OPTICAL FIBER CABLE CONNECTOR

PRIORITY CLAIM

This application claims priority to U.S. Patent Application No. 18/589,199 filed on February 27, 2024, the entirety of said application is incorporated by reference herein.

BACKGROUND OF THE INVENTION

Laser-based medical devices use laser radiation for medical treatments. The laser radiation type, power, and parameters vary depending upon the treatment. A laser energy generator connects to a medical device using connection systems having an optical connection portions and a mechanical connection portions.

The connector is a critical component of the delivery system. Generally the size of optical fiber connectors have decreased over time due to the desirability of a higher density of connectors on telecommunications equipment; that is, more connectors per square inch of equipment space. Typical connectors for medical purposes comprise slightly modified optical connectors developed for telecommunication devices use, such as SMA-905 or SMA-906 modified connectors with a forward projecting ferrule with an exposed fiber facet. Such connectors are of small size and the mating components are also small, specifically, the ferrule securing the optical fiber and the cooperating female component. The small size of the graspable portion requires delicate manipulations to make the optical fiber connection to the medical device. The small sized connectors are not conducive to handling with gloves, nor making a quick connection. Also, it is easy to contaminate or damage the input fiber facet during mating with a medical device connector on the laser energy generator as the facet is exposed and defines the furthermost portion of the connector. Any issue associated with the integrity of the connection between the laser source and medical device can impact the performance of the medical device and potentially the medical procedure.

In medical laser applications compared to telecommunications, the fiber and connection needs to efficiently pass much higher power levels. Where there is a miniscule misalignment of the optical connection portions, there can be excessive heat generation in

the connection and power loss to the medical device. The excessive heat generation can damage the connector portions, particularly where there is insufficient heat management means associated with the connector portions.

Most conventional fiber optic connectors for laser applications have the optical connection portions essentially fixed within the mechanical connection portions. In telecommunications applications, where alignment of the optical connection portions is not critical, this fixed relationship between the optical connection portion and the mechanical connection portion is satisfactory. This is in part due to the low power handling requirements of such telecommunications connectors. Heat management is not a significant factor and slight misalignments is not a significant issue. Optic fiber connectors in laser telecommunications applications are commonly connecting one optic fiber to another optic fiber and such connections have one optic fiber face confronting another optic fiber face. Thus, adequate alignment between optical connection portions of cooperating connectors is relatively simple and having the optical connection portions fixed to the mechanical connection portions is not a significant issue.

This compares to launch connectors in laser medical devices where there is a high criticality associated with alignment and in some cases heat management. In typical laser energy generators for medical devices, the launch connector that connects with the laser energy generator has an internal exposed fiber optic face that must be aligned with a conical focused laser beam at the connection of the laser generator. Any misalignment can cause energy losses and excessive heating of the connector portions.

Significant strides have been made in launch connectors for medical devices that plug into laser energy generators. Separating and isolating the mechanical connection portions from the optical connection portions and allowing the optical connection portion of the launch connector, for example a cylindrical male ferrule with the optical fiber face at a forward end, to resiliently float within the annular mechanical portion of the launch connector can provide acceptable alignment when mated with a female ferrule with a cylindrical bore at the laser generator. See U.S. Pat. Nos. 10,663,677 and 11,914,199, both owned by the owner of the instant application. Said patents are incorporated by reference herein for all purposes. The ‘677 patent discloses embodiments where the cylindrical male ferrule is supported within a uniform diameter bore of the housing exclusively by the fiber optic cable. Other embodiments disclose the cylindrical male

ferrule is supported within a uniform diameter bore of the launch connector housing with elastomeric material positioned rearwardly of the male ferrule providing centration of the male ferrule. Although these embodiments offer improvements over known launch connectors for medical applications, any further improvements relating to easier manufacturing, assembly, robustness, and heat management would be well received.

SUMMARY

A launch connector for connecting a medical device to a laser radiation source, has features providing easy assembly and that resists disassembly. The launch connector having a ferrule compliantly and resiliently seated in a housing. The housing having a nose portion and a gripping portion that includes a latch. A forwardly inserted sleeve that captures the ferrule within the housing and provides centration and spacing of the ferrule and allows insertion of the ferrule through the front opening of the nose portion. In embodiments, the nose portion and gripping portion are threadingly engaged and have a securement means comprising a locking tab that seats into a recess when the nose portion and griping portion are engaged. In embodiments, the elastomeric material that seats the ferrule may be utilized to retain the locking tab in the locked retention position. In embodiments, an O-ring that provides sealing between the nose portion and gripping portion may urge and retain the locking tab in the locked retention position.

