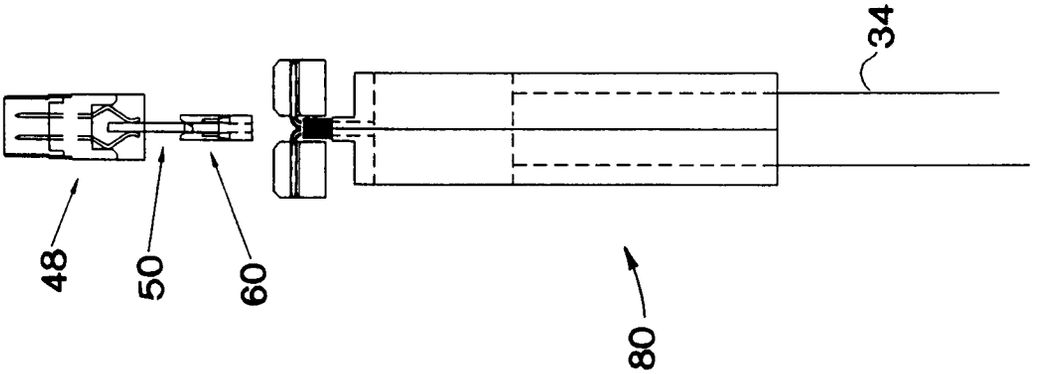

FIG. 9

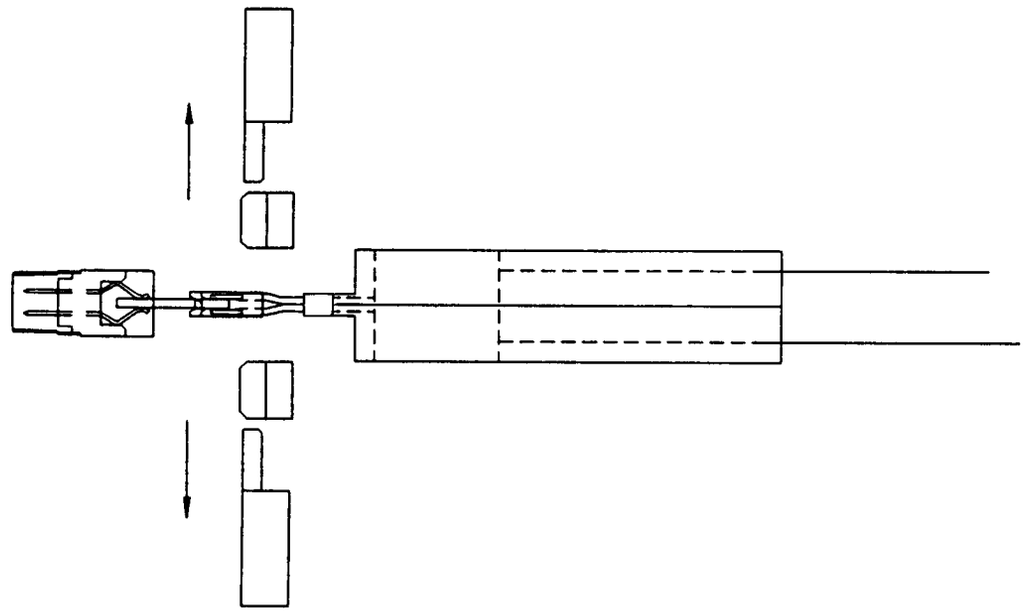

FIG. 14

