

Description

Field of the Invention

This invention relates generally to a fiber optic connector and more particularly to joining or splicing two or more optical fibers together.

Background of the Invention

The use of optical fibers as light guides or wave guides is now common in such fields as communications, local area networks, data transmission and optoelectronics. The need for splicing two single fibers in end-to-end orientation is well recognized and much development has been done with fusion techniques and with mechanical devices to achieve precise axial alignment. The devices generally are expensive, require a highly skilled individual for correct application and usually grip only the optic fiber itself, resulting in a fragile assembly requiring delicate handling as well as additional protective packaging to prevent breaking the brittle fiber.

The available prior art devices often comprise many separate pieces, adding to the difficulty of assembly. Additionally, these pieces will vary dimensionally one to another, even under careful manufacturing practice, and these variations will contribute to lateral misalignment of the optic fibers being spliced. Lateral misalignment is the greatest single factor in optic signal loss in fiber splices. Further, existing mechanical splices typically do not permit inspection of the fiber to fiber orientation after the fibers are in their locked condition.

Many prior art devices employ V-shaped grooves to aid in aligning the fibers. One such device for mounting optical fibers as described in US-A-4562632 has a base with a terminal positioning V-groove for placing a terminal in a reference position and a V-groove for positioning the optical fiber.

Another known device shown in US-A-4181400 is a two-part connector for joining the optical fibers wherein each part contains a cylindrical sleeve with a V-shaped longitudinal groove sloped in relation to the axis of the sleeve.

US-A-4629284 provides an apparatus which possesses a plastically deformable V-groove which coacts with a rigid face plate, said face plate exerting a force on two fibre ends retained in the V-groove, which ensures alignment.

EP-A-0146471 describes an optical fiber connector with a bottom section containing V-shaped grooves for receiving the fibers and a number of top sections hinged to the bottom section.

Other prior art devices employing V-shaped grooves or the like are shown in US-A-4201444,

US-A-4354731 and GB-A-2074748B.

SUMMARY OF THE INVENTION

The present invention provides a number of features not found in other devices, including those described in the aforementioned patents. These features make the optical fiber connector of the present invention easier to use so that durable, high efficiency, low loss splices can be made faster by less skilled individuals. The present invention may be used for splicing multi-mode as well as a single-mode optical fiber.

As is known from EP-A-0146471, the present invention provides a fiber optical connector for splicing at least one pair of optical fibers end-to-end said connector comprising: a body or housing containing V-shaped grooves for receiving the fibers and having a main bottom section and first, second and third top sections, each top section being connected to the bottom section by a flexible hinge and being adapted to close and latch with the bottom section independently of the other two top sections; said plurality of V-shaped grooves being disposed axially in the bottom section along three contiguously adjacent segments of said bottom section, a first segment being located at one end of the bottom section and adapted to receive and latch with the first top section, a second segment being located at the other end of the bottom section and adapted to receive and latch with the second top section and a central segment being adapted to receive and latch with the third, central top section; said first and second bottom segments each having an outermost end and an innermost end with the innermost ends of said first and second bottom segments facing said control segment. Each of the first and second top sections is provided with first and second finger sections which serve to grip the optical fibers in their respective grooves when the first and second top sections are closed and the central top section has a further finger section to grip and align the ends of both fibers when the central top section is closed.

In accordance with the invention, and in contrast to EP-A-0146471, the grooves comprise a first groove and a second groove disposed axially in said first bottom segment, the first groove being disposed at the outermost end of the first bottom segment and inclined relative to the second groove, a third groove and a fourth groove disposed axially in said second bottom segment, the third groove being disposed at the outermost end of the second bottom segment and inclined relative to the fourth groove, and a fifth groove in said central bottom segment disposed between the second and fourth grooves, said fifth groove being adjacent to but separated from the second and

fourth grooves by slots.

A preferred form of optical fiber connector in accordance with the present invention comprises a single molded body having four segments or sections appropriately hinged, thus eliminating multiple part handling and preventing incorrect assembly. It has a means whereby the device may be temporarily firmly held by a separate fixture, thus freeing both hands for the assembly operations of guiding and placing the fiber with one hand while closing the locking portion of the device with the other.

The bottom section of the connector body contains chambers with V-shaped grooves which permit easy insertion of the jacketed portion of the optical fiber on each end, with a short length of fiber filament end exposed in preparation for splicing. The grooves are formed in three principal areas. The outer grooves are inclined at a small angle to the grooves in the central area. The purpose of this inclination is to bend the fiber slightly to encourage the short exposed filament to lie in the bottom of the groove in the central area.

The upper segments or sections of the connector have lands or fingers to close on the fiber buffer or exposed optical fiber to force it into the bottom of the groove and lock it there. The outer segments are each provided with crosswise fins to force a misaligned fiber into the bottom of the groove without damage and thus prevent trapping a fiber in the misaligned position beside the finger.

