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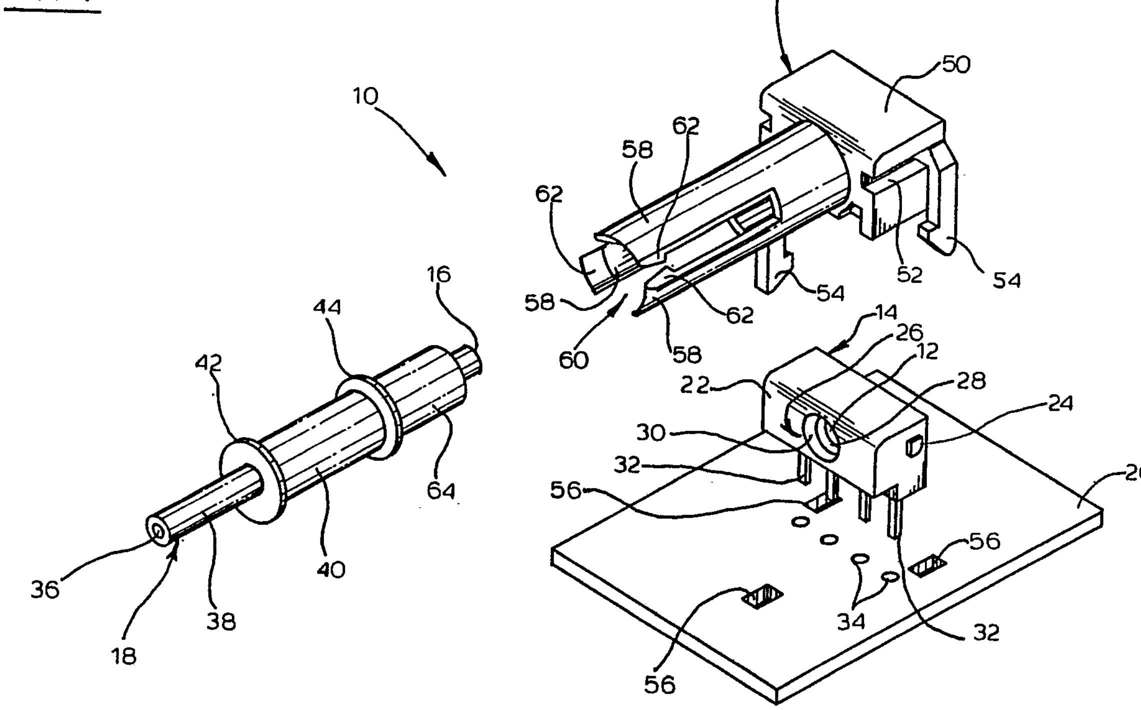
(54) Fiber optic connector assembly

(57) A connector assembly for connecting an optoelectronic device (14) mounted on the printed circuit board (20) with the end of an optic fiber (18) is provided in one embodiment. The optoelectronic device has a housing (22) including an optical port (26) surrounding an optical lens. The optical port has means (28, 30) for guiding a fiber end (16) in alignment with the lens. A cylindrical ferrule (40) having a flange (42) at one end is secured around the fiber. A unitary connector assembly housing (48) is provided for receiving and maintaining the fiber end and the optical lens in connected relation. The housing (48) includes a portion (50) for receiving the optoelectronic device and means defining the elongated passageway (60) for receiving the fiber and ferrule. The passageway communicates with the optical port. An open end, through which the fiber and ferrule are received, has expandable and engageable means (58, 62) for removeable cooperation with the ferrule flange (42) for positioning the fiber end against the optical port.

