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(54) **DISTRIBUTION TERMINAL FOR NETWORK ACCESS POINT**

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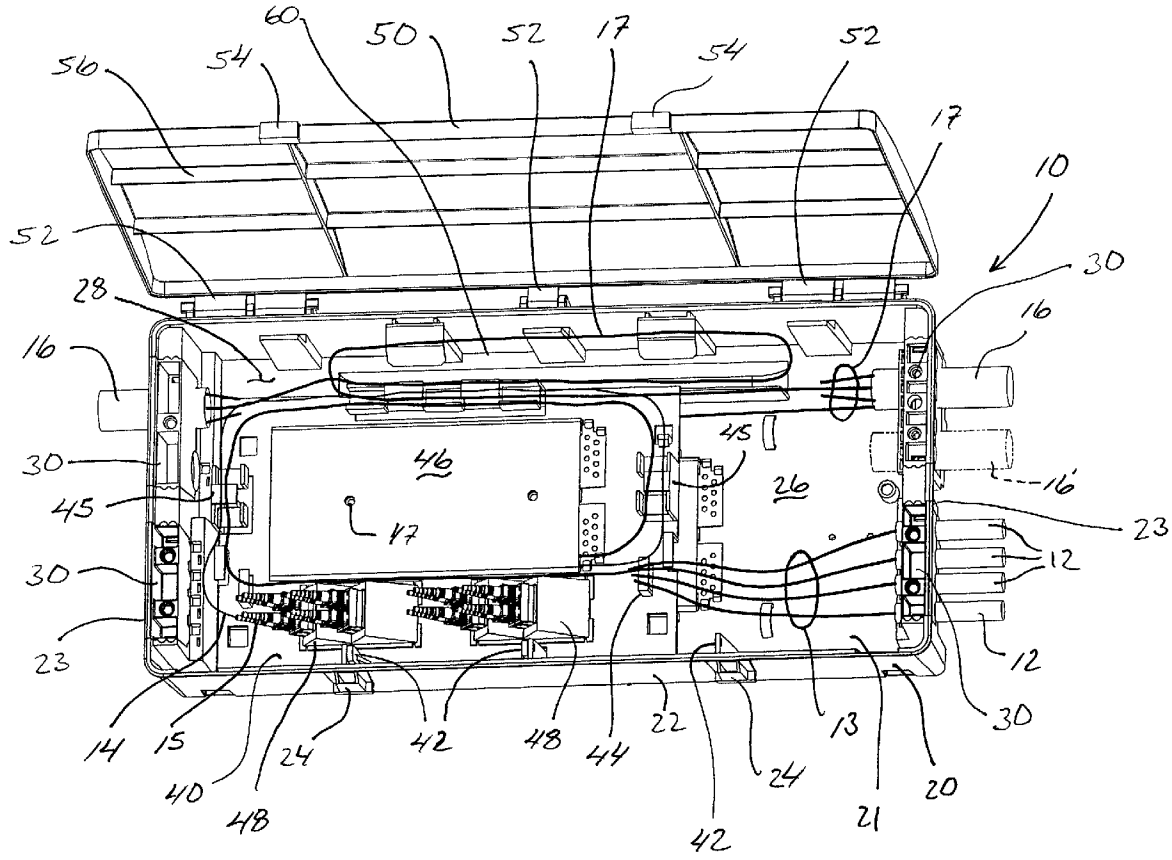
(57) **ABSTRACT**

A distribution terminal is provided for interconnecting one or more fiber optic drop cables with at least one fiber optic distribution cable at a convenient access point in a telecommunications network. The terminal comprises a base and a cover adapted to be opened and closed on the base. The base defines an interior cavity having a lower fiber management area for accessing the distribution cable and an upper fiber management area for accessing the drop cables. The upper fiber management area includes a transition panel that is movable relative to the base to provide access to the lower fiber management area. Thus, both the lower fiber management area and the upper fiber management area are easily and readily accessible to a field technician initially installing the terminal and subsequently reconfiguring the optical fiber connections within the terminal at the access point.



