

Description

This invention relates to connection systems and more particularly to connection systems for fiber optic transmission members.

Fiber optic connections systems are known for connecting fiber optic transmission members. A typical system has ends of fiber optic transmission members connected together by fusion splicing equipment and the fused ends are encased in an epoxy material. The encased fused ends are disposed in a rack that is mounted on an organizer; this assembly is then secured in a moisture proof enclosure. The fused fiber optic connections are not disconnectable, thus they cannot be tested nor adjusted to provide low light loss connections. The equipment to make the fusion splices is expensive and cannot be used in manholes because of explosion problems. Fusion splices of fiber optic transmission members cannot withstand wide temperature variations and they cannot be terminated except at the locations where the splices are to be made.

It is known from US-A-3,999,837 to provide a fiber optic connector for connecting fiber optic transmission members together comprising ferrule members of resilient material each of which has a profiled bore extending therethrough in which the fiber optic transmission members are secured with ends of the fiber optic transmission members being coplanar with front ends of ferrule members, forward ends of ferrule members having profiled configurations including cylindrical sections and tapered sections, a rigid housing member having a profiled bore extending therethrough which includes a central cylindrical section and tapered sections, said cylindrical sections of said ferrule members tightly engaging said central cylindrical section when urged thereinto causing said cylindrical sections to be radially reduced in diameter thereby axially aligning the fiber optic transmission members, and members engaging said ferrule members urging the profiled front ends into the profiled bore.

It is known from US-A-4,332,435 to provide a fiber optic connection assembly for connecting fiber optic transmission members of fiber optic cables together comprising end caps secured onto jackets of cables, bars secured to end caps spacing end caps from each other, an organizer mounted on the bars, fiber optic connectors connecting respective fiber optic transmission members together and mounted on the organizer and a cover member sealingly secured onto the end caps.

It is an object of the present invention to provide an improved connector having the features known from US-A-3,999,837 and it is a further object to provide an improved assembly having the features known from US-A-4,332,435.

According to this invention a connector having the features acknowledged to be known from US-A-3,999,837 is characterized in that said members are forked ends of a spring clip member having an

arcuate-shaped base member extending inwardly between said forked ends said forked ends being deflectable apart when the fiber optic connectors are assembled therebetween with tubular members of said ferrule members inserted into said forked ends, said forked ends thereafter continually engaging shoulder sections of said ferrule members under spring bias thereby axially urging the profiled front ends into the complementary profiled sections of said profiled bore.

According to a further aspect of the invention an assembly having the features acknowledged to be known from US-A-4,332,435 is characterized in that said fiber optic connectors are according to the present invention and mounting members on the spring clip members mount the spring clip members with the tubular members and ferrule members therein onto the organizer.

The invention will now be described, by way of example, with reference to the accompanying partly diagrammatic drawings, in which:

Figure 1 is an exploded and perspective view of the components of the fiber optic connection assembly.

Figure 2 is an exploded and perspective view of the cable anchor and ground connection.

Figures 3 through 8 illustrate the various steps in completing the fiber optic connection assembly.

Figures 9 through 11 illustrate details of the fiber optic connector.

Figures 1 through 8 illustrate a fiber optic connection assembly 10 for connecting fiber optic transmission members 12 of each of fiber optic cables 14, the cable having a center wire strength member 16 around which is disposed the fiber optic transmission members 12. Woven plastic strength members 18 surround the bundle of fiber optic transmission members 12 and a plastic sheath 20 surrounds the layer of strength members 18. A metallic layer 22 covers sheath 20 and can be either in braid or foil form. A plastic jacket 24 surrounds metallic layer 22 thereby completing the construction of the fiber optic cable.

The end of cables 14 are prepared by exposing transmission members 12, strength members 16, 18, and a section of sheath 20. A rectangular flap section 26 of layer 22 and jacket 24 is cut from the remainder of metallic layer 22 and jacket 24 and is hingeably connected thereto as shown in Figure 2. A dielectric support member 30 is positioned on sheath 20 along the area from which rectangular section 26 has been cut and its edges are disposed between sheath 20 and metallic layer 22 as shown in Figure 2. A bottom anchor plate 32 is positioned on support member 30 and has a bolt 34 extending outwardly therefrom on which is positioned electrical contact member 36. A series of barbs 38 are formed in contact member 36 and they make electrical connection with the metallic layer of flap section 26. Bolt 34 extends through hole 28 when flap section 26 is moved into engagement with contact member 36. A top anchor plate 40 is on bolt 34 in engagement with flap section 26 and nut 42 is threadably positioned

on bolt 34 and tightened thereby providing an anchor and ground connection to the end of cable 14.