FIG. 1



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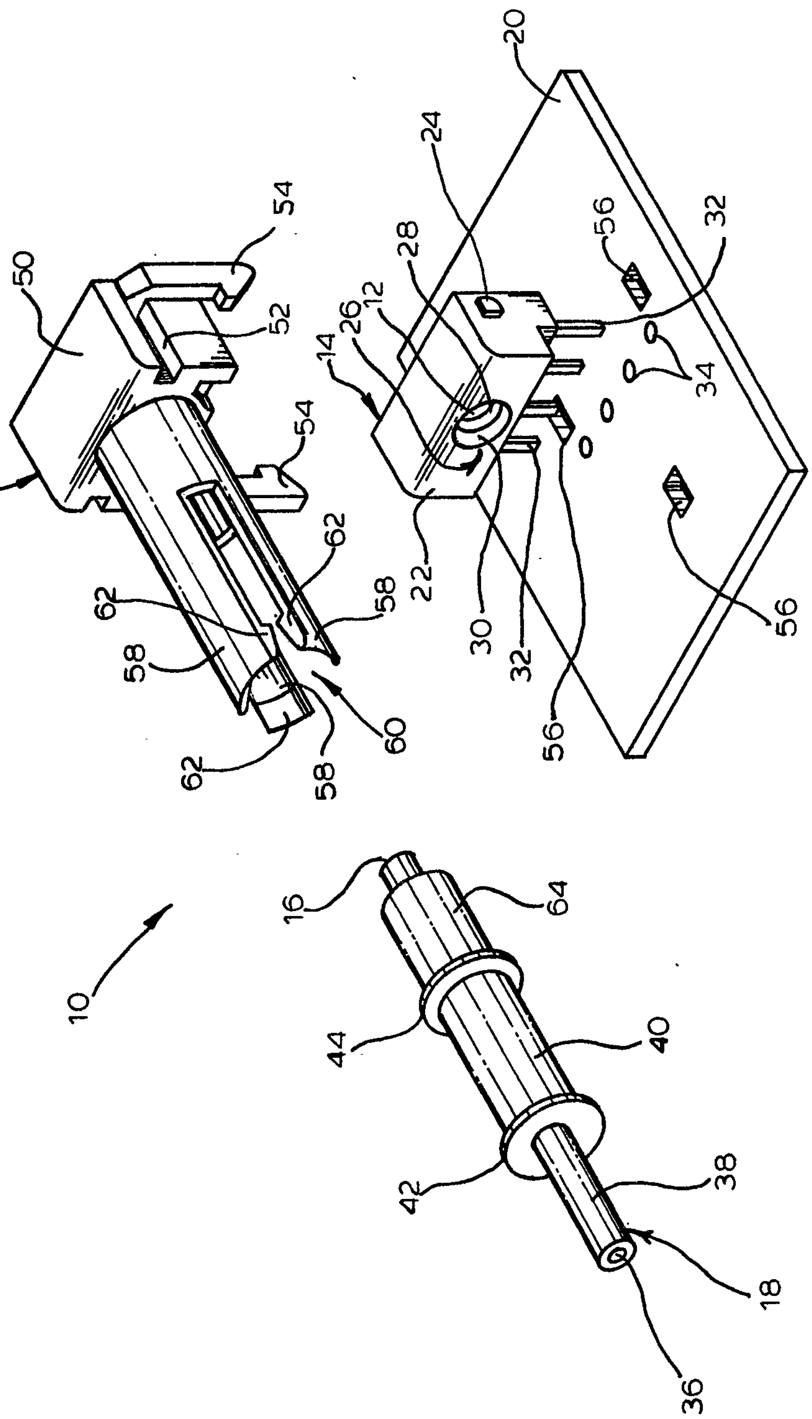
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62
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32
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22
30
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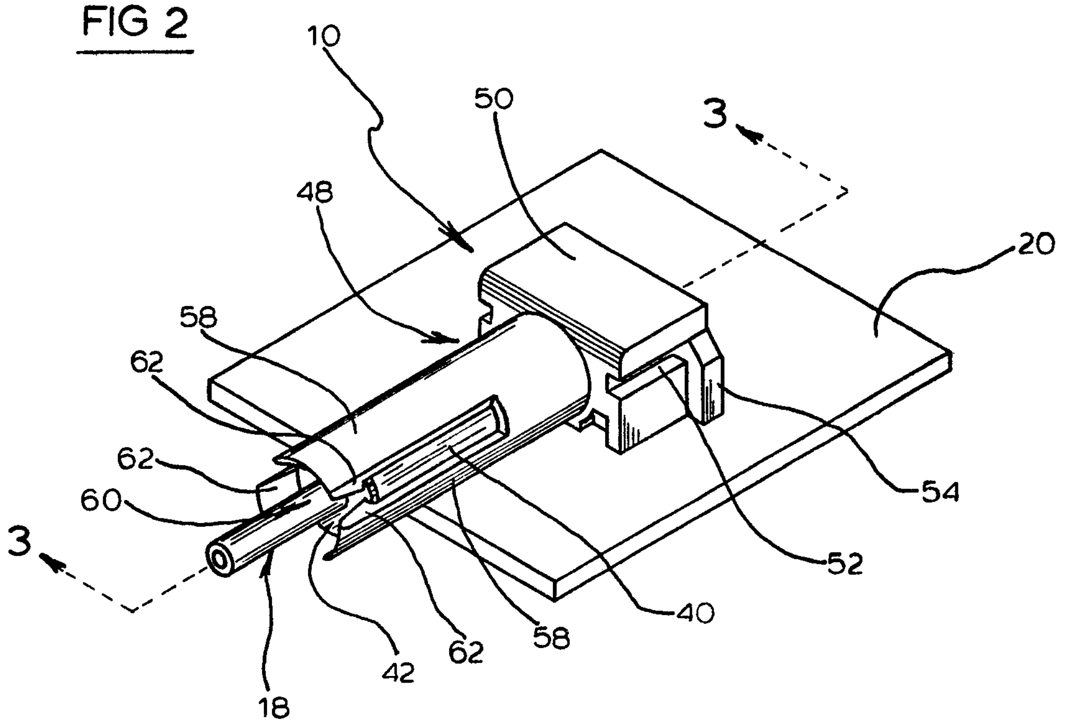
56

FIG.1

FIG 2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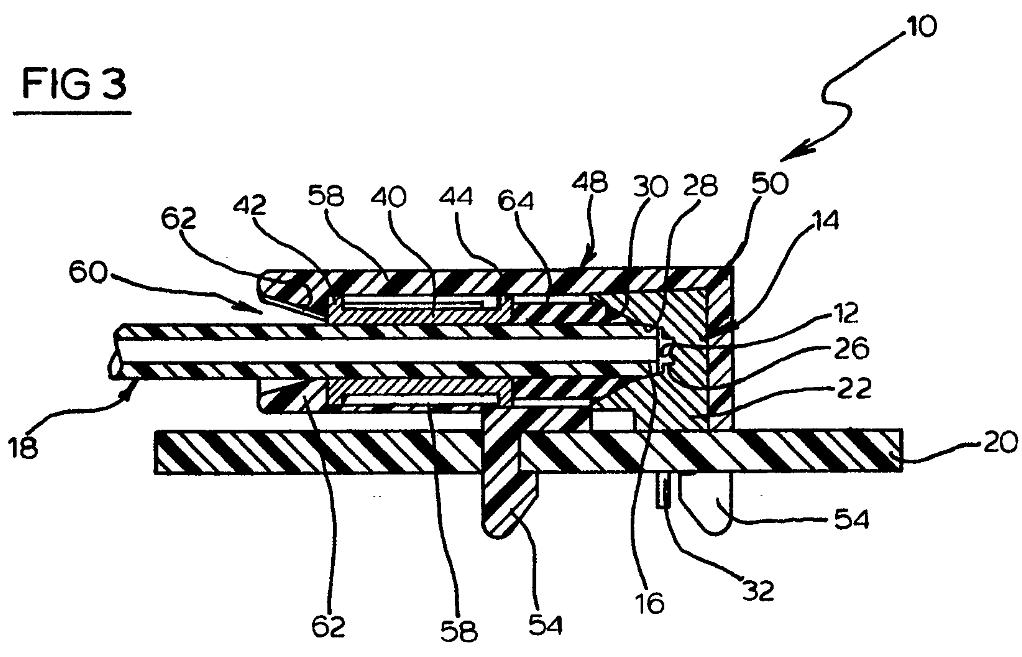
58
62
42
18