The optical fiber connector of the present invention permits handling of only one fiber at a time, locking each fiber in place by gripping both the fiber and its plastic jacket (buffer) and permitting examination of the orientation of the fibers one to another before finally locking the fiber ends into the axially aligned position. In addition to permitting inspection, a short length of each fiber, as well as the ends of the fibers and the joint between them, are accessible so that an index matching fluid or epoxy can readily be applied before closing the splice connector and locking the fibers in alignment. While providing these desirable features, the connector splicing device is a single piece, thus preventing incorrect assembly and making possible the manufacture of the device at low cost.

The connector of the present invention may be constructed to accept and splice more than one pair of optical fibers at a time. For example, by providing two or more parallel chambers with V-shaped grooves, two or more pair of fibers may be simultaneously spliced end to end.

A strain or tension relief may be installed over the connector or splice assembly to relieve the tension on the cable at each end. The strain relief comprises two sections. One section has grooves which receive flanged ferrules inserted over the

prepared end of each optical fiber cable. The second strain relief section may be snapped together with the first to provide a quick and easy means of strain relief.

Finally, the connector body may conveniently be provided with a projection along its bottom adapted to be received and held in a fixture assembly. This permits the operator to have both hands free during the splicing operation.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of one embodiment of the present invention illustrating the fiber optic connector in the open position without optical fiber.

FIG. 2 is a perspective view of the connector of FIG. 1 illustrating one stage of the splicing technique in accordance with the invention wherein two optical fibers are locked in place by the outer top segments of the connectors and the center top segment is open.

FIG. 3 is a side view of the connector of FIG. 1 illustrating a completed splice in accordance with the invention with the spliced optical fibers shown in phantom.

FIG. 4 is a sectional view taken along a line A-A of FIG. 3 illustrating the connector in the closed and latched position gripping the fiber buffer securely.

FIG. 5 is a sectional view taken along a line B-B of FIG. 3 illustrating the connector at a partially closed stage with an assumed misaligned optic fiber in contact with the crosswise vane forcing proper fiber alignment.

FIG. 6 is also a sectional view taken along a line B-B of FIG. 3 illustrating the connector at a stage subsequent to that of FIG. 5 in the closed and latched position with the optical fiber properly located.

FIG. 7 is a sectional view taken along a line at C-C of FIG. 3 in the central portion of the connector illustrating the optical fibers being held in precise axial alignment in the closed and latched position.

FIG. 8 is an end view of the connector in the closed position showing it held firmly in a fixture which permits both hands of the operator to be free for the splicing operation.

FIG. 9 is a sectional view of a double splice connector taken at a location equivalent to the line A-A of FIG. 3 and illustrating the connector in the closed and latched position gripping the buffers of two optical fibers.

FIG. 10A illustrates a strain relief device applied over the connector of the present invention for relieving cable tension and protecting the connector splice from mechanical damage as well as

tension induced failure.

FIG. 10B is a section view of the strain relief of FIG. 10A taken along line D-D.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 illustrates a preferred embodiment of the present invention for joining or splicing of optical fibers using a connector or splice. The connector comprises a foldable, latchable holder having four main sections, each shown in the open position in FIG. 1. The connector body 10 includes two chambers 11 and 12 which receive optical fibers having plastic insulating jackets or buffers surrounding the optical fiber. A central chamber 13 receives and aligns the ends of both optical fibers which have been stripped of their insulating jackets or buffers. A first buffer lock 14 is connected to the body 10 by a flexible hinge 15 such that buffer lock 14 can be closed over chamber 11. A second buffer lock 16 is similarly joined to the body 10 by flexible hinge 17 and a fiber lock 18 is connected to the body 10 by a hinge 19. Buffer lock 16 can be closed over chamber 12 and fiber lock 18 can be closed over chamber 13. Buffer locks 14 and 16 and fiber lock 18 can be closed independent of one another.

Chamber 11 comprises a first V-shaped groove 20 which is sized to receive the jacketed optical fiber and a second V-shaped groove 21 sized to receive the optical fiber from which the plastic jacket has been removed. The first V-shaped groove 20 is inclined relative to the second V-shaped groove 21 so that the included angle between 20 and 21 is somewhat less than 180°. A suitable angle for the purpose of this invention has been found to be 173° though it should be clearly understood that the invention is not restricted to this angle.

Chamber 12 also comprises a first V-shaped groove 22 and a second V-shaped groove 23 which are oriented similarly to V-shaped grooves 20 and 21, respectively, of chamber 11. Chamber 13 comprises a single V-shaped groove 36' which is collinear with V-shaped grooves 21 and 23 and is therefore inclined with respect to V-shaped grooves 20 and 22. The included angle between the planar side walls of V-shaped grooves 20, 21, 22, 23 and of chamber 13 is suitably 60°, although again not restricted to this angle.

Buffer locks 14 and 16 are similar, but for the purposes of this invention, are of opposite hand or mirror images of one another. Only buffer lock 14 will therefore be described fully.