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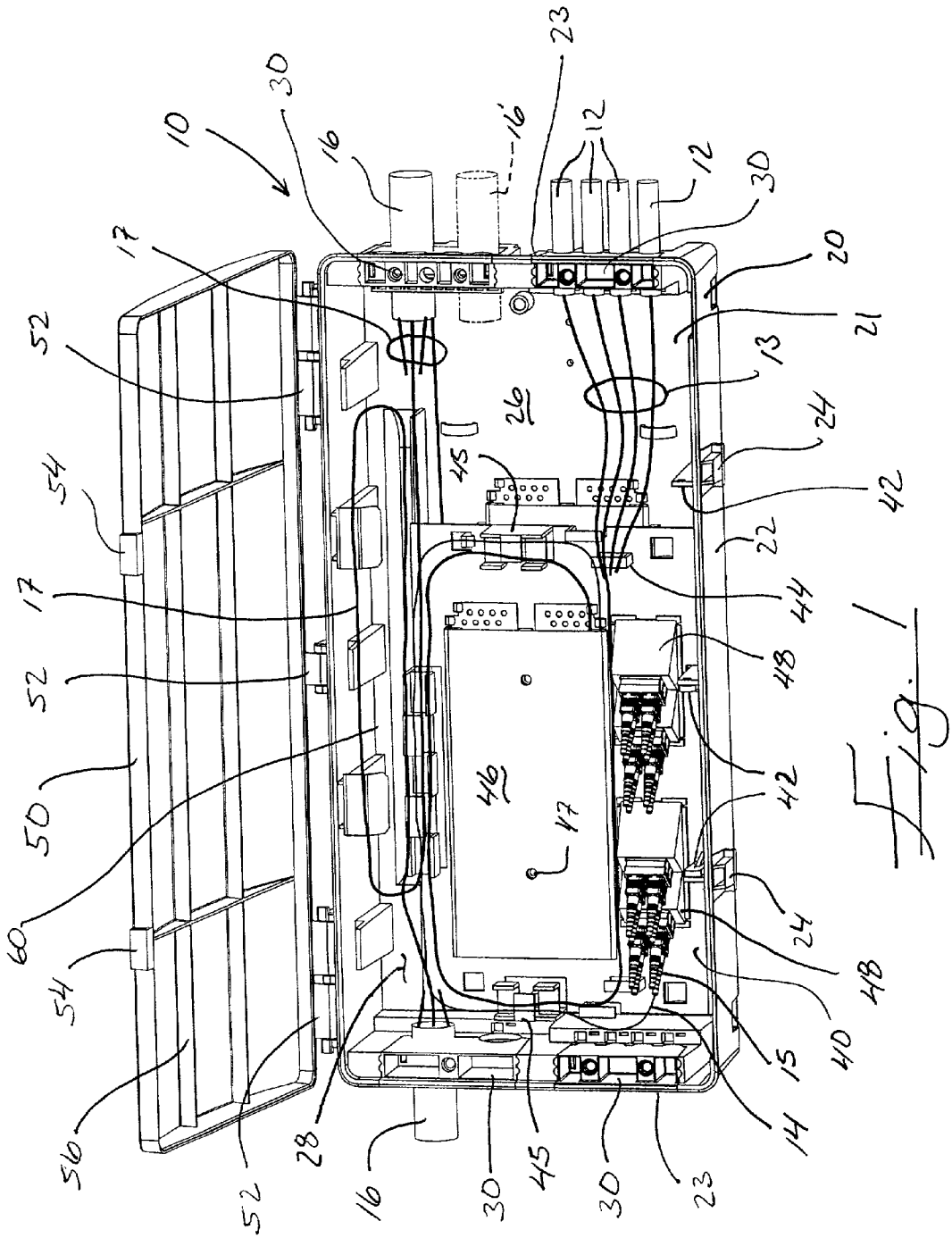
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Fig. 1

