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ADAPTERS AND OPTICAL ASSEMBLIES FOR MATING DISSIMILAR OPTICAL CONNECTORS

Abstract

An adapter for coupling two dissimilar optical connectors includes a first end and a second end opposite from the first end, where the first end is operable to receive a first optical connector of a first optical connector type and the second end is operable to receive a second optical connector of a second optical connector type. The adapter further includes a receptacle holder and a flange adjacent to the first end, where the receptacle holder extends from the flange and defines a rectangular opening, an adapter body extending from the flange to the second end, and a lock opening within the adapter body and adjacent to the flange. The adapter also includes a lock tab secured within the lock opening such that the lock tab is operable to engage the threads of the second optical connector when the second optical connector is inserted into the adapter.

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Background/Summary

[0001] This application claims the benefit of priority of U.S. Provisional Application Ser. No. 63/555,641 filed on Feb. 20, 2024, the content of which is relied upon and incorporated herein by reference in its entirety.

BACKGROUND

Background

[0002] Optical fiber is increasingly being used for a variety of applications, including but not limited to broadband voice, video, and data transmission. As bandwidth demands increase optical fiber is migrating deeper into communication networks such as in fiber to the premises applications such as FTTx, 5G and the like. As optical fiber extends deeper into communication networks there exist a need for building more complex and flexible fiber optic networks using fiber optic connectors that are capable of making connections in a quick and easy manner.

[0003] Fiber optic connectors were developed for making plug and play optical connections at links or devices in the communication network such as terminals, cabinets, patch panels, and like. The fiber optic connectors allow the distribution of optical signals within an optical network and provide the flexibility of locating the devices in convenient locations for efficient network design and deployment and also deferring connectivity and the associated expense until needed in the communication network. As the deployment of optical networks expands, more multi-fiber optical connectors are needed for building a suitable communications network. Multi-fiber connectors using a ferrule that supports and connects multiple optical fibers at a ferrule mating interface are much more challenging than optical connectors having ferrules that support a single optical fiber. Specifically, optical connectors with ferrules supporting multiple fibers requires the alignment and physical contact of all of the end faces of the multiple optical fibers across the fiber array, and all of optical channels of the optical connector need to meet the optical mating performance specification. Different types of optical connectors exist and are deployed by network operators, but are typically not compatible with newer connector designs. This causes concerns and complexity for network operators for managing their communication networks.

[0004] Accordingly, alternative devices and methods for coupling of dissimilar optical connectors are desired.

SUMMARY

[0005] Embodiments of the present disclosure are directed to adapters that enable the mating of two dissimilar optical connectors. The adapters disclosed herein also enable dissimilar optical connectors to be positioned in legacy telecommunications ports designed for electrical cables and connectors, such as ⅝-24 ports. The adapters eliminate the need for fiber splicing within legacy enclosures, thereby reducing installation costs.

[0006] In one embodiment, an adapter for coupling two dissimilar optical connectors includes a first end and a second end opposite from the first end, where the first end is operable to receive a first optical connector of a first optical connector type and the second end is operable to receive a second optical connector of a second optical connector type. The adapter further includes a passageway extending from the first end to the second end, a receptacle holder and a flange adjacent to the first end, where the receptacle holder extends from the flange and defines a rectangular opening, an adapter body extending from the flange to the second end, and a lock opening within the adapter body and adjacent to the flange. The lock opening is operable to expose threads of the second optical connector when the second optical connector is inserted into the adapter. The adapter also includes a lock tab secured within the lock opening such that the lock tab