Prior to top anchor plate 40 being secured in position, sealing tape 44 as shown in Figure 3 is wrapped around the end of the cable along jacket 24 whereafter anchor plate 40 is secured in position by nut 42. Members 46 are positioned onto the sealing tape 44 on the ends of cables 14 via straps 48 thereby forming end caps 50. Insulation-covered bars 52 and grounding bands 54 are secured onto bolts 58 and end caps 50 via nut 60 with organizer 56 disposed between bars 52 and mounted thereon by legs 62 extending outwardly from plate 64. Nuts 66 are threadably mounted on bolts 34 to secure grounding bands 54 in connection with the anchor and ground connection. Screws 68 secure center wire strength members 16 and strength members 18 of cables 14 to plate 64 of organizer 56 as illustrated in Figures 5 and 6. Ground wire 70, if used, is electrically connected between ground tap 72 in end caps 50 and one of bolts 58. Ground tap 72 has an external connection for connection to ground.

Organizer 56 also has inwardly-directed legs 74 spaced along each side thereof and rows of holes 76 extending therethrough. Fiber optic connectors 78 connect fiber optic transmission members 12 together. Each fiber optic connector 78 includes ferrule members 80 for terminating the ends of fiber optic transmission members 12, a tubular member 82 in which the profiled forward ends of ferrule members 80 are disposed, and a spring clip member 84 for maintaining ferrule members 80 in position in tubular member 82 and which are mounted on organizer 56. Ferrule members 80 are of the type disclosed in U.S. Patent No. 3,999,837. Each ferrule member 80 is molded from a suitable plastic material having resilient characteristics and has a profiled bore 86 extending therethrough which has a rear cylindrical configuration, an intermediate conical section, and a forward cylindrical configuration, the forward cylindrical section being of smaller diameter than the rear cylindrical section. The exterior configuration of ferrule member 80 includes a rear cylindrical section 88, an annular shoulder section 90, a tapered section 92, and a front cylindrical section 94. Section 94 defines a forward profiled section that tightly fits into a complementary section 100 of profiled bore 102 in tubular member 82. Sections 90 of ferrule members 80 fit within sections 96 of profiled bore 102 to limit movement of sections 94 into complementary section 100 while tapered sections 92 of ferrule members 80 are preferably slightly spaced from sections 98. Tubular member 82 is molded from a rigid plastic material or it can be a machined metal member with profiled bore 102 having close tolerance dimensions so that when the profiled forward ends of ferrule members 80 are inserted into the complementary profiled sections of bore 102, the resilient nature of the material of ferrule members 80 will cause the forward ends of ferrule members 80 to be concen-

trically aligned within bore 102 as shown in Figure 11 so that the ends of fiber optic transmission members 12 are axially aligned therein. A small slot 100A is in communication with section 100 which acts as a vent to prevent hydraulic action from taking place if index matching liquid, such as silicon oil or the like, is used in the connection of ferrule members 80 within profiled bore 102.

The ends of fiber optic transmission members 12 are stripped to expose fiber optic cores 104 which can be either glass or plastic material having cladding thereover, a buffer material (not shown), and an outer protective jacket 106. A potting material 108 such as epoxy resin or like material is disposed in bores 86 of ferrule members 80 and the stripped ends of fiber optic transmission members 12 are positioned therein until the forward ends of fiber optic cores 104 extend outwardly from front cylindrical sections 94. The potting material is allowed to cure after which the sections of fiber optic cores 104 extending outwardly from cylindrical sections 94 are removed at the front surfaces thereof. The surfaces of cylindrical sections 94 along with the ends of fiber optic cores 104 are polished thereby completing the termination of the ends of fiber optic transmission members 12 in ferrule members 80. The profiled forward ends of ferrule members 80 are then positioned within the complementary profiled sections of profiled bore 102 in tubular member 82 as shown in Figure 11 with cylindrical sections 94 being concentric and the abutting ends of fiber optic cores 104 in axial alignment thereby minimizing light losses therebetween.