FIG 3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16
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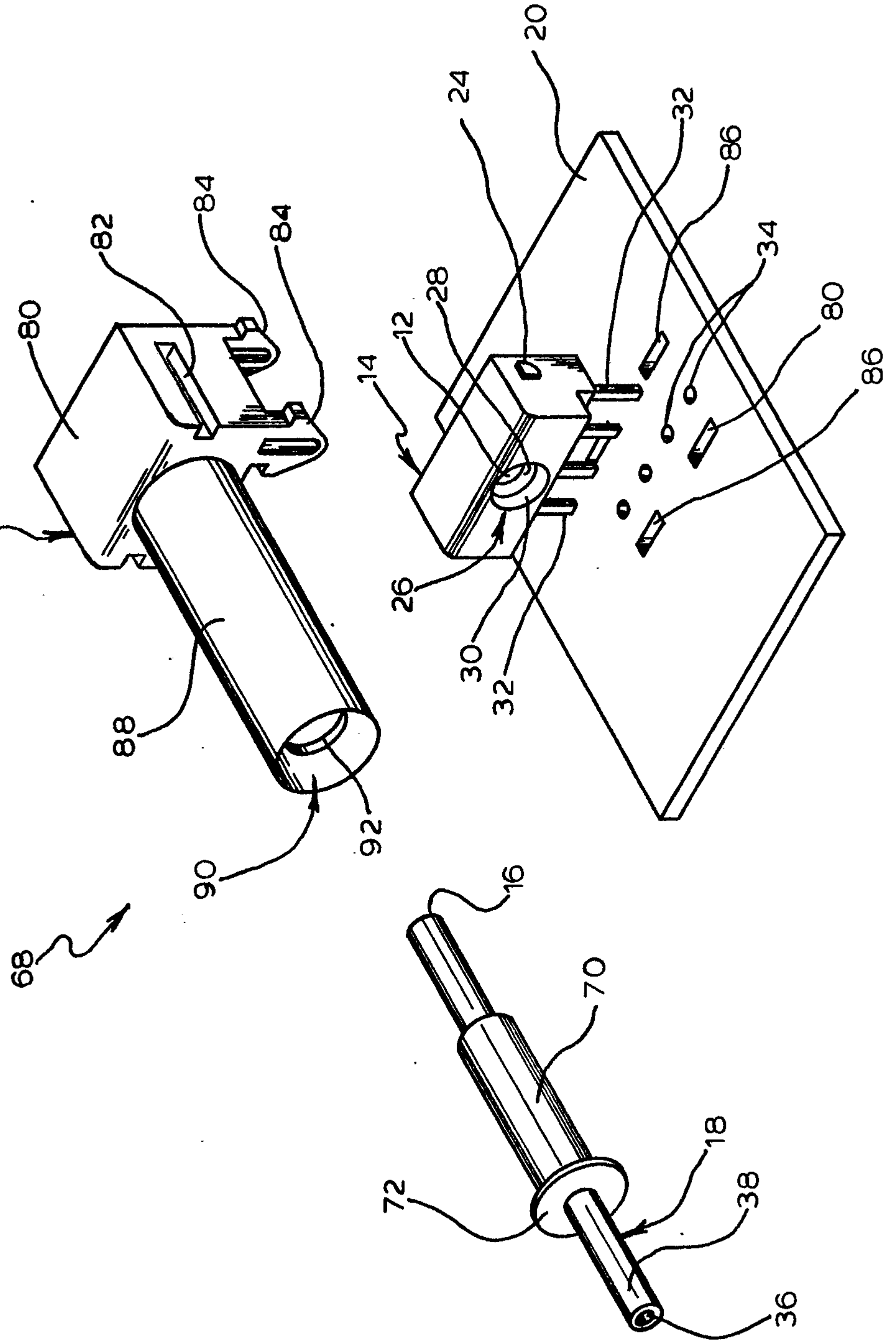
58
54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26
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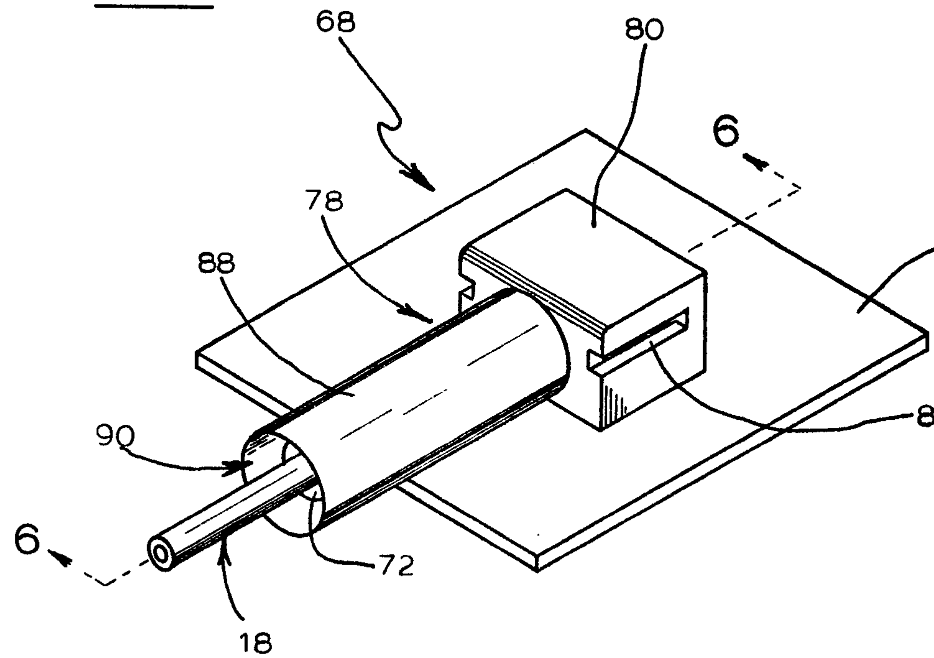
92
68
16
70
18
38
72
36