is operable to engage the threads of the second optical connector when the second optical connector is inserted into the adapter.
[0007] In another embodiment, an adapter assembly includes an adapter and a node. The adapter includes a first end and a second end opposite from the first end, where the first end is operable to receive a first optical connector of a first optical connector type and the second end is operable to receive a second optical connector of a second optical connector type. The adapter further includes a passageway extending from the first end to the second end, a receptacle holder and a flange adjacent to the first end, where the receptacle holder extends from the flange and defines a rectangular opening, an adapter body extending from the flange to the second end, and a lock opening within the adapter body and adjacent to the flange. The lock opening is operable to expose threads of the second optical connector when the second optical connector is inserted into the adapter. The adapter also includes a lock tab secured within the lock opening such that the lock tab is operable to engage the threads of the second optical connector when the second optical connector is inserted into the adapter. The node has a threaded end, wherein the adapter body has a diameter such that it is disposed within the node.
[0008] In another embodiment, an optical assembly includes a first optical connector of a first optical connector type, a second optical connector of a second optical connector type, and an adapter. The adapter includes a first end and a second end opposite from the first end, where the first end is operable to receive the first optical connector and the second end is operable to receive the second optical connector. The adapter further includes a passageway extending from the first end to the second end, a receptacle holder and a flange adjacent to the first end, where the receptacle holder extends from the flange and defines a rectangular opening, an adapter body extending from the flange to the second end, and a lock opening within the adapter body and adjacent to the flange, where the lock opening is operable to expose threads of the second optical connector when the second optical connector is inserted into the adapter. The adapter also includes a lock tab secured within the lock opening such that the lock tab is operable to engage the threads of the second optical connector when the second optical connector is inserted into the adapter.

Description

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS
[0009] To easily identify the discussion of any particular element or act, the most significant digit or digits in a reference number refer to the figure number in which that element is first introduced.
[0010] FIG. **1** illustrates a partial exploded view of two dissimilar optical connectors and an adapter according to one or more embodiments described and illustrated herein.
[0011] FIG. **2** illustrates a perspective view of two dissimilar optical connectors mated using an adapter according to one or more embodiments described and illustrated herein.
[0012] FIG. **3** illustrates a perspective view of an example adapter according to one or more embodiments described and illustrated herein.
[0013] FIG. **4** illustrates a cross-sectional view of an example adapter according to one or more embodiments described and illustrated herein.
[0014] FIG. **5** illustrates a node within a wall of an enclosure, a first optical connector, a second optical connector and an adapter in an unmated state according to one or more embodiments described and illustrated herein.
[0015] FIG. **6** illustrates a node within a wall of an enclosure, a first optical connector, a second optical connector and an adapter in a mated state according to one or more embodiments described and illustrated herein.
[0016] FIG. **7** illustrates a perspective view of a node, a first optical connector, a second optical connector, and an adapter in an unmated state according to one or more embodiments described

and illustrated herein.
[0017] FIG. **8** illustrates a perspective view of a node, a first optical connector, a second optical connector, and an adapter in a partially mated state according to one or more embodiments described and illustrated herein.
[0018] FIG. **9** illustrates a perspective view of a node, a first optical connector, a second optical connector, and an adapter in a mated state according to one or more embodiments described and illustrated herein.
DETAILED DESCRIPTION
[0019] Embodiments of the present disclosure are directed to adapters for coupling two dissimilar optical connectors, as well as optical assemblies that include such adapters. The adapter comprises a receptacle holder and a receptacle for receiving the second optical connector. The optical interface of the ferrule of the first optical connector is disposed within the receptacle to mate with the optical interface of the second optical connector also within the receptacle. The adapter further includes a locking mechanism to lock the first optical connector within the adapter.
[0020] In addition to enabling the mating of two dissimilar optical connectors, the adapters described herein also leverage legacy telecommunication connection equipment such that enclosure nodes designed for legacy communication cables and connectors (e.g., cable television cables and connectors) can be used for fiber optic communication cables and connectors. The adapters disclosed herein have an adapter body that is dimensioned to fit within enclosure nodes, such as The Society of Cable Telecommunication Engineers (SCTE) standard ⅝-24 ports. Thus, optical cables and optical connectors can be used in nodes/ports designed for electrical cables and connectors. Enabling optical mating within the enclosure using connectors eliminates the need for fiber splicing within the enclosure, which is time consuming and costly.
[0021] Various embodiments of optical adapters for mating dissimilar optical connectors and optical assemblies are described in detail below.
[0022] Referring now to FIG. **1**, and example optical connector assembly **100** is schematically illustrated. The optical connector assembly **100** generally includes a first optical connector **104** of a first optical connector type, an adapter **118**, and a second optical connector **130** of a second optical connector type. The first optical connector type and the second optical connector type are dissimilar from one another. As a non-limiting example, the first optical connector type of the first optical connector **104** may be a multi-fiber Pushlok® optical connector sold by Corning Optical Communications of Charlotte, North Carolina. Additional information regarding example multi-fiber Pushlok® optical connectors is provided in U.S. Pat. Publ. No. 2023/0204867, which is hereby incorporated by reference in its entirety. The second optical connector type of the second optical connector **130** may be a traditional multi-fiber push-on (MPO) optical connector type, for example. As described in more detail below, the adapter **118** is operable to provide coupling between the two dissimilar optical connector types.
[0023] The first optical connector **104** is illustrated as a component of an optical cable assembly **102** that further includes an optical cable **106** having a plurality of optical fibers. The first optical connector **104** comprises a ferrule **116**, a nosepiece **114**, a connector housing **112**, and a boot **110**. The nosepiece **114** surrounds the ferrule **116**, which in some embodiments is biased (e.g., by a spring) in a positive z-axis direction. The nosepiece **114** has a non-round cross-section to accommodate the ferrule **116**.
[0024] The connector housing **112** comprises a rear end and a front end with a longitudinal passageway extending therebetween. The ferrule **116** comprises a plurality of bores (not shown) for receiving one or more optical fibers (not shown) within the optical cable **106**. By way of example, the ferrule **116** may be a MT or MPO ferrule, but other suitable ferrule are possible using the disclosed concepts. The connector housing **112** has a generally round cross-section or cylindrical sleeve. The boot **110** is coupled to a rear of the connector housing **112**, such as by a snap fit, for example.