Buffer lock 14 comprises an outer portion 24 and an inner portion 25. The inner portion 25 comprises a finger section 26 which, when buffer

lock 14 is closed, grips the fiber buffer; a finger section 27 which, when closed, grips the optical fiber; and a cross vane 28, the purpose of which will be described below.

FIG. 4 is a cross section of the body 10 at buffer lock 14 in the finger section 26 and V-shaped groove 20 with buffer lock 14 in the closed and latched position. The V-shaped groove 20 and finger 26 are sized so that in the closed and latched position, the optical fiber buffer or plastic jacket 29 is pressed into V-shaped groove 20 and held firmly by the edge surface 30 of finger 26. The sides of finger 26 are inclined at an included angle of not more than that of V-shaped groove 20 or preferably less so as not to press into the sides of V-shaped groove 20. For the purposes of this embodiment, the included angle on the sides of finger 26 may be about 50°. Referring still to FIG. 4, the outer portion 24 of buffer lock 14 comprises a latching surface 31 which snaps over an appropriate ledge 32 on body 10 and, in cooperation with hinge 15, applies and maintains a firm grip on buffer 29 between finger surface 30 and the side walls of the V-shaped groove 20.

Referring now to FIG. 3 and buffer lock 14, it will be understood that the edge surface 30 of finger 26, shown in phantom, is inclined at a suitable angle such that it contacts buffer 29 along surface 26 and maintains an approximately uniform grip along that portion of buffer 29 residing in body 10. Optical fiber 34, from which the buffer 29 has been removed at the end, extends to about the middle of the center area of body 10. Similarly, an optical fiber 39 with buffer 38 is held by buffer lock 16. The end of optical fiber 39 from which the buffer 38 has been removed extends into the center section of body 10 such that the prepared ends of fiber 34 and fiber 39 are in close proximity. Both fiber ends are held by fiber lock 18.

Referring again to FIG. 1, as buffer lock 14 is closed over body 10, finger 27 moves into V-shaped groove 21 and crossvane 28 moves into cross slot 33. Cross vane 28 is oriented perpendicular to the axis of finger 27 and slot 33 is oriented perpendicular to the longitudinal axis of V-shaped groove 21. In addition, the crosswise edge of vane 28 is coplanar with the edge of finger 27. The purpose and action of vane 28 in practicing this invention will be readily understood from the following description with reference to FIG. 5.

FIG. 5 illustrates a cross section taken along a line B-B of FIG. 3 through vane 28 and slot 33 and shows an assumed misaligned optical fiber 34 in V-shaped groove 21. As buffer lock 14 is closed, vane 28 urges optical fiber 34 toward the convergence of the sides of V-shaped groove 21 and prevents the fiber 34 from being trapped between the side of finger 27 and the side of V-shaped

groove 21.

The final phase of the splicing technique of the present invention is illustrated and further described with reference to FIG. 6. As buffer lock 14 is fully closed, latch surface 31 snaps over ledge 32 holding buffer lock 14 in the closed and latched position. In achieving this position, optical fiber 34 has been urged into the confluence of the side walls of V-shaped groove 21 by vane 28 and positioned fiber 34 under the edge of vane 28 where it is held firmly by the full length of finger 27 in V-shaped groove 21 and part of V-shaped groove 13 which is coplanar with V-shaped groove 21. Cross slot 33 is sufficiently wide and deep so as to provide no interference with vane 28 although at the same time slot 33 is shallower than V-shaped groove 21 by an amount sufficient to support the optical fiber. The difference in depth between slot 33 and V-shaped groove 21 is appropriately about the diameter of the optical fibers being spliced.

Referring again to FIG. 1, fiber lock 18 includes a latch 35, a finger 36 having an edge surface 37 and is hinged to body 10 by hinge 19. Edge surface 37 is coplanar with edge surface 27 of buffer lock 14 and the corresponding edge surface of buffer lock 16. When fiber lock 18 is closed bending hinge 19, as shown in FIG. 7, finger 36 enters V-shaped groove 13 and edge surface 37 of finger 36 contacts optical fibers 34 and 39. As fiber lock 18 is fully closed, latch 35 snaps over ledge 40 urging optical fibers 34 and 39 into axial alignment.

Prior to starting assembly, the operator may place the molded splice 10 into an assembly fixture 43, as shown in FIG. 8, which would hold the connector or splice 10 firmly while permitting the operator to use both hands for assembly work. One method for accomplishing this is simply to mold a projection 42 onto body 10 which would fit snugly into a groove 43a in the fixture.