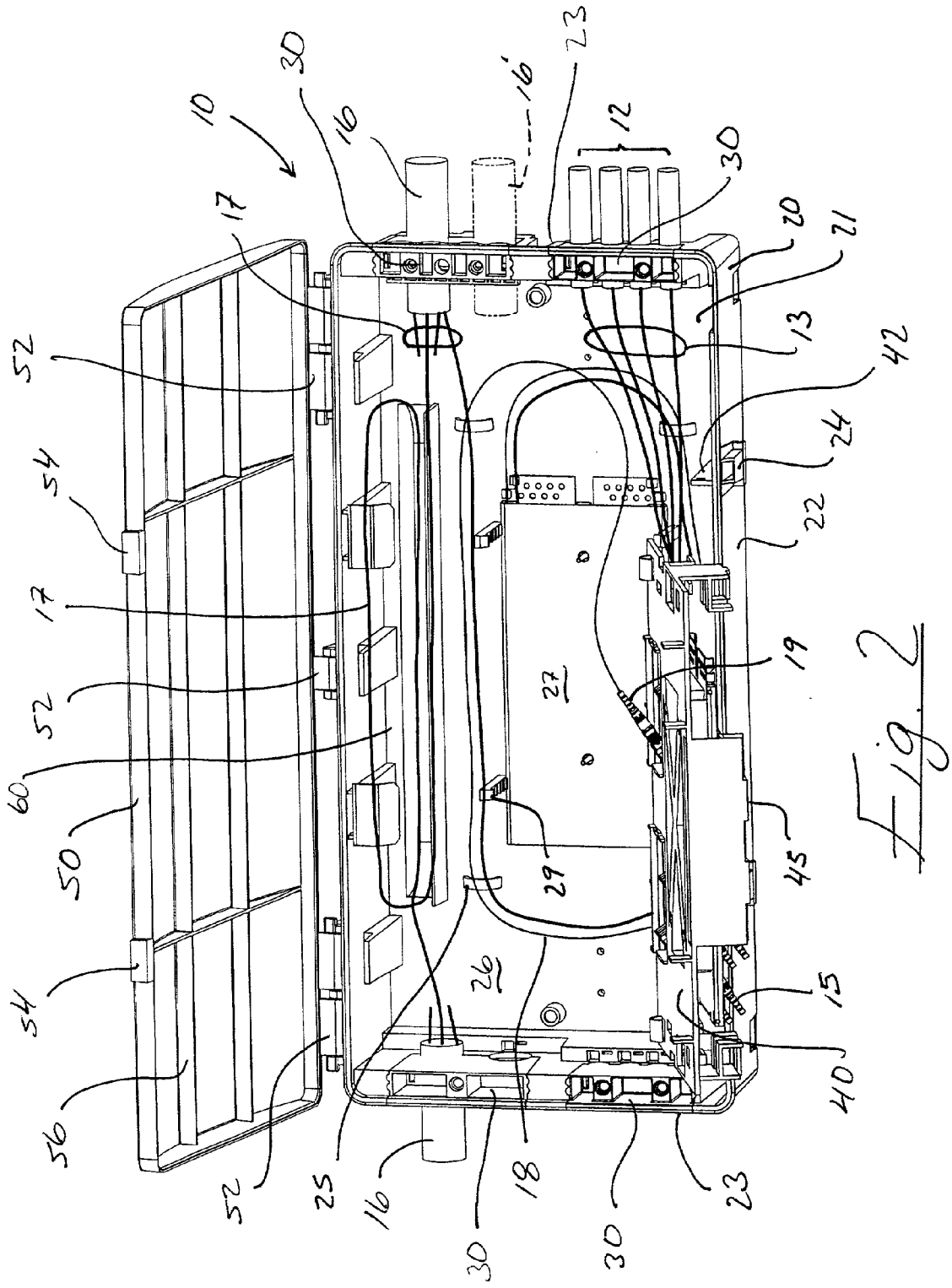
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Fig. 2