[0025] The second optical connector type of the second optical connector **130** may be a MPO-type optical connector having a configuration that is different from the first optical connector **104**. The second optical connector **130** includes an MPO nosepiece **132** that surrounds a multi-fiber ferrule **154** comprising a plurality of bores (not shown) for receiving and maintaining a plurality of optical fibers (not shown). The second optical connector **130** further includes a body **134** having threads **164** and an arm receiving portion **166** for receiving arms **128** of the adapter **118** as described in more detail below. In embodiments the second optical connector **130** may include a sealing element **136** for protecting the mating optical interface from the external environment and a threaded end **138**.
[0026] Despite both the first and second optical connectors **104**, **130** having similar MT or MPO ferrules **116**, **154**, due to the differences in physical characteristics between the two connectors and that they are both male optical connectors, the first and second optical connectors **104**, **130** cannot mate with one another. However, the adapter **118** is designed to enable mating between the first optical connector **104** and the second optical connector **130**. As described in more detail below, the adapter **118** converts the first optical connector **104** from a male connector to a female connector to enable the first optical connector **104** to be optically mated with the second optical connector **130**.
[0027] FIG. **2** illustrates a perspective view of the example adapter **118** of FIG. **1** for enabling mating between the dissimilar first optical connector **104** and second optical connector **130**. Referring to both FIG. **1** and FIG. **2**, the adapter **118** includes a receptacle holder **124** extending from a flange **126** in a positive z-axis direction and an adapter body **120** extending from the flange **126** in a negative z-axis direction. A passageway extends between a first end **156** and a second end **158** of the adapter **118**. As shown in FIG. **1**, the cylindrical adapter body **120** is operable to receive the first optical connector **104** at the first end and the receptacle holder **124** is operable to receive the second optical connector **130** at the second end **158**. The adapter body **120** has a cylindrical shape with an internal diameter corresponding to an outer diameter of the connector housing **112**.
[0028] In some embodiments, the first end **156** has a slit **144** that enables the adapter body **120** to fit over a flange **160** of the connector housing **112** having an increased outer diameter from the remainder of the connector housing **112**. The slit **144** opens up when the first end **156** of the adapter **118** is positioned over the flange **160**, causing an interference fit between the first end **156** of the adapter body **120** and the flange **160** of the connector housing **112**.
[0029] The receptacle holder **124** at the second end **158** of the adapter **118** is sized and shaped to receive the body **134** of the second optical connector **130**. The receptacle holder **124** generally includes four arms **128** that are operable to fit on the arm receiving portion **166** of the body **134**. The arms **128** may flex to open up when in contact with the arm receiving portion **166**. In this manner the arms **128** maintain a mated relationship between the adapter **118** and the second optical connector **130**.
[0030] The receptacle holder **124** surrounds a receptacle **168** that is sized and shaped to receive the MPO nosepiece **132** of the second optical connector **130**. When the second optical connector is inserted into the receptacle holder **124** the MPO nosepiece **132** resides within the receptacle **168**. The MPO nosepiece **132** may be coupled to the receptacle **168** by an interference fit, for example.
[0031] FIG. **3** illustrates the first optical connector **104** mated to the second optical connector by way of the adapter. The adapter **118** is operable to align the front faces of the two ferrules **116**, **154**. First optical connector **104** is inserted into the first end **156** such that the slit **144** is positioned over the flange **160** of the connector housing **112** and the first end **156** abuts an edge of the boot **110**.
[0032] The adapter **118** includes a lock opening **140** and a lock tab **122** to securely lock the first optical connector **104** to the adapter **118**. The lock opening **140** is generally U-shaped and exposes the threads **146** of the connector housing **112** disposed within the adapter body **120**. The lock tab **122**, which is also generally U-shaped, snaps into the connector housing **112** to engage the threads **146** of the connector housing **112** to prevent the first optical connector **104** from being pulled out of the adapter **118**.