FIG4

FIG 5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78
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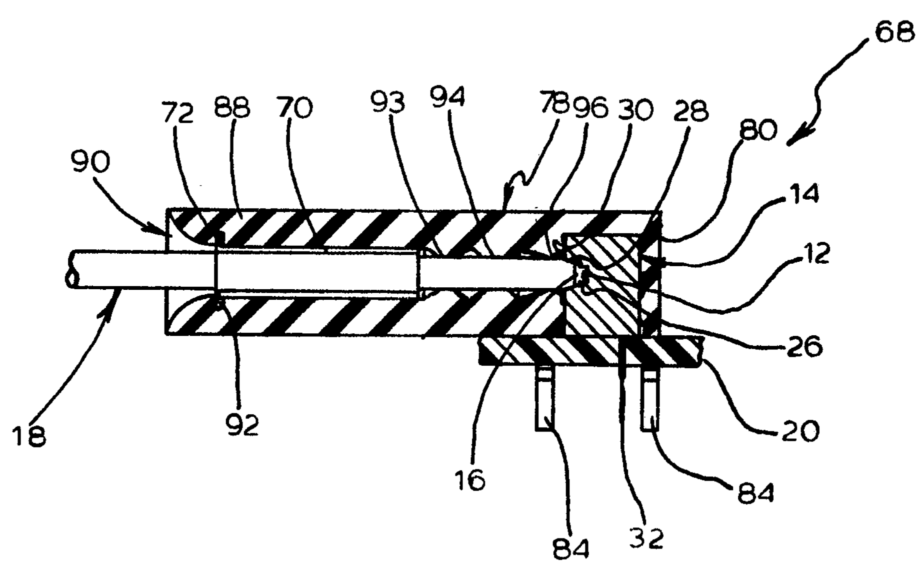
6
72
18

FIG 6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72
88
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93
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14
12
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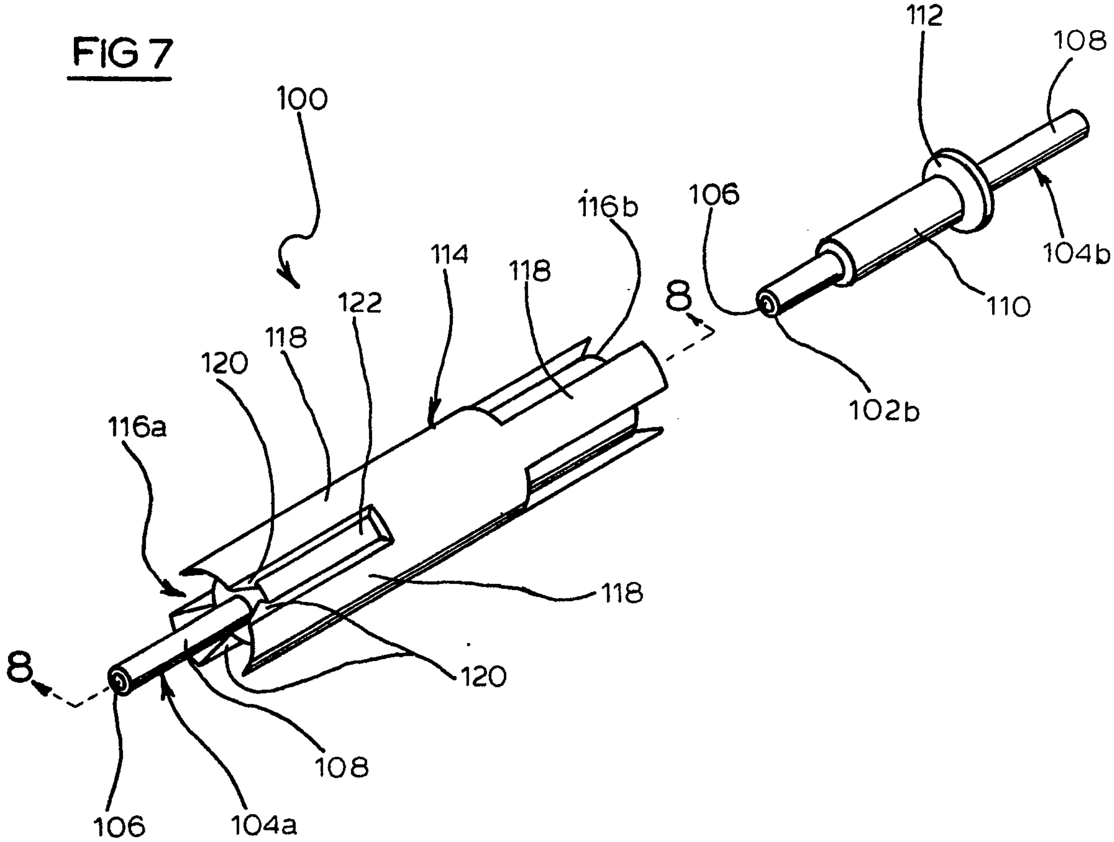
18
92
20
16
84
84
32

FIG 7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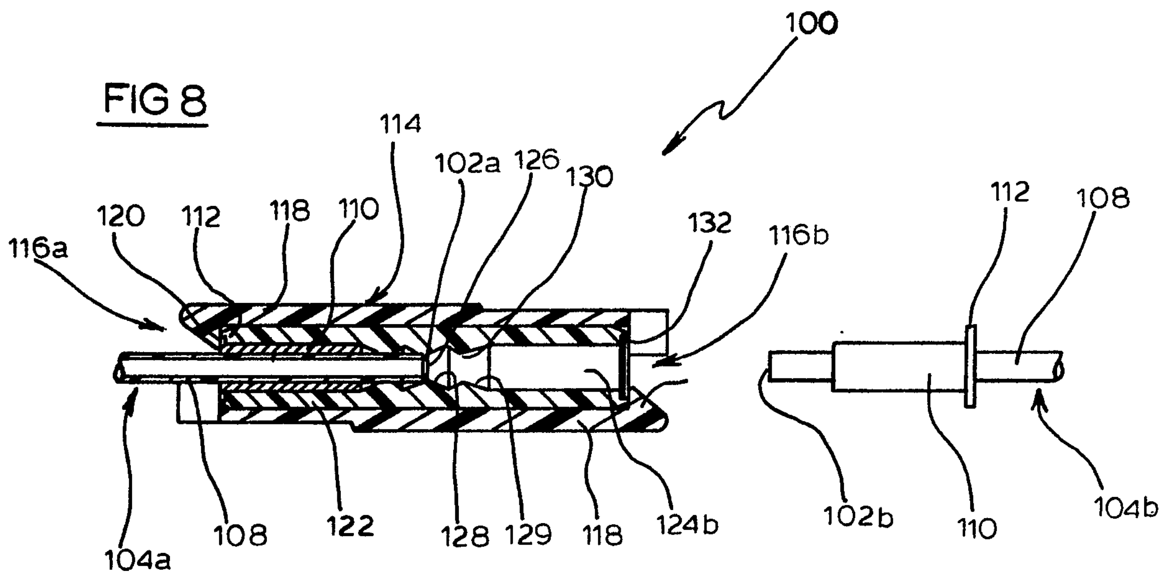
112
108
116b
106
114
118
104b
8
122
110
118
120
102b
116a
118
120
8
108
106
104a