FIG. 9 illustrates the cross section of a multiple fiber splice, in this case two, in which body 44 comprises chambers with V-shaped groove configurations 45 and 46 for two optical fibers with buffers 47 and 48. A buffer lock 49 is connected to body 44 by hinge 50 and comprises two fingers 51 and 52 which in the closed and latched position grip buffers 47 and 48 respectively securely holding them in their correct positions. The outer portion 53 of buffer lock 49 comprises a latching surface 54 which snaps over an appropriate ledge 55 on body 44 and in cooperation with hinge 50 applies and maintains a firm grip on fiber buffers 47 and 48. Other portions of the dual splice are functionally similar to the single splice but duplicated as appropriate so that two splices are made.

FIGS. 10A and 10B illustrate a tension or strain relief installed over the splice assembly of FIG. 3. FIG. 10A shows the splice 10 installed in one half of the tension relief with the other half removed. Splice body 10 joins the optical fiber of cable 56 with that of cable 57. The end of cable 56 is prepared by shortening jacket 58 leaving buffer 29 and its fiber projecting and also tension support fibers 59. A flanged ferrule 60 is inserted over buffer 29 and under tension support fibers 59 which in turn are wrapped back outside of jacket 58 and pulled snug. Sleeve 61 is slipped over fibers 59 and crimped firmly, thus locking fibers 59 and jacket 58 to flanged ferrule 60.

Cable 57 is similarly prepared with its fibers and jacket locked to a flanged ferrule 62. Before installing the tension relief, soft material 63 is either wrapped around splice body 10 or placed into relief member 64 to cushion the splice and protect it from mechanical shock or vibration, either of which might break the brittle optic fiber. Tension member 64 is then placed around the splice and cable ends such that the beveled edges of flanged ferrules 60 and 62 fit into one of a series of grooves 65 and 66 respectively in tension member 64 such that buffers 29 and 38 are limp and free of tension. A series of grooves is provided so that the finished length between flanges 60 and 62 is not critical and a reasonable variation, (1/4 inch) 6.4 mm more or less, can be accommodated. At this time, the other tension relief member 67 (FIG. 10B) can be placed over the top and tightly assembled to member 64. After assembly, any tension between cables 56 and 57 will be borne by the tension relief members 64 and 67, thus protecting splice 10.

Figure 10B is a cross section taken along line D-D of Figure 10A and shows one form of attachment for parts 64 and 67 which include flexible fingers 68 and 69 which snap over ledges 70 and 71 respectively. Other forms of attachment might also be used such as screws with threaded holes or nuts or self-tapping screws with appropriate lead holes.

The simple operation of practicing this invention may now be easily understood with the following description and reference to Figures 2 and 8. The operator prepares the end of the two fibers to be spliced by techniques well known in the art so that after end preparation, approximately 25.4 mm (1 inch) of fiber extends beyond the end of the jacket of this length, approximately 9.5 mm (3/8 inches) is stripped of the plastic buffer leaving about 15.9 mm (5/6 inches) cover with the buffer.

Referring first to Figure 8, the operator may place the splice into the assembly fixture. Then, referring to Figure 2, the operator places one fiber 34 with its buffer 29 into one side of body 10 so that the end of the fiber 41 is approximately in the

centre of body 10. Suffer lock 14 is then closed and latched. The operator then places the second fiber 39 with buffer 38 into the other side of the splice so that the end of fiber 39 is butted against fiber end 41. Buffer lock 16 is then closed and latched. The operator then examines the ends of the fibers with an appropriate magnifier. If the ends of the fibers were not properly butted, the operator could open one buffer lock and adjust the relationship of the two fibers and again close and latch the buffer lock. At this stage, fiber lock 18 is closed and latched or, if desired, an index matching fluid or index matching cement, commonly used materials in the art, could readily be added before closing and latching the fiber lock 18. At this point, the splice is complete.

If the splice were going to be assembled with a strain relief as in Figure 10, the operator would leave approximately 25.4 mm (1 inch) of tension support fiber extending beyond the end of the jacket and would install the flanged ferrule 60 and sleeve 61 before splicing to a similarly prepared cable.

Claims

1. A fiber optical connector for splicing at least one pair of optical fibers end-to-end said connector comprising: a body or housing containing V-shaped grooves (20, 21, 22, 23, 36') for receiving the fibers and having a main bottom section (10) and first, second and third top sections (14, 16, 18), each top section being connected to the bottom section (10) by a flexible hinge (15, 17, 19) and adapted to close and latch with the bottom section independently of the other two top sections; said plurality of V-shaped grooves (20-23, 36') being disposed axially in the bottom section (10) along three contiguously adjacent segments (11, 12, 13) of said bottom section (10), a first segment (11) being located at one end of the bottom section (10) and adapted to receive and latch with the first top section (14), a second segment (12) being located at the other end of the bottom section (10) and adapted to receive and latch with the second top section (16), and a central segment (13) being adapted to receive and latch with the third, central top section (18), said first and second bottom segments each having an outermost and an innermost end, with the innermost ends of said first and second bottom segments facing said central bottom segment; wherein each of the first and second top sections (14, 16) is provided with first and second finger sections (26, 26', 27', 27) which serve to grip the optical fibers in their respective grooves when the first