In embodiments, the locking tab may be part of an internal retainer that confronts and engages the elastomeric material. In embodiments, the elastomeric material is configured as a bushing in which the ferrule is compliantly seated. In embodiments, the retainer secures the elastomeric bushing within the housing by a clamping action. In embodiments, the retainer comprises a flange portion that cooperatively engages the nose portion and rotates therewith when the nose portion is rotated with respect to the gripping portion during assembly of the housing. The retainer may have one or more locking tabs that seat within one or more recesses defined in the gripping portion when the nose portion and retainer are rotated with respect to the gripping portion. In embodiments, the retainer may have a tubular portion extending rearwardly from the flange portion, the tubular portion retaining the fiber optic line therein. The tubular portion may extend to the rearward end of the housing and may engage a strain relief member.

A delivery system extending from a laser radiation source for connecting to a medical device that utilizes the laser radiation for medical treatment. The delivery system comprises an optical cable with an optical fiber extending from the laser source with a male launch connecter having a male ferrule on the optical cable. The launch connector couples to a receiving connector having a female ferrule that interfaces with the male ferrule on the medical device. The male launch connector having a body portion with an outer wall defining an interior and with a tubular portion projecting forward with an outermost or forwardmost edge and having a central axial recess defined therein. The optical fiber terminating at the male ferrule positioned in the central recess rearward of the forwardmost edge of the body portion and presenting a forward facing fiber facet. In embodiments, when not connected to the receiving connector, the male ferrule is compliantly positioned within the central recess. In embodiments, when the launch connector is not connected, the male ferrule is compliantly positioned by way of an elastomeric material directly or indirectly supporting the male ferrule with respect to the body portion and with circumferentially and axially extending conforming spacing between the male ferrule and wall surface of the body portion in the central axial recess providing a defined freedom of movement in all radial directions and axial compliancy of the male ferrule. The launch connector having means for la

In embodiments, the male ferrule is seated in a rigid sleeve with the ferrule extending forwardly from the sleeve, the sleeve engaging and/or supported by an elastomeric material that is seated in the body portion, the sleeve spaced from the interior body wall surface providing the radial compliancy and resiliency in all radial directions when the launch connector is not attached to the receiving connector. In embodiments, compliancy and resiliency is provided in forward and rearward axial directions. In embodiments, the elastomeric material is configured as an annular member extending between the sleeve and interior wall surface of the body portion. In embodiments, the elastomeric material is configured as one or more blocks, bushings, sleeves, or cups of elastomeric material with a rearward edge or edge portion of the rigid sleeve engaging or confronting or seated in the elastomeric material.

In embodiments, the male ferrule, any sleeve or fitting thereon, and the optical fiber and any coverings thereon are supported within the body portion, when not connected to a receiving connector, exclusively by way of compliant material providing centration and compliancy. In embodiments, the compliancy is in all directions. In

embodiments, movement of the ferrule is constrained by the body portion or other structure of the launch connector that encompasses the male ferrule and any sleeve or fitting thereon. The body portion or other structure can provide a form fitting cavity for the male ferrule and any sleeve or fitting thereon.

In embodiments the components of the launch connector assembly together with minimal or no welding, glues, adhesives, or separate fasteners. In embodiments, all exteriorly facing components, the forward plug portion, the handle portion, and the strain relief member are assemblable without welding, glues, adhesives, or separate fasteners, and are retained together by polymer features on the components.

In embodiments, a housing of the launch connector comprises a polymer handle or gripping portion molded as a single unitary component and a polymer forward nose or plug portion molded as a single unitary component. The launch connector is rotatingly assembled by way of cooperating threaded connection portions, one unitary with the handle portion and one unitary with the forward plug portion. Upon assembly, the threaded connections are concealed. In embodiments, an O-ring is in the juncture between the plug portion and the handle portion, with the O-ring being compressed as the connection is made providing exterior pressure on the respective plug portion and handle portions of the housing, resisting any disconnection torques and providing a hermetic seal. In embodiments, the O-ring is compressed at an angle to the axis of the plug portion, the measurement of the acute angle of the respective axis is greater than 20 degrees and less than 70 degrees. In embodiments, the polymer plug portion and the polymer handle portion of the housing may be snap-fit assembled by pushing them together axially where cooperating features on connection portions of the components mate.