Ferrule members 90 can also be of any type that is terminatable onto the ends of fiber optic transmission members.

Spring clip member 84 is stamped and formed from a metal having suitable spring characteristics such as, for example, spring steel, and it includes an arcuate shaped base member 110, the ends of which are formed into curved forks 112. A connector 78 is positioned in spring clip member 84 with cylindrical sections 88 of ferrule members 80 being disposed in curved fork ends 112 as shown in Figures 10 and 11, with the curved fork ends 112 engaging against shoulder sections 90 of ferrule members 80 thereby applying axial forces onto ferrule members 80 to maintain cylindrical sections 94 in concentric alignment within cylindrical section 100 of profiled bore 102 in tubular member 82 thereby maintaining fiber optic cores 104 in axial alignment due to the resilient characteristics of ferrule members 80. The arcuate configuration of base member 110 extending inwardly between the ends contributes to the spring characteristics of forked ends 112.

A pair of barbed legs 114 extend outwardly from base member 110 on each side thereof at a central location thereof for engagement with holes 76 in plate 64 of organizer 56 to position fiber optic connectors 78 in organizer 56 and fiber optic transmission members 12 are neatly arranged within organizer 56 with inwardly-

directed legs 74 maintaining transmission members 12 in position therein as shown in Figure 7. Spring clip members 84 can also be used to maintain fiber optic connectors 78 in a connected condition in a free-hanging manner if desired, legs 114 being absent.

Sealing material is placed in recesses 116 of end caps 50 after which split sleeve 118 of plastic material is placed onto end caps 50 covering the terminated fiber optic transmission members, clamping bars 120 are moved along sealingly mateable closing edges 122 and secured in position by clamping band 124 as illustrated in Figure 8.

From the foregoing, a fiber optic connection has been described that is sealed from the environment, can withstand wide temperature variations, can be used in underground installations, enables the fiber optic connectors to be disconnected, enables the fiber optic connectors to be adjusted to provide low loss connections, and enables the terminations to be tested.

Claims

1. A fiber optic connector for connecting fiber optic transmission members (12) together comprising ferrule members (80) of resilient material each of which has a profiled bore (102) extending therethrough in which the fiber optic transmission members (12) are secured with ends of the fiber optic transmission members being coplanar with front ends of ferrule members (80), forward ends of ferrule members (80) having profiled configurations including cylindrical sections (94) and tapered sections (92), a rigid housing member (82) having a profiled bore (102) extending therethrough which includes a central cylindrical section (100) and tapered sections (102), said cylindrical sections (94) of said ferrule members (80) tightly engaging said central cylindrical section (100) when urged thereinto causing said cylindrical sections (94) to be radially reduced in diameter thereby axially aligning the fiber optic transmission members (12), and members (112) engaging said ferrule members (80) urging the profiled front ends (92,94) into the profiled bore (102), characterized in that said members (112) are forked ends (112) of a spring clip member (84) having an arcuate-shaped base member (110), extending inwardly between said forked ends (12), said forked ends (12) being deflectable apart when the fiber optic connectors (78) are assembled therebetween with tubular members (88) of said ferrule members (80) inserted into said forked ends (112), said forked ends (112) thereafter continually engaging shoulder sections (90) of said ferrule members (80) under spring bias thereby axially urging the profiled front ends (92,94) into the complementary profiled sections (98,100) of said profiled bore (102).

2. A fiber optic connector set forth in claim 1, characterized in that the opposed pairs of forked ends (112) of said spring clip member (84) are inwardly curved towards each other.

3. A fiber optic connector as set forth in claim 2, characterized in that spring leg members (114) extend outwardly from said base member (110).

4. A fiber optic connector as set forth in claim 1, characterized in that said shoulder sections (90) of said ferrule members (80) engage surfaces in said profiled bore (102) limiting movement of the profiled front ends (92,94) within the profiled bore (102).

5. A fiber optic connector as set forth in claim 1, characterized in that said central cylindrical section (100) of said profiled bore (102) includes a slot (100A).