and second top sections are closed; and the central top section (18) has a further finger section (36) to grip and align the ends of both fibers (34, 39) when the central top section is closed; characterised in that the grooves comprise a first groove (20) and a second groove (21) disposed axially in said first bottom segment (11), the first groove (20) being disposed at the outermost end of the first bottom segment (11), and inclined relative to the second groove (21), a third groove (22) and a fourth groove (23) disposed axially in said second bottom segment (12), the third groove (22) being disposed at the outermost end of the second bottom segment (12) and inclined relative to the fourth groove (23), and a fifth groove (36') in said central bottom segment (13) disposed between the second and fourth grooves (21, 23), said fifth groove being adjacent to but separated from the second and fourth grooves (21, 23) by slots (33, 33').

2. A connector according to Claim 1 wherein each second finger section (27, 27') further includes a cross vane (28, 28') oriented perpendicular to each respective finger section (27, 27'), each cross vane (28, 28') being adapted to be received by a respective slot (33, 33').
3. A connector according to Claim 1 or 2 wherein the first finger sections (26, 26') have inclined surfaces to urge the first and second optical fibers progressively downward into their respective grooves (20, 22) when the top sections (14, 16) are closed.
4. A connector according to Claim 1, 2 or 3 wherein the inclined angle between each of the first and third grooves (20, 22) and the second and fourth grooves (21, 23), respectively, of the first and second bottom segments (11, 12) is less than 180°.
5. A connector according to any one of Claims 1 to 4, wherein each optical fiber includes an optical fiber core (34, 39) surrounded by an insulating buffer (29, 38) except at an end where the buffer has been removed to expose the fiber core (34, 39); and wherein said first finger sections (26, 26') are adapted to grip respectively the insulating buffers (29, 38) of the optical fibers, said second finger sections (27, 27') are adapted to grip respectively the exposed fiber cores (34, 39) of said first and second optical fibers, and said further finger section (36) is adapted to grip simultaneously the ends of the exposed fiber cores (34, 39) of



centre of body 10. Suffer lock 14 is then closed and latched. The operator then places the second fiber 39 with buffer 38 into the other side of the splice so that the end of fiber 39 is butted against fiber end 41. Buffer lock 16 is then closed and latched. The operator then examines the ends of the fibers with an appropriate magnifier. If the ends of the fibers were not properly butted, the operator could open one buffer lock and adjust the relationship of the two fibers and again close and latch the buffer lock. At this stage, fiber lock 18 is closed and latched or, if desired, an index matching fluid or index matching cement, commonly used materials in the art, could readily be added before closing and latching the fiber lock 18. At this point, the splice is complete.

If the splice were going to be assembled with a strain relief as in Figure 10, the operator would leave approximately 25.4 mm (1 inch) of tension support fiber extending beyond the end of the jacket and would install the flanged ferrule 60 and sleeve 61 before splicing to a similarly prepared cable.

Claims

1. A fiber optical connector for splicing at least one pair of optical fibers end-to-end said connector comprising: a body or housing containing V-shaped grooves (20, 21, 22, 23, 36') for receiving the fibers and having a main bottom section (10) and first, second and third top sections (14, 16, 18), each top section being connected to the bottom section (10) by a flexible hinge (15, 17, 19) and adapted to close and latch with the bottom section independently of the other two top sections; said plurality of V-shaped grooves (20-23, 36') being disposed axially in the bottom section (10) along three contiguously adjacent segments (11, 12, 13) of said bottom section (10), a first segment (11) being located at one end of the bottom section (10) and adapted to receive and latch with the first top section (14), a second segment (12) being located at the other end of the bottom section (10) and adapted to receive and latch with the second top section (16), and a central segment (13) being adapted to receive and latch with the third, central top section (18), said first and second bottom segments each having an outermost and an innermost end, with the innermost ends of said first and second bottom segments facing said central bottom segment; wherein each of the first and second top sections (14, 16) is provided with first and second finger sections (26, 26', 27', 27) which serve to grip the optical fibers in their respective grooves when the first

and second top sections are closed; and the central top section (18) has a further finger section (36) to grip and align the ends of both fibers (34, 39) when the central top section is closed; characterised in that the grooves comprise a first groove (20) and a second groove (21) disposed axially in said first bottom segment (11), the first groove (20) being disposed at the outermost end of the first bottom segment (11), and inclined relative to the second groove (21), a third groove (22) and a fourth groove (23) disposed axially in said second bottom segment (12), the third groove (22) being disposed at the outermost end of the second bottom segment (12) and inclined relative to the fourth groove (23), and a fifth groove (36') in said central bottom segment (13) disposed between the second and fourth grooves (21, 23), said fifth groove being adjacent to but separated from the second and fourth grooves (21, 23) by slots (33, 33').