In embodiments, a launch connector has a polymer housing defined by a nose or plug portion and a grasping or handle portion, the plug portion defining a mechanical connection portion of the launch connector. An optical connection portion has a compliantly centrated rigid male ferrule component connected to the optical fiber and compliantly centrated by a support formed of elastomeric material that is positioned rearwardly of and that is engaging and/or capturing the rearwardmost portion of the rigid male ferrule component. In embodiments, none of the rigid male ferrule portion of the optical connection portion extends rearwardly of the elastomeric support. In embodiments, the compliantly centrated male ferrule component extends forwardly from

the elastomeric support and is cantilevered therefrom. In embodiments, the elastomeric support is a cup shaped member with a central opening for the optical fiber. In embodiments, the elastomeric support is block shaped with two separable portions that grasp or clamp onto the optical fiber that extends therethrough. In embodiments, when the launch connector is connected to the laser energy generator at the female coupling portion, the elastomeric support is primarily deflected axially and thereby primarily compressed.

In embodiments, a launch connector connects to a receiving connector on a laser energy generator with a heat transfer pathway extending from the male ferrule through an annular heat transfer member that is interior to a gripping portion of the launch connector and that engages with a annular engagement member of the receiving connector, the laser energy generator providing a heat sink for the heat energy transferred from the male ferrule. In embodiments, a resilient member provides rearward axial displacement of the annular heat transfer member and provides a forward bias to provide a compressive engagement with the annular engagement member of the receiving connector when connected.

A feature and advantage of embodiments of the invention is a optical fiber coupling with cooperating connectors, one connector being a launch connector with a ferrule supporting an optical fiber with a fiber facet, the other connector receiving the one connector and having an optical registration receiver that receives the ferrule. Each connector having the optical connecting portion of the connector recessed from the exterior of the connector.

In embodiments, the optical connection portion of the launch connector having a forward cylindrical portion, a mid cylindrical portion diametrically larger than the forward cylindrical portion, and a rearward cylindrical portion diametrically smaller than the mid cylindrical portion. The forward cylindrical portion having a central axial bore sized to the fiber optic and the fiber optic secured therein and having an end exposed at the front end of the forward fiber optic. In embodiments the forward cylindrical portion is diametrically equal to the rearward cylindrical portion. In embodiments, the housing of the launch connector provides an interior cavity conformingly shaped to the three cylindrical portions of the optical connection portion of the launch connector. In embodiments, the three cylindrical portions are provided by a glass or ceramic cylindrical ferrule extending from a stainless steel fitting, the stainless steel fitting providing the cylindrical mid portion

and the cylindrical rearward portion and the glass or ceramic cylindrical ferrule providing the forward cylindrical portion. In embodiments, the three cylindrical portions are provided by a unitary stainless steel ferrule. In embodiments the ferrule may be of other compositions, for example ceramic material. In embodiments the internal cavity is defined by the housing and a sleeve insert retained in the housing.

In embodiments, a cooperating pair of connectors for connecting a laser source to a medical device for delivery of laser energy, each connector having an outer mechanical coupling portion and an inner optical coupling portion, each of the outer mechanical coupling portions configured as an outer tubular portion with a forward edge, each outer tubular portion having a tubular wall and defining respective axial recesses, the optical coupling portions concentrically positioned within the axial recesses and spaced from the tubular walls, the optical coupling portions inset from the respective forward edges. In embodiments, one connector provides an optical cable with an optical fiber connecting to a ferrule and presenting a fiber facet. The ferrule having a central position, the ferrule received within a female portion of an optical registration receiver. In embodiments, one of the tubular mechanical coupling portions interlaced between the tubular mechanical coupling portion of the other coupling and the optical coupling portion of the other coupling. The tubular mechanical coupling portions slidingly engaged with one another. In embodiments, the connector supplying the laser energy to the medical device, a launch connector, has its outer tubular portion extending within the outer tubular portion of the connector associated with the medical device. In embodiments, as the connectors are manually manipulated, the outer mechanical couplings engage first and bring the connectors into an axial alignment as the outer mechanical couplings are slidingly engaged and brought together, the connectors become axially aligned before the optical coupling portions engage each other. The optical coupling portions then are prealigned and as the optical coupling portions engage with tapered surfaces on one or both optical coupling portion, the optical couplings are brought into final operational alignment. In embodiments one optical coupling portion is laterally movable with respect to its respective mechanical coupling portion.