[0033] FIG. **4** illustrates a cross-sectional view of the adapter **118** as well as the threads **146** of a connector housing **112** of a first optical connector **104**. When the connector housing **112** is fully inserted into the adapter **118**, the threads **146** are exposed within the lock opening **140** of the adapter **118**. The lock tab **122** is disposed within the lock opening **140** to engage the threads **146** to thereby lock the first optical connector **104** to the adapter **118**. In some embodiments, the lock tab **122** is a loose component that snaps into the lock opening **140**. In the embodiment of FIG. **4**, the lock tab **122** rotationally mates with the adapter **118** by a pivot point **176**. The pivot point **176** may be defined by a portion of the lock tab **122** that snaps into recesses of the adapter **118**, or by a pivot pin that extends through both the lock tab **122** and the adapter **118**.
[0034] The lock tab **122** includes features that are configured to engage the threads **146** of the connector housing **112**. As one non-limiting example, the bottom surface of the lock tab **122** includes threads corresponding to the threads **146** of the connector housing **112** to lock the first optical connector **104** to the adapter **118**. As another non-limiting example, the lock tab **122** includes a capture portion **174** at an end that engages an end of the threads **146** to lock the first optical connector **104** to the adapter. The capture portion **174** may also be wedged under the adapter body **120** to further secure and snap the lock tab **122** within the lock opening **140**.
[0035] The first optical connector **104** is unlocked from the adapter **118** by removing the lock tab **122** from the lock opening **140** by either pulling the lock tab **122** out of lock opening **140**, or by rotating the lock opening **140** about the pivot point **176** out of the lock opening.
[0036] Referring now to FIG. **5**, the adapter **118** not only allows the mating of dissimilar optical connectors but also enables a multi-fiber optical connector such as the first optical connector **104** to be used in outdoor infrastructure utilized by multi-system operators (MSO), such as cable TV operators. More particularly, the adapter **118** is operable to fit within a metal node **148** compatible with the SCTE standard for ⅝-24 ports. Thus, the adapter **118** described herein allows fiber communication hardware and cables to be utilized in historical cable telecommunication ports and enclosures. Current solutions require the optical cable to be run through the node and then spliced within the enclosure. Embodiments of the present disclosure allow for a simpler connection solution without the need for splicing.
[0037] FIG. **5** illustrates an enclosure wall **150** defining an enclosure interior **170**. The enclosure defined by the enclosure wall **150** may be any type of enclosure, such as an outdoor telecommunications enclosure. A node **148** having a threaded end **152** is screwed into the opening **172** of the wall **150** of the enclosure. As stated above, the node **148** may be an SCTE standard ⅝-24 port. The first end **156** of the adapter **118** is inserted into the node **148** from the enclosure interior **170**. The first optical connector **104** is inserted into the node **148** from the exterior of the wall **150**.
[0038] FIG. **6** illustrates a first optical connector **104** mated to a second optical connector **130** through a node **148** disposed within a wall **150** of an enclosure by way of an adapter **118**. The hardened first optical connector **104** is mated to the second optical connector **130**, which may be or may not be hardened. As used herein, “hardened” means that it is suitable for exterior environments.
[0039] FIGS. **7-9** illustrate perspective views of a process for coupling a first optical connector **104** to a second optical connector **130** using an adapter **118** as well as through a telecommunications node **148**. Referring to FIG. **7**, the first optical connector **104** is pushed through the node **148**, which may be secured to a wall of an enclosure, as described above. The adapter **118** is positioned within the enclosure interior **170** and is slid onto the connector housing **112** of the first optical connector **104** in a direction as indicated by the arrow.
[0040] Referring to FIG. **8**, the adapter **118** is locked to the connector housing **112** by way of the lock tab **122** and features of the connector housing **112**, such as the threads **146**. When the adapter **118** is fully seated on the connector housing **112** the lock tab is snapped into the lock opening **140** to lock the first optical connector **104** to the adapter **118**.
[0041] After the adapter **118** is locked onto the connector housing **112** of the first optical connector