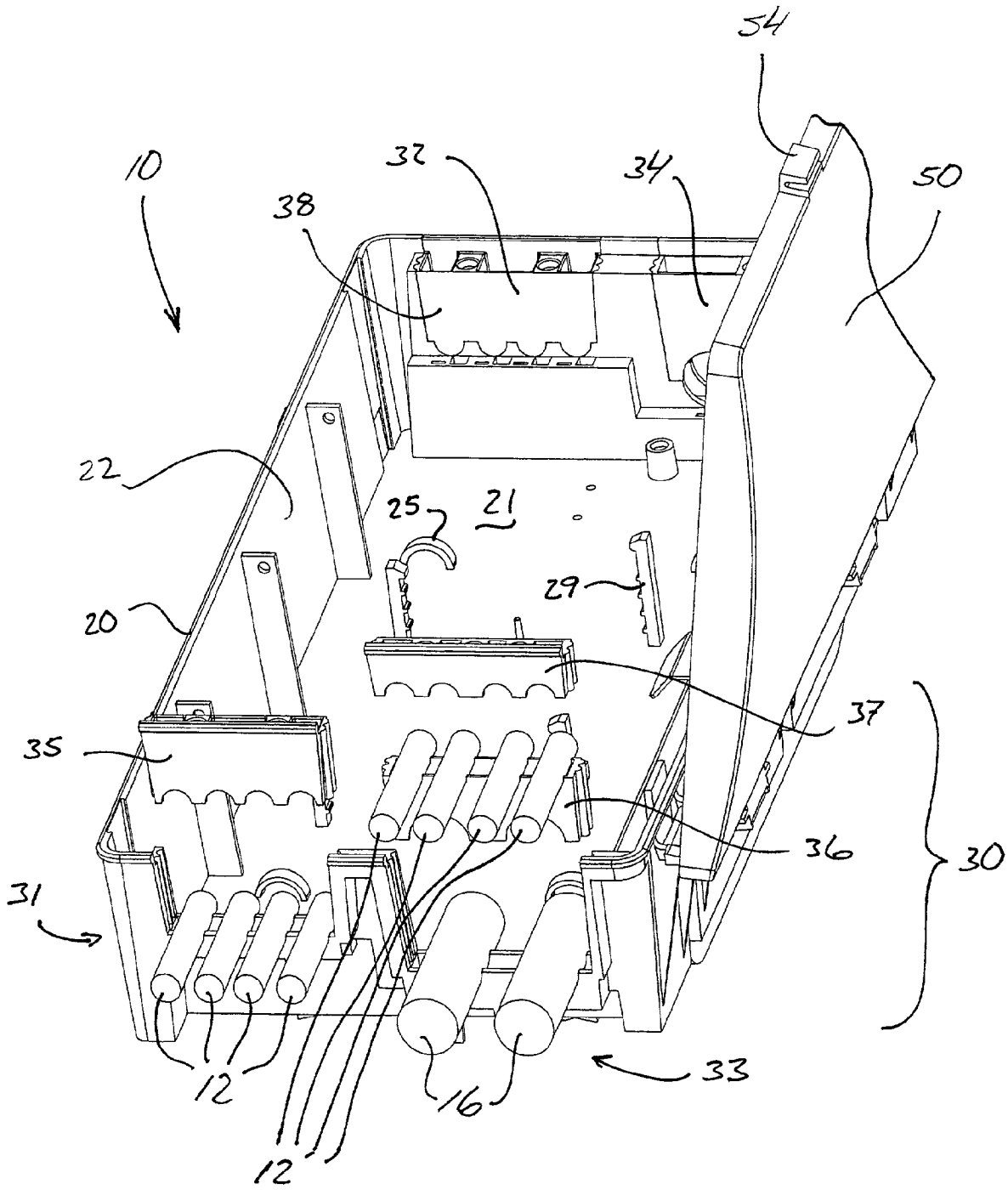

Fig. 3

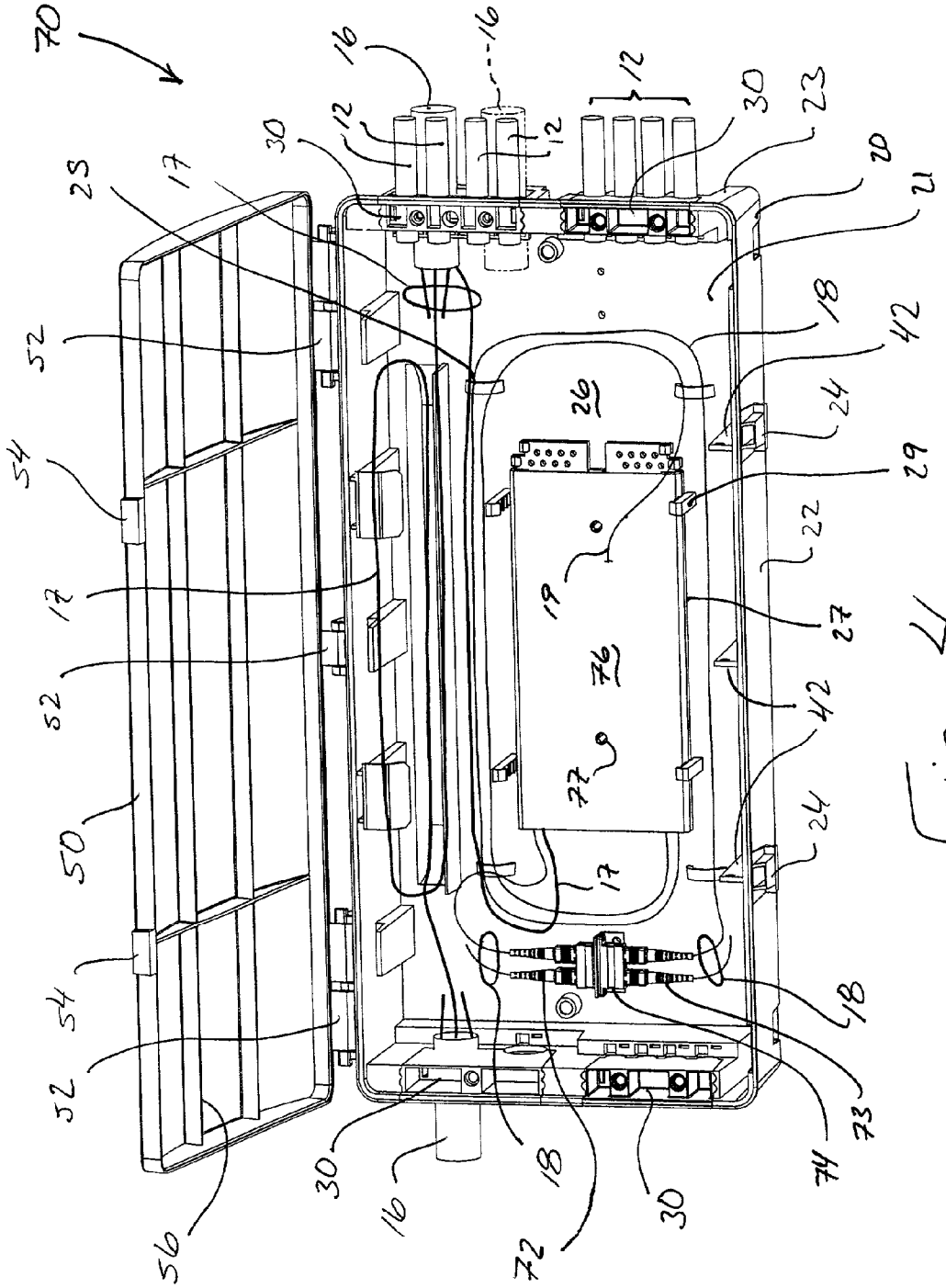
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Fig. 4