In embodiments, a launch connector with an optical connection portion comprising or configured as a male ferrule is supported by elastomeric material within a mechanical connection portion configured as a housing. The optical connection portion recessed entirely within a cavity defined by the housing optical connection. The optical connection

portion having cylindrical surfaces that mates with cylindrical surfaces of an optical connection portion of a receiving coupling. The optical connection portion in the launch connector having freedom to move axially and radially by an elastomeric block axially engaging or axially confronting a rearward axial face of the optical connection portion, is captured radially and axially within a housing formed of polymer. In embodiments, the housing of the launch connector provides an interior cavity conformingly shaped to the optical connection portion, for example the male ferrule, such that the male ferrule is forwardly captured and constrained at a shoulder rearwardly of the forward end of the male ferrule. That is, in an assembled launch connector, the male ferrule has axial freedom of movement but is constrained forwardly by a rearward facing stop surface of the housing of the mechanical connection portion.

In embodiments, this rearward facing stop surface may be provided by an annular forward ring configured as a sleeve insertable into the forward end of the forward nose portion during assembly of the launch connector. This allows an assembly step where the ferrule is inserted and positioned in the housing of the launch connector through the forward opening of the housing, and then the annular stop ring is inserted capturing the ferrule within the housing and radially constraining the ferrule while still allowing forward rearward movement and compliancy and radial movement and compliancy of the ferrule.

In embodiments, a launch connector of a laser light energy coupling has a housing containing an optical connection portion including a male ferrule with an optical fiber extending from the male ferrule. The optical connection portion positioned rearwardly from an open forward end of the housing for mating with and connecting to a receiving connector of the coupling. The optical connection portion compliantly positioned within the housing by seating a rearward end of the optical connection portion with an elastomeric component within the housing. The elastomeric component positioned at a threaded connection between a nose portion and a grasping portion of the housing. An internal retention portion engaged with the nose portion and grasping portion clamps the elastomeric component in the nose portion. The retention portion further having a tubular portion extending rearwardly through the grasping portion to an elastomeric strain relief member attached to a rearward end of the connector, the tubular portion aligned with a optical fiber opening extending through the strain relief member facilitating threading of a rearward end of an optical fiber through the housing, through the retention portion including the tubular portion and through the optical fiber opening in the strain relief

member. A sleeve seated in the nose portion defines, with the nose portion, an interior conformingly shaped to the optical connection portion with a circumferential gap allowing radial movement of the optical connection portion. The sleeve allowing insertion of the optical connection portion through a forward opening of the nose portion before seating the sleeve. The tubular portion of the retainer providing a threading guide for the fiber allowing insertion of a rearward end of the optical fiber through the forward opening of an assembled or partially assembled launch connector. The optical connection portion may be already attached to the optical fiber being threaded through the launch connector or may be subsequently attached.

A feature and advantage of embodiments is that this may facilitate manufacturing and ease of shipping. For example, assembled housings may be packed and shipped en masse, while the more delicate optical connection portions and optical fibers which may be more carefully packed separate from the assembled housings.

DESCRIPTION OF THE FIGURES

Figure 1 is a perspective view of a delivery system with a launch connector disconnected from a connector on a laser energy generator in accord with inventions herein.

Figure 2 is a perspective view of launch connector of Figure 1 connected to the laser energy generator.

Figure 3 is a perspective view of another embodiment of a launch connector.

Figure 4 is a top plan view of the launch connector of Figure 19A.

Figure 5 is a cross sectional view taken at line 19C-19C of Figure 19B.

Figure 6 is an exploded view of the launch connector of Figure 19A.

Figure 7 is another exploded view of the launch connector of Figure 19A.

Figure 8 is another cross sectional view of the launch connector of Figure 19A.

Figure 9 is a detailed cross sectional view of the nose portion.

Figure 10 is a detailed cross sectional view of the grasping portion.

Figure 11 is an exploded view of components providing a twist and lock functionality.

Figure 12 is another exploded view of components providing a twist and lock functionality.

Figure 13 is an exploded view of the internal components of a launch connector and the strain relief member of an embodiment.

Figure 14 is an exploded view of the sleeve, ferrule, and nose portion of an embodiment.