FIG 8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114
102a
126
130
120
112
118
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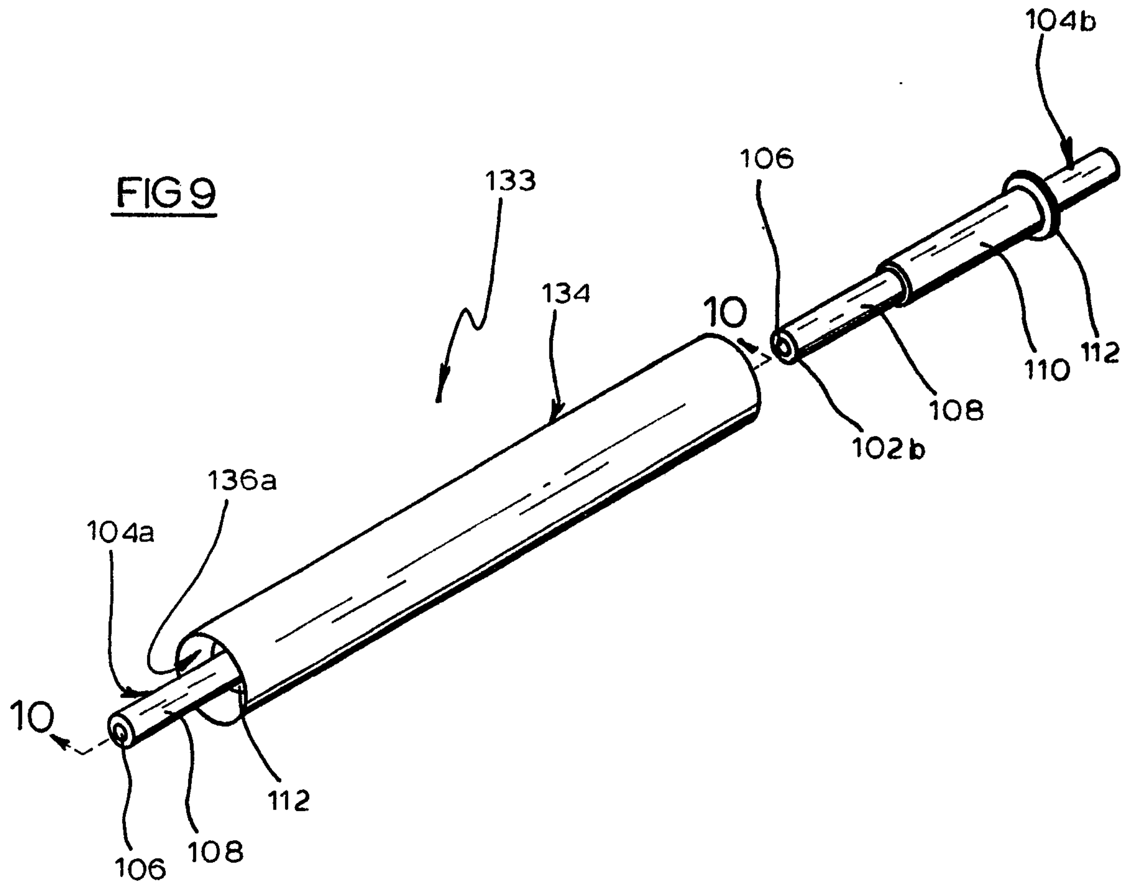
132
116b
112
108
116a
104a
108
122
128
129
118
124b
102b
110
104b

FIG 9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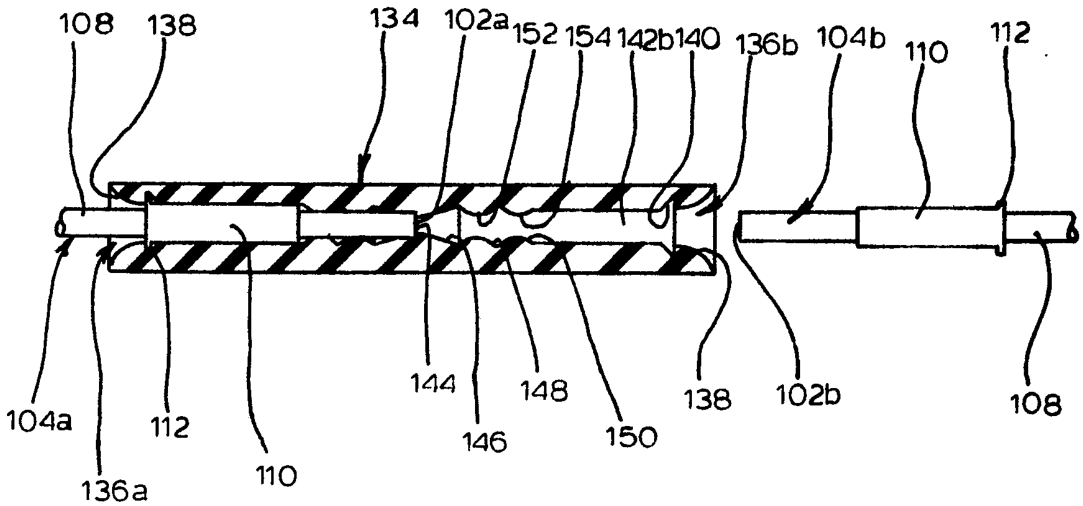
134
10
106
104b
108
110
112
102b
136a
104a
10
106
108
112

FIG 10


108
138
134
102a
152
154
142b
140
136b
104b
110
112
104a
136a
112
110
144
146
148
150
138
102b
108

SPECIFICATION

Fiber optic connector assembly

The present invention relates to a connector assembly for connecting an optoelectronic device with the end of an optic fiber and to a connector assembly for connecting a pair of fiber optic ends with one another.