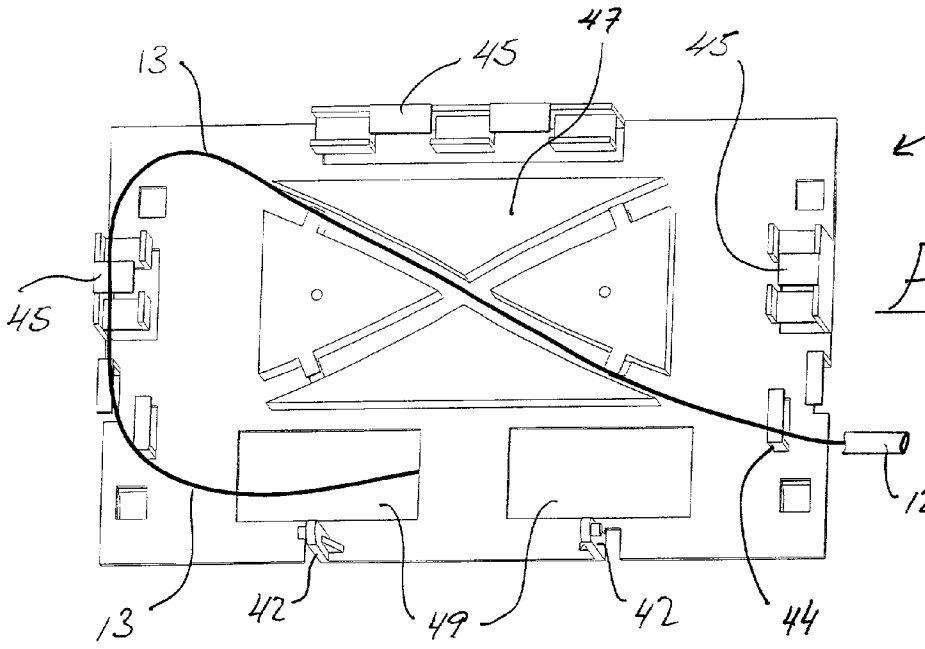
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Fig. 5