2. A connector according to Claim 1 wherein each second finger section (27, 27') further includes a cross vane (28, 28') oriented perpendicular to each respective finger section (27, 27'), each cross vane (28, 28') being adapted to be received by a respective slot (33, 33').
3. A connector according to Claim 1 or 2 wherein the first finger sections (26, 26') have inclined surfaces to urge the first and second optical fibers progressively downward into their respective grooves (20, 22) when the top sections (14, 16) are closed.
4. A connector according to Claim 1, 2 or 3 wherein the inclined angle between each of the first and third grooves (20, 22) and the second and fourth grooves (21, 23), respectively, of the first and second bottom segments (11, 12) is less than 180°.
5. A connector according to any one of Claims 1 to 4, wherein each optical fiber includes an optical fiber core (34, 39) surrounded by an insulating buffer (29, 38) except at an end where the buffer has been removed to expose the fiber core (34, 39); and wherein said first finger sections (26, 26') are adapted to grip respectively the insulating buffers (29, 38) of the optical fibers, said second finger sections (27, 27') are adapted to grip respectively the exposed fiber cores (34, 39) of said first and second optical fibers, and said further finger section (36) is adapted to grip simultaneously the ends of the exposed fiber cores (34, 39) of



the optical fibers.

6. A connector according to any one of Claims 1 to 5, wherein each of the three top sections (14, 15, 18) has a latching surface (31) adapted to snap over on a ledge (32) along a bottom surface of the bottom section (10). 5
7. A connector according to any one of Claims 1 to 6, wherein the bottom section (10) has a longitudinal projection (42) adapted to be received and held in a fixture assembly. 10
8. A connector according to any one of Claims 1 to 7, and further including a strain relief comprising a first and second member (64, 67), a first ferrule (60) secured to a first optical fiber cable (56) which includes one of the optical fibers, a second ferrule (60) secured to a second optical fiber cable (57) which includes another of the optical fibers, a plurality of recesses (65, 66) in said first relief member (64) adapted to receive said first and second ferrules, and latching means (68, 70) for joining said first and second relief members (64, 67), so that the connector is surrounded by the strain relief. 15 20 25

Patentansprüche

1. Lichtleitfaser-Verbinder zur endseitigen Spleißverbindung wenigstens eines Paares von Lichtleitfasern, wobei der Verbinder folgendes aufweist: Einen Körper oder ein Gehäuse, welches V-förmige Ausnehmungen (20, 21, 22, 23, 36') zur Aufnahme der Fasern enthält und ein Hauptkörperteil (10) und erste, zweite und dritte obere Teile (14, 16, 18) hat, wobei jedes obere Teil mit dem Bodenteil (10) durch ein flexibles Gelenk (15, 17, 19) verbunden und derart ausgelegt ist, daß mit dem Bodenteil unabhängig von den anderen beiden oberen Teilen diese geschlossen und verriegelt werden; die Mehrzahl von V-förmigen Ausnehmungen (20-23, 36') axial in dem Bodenteil (10) entlang drei angrenzenden, benachbarten Segmenten (11, 12, 13) des Bodenteils (10) angeordnet sind, ein erstes Segment (11) an einem Ende des Bodenteils (10) liegt und derart ausgelegt ist, daß das erste, obere Teil (14) aufgenommen und verriegelt wird, ein zweites Segment (12) an dem anderen Ende des Bodenteils (10) liegt und derart ausgelegt ist, daß das zweite, obere Teil (16) aufgenommen und verriegelt wird, und ein mittleres Segment (13) derart ausgelegt ist, daß das dritte, mittlere, obere Teil (18) aufgenommen und verriegelt wird, wobei die ersten und zweiten Bodenseg- 30 35 40 45 50 55

mente jeweils ein am weitesten außen und ein am weitesten innenliegendes Ende haben, wobei die zu innerst liegenden Enden der ersten und zweiten Bodensegmente dem mittleren Bodensegment zugewandt sind, bei dem jedes erste und zweite, obere Teil (14, 16) mit ersten und zweiten Fingerteilen (26, 26', 27', 27) versehen sind, welche dazu dienen, die Lichtleitfasern in ihren zugeordneten Ausnehmungen zu erfassen, wenn die ersten und zweiten oberen Teile geschlossen sind; und das mittlere, obere Teil (18) ein weiteres Fingerteil (36) hat, um die Enden beider Fasern (34, 39) zu erfassen und auszurichten, wenn das mittlere, obere Teil geschlossen ist, **dadurch gekennzeichnet**, daß die Ausnehmungen eine erste Ausnehmung (20) und eine zweite Ausnehmung (21) aufweisen, welche axial im ersten Bodensegment (11) angeordnet sind, die erste Ausnehmung (20) an dem zu äußerst liegenden Ende des ersten Bodensegments (11) angeordnet ist und relativ zur zweiten Ausnehmung (21) geneigt angeordnet ist, eine dritte Ausnehmung (22) und eine vierte Ausnehmung (23) axial im zweiten Bodensegment (12) angeordnet sind, die dritte Ausnehmung (22) an dem zu äußerst liegenden Ende des zweiten Bodensegments (12) angeordnet und relativ zur vierten Ausnehmung (23) geneigt ist, und eine fünfte Ausnehmung (36') im mittleren Bodensegment (13) zwischen den zweiten und vierten Ausnehmungen (21, 23) angeordnet ist, und die fünfte Ausnehmung benachbart, aber getrennt von den zweiten und vierten Ausnehmungen (21, 23) durch Schlitze (33, 33') vorgesehen ist.