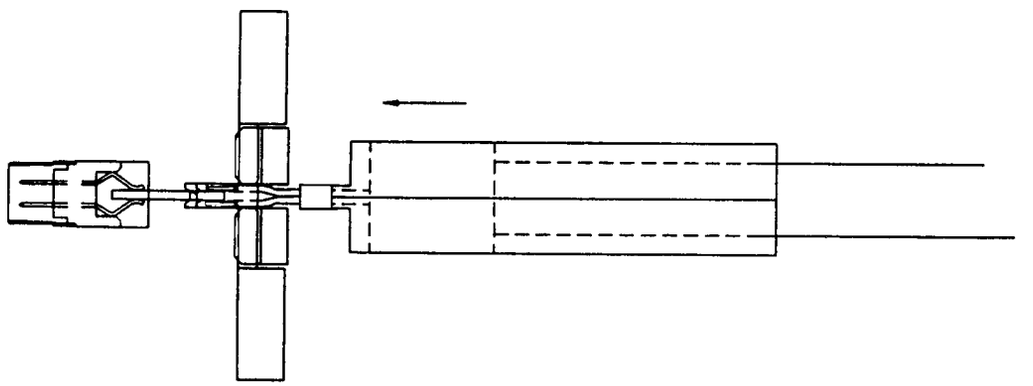

FIG. 13

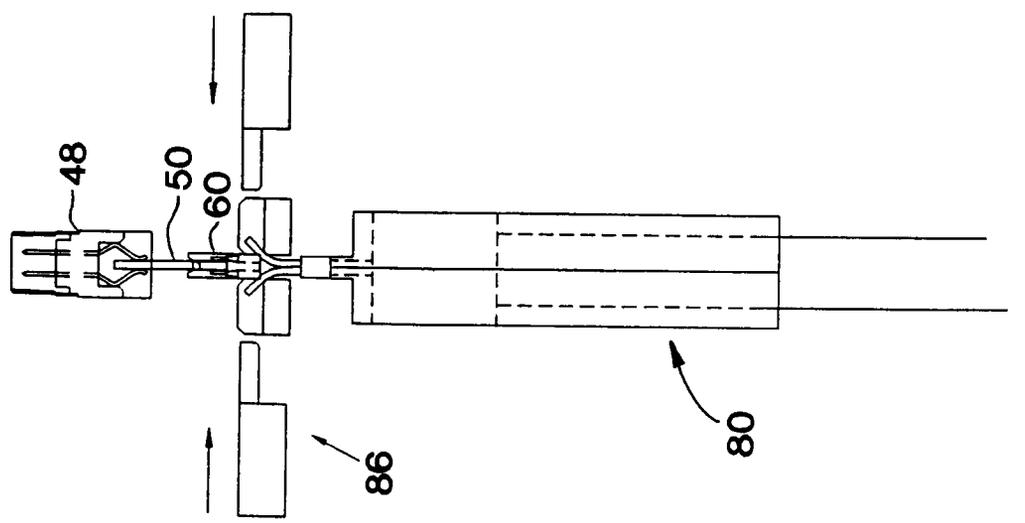

FIG. 12