DETAILED DESCRIPTION

Referring to Figures 3-14, a launch connector 100 and components thereof are illustrated and generally has a housing 110 with a cap 112 at a forward end 113 of the housing and with a strap 114 connecting the cap to a strain relief member 116 at a rearward end 117. A optical fiber 118 extends rearwardly out of the strain relief member. The housing being a mechanical connection portion 114 for connecting to a mechanical connection portion of a cooperating receiving coupling, and enclosing and generally covering an optical connection portion 120 the cooperates with an optical portion of a cooperating receiving connector as described above. The housing having a housing wall 122 defining a launch connector interior 126. The housing comprising a nose portion 130 and a grasping portion 132 joined at a connection 134. The connection may be a threaded connection with thread portions 135, 137. The nose portion having a forward opening 136 extending into the nose portion open interior 140 with the optical connection portion 120 displaced rearwardly from the forward opening 136. The optical connection portion 120 may be a ferrule in a ferrule sleeve, not shown, or may be a unitary ferrule 148 as illustrated in Figures 5 and 8, formed, for example, of stainless steel. The optical connection portion, as depicted the ferrule 148, is seated in an elastomeric component 150, which is depicted as a cup with an annular portion 151 and a traversing portion 152 having a central aperture 154. The cup shaped elastomeric component is seated in a rearward facing annular recess 156 defined at a rearward end 157 of the nose portion 130. The cup shaped elastomeric component 150 having a forward facing cup or recess 160 into which

is seated the rearward end 162 of the ferrule 148. In embodiments, the exterior surface 163 of the ferrule being engaged with the elastomeric component but separated from the interior surface 164 of the housing, more particularly the nose portion 130. The optical fiber 118 has a forward end 167 with a forward facet 168 positioned at the forward end 171 of the ferrule 148. The optical fiber 118 may be fixed into the bore 173 of the ferrule such as by epoxy 174 as depicted best in Figure 8.

The cup shaped elastomeric component 150 may be secured in the recess 156 by a retainer portion 175 having a flange portion 176 and a tubular portion 177 that extends rearwardly from the flange portion through the open interior of the grasping portion. The retainer portion having a central opening 179 extending through the flange portion and the tubular portion. A rearward end 181 of the tubular portion extends to an opening 183 in and extending through the strain relief member 116. The flange portion 176 of the retainer portion 175 engages the rearward face 185 of the elastomeric component and clamps or sandwiches the elastomeric component 150 between the nose portion 130, in the recess 156 at the rearward end 157 and the forward face 187 of the retainer flange portion 176.

Still referring to Figures 3 to 13, the ferrule 148 may have four different cylindrical portions, first, second, third, and fourth cylindrical portions 198, 190, 191, 192 with two forward facing shoulders 194, 195 in between cylindrical portions in between the first and second cylindrical portions 198, 190, and in between the second and third cylindrical portions 190, 191. A rearward facing shoulder 196 is in between the third and fourth cylindrical portions 191, 192. The interior surface 164 of the housing wall 122 is configured to be conformingly shaped to the third cylindrical portion 191 but oversized providing freedom of movement in the radial direction but also limiting the freedom of movement of the ferrule 148.

In embodiments, the launch connector housing 110 may have a sleeve 200 that is tubular shaped with a central bore 204 and a generally cylindrical exterior surface with axially extending ribs 206. As shown in Figure 25, the dimensions of the sleeve may provide an interference fit with the interior surface 164 of the housing wall 122. The inner cylindrical surface 210 of the sleeve 200 may be sized to conform to the shape of, but be over-sized with respect to, the second cylindrical portion 190, thus providing radial freedom of movement that is limited by the gap 216 between the second cylindrical portion 190 and the inside surface 220 defining the bore 204 of the sleeve 200. The inside

diameter ID1 of the sleeve may be less than the outside diameter OD1 of the third cylindrical portion 191 such that the rearward face 224 of the sleeve 200 provides a stop surface 224 for the shoulder 194. The outside diameter OD2 of the sleeve including the ribs 206 may be greater than the inside diameter ID2 of the housing wall at the seating location 228 of the sleeve. The housing wall 122 may have axial ribs 230 that have forward facing stop surfaces 232 for positioning the sleeve at the seating location 228.

The utilization of the sleeve 200 for defining the housing interior surface allows insertion of the optical portion, for example the ferrule, with the attached optical fiber 118, into the forward opening 136 of the nose portion, for example, with the nose portion 130, the grasping portion 132, the retainer portion 175, the elastomeric component 150, and the strain relief member 116 already assembled. A rearward end 241 of the optical fiber extending from the male ferrule 148 may be inserted first through the aperture 154 of the seated elastomeric component 150, into the central opening 179 of the retention portion, through the tubular portion, which then provides a guide into the optical fiber opening 183 of the strain relief member 116. The fiber optic line extending out of the strain relief member may then be pulled to pull the ferrule rearwardly into the forward opening 136 of the nose portion to be seated in the elastomeric component 150. Such assembly may be accomplished manually or by automated means. The sleeve 200 may then be inserted into the forward opening of the nose portion to be seated in the nose portion thereby capturing the ferrule or optical connection portion. In embodiments, the sleeve is spaced from the ferrule and does not contact the ferrule in a normal state.