Most fiber optic connector assemblies are either difficult to manufacture, difficult to assemble and/or expensive to make and use. While it may be necessary to have a great degree of accuracy in the alignment of different optic elements with one another when dealing in telecommunication or digital applications, it is not always necessary to have the same degree of accuracy where the application does not demand it. Such applications are usually found in the consumer electronic markets which would use fiber optics for communication between two relatively short distances. One example of such application may be in the automotive industry.

It is, therefore, the principal object of the present invention to provide a simple, easy to make and assemble, low cost fiber optic connector assembly to connect one end of an optic fiber with either an optoelectronic device or the end of another optic fiber.

The present invention provides, from one aspect, a connector assembly for connecting the optical lens of an optoelectronic device with the end of an optic fiber, the optoelectronic device including a housing having an optical port for the lens, the connector assembly comprising a cylindrical ferrule having a flange at one end adapted to be secured around the fiber at a predetermined distance from the end of the fiber and a connector assembly housing for receiving the ferrule bearing fiber end and the optoelectronic device and for maintaining the fiber end and the lens in connected relation, said connector assembly housing including a portion for receiving the optoelectronic device, and means defining an elongated passageway for receiving the ferrule bearing fiber end, said passageway communicating with said optoelectronic device receiving portion in alignment with said optical port and an open end through which the fiber and ferrule are received, said open end including expandable engageable means for removable cooperation with said ferrule flange for positioning said fiber end against the optical port.

The present invention also provides a connector assembly for connecting the end of one optic fiber to the end of another optic fiber comprising for each fiber, a cylindrical ferrule having a flange at one end adapted to be secured around the fiber said flange being located a predetermined distance from the end of the fiber, a housing for receiving and maintaining the fiber ends in connected relation, said housing including means defining two elongated passageways, each for receiving its respective fiber and ferrule, a pair of open ends opposite each other through which each fiber and ferrule are received, a connecting port through which communication is allowed between said passageways, expandable engageable means formed on each open end for removable cooperation with the respective ferrule flange for positioning the fiber ends against each other at the connecting port, and means formed adjacent both sides of the connecting port for guiding each fiber end in alignment with the other fiber end.

Specific embodiments of the present invention will now be described by way of example and not by way of limitation with reference to the accompanying drawings in which:

FIGURE 1 is an exploded perspective view of one embodiment of a connector assembly of the present invention which connects the end of an optic fiber with an optoelectronic device;

FIGURE 2 is a perspective view of the connector assembly of Figure 1 in an assembled condition;

FIGURE 3 is a sectional view taken generally along the line 3—3 of Figure 2;

FIGURE 4 is an exploded perspective view of another embodiment of a connector assembly of the present invention which connects an optic fiber end with an optoelectronic device;

FIGURE 5 is a perspective view of the connector assembly of Figure 4 in an assembled condition;

FIGURE 6 is a sectional view taken generally along the line 6—6 of Figure 5;

FIGURE 7 is a partially exploded perspective view of another embodiment of a connector assembly of the present invention which connects the ends of a pair of optic fibers;

FIGURE 8 is a sectional view taken generally along the line 8—8 of Figure 7;

FIGURE 9 is a partially exploded perspective view of another embodiment of a connector assembly of the present invention which connects the ends of a pair of optic fibers; and

FIGURE 10 is a sectional view taken generally along the line 10—10 of Figure 9.

With reference now to the accompanying drawings, Figs. 1 to 3 show a connector assembly, generally designated 10, which is designed for connecting the optical lens 12 of an optoelectronic device, generally designated 14, with the end 16 of an optic fiber, generally designated 18. The optoelectronic device 14 is adapted to be mounted on a printed circuit board, generally designated 20, in a manner which will be discussed in greater detail hereinafter.

Looking at the Fig. 1, the optoelectronic device 14 is seen to include a housing 22 having protrusions 24 formed on either side thereof. An optical port 26 surrounds the lens 12 and provides communication therewith. Guiding and alignment means in the form of two funnel shaped portions 28 and 30 initially engage the fiber end 16 so that it will be accurately positioned with respect to the optical lens 12. The bottom of the optoelectronic device 14 is provided with a plurality of printed circuit board leads 32 which are receivable in corresponding holes 34 formed in the printed circuit board 20. After insertion into the holes 34, the leads 32 are soldered to the board.

The optic fiber 18 has a core 36 made of suitable light transmissive material such as a glass or clear plastics. The core 36 is encased in a cable jacket 38 made of material that is well known in the art.

An open ended cylindrical ferrule 40 is provided and is adapted to be crimped around the optic fiber 18. The ferrule 40 has two annular flanges 42 and 44 formed at either end thereof. When the ferrule is crimped on the fiber 18, the flanges 42 and 44 are located at predetermined distances from the end 16 of the optic fiber 18.

The connector assembly 10 has a unitary connector assembly housing, generally designated 48, for receiving the optoelectronic device 14 and optic fiber 18 therein. The housing 48 is made of plastics or other suitable material. The connector assembly housing 48 has a portion or cavity 50 for receiving the optoelectronic device 14 upwardly therein. The portion 50 has slots 52 on either side thereof for receiving protrusions 24 on the side walls of the device 14. This serves to position the optoelectronic device 14 within the connector assembly housing 48 so that lens 12 assumes the proper location. The housing 48 is sufficiently forgiving to allow the optoelectronic device to be pushed into the cavity 50, the protrusions 24 finally snapping into the slots 52 to retain the device in the housing, the device then fitting between the front and rear walls of the cavity 50.