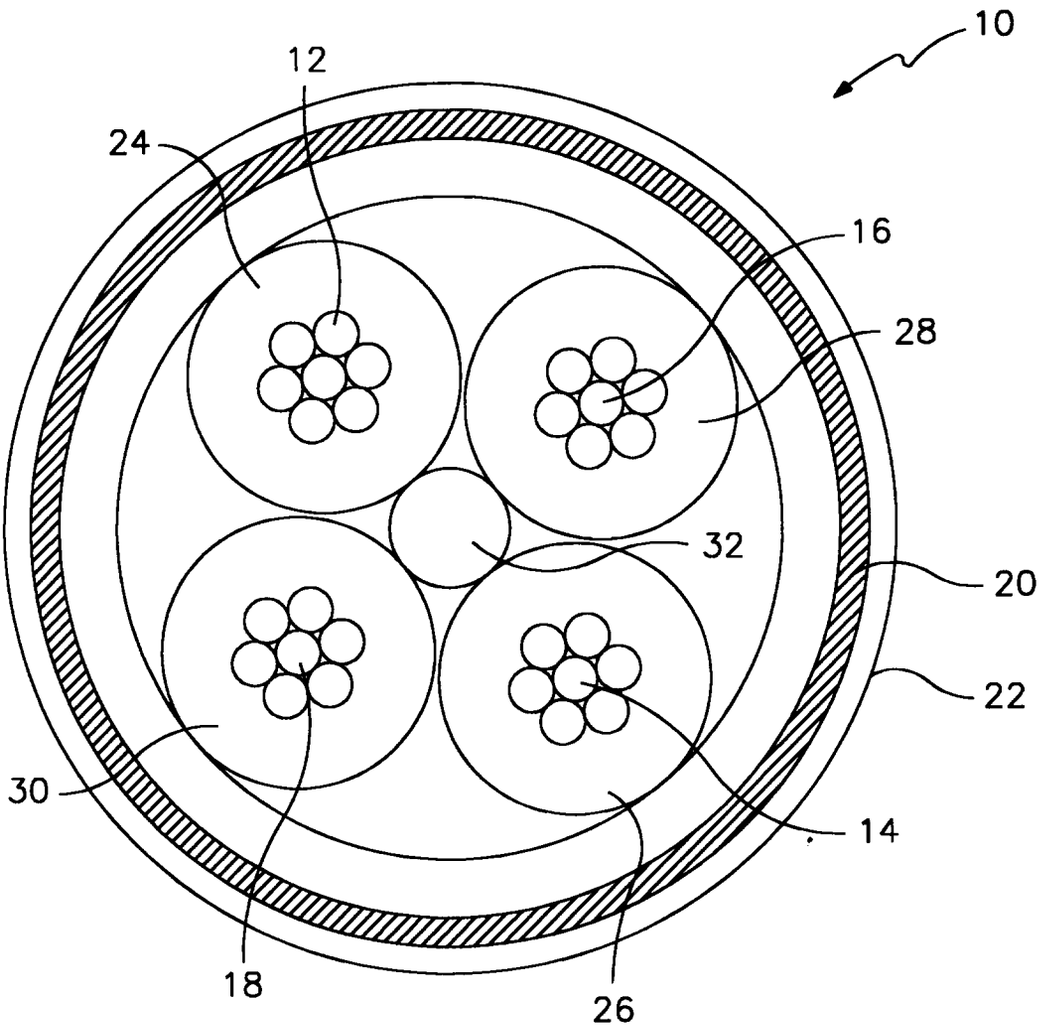

FIG. 15

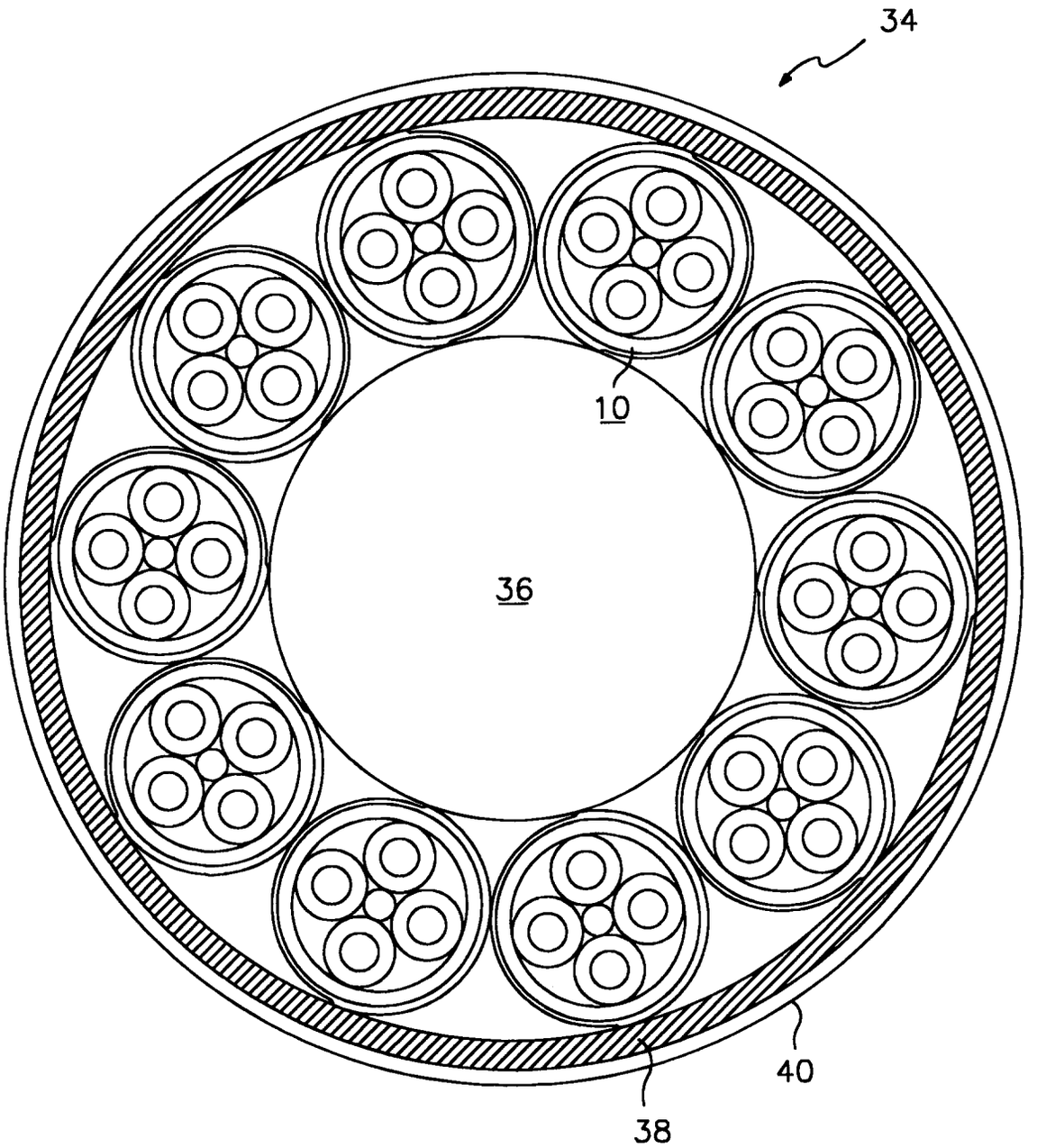

FIG. 16