In embodiments, the nose portion 130 is joined to the grasping portion 132 at a threaded connection 134 with the flange portion 176 of the retainer portion 175 sandwiched between and engaging both the nose portion 130 and the grasping portion 132. The retainer portion has a pair of keyed portions 252, 254 projecting radially and forward axially that seat within cooperating rearward facing recesses 258, 260 in the rearward portion of the nose portion 130. The keyed portions thus fix the retainer portion 175 to the nose portion 130 when the nose portion 130 is rotated with respect to the grasping portion 132 during the screwing of the components together during assembly. The flange portion 176 of the retainer portion 175 may further have a pair of latch members 267, 268 that project rearwardly and that seat and latch into cooperating recesses 270, 271 when the nose portion and grasping portion are at a fully connected state. In embodiments the latch members are wedge shaped tabs. In other embodiments the latch members may be

flexible fingers or tabs. The latching members 267, 268 thus inhibit reverse rotation that could unscrew the components. An O-ring 275 can be compressed, provide a seal at the connection, and also provide a frictional resistance to a reverse unscrewing rotation between the nose portion and grasping portion.

In embodiments, the mechanical connection portions may be configured as bayonet connections, screw on connections, press fit connections, or detent connections. In embodiments, the elastomeric support may be replaced by other resilient compliant supports, for example, coil spring configurations may be suitable in some embodiments.

The following U.S. patents/publications are incorporated by reference for all purposes: 5329541; 5337386; 5907650; 5,943,460; 6,238,103; 7503701; 8419293; 8888378; 9329350; 9393081; 9395496; 9,429,713; 10082632; and US 2019/0094472.

This application is related to U.S. Patent Nos. 10,082,632; 10,663,677; 11,307,365; U.S. Pat. Pub. No. 2023/0077457, and Provisional Patent Applications Nos. 62/428269 filed Nov. 30, 2016, and 62/317,296 filed on April 1, 2016, all owned by the owner of the instant application. These patents and applications are incorporated by reference herein for all purposes.

The invention is not restricted to the details of the foregoing embodiment (s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any incorporated by reference references, any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed. The above references in all sections of this application are herein incorporated by references in their entirety for all purposes. The term “portion” when used herein may include part of a unitary or integrated component or the entirety of the unitary or integrated component, it not to be considered limiting.

Although specific examples have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art that any arrangement calculated to achieve the same purpose could be substituted for the specific examples shown. This application is intended to cover adaptations or variations of the present subject matter. Therefore, it is intended that the invention be defined by the attached claims and their legal equivalents, as well as the following illustrative aspects. The above described aspects embodiments of the invention are merely descriptive of its principles and are not to be considered limiting.

Further modifications of the invention herein disclosed will occur to those skilled in the respective arts and all such modifications are deemed to be within the scope of the invention.

We claim:

1. A coupling for connecting a medical laser radiation source to a medical device, the coupling comprising a launch connector that is readily assembleable and resists disassembly, the launch connector comprising:

a mechanical connection portion defining a cavity with an optical connection portion compliantly contained therein;

the mechanical connection portion comprising a housing with a forward opening;

the optical connection portion comprising a male ferrule with an optical fiber fixed thereto with a facet of the optical fiber positioned at a forward end of the male ferrule, the forward end of the male ferrule displaced rearwardly from the forward opening of the housing;

a rearward end of the optical connection portion compliantly seated in the housing providing axial and radial compliancy of the male ferrule;

the housing comprising a nose portion and a gripping portion that are latched together and the optical connection portion axially captured within the housing by an annular sleeve with a rearward facing surface confronting a shoulder of the optical connection portion, the annular sleeve engaged with an internal surface of a wall of the housing.

2. The coupling of claim 1, wherein the nose portion and the gripping portion of the housing are threadingly connected.

3. The coupling of claim 1, wherein optical connection portion is seated in an elastomeric component at a rearward end of the optical connection portion and wherein the optical connection portion is not in contact with the housing and is not in contact with the annular sleeve.

4. The coupling of claim 3, wherein the elastomeric component is cup shaped and is retained in the nose portion of the housing.

5. The coupling of any of claim 3, wherein the launch connector further comprises an internal retainer with a flange portion that engages a rearward face of the elastomeric component and secures the elastomeric component in the nose portion.