6. A fiber optic connection assembly for connecting fiber optic transmission members (12) of fiber optic cables (14) together comprising end caps (50) secured onto jackets (24) of cables (14), bars (52) secured to end caps (50) spacing end caps (50) from each other, an organizer (56) mounted on the bars (52), fiber optic connectors (78) connecting respective fiber optic transmission members (12) together and mounted on the organizer (56) and a cover member (118) sealingly secured onto end caps (50), characterized in that said fiber optic connectors (78) are as claimed in any preceding claim and mounting members (114) on the spring clip members (84) mount the spring clip members with the tubular members (82) and ferrule members (80) therein onto organizer (56).

7. A fiber optic connection assembly as set forth in claim 6, characterized in that said organizer (56) includes leg members (62) mounting said organizer (56) onto said bars (52) and other leg members (74) maintaining the fiber optic transmission members (12) in an orderly arrangement along the organizer (56).

8. A fiber optic connection assembly as set forth in claim 6 or claim 7, characterized in that said mounting members (114) are barbed legs engaging holes (76) in the organizer (56).

9. A fiber optic connection assembly as set forth in claim 6, characterized in that anchor members (32, 36, 40) are secured onto sections (26) of cables (14), grounding bands (54) are secured to anchor members (32, 36, 40) and to bars (52) and a ground wire (70) is secured to a bar (52) and a ground tap (72) in an end cap (50).

Patentansprüche

1. Faseroptik-Verbinder zum miteinander Verbinden von faseroptischen Übertragungselementen (12), mit Zwingenelementen (80) aus federnd nachgiebigem Material, deren jedes eine sich durch dieses hindurcherstreckende Profilbohrung (102) aufweist, in der die faseroptischen Übertragungselemente (12) derart befestigt sind, daß Enden der faseroptischen Übertragungselemente mit Frontenden der Zwingenelemente (80) koplanar sind, wobei vordere Enden der Zwingenelemente (80) mit Profil versehene Konfigurationen aufweisen, die zylindrische Abschnitte (94) und sich verjüngende Abschnitte (92) beinhalten, mit einem starren Gehäuseelement (82), das eine sich



directed legs 74 maintaining transmission members 12 in position therein as shown in Figure 7. Spring clip members 84 can also be used to maintain fiber optic connectors 78 in a connected condition in a free-hanging manner if desired, legs 114 being absent.

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durch dieses hindurcherstreckende Profilbohrung (102) aufweist, die einen zentralen zylindrischen Abschnitt (100) und sich verjüngende Abschnitte (102) beinhaltet, wobei die zylindrischen Abschnitte (94) der Zwingenelemente (80) in dem in den zentralen zylindrischen Abschnitt (100) gedrückten Zustand fest an diesem angreifen und die zylindrischen Abschnitte (94) dadurch in ihrem Durchmesser radial reduziert werden und die faseroptischen Übertragungselemente (12) dadurch axial miteinander ausgerichtet sind, und mit an den Zwingenelementen (80) angreifenden Elementen (112) zum Drücken der mit Profil versehenen Frontenden (92, 94) in die Profilbohrung (102), dadurch gekennzeichnet, daß es sich bei den Elementen (112) um gegabelte Enden (112) eines Federclipelements (84) handelt, wobei ein bogenförmig ausgebildetes Basiselement (110) sich zwischen den gegabelten Enden (12) nach innen erstreckt und die gegabelten Enden (12) auseinanderbiegbar sind, wenn die Faseroptik-Verbinder (78) dazwischen montiert werden und dabei rohrförmige Elemente (88) der Zwingenelemente (80) in die gegabelten Enden (112) eingesetzt werden, wobei die gegabelten Enden (112) danach an Schulterabschnitten (90) der Zwingenelemente (80) unter Federvorspannung kontinuierlich angreifen und dadurch die mit Profil versehenen Frontenden (92, 94) in die komplementären, mit Profil versehenen Abschnitte (98, 100) der Profilbohrung (102) hineindrücken.

2. Faseroptik-Verbinder nach Anspruch 1, dadurch gekennzeichnet, daß die einander gegenüberliegenden Paare von gegabelten Enden (112) des Federclipelements (84) in Richtung aufeinander zu nach innen gekrümmt sind.