2. Verbinder nach Anspruch 1, bei dem das zweite Fingerteil (27, 27') ferner einen Quersteg (28, 28') umfaßt, welcher senkrecht zu dem jeweiligen Fingerteil (27, 27') ausgerichtet ist, und jeder Quersteg (28, 28') derart ausgelegt ist, daß er mittels eines zugeordneten Schlitzes (33, 33') aufnehmbar ist.
3. Verbinder nach Anspruch 1 oder 2, bei dem die ersten Fingerteile (26, 26') geneigte Flächen haben, um die ersten und zweiten Lichtleitfasern progressiv nach unten in die zugeordneten Ausnehmungen (20, 22) zu drücken, wenn die oberen Teile (14, 16) geschlossen werden.
4. Verbinder nach Anspruch 1, 2 oder 3, bei dem der Neigungswinkel zwischen den jeweiligen ersten und dritten Ausnehmungen (20, 22) und der zweiten und vierten Ausnehmungen (21, 23) jeweils von den ersten und zweiten Boden-



segmenten (11, 12) kleiner als 180° ist.

5. Verbinder nach einem der Ansprüche 1 bis 4, bei dem jede Lichtleitfaser einen Lichtleitfaserkern (34, 39) umfaßt, welcher von einem Isolierpuffer (29, 38) abgesehen von einem Ende umgeben ist, an dem der Puffer zum Freilegen des Faserkerns (34, 39) entfernt ist, und bei dem die ersten Fingerteile (26, 26') derart ausgelegt sind, daß jeweils die Isolierpuffer (29, 38) der Lichtleitfasern ergriffen werden, die zweiten Fingerteile (27, 27') derart ausgelegt sind, daß jeweils die freigelegten Faserkerne (34, 39) der ersten und zweiten Lichtleitfasern ergriffen werden, und das weitere Fingerteil (36) derart ausgelegt ist, daß gleichzeitig die Enden der freigelegten Faserkerne (34, 39) der Lichtleitfasern ergriffen werden.

6. Verbinder nach einem der Ansprüche 1 bis 5, bei dem jedes der drei oberen Teile (14, 15, 18) eine Verriegelungsfläche (31) hat, welche derart ausgelegt ist, daß sie über eine Kante (32) entlang einer Bodenfläche des Bodenteils (10) schnappt.

7. Verbinder nach einem der Ansprüche 1 bis 6, bei dem das Bodenteil (10) einen Längsvorsprung (42) hat, welcher derart ausgelegt ist, daß er in einer Befestigungsanordnung aufgenommen und dort gehalten ist.

8. Verbinder nach einem der Ansprüche 1 bis 7, welcher ferner eine Zugentlastungseinrichtung umfaßt, welche ein erstes und ein zweites Teil (64, 67), eine erste Zwinge (60), die fest mit einem ersten Lichtleitfaserkabel (56) verbunden ist, welches eines der Lichtleitfasern umfaßt, eine zweite Zwinge (60), welche fest mit dem zweiten Lichtleitfaserkabel (57) verbunden ist, welches die weitere Lichtleitfaser umfaßt, eine Mehrzahl von Ausnehmungen (65, 66) in dem ersten Zugentlastungsteil (64), welches derart ausgelegt ist, daß die ersten und zweiten Zwingen aufgenommen sind, und Verriegelungseinrichtungen (68, 70) zum Verbinden der ersten und zweiten Zugentlastungsteile (64, 67) derart aufweist, daß der Verbinder durch die Zugentlastungseinrichtungen umgeben ist.

Revendications

1. Un connecteur pour fibres optiques pour raccorder bout-à-bout par d'une épissure, au moins une paire de fibres optiques, ledit connecteur comprenant: un corps ou boîtier présentant des rainures en forme de V (20, 21, 22, 23, 36') pour recevoir les fibres et présen-