A plurality of depending mounting legs 54 are formed on the housing 48. The legs 54 are adapted to be received in corresponding holes 56 formed in the printed circuit board 20. Legs 54 are adapted to interengage with the holes 56 so that the housing 48 is securely fastened to the board 20.

An elongated passageway is defined by three cantilevered flexible fingers 58 extending from the portion 50 of the connector housing 48 which receives the optoelectronic device 14. This passageway has an open end 60 through which the end 16 of the optic fiber 18 is received and moved toward the other end thereof.

Shoulders 62 are formed on the free ends of fingers 58 adjacent the open end 60 of the passageway. The shoulders 62 are adapted to engage the annular flange 42 of ferrule 40. In this manner, not only is the end 16 of the optic fiber 18 positioned adjacent the optical lens 12, but, accidental withdrawal of the optic fiber 18 from the passageway is prevented.

In the event that the interface between the end 16 of the optic fiber 18 and the lens 12 is to be environmentally sealed, open ended cylindrical elastomer insert 64 is provided to be received on the end 16 of the fiber so that it abuts against the second annular flange 44 of the ferrule 40. As is best shown in Fig. 3, the free end of the insert 64 is pressed against contour or profile 28 adjacent the optical port 26. This forms an annular seal around the optical port 26.

Figs. 4 to 6 show another embodiment of a connector assembly, generally designated 68, which is designed for connecting the optical lens 12 of an optoelectronic device, generally designated 14, with the end 16 of an optic fiber, generally designated 18. The optoelectronic device 14 and the optic fiber 18 are identical with that which has already been described with respect to Figs. 1 to 3 and the same reference numerals are used in Figs. 4 to 6.

An open ended cylindrical ferrule 70 is provided and is adapted to be crimped around the optic fiber 18. The ferrule 70 has an annular flange 72 formed at one end thereof. When the ferrule 70 is crimped on to the fiber, the flange 72 is located a predetermined distance from the end 16 of the optic fiber 18.

The connector assembly 68 has a unitary connector assembly housing, generally designated 78, for receiving the optoelectronic device 14 and optic fiber 18 therein. The connector assembly 68 is made of a resilient elastomeric material. The connector housing 78 has a portion or cavity 80 for receiving the optoelectronic device 14 upwardly therein. The portion 80 has slots 82 on either side thereof for receiving protrusions 24 snapped therein. This serves to position the optoelectronic device 14 within the connector housing 78 so that lens 12 assumes the proper location.

A plurality of depending mounting legs 84 are formed on the connector housing 78. The legs 84 are adapted to be received in corresponding holes 86 formed in the printed circuit board 20. Legs 84 are adapted to interengage with the holes 86 so that the connector housing 78 is securely fastened to the board 20.

An elongated passageway is defined by the interior of a generally cylindrical portion 88 which extends from the portion 80 of the connector housing 78 which receives the optoelectronic device 14. This passageway has a flared open end 90 through which the end 16 of the optic fiber 18 is received and moved toward the other end thereof.

An annular slot 92 is formed adjacent the open end 90 and is adapted to receive the edge of the annular flange 72 of ferrule 70. In this manner, not only is the end 16 of the optic fiber 18 held adjacent the optical lens 12, but, accidental withdrawal of the optic fiber 18 from the passageway is prevented.

It is desired that this connector assembly 68 be environmentally sealed. To that end, there is provided three restricted openings 93, 94 and 96 formed in the interior of the passageway between the optical port 26 and ferrule 70 as is best shown in Fig. 6. The restricted openings 93, 94 and 96 not only prevent dust and/or moisture from interfering with the interface between the end 16 of optic fiber 18 and the lens 12, but, also make it easier to insert the optic fiber 18 through the passageway.

Turning now to Figs. 7 and 8, a connector assembly, generally designated 100, is used for the purpose of connecting the ends 102*a* and

102*b* of two optic fibers, generally designated 104*a* and 104*b*, together. The optic fibers 104*a* and 104*b* have a typical fiber core 106 made of suitable light transmissive material such as glass or clear plastics. The core 106 is surrounded by a cable jacket 108.

A ferrule 110 is crimped about each optic fiber 104*a* and 104*b*. The ferrule 110 has an annular flange 112 at one end thereof. When the ferrule 110 is crimped about an optic fiber, the flange 112 is at a given distance from the end 102*a* and 102*b* of its respective fiber 104*a* and 104*b*.

A housing body, generally designated 114, having two opposing open ends, 116*a* and 116*b*, is made of plastics material. The housing body 114 has three flexible cantilevered fingers 118 extending from either end thereof. The free ends of the fingers define the open ends 116*a* and 116*b* through which each of the optic fibers 104*a* and 104*b* are received. Engageable shoulders 120 are formed at the free end of each flexible finger 118 for purposes which will become more apparent hereinafter.

A generally open ended cylindrical resilient insert 122 is adapted to be received within the body 114 and captured between the shoulders 120 of the fingers 118. The insert 122 has an outside diameter substantially the same as the inside diameter of the housing body 114.

The insert 122 is divided generally into two cavities or passageways 124*a* and 124*b* which are connected by a restricted connecting port 126. Passageway 124*a* receives optic fiber 104*a* through open end 116*a* while passageway 124*b* receives optic fiber 104*b* through open end 116*b*. The ends 102*a* and 102*b* of optic fibers 104*a* and 104*b* are adapted to meet and abut at the connecting port 126.

In order to facilitate the guiding and alignment of ends 102*a* and 102*b*, the insert 122 has a profiled guide portion 128 which leads to the connecting port 126. In addition, a second profiled guide portion 129 is provided which leads to a second restricted opening 130 which is located between the connecting port 126 and the respective open ends 116*a* and 116*b*. The second restricted opening 130 is employed for sealing the interface between the two fiber ends 102*a* and 102*b* at the connecting portion 126.