3. Faseroptik-Verbinder nach Anspruch 2, dadurch gekennzeichnet, daß sich Federschenkellemente (114) von dem Basiselement (110) nach außen wegerstrecken.

4. Faseroptik-Verbinder nach Anspruch 1, dadurch gekennzeichnet, daß die Schulterabschnitte (90) der Zwingenelemente (80) an Flächen in der Profilbohrung (102) angreifen, die eine Bewegung der mit Profil versehenen Frontenden (92, 94) innerhalb der Profilbohrung (102) begrenzen.

5. Faseroptik-Verbinder nach Anspruch 1, dadurch gekennzeichnet, daß der zentrale zylindrische Abschnitt (100) der Profilbohrung (102) einen Schlitz (100A) beinhaltet.

6. Faseroptik-Verbindungsanordnung zum miteinander Verbinden von faseroptischen Übertragungselementen (12) faseroptischer Kabel (14), mit auf Mänteln (24) der Kabel (14) befestigten Endkappen (50), mit an den Endkappen (50) befestigten Stangen (52) zur Beabstandung der Endkappen (50) voneinander, mit einer an den Stangen (52) montierten Ordnungseinrichtung (56), mit Faseroptik-Verbindern (78), die jeweilige faseroptische Übertragungselemente (12) miteinander verbinden und auf der Ordnungseinrichtung (56) montiert sind, und mit einem Abdeckelement (118), das an den Endkappen (50) in abdichtender Weise befestigt ist, dadurch

gekennzeichnet, daß die Faseroptik-Verbinder (78) nach einem der vorausgehenden Ansprüche ausgebildet sind, und daß durch an den Federclipelementen (84) vorgesehene Befestigungselemente (114) die Federclipelemente mit den darin aufgenommenen rohrförmigen Elementen (82) und Zwingenelementen (80) auf der Ordnungseinrichtung (56) montiert sind.

7. Faseroptik-Verbindungsanordnung nach Anspruch 6, dadurch gekennzeichnet, daß die Ordnungseinrichtung (56) Schenkelemente (62), durch die die Ordnungseinrichtung (56) an den Stangen (52) montiert ist, sowie weitere Schenkellemente (74), durch die die faseroptischen Übertragungselemente (12) in einer ordentlichen Anordnung längs der Ordnungseinrichtung (56) gehalten sind, aufweist.

8. Faseroptik-Verbindungsanordnung nach Anspruch 6 oder Anspruch 7, dadurch gekennzeichnet, daß es sich bei den Befestigungselementen (114) um mit Widerhaken versehene Schenkel handelt, die in der Ordnungseinrichtung (56) vorgesehene Löcher (76) eingreifen.

9. Faseroptik-Verbindungsanordnung nach Anspruch 6, dadurch gekennzeichnet, daß Verankerungselemente (32, 36, 40) auf Abschnitten (26) der Kabel (14) befestigt sind, daß Erdungsbänder (54) an den Verankerungselementen (32, 36, 40) und den Stangen (52) befestigt sind und daß ein Erdungsdraht (70) an einer Stange (52) und einer Erdungszunge (72) in einer Endkappe (50) befestigt ist.

Revendications

1. Connecteur de fibres optiques destiné à connecter entre eux des éléments (12) de transmission à fibres optiques, comprenant des éléments de viroles (80) en matière élastique à travers chacun desquels s'étend une lumière profilée (102) dans laquelle les éléments (12) de transmission à fibres optiques sont fixés, des extrémités des éléments de transmission à fibres optiques étant coplanaires avec des extrémités frontales des éléments de viroles (80), des extrémités avant des éléments de viroles (80) ayant des configurations profilées comprenant des tronçons cylindriques (94) et des tronçons coniques (92), un élément de boîtier rigide (82) étant traversé par une lumière profilée (102) qui comprend un tronçon cylindrique central (100) et des tronçons coniques (102), lesdits tronçons cylindriques (94) desdits éléments de viroles (80) étant en prise étroite avec ledit tronçon cylindrique central (100) lorsqu'ils sont poussés dans ce dernier, amenant lesdits tronçons cylindriques (94) à être réduits radialement en diamètre, ce qui aligne axialement les éléments (12) de transmission à fibres optiques, et des éléments (112) portant contre lesdits éléments de viroles (80) et sollicitant les extrémités frontales profilées (92, 94) vers l'intérieur de la lumière profilée (102), caractérisé en ce que lesdits éléments (112) sont des extrémités en fourche (112) d'un élément de pince à ressort (84) comportant un élément de base (110)