104, the first optical connector **104** and the adapter **118** are pulled back toward the node **148** until the flange **126** of the adapter **118** contacts the end of the node **148**. The adapter body **120** is secured within the node **148** by an interference fit, for example.
[0042] The adapter **118** provides a receptacle for mating with the second optical connector **130**, such as an MPO optical connector within an enclosure. Thus, embodiments of the present disclosure provide the ability to couple two dissimilar optical connectors using legacy telecommunications hardware, such as cable television nodes/ports.
[0043] It should now be understood that embodiments of the present disclosure are directed to adapters for coupling two dissimilar optical connectors. A first optical connector may be a male Pushlok® connector and a second optical connector may be a male MPO optical connector which are not generally compatible with one another despite both having a multi-fiber MT or MPO ferrule. The adapter comprises a receptacle holder and a receptacle for receiving the second optical connector. The optical interface of the ferrule of the first optical connector is disposed within the receptacle to mate with the optical interface of the second optical connector within the receptacle. The adapter includes a locking mechanism to lock the first optical connector within the adapter. The locking mechanism includes a lock opening within the adapter body and a lock tab that snaps into the lock opening.
[0044] In addition to enabling the mating of two dissimilar optical connectors, the adapters described herein also leverage legacy telecommunication equipment such that enclosure nodes designed for legacy communication cables and connectors (e.g., cable television cables and connectors) can be used for fiber optic communication cables and connectors. The adapters disclosed herein have an adapter body that is dimensioned to fit within enclosure nodes, such as Society of Cable Telecommunication Engineers (SCTE) standard ⅝-24 ports. Thus, optical cables and optical connectors can be used in nodes/ports designed for electrical cables and connectors.
[0045] Although the disclosure has been illustrated and described herein with reference to explanatory embodiments and specific examples thereof, it will be readily apparent to those of ordinary skill in the art that other embodiments and examples can perform similar functions and/or achieve like results. All such equivalent embodiments and examples are within the spirit and scope of the disclosure and are intended to be covered by the appended claims. It will also be apparent to those skilled in the art that various modifications and variations can be made to the concepts disclosed without departing from the spirit and scope of the same. Thus, it is intended that the present application covers the modifications and variations provided they come within the scope of the appended claims and their equivalents.

Claims

1. An adapter for coupling two dissimilar optical connectors comprising: a first end and a second end opposite from the first end, wherein the first end is operable to receive a first optical connector of a first optical connector type and the second end is operable to receive a second optical connector of a second optical connector type; a passageway extending from the first end to the second end; a receptacle holder and a flange adjacent to the first end, wherein the receptacle holder extends from the flange and defines a rectangular opening; an adapter body extending from the flange to the second end; a lock opening within the adapter body and adjacent to the flange, wherein the lock opening is operable to expose threads of the second optical connector when the second optical connector is inserted into the adapter; and a lock tab secured within the lock opening such that the lock tab is operable to engage the threads of the second optical connector when the second optical connector is inserted into the adapter.
2. The adapter of claim 1, wherein the adapter body has a diameter for insertion into a node positioned within a wall.
3. The adapter of claim 2, wherein the node is a ⅝-24 port as specified by The Society of Cable