6. The coupling of claim 5, wherein the nose portion and the gripping portion are threadingly engaged and wherein the internal retainer cooperates with the nose portion such that when the nose portion is rotated with respect to the gripping portion, the retainer portion also rotates.

7. The coupling of claim 6, wherein the flange portion engages the nose portion for rotating the internal retainer with the nose portion, and the flange portion further has a latching member that latches with the gripping portion as the nose portion and flange portion are assembled.

8. The coupling of claim 7, wherein the latching member is a wedge shaped tab that seats in a recess defined in the gripping portion.

9. The coupling of any of claim 1-8, further comprising a tubular portion extending through the housing for facilitating assembly and stringing of the fiber optic through the housing.

10. The coupling of claim 9, wherein the tubular portion extends from a forward end of the gripping portion to a rearward end of the gripping portion.

11. The coupling of any of claims 5-8, further comprising a tubular portion that is centrally connected to the flange portion, the tubular portion for facilitating insertion of the fiber optic cable through the housing.

12. The coupling of claim 11, wherein the tubular portion is unitary with the flange portion.

13. A coupling for connecting a medical laser radiation source to a medical device, the coupling comprising a launch connector that is readily assembleable and resists disassembly, the launch connector comprising:

a mechanical connection portion defining a cavity with an optical connection portion compliantly contained therein;

the mechanical connection portion comprising a housing with a forward opening;

the optical connection portion comprising a male ferrule with an optical fiber fixed thereto with a facet of the optical fiber positioned at a forward end of the male ferrule, the

forward end of the male ferrule displaced rearwardly from the forward opening of the housing;

a rearward end of the optical connection portion compliantly seated in the housing providing axial and radial compliancy of the male ferrule;

the housing comprising a nose portion and a gripping portion that are threadingly engaged and latched together.

14. The coupling of claim 13, further comprising an elastomeric component into which the optical connection portion is seated, the elastomeric component retained within the housing when the nose portion and gripping portion are threadingly engaged.

15. The coupling of claim 14, further comprising a retainer that engages both the nose portion and the gripping portion when the nose portion and gripping portion are threadingly engaged.

16. The coupling of claim 15, wherein the retainer engages a rearward face of the elastomeric component and clamps or secures the elastomeric component in the nose portion.

17. The coupling of claim 15 or 16, wherein the retainer has a locking tab that engages the housing for resisting unscrewing the nose portion from the gripping portion.

18. The coupling of any of claims 13-16, wherein the optical connection portion is a ferrule with a plurality of different cylindrical surfaces and wherein the nose portion is configured to be form fit and spaced from the plurality of different cylindrical surfaces.

19. The coupling of claim 18, further comprising a annular sleeve insertable in the forward opening of the housing for capturing the optical connection portion within the housing.

20. The coupling of claim 19, wherein the annular sleeve is retained in the nose porton and has an inner diameter greater than the outer diameter of a cylindrical surface of the ferrule radially inward from the annular sleeve and is spaced therefrom.

21. A coupling for connecting a medical laser radiation source to a medical device, the coupling comprising a launch connector, the launch connector comprising:

a mechanical connection portion defining a cavity with an optical connection portion compliantly contained therein;

the mechanical connection portion comprising a housing with a forward opening;

the optical connection portion comprising a male ferrule with an optical fiber fixed thereto with a facet of the optical fiber positioned at a forward end of the male ferrule, the forward end of the male ferrule displaced rearwardly from the forward opening of the housing;

a rearward end of the optical connection portion seated on an elastomeric component fixed within the housing providing axial and radial compliancy of the male ferrule;

the male ferrule axially captured within the housing by an annular ring with a rearward facing stop surface confronting a shoulder of the optical connection portion, the annulap ring engaged with an internal surface of a wall of the housing.

22. The coupling of claim 21, wherein the annular stop ring extends around a cylindrical surface of the optical connection portion with a gap therebetween whereby there is radial freedom of movement of the optical connection portion.

23. The coupling of claim 22, wherein the cylindrical surface of the optical connection portion is a cylindrical surface of the male ferrule.

24. The coupling of claim 21, wherein the elastomeric component is shaped as a cup with an annular portion and a traversing portion extending from a rearward end of the annular portion, the traversing portion having a central aperture through which the optical fiber extends.

25. The coupling of claim 24, wherein the elastomeric component is sandwiched between a rearwardly facing shoulder of the internal surface of the wall of the housing and a retention portion; the retention portion engaging a rearward face of the elastomeric component, the retention portion axially and radially fixed.