de forme incurvée qui s'étend vers l'intérieur entre lesdites extrémités en fourche (112), lesdites extrémités en fourche (112) pouvant être déformées à l'écart l'une de l'autre lorsque les connecteurs (78) de fibres optiques sont assemblés entre eux avec des éléments tubulaires (88) desdits éléments de viroles (80) insérés dans lesdites extrémités en fourche (112), lesdites extrémités en fourche (112) portant ensuite de façon continue contre des tronçons épaulés (90) desdits éléments de viroles (80), sous une force de rappel de ressort, repoussant ainsi axialement les extrémités frontales profilées (92, 94) dans les tronçons profilés complémentaires (98, 100) de ladite lumière profilée (102).

2. Connecteur de fibres optiques selon la revendication 1, caractérisé en ce que les paires opposées d'extrémités en fourche (112) dudit élément de pince à ressort (84) sont incurvées vers l'intérieur en direction l'une de l'autre.

3. Connecteur de fibres optiques selon la revendication 2, caractérisé en ce que des éléments à pince à ressort (114) font saillie vers l'extérieur dudit élément de base (110).

4. Connecteur de fibres optiques selon la revendication 1, caractérisé en ce que lesdits tronçons épaulés (90) desdits éléments de viroles (80) portent contre des surfaces de ladite lumière profilée (102), limitant le mouvement des extrémités frontales profilées (92, 94) à l'intérieur de la lumière profilée (102).

5. Connecteur de fibres optiques selon la revendication 1, caractérisé en ce que ledit tronçon cylindrique central (100) de ladite lumière profilée (102) présente une fente (100A).

6. Ensemble de connexion de fibres optiques destiné à connecter entre eux des éléments (12) de transmission à fibres optiques de câbles (14) à fibres optiques, comprenant des chapeaux d'extrémité (50) fixés sur des gaines (24) des câbles

(14), des barrettes (52) fixées sur les chapeaux d'extrémité (50) et espaçant les chapeaux d'extrémité (50) l'un de l'autre, un distributeur (56) monté sur les barrettes (52), des connecteurs (78) de fibres optiques connectant entre eux les éléments respectifs (12) de transmission à fibres optiques et montés sur le distributeur (56), et un élément de recouvrement (118) fixé de façon étanche sur les chapeaux d'extrémité (50), caractérisé en ce que lesdits connecteurs (78) de fibres optiques sont tels que revendiqués dans l'une quelconque des revendications précédentes et des éléments de montage (114), situés sur les éléments de pince à ressort (84), sont utilisés pour le montage sur le distributeur (56) des éléments de pince à ressort dans lesquels sont disposés les éléments tubulaires (82) et les éléments de viroles (80).

7. Ensemble de connexion de fibres optiques selon la revendication 6, caractérisé en ce que ledit distributeur (56) comprend des pattes (62) au moyen desquelles ledit distributeur (56) est monté sur lesdites barrettes (52) et d'autres pattes (74) maintenant les éléments (12) de transmission à fibres optiques dans une disposition ordonnée le long du distributeur (56).

8. Ensemble de connexion de fibres optiques selon la revendication 6 ou la revendication 7, caractérisé en ce que lesdits éléments (114) de montage sont des pattes barbelées s'engageant dans des trous (76) du distributeur (56).

9. Ensemble de connexion de fibres optiques selon la revendication 6, caractérisé en ce que des éléments d'ancrage (32, 36, 40) sont fixés sur des parties (26) des câbles (14), des bandes (54) de mise à la masse sont fixées aux éléments d'ancrage (32, 36, 40) et aux barrettes (52), et un fil (70) de mise à la masse est fixé à une barrette (52) et à une prise (72) de masse dans un chapeau d'extrémité (50).

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