The insert 122 has a countersunk ring portion 132 formed at each end adjacent the open ends 116*a* and 116*b* of the housing body 114. The space formed between the countersink 132 and shoulders 120 are provided to receive the flange 112 of the ferrule 110 when received in the respective passageway 124*a* and 124*b*. In this manner, the optic fibers 104*a* and 104*b* are correctly positioned within the housing body 114 and insert 122 so that the ends 102*a* and 102*b* will be aligned and meet at the connecting port 126.

Turning now to Figs. 9 and 10, a similar connector assembly, generally designated 133, is provided for the purpose of joining the ends 102*a* and 102*b* of a pair of optic fibers 104*a* and 104*b*. The fibers 104*a* and 104*b* have the same core 106 and jacket as described above. In addition, each of the fibers 104*a* and 104*b* has a ferrule 110 with an annular flange 112 crimped therearound in the manner already described.

The connector assembly 133 includes a unitary housing body 134 made of resilient elastomeric material. The housing body 134 is generally cylindrical and has two opposing open ends 136*a* and 136*b* through which fibers 104*a* and 104*b* are received therein. Each open end 136*a* and 136*b* has an inwardly flared guide surface 138 to facilitate the insertion of the fibers 104*a* and 104*b* and its crimped ferrule 120 therethrough.

Immediately inwardly of the flared surface 138 a generally annular slot 140 is formed for receiving the flange 112 therein in a snap fit.

The unitary housing body 134 is divided into two passageways 142*a* and 142*b* which are joined at connecting port 144. The optic fibers 104*a* and 104*b* are received in the corresponding passageways 142*a* and 142*b*, respectively.

A profiled guide surface 146 is provided leading to the connecting port 144 to align and guide the ends 102*a* and 102*b* of the fibers 104*a* and 104*b* together. Other profiled surfaces 148 and 150 are formed in each passageway 142*a* and 142*b* which lead to other restricted openings 152 and 154, respectively. The restricted openings 152 and 154 are generally the same diameter as the outer diameter of the optic fibers 104*a* and 104*b* and are provided for the purposes of sealing the interface between the fiber ends 102*a* and 102*b* as well as facilitating the insertion of the fibers 104*a* and 104*b* into their respective passageways 142*a* and 142*b*.

CLAIMS

1. A connector assembly for connecting the optical lens of an optoelectronic device with the end of an optic fiber, the optoelectronic device including a housing having an optical port for the lens, the connector assembly comprising a cylindrical ferrule having a flange at one end adapted to be secured around the fiber at a predetermined distance from the end of the fiber and a connector assembly housing for receiving the ferrule bearing fiber end and the optoelectronic device and for maintaining the fiber end and the lens in connected relation, said connector assembly housing including a portion for receiving the optoelectronic device, and means defining an elongated passageway for receiving the ferrule bearing fiber end, said passageway communicating with said optoelectronic device receiving portion in alignment with said optical port and an open end through which the fiber and ferrule are received, said open end including expandable engageable means for removable cooperation with said ferrule flange for positioning said fiber end against the optical port.

2. The connector assembly of claim 1 wherein a plurality of cantilevered elongated resilient fingers define the passageway, the free ends of said fingers having shoulders formed thereon adapted

to engage the flange of the ferrule.

3. The connector assembly of claim 1 or 2 in combination with the optoelectronic device and further including means for guiding said fiber end in alignment with said optical lens, said guiding means comprising an inverted funnel shaped portion of said optoelectronic housing around the periphery of the optical port.

4. The connector assembly of claim 1 or 2 or the combination of claim 3 wherein said optoelectronic device is adapted to be mounted on a printed circuit board which has apertures formed therein, said connector assembly housing including depending legs receivable through such apertures and having locking means formed at the ends thereof to engage the circuit board.

5. The combination of claim 3 or 4 wherein said ferrule includes a second flange formed at the end opposite the first flange and associated with the optic port and an open-ended cylindrically shaped elastomeric member is provided to be mounted between said second flange and the periphery of the optical port, said member having an outside diameter larger than the diameter of the optic port.

6. The connector assembly of claim 1 wherein said connector assembly housing is made of a generally resilient elastomeric material, said passageway being defined by a generally hollow cylindrical portion having an interior with an annular shoulder formed at the open end to define said engageable means, said passageway having a restricted opening inwardly of its open end seatably to engage with the optic fiber.

7. A connector assembly for connecting the end of one optic fiber to the end of another optic fiber comprising:

for each fiber, a cylindrical ferrule having a flange at one end adapted to be secured around the fiber said flange being located a predetermined distance from the end of the fiber;

a housing for receiving and maintaining the fiber ends in connected relation, said housing including

means defining two elongated passageways, *each for receiving its respective fiber and* ferrule, a pair of open ends opposite each other through which each fiber and ferrule are received, a connecting port through which communication is allowed between said passageways, expandable engageable means formed on each end for removable cooperation with the respective ferrule flange for positioning the fiber ends against each other at the connecting port, and means formed adjacent both sides of the connecting port for guiding each fiber end in alignment with the other fiber end.

8. The connector assembly of claim 7 wherein said means defining two elongated passageways is made of resilient material, each passageway including at least one restricted opening adjacent the connecting port for facilitating receipt of the end of the optic fiber and environmentally sealing said connecting port.

9. The connector assembly of claim 7 wherein said housing includes a generally cylindrical open-ended outer housing shell, said expandable engageable means being formed at the outer ends thereof, and a generally cylindrical open-ended insert made of resilient material receivable within said outer shell between the engageable means at opposite ends thereof, said passageway being formed in the interior of said insert and having at least one restricted opening adjacent the connecting port for facilitating receipt of the end of the optic fiber and environmentally sealing said connecting port.

10. The connector assembly of claim 7 wherein said housing comprises a one-piece member formed of resilient material, said passageways being formed in the interior of said housing and including at least one restricted opening adjacent the connecting port for facilitating receipt of the end of the optic fiber and environmentally sealing said connecting port.

11. A connector assembly substantially as any one of the specific embodiments hereinbefore described with reference to the accompanying drawings.

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