26. The coupling of claim 25, wherein the retention portion is configured as a discrete component separate from the housing with a forward flange portion, the forward flange portion engaged with the rearward face of the elastomeric component and secured to the interior surface of the housing wall rearward of the elastomeric component in the launch connector.

27. The coupling of claim 26, wherein the retention portion has a tubular portion extending rearwardly from the flange portion to a strain relief member at a rearward end of the housing, wherein the open interior of the tubular portion is in alignment with an open interior of the strain relief member.

28. The coupling of claim 26, wherein housing comprises a nose portion and a gripping portion that are threadably connected, and wherein the retention portion is keyed to and rotates with the nose portion and further has a locking tab that seats within a recess of the gripping portion when the nose portion and gripping portion are in a full screwed together connection state.

29. The coupling of claim 21, wherein the housing comprises a nose portion and a gripping portion have cooperating threads, and wherein upon a full screwed together connection state the nose portion and grasping portion are further latched together to resist unscrewing.

30. A launch connector for connecting to a receiving connector, the launch connector comprising:

a housing comprising a nose portion and a grasping portion connected at a connection, the nose portion having a forward opening extending into a nose portion open interior extending a length of the nose portion, the grasping portion defining a grasping portion open interior;

an optical connection portion having a male ferrule connected to a optical fiber, the optical fiber having an end at a forward end of the male ferrule, the forward end of the male ferrule displaced rearwardly from the forward opening of the nose portion;

the optical connection portion compliantly seated at an elastomeric component secured within the housing at the connection between the nose portion and the grasping portion by a retention portion clamping the elastomeric component to the nose portion.

31. The launch connector of claim 30, wherein the retention component has a flange portion engaging a rearward face of the elastomeric component and a tubular portion extending from the flange portion through the open interior of the grasping portion to a rearward end of the grasping portion.

32. The launch connector of clam 31, further comprising an elastomeric strain relief member at the rearward end of the grasping portion, the elastomeric strain relief member

having an optical fiber opening extending therethrough, wherein the tubular portion has an optical fiber opening extending therethrough that is aligned with the optical fiber opening of the strain relief member, and wherein the optical fiber extends through the tubular portion and the strain relief member.

33. The launch connector of claim 30, wherein the connection between the nose portion and the grasping portion is a threaded connection, and wherein the launch connector has a latch to prevent unscrewing the nose portion and the grasping portion when they are in a fully connected state.

34. The launch connector of claim 33, wherein the elastomeric component is secured in place by a retention member engaging a rearward face of the elastomeric component, wherein the latch is provided by the retention member.

35. The launch connector of claim 30, wherein the open interior of the nose portion has a sleeve inserted therein and wherein the interior of the nose portion defined by the nose portion and the sleeve is conformingly shaped to and is oversized with respect to the optical connection portion thereby providing a circumferential gap between the optical connection portion and the interior of the nose portion defined by the nose portion and the sleeve.

36. The launch connector of claim 35, wherein the sleeve provides a rearward stop surface that confronts a forward facing shoulder on the optical connection portion.

37. A method of assembling a launch connector comprising:

assembling a housing of a launch connector from housing components, comprising;

connecting a forward tubular nose portion to a grasping portion;

positioning a compliant elastomeric component within the housing;

attaching a male ferrule to a forward end of an optical fiber;

extending an optical fiber through the housing components of a launch connector;

inserting the male ferrule connected to the optical fiber through a forward opening of the tubular nose portion;

seating the male ferrule connected to the optical fiber with the elastomeric component within the housing by pulling a portion of the optical fiber that extends rearwardly of the housing.

inserting a sleeve through the forward opening of the tubular nose portion to seat at a position providing restricted radial freedom of motion of the optical connection portion.

38. The method of claim 37, further comprising clamping the elastomeric component to the forward nose portion by a retainer portion having a flange portion engaging a rearward face of the elastomeric component, the retainer portion having a tubular portion extending rearwardly from the flange portion to a rearward end of the grasping portion.

39. The method of claim 37, further comprising, before seating the male ferrule with the elastomeric component, attaching an elastomeric strain relief member with an opening extending therethrough to a rearward end of the housing, the method further comprising threading a rearward end of the optical fiber through an aperture in the elastomeric component, through the flange portion and the tubular portion of the retainer portion, and threading the rearward end of the optical fiber through the opening of the elastomeric strain relief member.

40. The method of claim 39, further comprising screwing together the nose portion to the grasping portion and further comprising latching said grasping portion to the nose portion to inhibit reverse rotation when a fully screwed together state is reached.