tant une section principale inférieure (10) et des première, deuxième et troisième section supérieure (14, 16, 18), chaque section supérieure étant reliée à la section inférieure (10) par une articulation flexible (15, 17, 19) et étant conçue pour se fermer et se verrouiller avec la section inférieure indépendamment des deux autres sections supérieures, ladite pluralité de rainures en forme de V (20-23, 36') étant disposées axialement dans la section inférieure 10 le long de trois segments contigus adjacents (11, 12, 13) de ladite section inférieure (10), un premier segment (11) étant situé à l'une des extrémités de la section inférieure (10) et étant conçue pour recevoir et se verrouiller avec la première section supérieure (14), un deuxième segment (12) étant situé à l'autre extrémité de la section inférieure (10) et étant adapté à recevoir, et à se verrouiller avec la deuxième section supérieure (16), et un segment central (13) étant adapté à recevoir et à se verrouiller à la troisième section centrale supérieure (18), lesdits premier et deuxième segments inférieurs présentant une extrémité externe et une extrémité interne, les extrémités les plus internes desdits premier et deuxième segments inférieurs faisant face audit segment central inférieur; dans lequel chacune desdites première et deuxième sections supérieures (14, 16) est munie d'une première et d'une deuxième sections en forme de doigt (26, 26', 27', 27) destinées à serrer les fibres optiques dans leurs rainures respectives quand les première et deuxième sections supérieures sont fermées; et la section centrale supérieure (18) présentant une section supplémentaire en forme de doigt (36) conçue pour serrer et aligner les extrémités des deux fibres (34, 39) quand la section centrale supérieure est fermée; caractérisé en ce que les rainures comprennent une première rainure (20) et une deuxième rainure (21) disposées axialement dans ledit premier segment inférieur (11), la première rainure (20) étant disposée à l'extrémité la plus externe du premier segment inférieur (11) et étant inclinée par rapport à la deuxième rainure (21), une troisième rainure (22) et une quatrième rainure (23) disposées axialement dans ledit deuxième segment inférieur (12), la troisième rainure (22) étant disposée à l'extrémité la plus externe du deuxième segment inférieur (12) en étant inclinée par rapport à la quatrième rainure (23), et une cinquième rainure (36') dans ledit segment central inférieur (13) disposée entre la deuxième et la quatrième rainure (21, 23), ladite cinquième rainure étant adjacente mais séparée de la deuxième et la quatrième rainure (21, 23) grâce à des lentes (33,



33').

2. Un connecteur selon la revendication 1, dans lequel chaque deuxième section en forme de doigt (27, 27') comporte en outre une cloison transversale (28, 28') orientée perpendiculairement à chaque section respective en forme de doigt (27, 27'), chaque cloison transversale (28, 28') étant faite pour être reçue par une lente correspondante (33, 33').

3. Un connecteur selon la revendication 1 ou 2, dans lequel les premières sections en forme de doigt (26, 26') présentent des surfaces inclinées conçues pour solliciter les première et deuxième fibres optiques progressivement vers le bas dans leurs rainures respectives (20, 22) lors de la fermeture des sections supérieures (14, 16).

4. Un connecteur selon la revendication 1, 2 ou 3, dans lequel l'angle compris entre chacune des première et troisième rainures (20, 22) et des deuxième et quatrième rainures (21, 23) du premier et du deuxième segments inférieurs (11, 12), respectivement, est inférieur à 180°.

5. Un connecteur selon l'une quelconque des revendications 1 à 4, dans lequel chaque fibre optique comprend un noyau de fibres optiques (34, 39) entouré d'un revêtement tampon isolant (29, 38) sauf à l'une de ses extrémités où le revêtement tampon a été enlevé pour exposer le noyau de la fibre (34, 39); et dans lequel lesdites premières sections en forme de doigt (26, 26') sont conçues pour serrer respectivement les revêtements tampons isolants (29, 38) des fibres optiques, lesdites deuxième sections en forme de doigt (27, 27') étant capable de serrer respectivement les noyaux de fibres exposés (34, 39) de ladite première et de ladite deuxième fibres optiques, et ladite section supplémentaire en forme de doigt (36) est capable de serrer simultanément les extrémités des noyaux de fibres exposés (34, 39) des fibres optiques.

6. Un connecteur selon l'une quelconque des revendications 1 à 5, dans lequel chacune des trois sections supérieures (14, 15, 18) présente une surface de verrouillage (31) conçue pour dépasser avec une action d'encliquetage un rebord (32) le long d'une surface inférieure de la section inférieure (10).

7. Un connecteur selon l'une quelconque des revendications 1 à 6, dans lequel la section inférieure (10) présente une partie longitudinale

en saillie (42) qui peut se loger et être maintenue dans un montage de fixation.

8. Un connecteur selon l'une quelconque des revendications 1 à 7, comportant en outre un dispositif détendeur de tension comprenant un premier et un deuxième organes (64, 67), une première (60) fixée à un premier câble à fibres optiques (56) qui comporte une desdites fibres optiques, une deuxième (60) fixée à un deuxième câble à fibres optiques (57) qui comporte une autre desdites fibres optiques, une pluralité d'évidements (65, 66) dans le premier organe détendeur (64) étant conçus pour recevoir ladite première et ladite deuxième bagues, et des moyens de verrouillage (68, 70) réalisés pour unir ledit premier et ledit deuxième organes détendeurs (64, 67) de sorte que le connecteur soit entouré par le détendeur de tension.

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