Telecommunication Engineers (SCTE).
4. The adapter of claim 1, wherein the passageway is shaped to accept the first optical connector type at the first end and to accept the second optical connector type at the second end.
5. The adapter of claim 1, wherein the lock tab comprises a release button for releasing the second optical connector from the adapter.
6. The adapter of claim 1, wherein the first optical connector and the second optical connector are each multi-fiber connectors.
7. The adapter of claim 1, wherein the first optical connector type is a multi-fiber push-on optical connector type.
8. The adapter of claim 1, wherein the lock opening and the lock tab are U-shaped.
9. The adapter of claim 1, wherein the lock tab includes a threaded surface for engaging the threads of the second optical connector.
10. An adapter assembly comprising: an adapter comprising: a first end and a second end opposite from the first end, wherein the first end is operable to receive a first optical connector of a first optical connector type and the second end is operable to receive a second optical connector of a second optical connector type; a passageway extending from the first end to the second end; a receptacle holder and a flange adjacent to the first end, wherein the receptacle holder extends from the flange and defines a rectangular opening; an adapter body extending from the flange to the second end; a lock opening within the adapter body and adjacent to the flange, wherein the lock opening is operable to expose threads of the second optical connector when the second optical connector is inserted into the adapter; and a lock tab secured within the lock opening such that the lock tab is operable to engage the threads of the second optical connector when the second optical connector is inserted into the adapter; and a node having a threaded end, wherein the adapter body has a diameter such that it is disposed within the node.
11. The adapter assembly of claim 10, wherein the node is a ⅝-24 port as specified by The Society of Cable Telecommunication Engineers (SCTE).
12. The adapter assembly of claim 10, wherein the passageway is shaped to accept the first optical connector type at the first end and to accept the second optical connector type at the second end.
13. The adapter assembly of claim 10, wherein the lock tab comprises a release button for releasing the second optical connector from the adapter.
14. The adapter assembly of claim 10, wherein the first optical connector and the second optical connector are each multi-fiber connectors.
15. The adapter assembly of claim 10, wherein the first optical connector type is a multi-fiber push-on optical connector type.
16. The adapter assembly of claim 10, wherein the lock opening and the lock tab are U-shaped.
17. The adapter assembly of claim 10, wherein the lock tab includes a threaded surface for engaging the threads of the second optical connector.
18. An optical assembly comprising: a first optical connector of a first optical connector type; a second optical connector of a second optical connector type; and an adapter comprising: a first end and a second end opposite from the first end, wherein the first end is operable to receive the first optical connector and the second end is operable to receive the second optical connector; a passageway extending from the first end to the second end; a receptacle holder and a flange adjacent to the first end, wherein the receptacle holder extends from the flange and defines a rectangular opening; an adapter body extending from the flange to the second end; a lock opening within the adapter body and adjacent to the flange, wherein the lock opening is operable to expose threads of the second optical connector when the second optical connector is inserted into the adapter; and a lock tab secured within the lock opening such that the lock tab is operable to engage the threads of the second optical connector when the second optical connector is inserted into the adapter.
19. The adapter of claim 18, wherein the adapter body has a diameter for insertion into a node

positioned within a wall.

20. The adapter of claim 19, wherein the node is a ⅝-24 port as specified by The Society of Cable Telecommunication Engineers (SCTE).

21. The adapter of claim 18, wherein the passageway is shaped to accept the first optical connector type at the first end and to accept the second optical connector type at the second end.

22. The adapter of claim 18, wherein the lock tab comprises a release button for releasing the second optical connector from the adapter.

23. The adapter of claim 18, wherein the first optical connector and the second optical connector are each multi-fiber connectors.

24. The adapter of claim 18, wherein the first optical connector type is a multi-fiber push-on optical connector type.

25. The adapter of claim 18, wherein the lock opening and the lock tab are U-shaped.

26. The adapter of claim 18, wherein the lock tab includes a threaded surface for engaging the threads of the second optical connector.