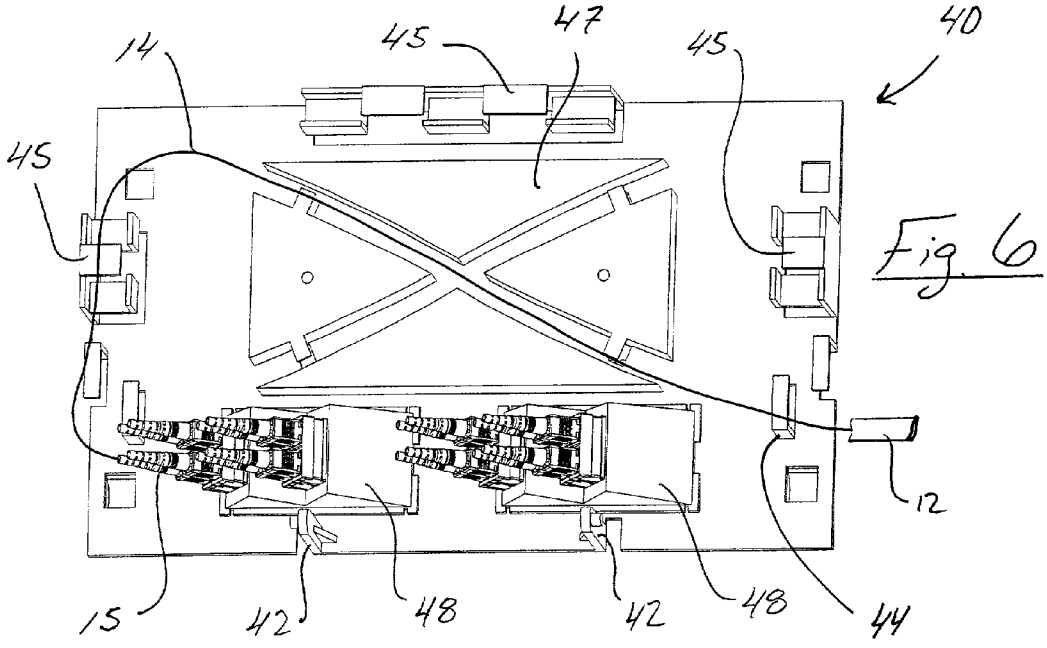
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Fig. 6

DISTRIBUTION TERMINAL FOR NETWORK ACCESS POINT

FIELD OF THE INVENTION

[0001] The present invention relates generally to enclosures for telecommunications equipment. More particularly, the invention relates to a distribution terminal for interconnecting one or more drop cables with a distribution cable at an access point in a telecommunications network.

BACKGROUND OF THE INVENTION

[0002] Telecommunications service providers are currently developing networks consisting entirely of fiber optic components to meet the demand for high bandwidth communications service to businesses and homes. These "all-optical" telecommunications networks require service terminals, referred to herein as "distribution" terminals, located at access points along the network for interconnecting one or more drop cables to a distribution cable from the service provider. In some instances, certain optical fibers of the distribution cable are connected to optical fibers of a drop cable that is routed directly to the business or home of a subscriber of the communications service. In other instances, the drop cable is routed from the terminal to yet another access point along the telecommunications network to serve as a further distribution cable for additional drop cables. The further distribution cable is sometimes referred to in the art as a branch or "feeder" cable. The optical fiber network may be configured in many different ways, but typically, is configured with a plurality of main distribution cables from the service provider that are interconnected with feeder cables at various network access points. The feeder cables in turn are interconnected with further feeder cables, or with drop cables containing optical fibers that are routed directly to communications equipment belonging to subscribers. As used herein, the term "distribution cable" includes both main distribution cables and feeder cables, as those terms are presently understood by one skilled in the art.

[0003] In existing telecommunications networks, the drop cables are typically interconnected with a distribution cable within a splice closure suspended from an aerial telephone cable strand or mounted on a telephone pole. An aerial splice closure is a particular type of network access point terminal that generally includes a longitudinal frame enclosed by a cylindrical housing. The cylindrical housing is intended to optimize the number of optical fiber connections that can be made within the closure. During initial configuration, the fiber management area within the closure for the optical fiber connections may be readily accessible. However, due to the aerial location of the closure and the congestion of the fiber management area, substantial expertise and experience are required to subsequently reconfigure the optical fiber connections. In particular, it is often difficult to locate and identify the optical fibers of the distribution cable that are interconnected with a particular drop cable. Once identified, the opportunity to re-route existing drop cables or to install additional drop cables without exceeding the minimum bend radius of the optical fibers is limited by the complicated fiber routing and the congestion of the fiber management area. The situation is further exacerbated because conventional aerial closures do not include a cover that can be positioned at the aerial location so as to provide substantially unrestricted access to the optical fiber connections within the closure.

[0004] While fiber optic networks have traditionally served as the back bone or trunk line of telecommunication networks to transmit signals over relatively long distances, all-optical networks are gradually being extended closer to the end points of the network. In this regard, fiber optic networks are being developed that deliver fiber-to-the-home, fiber-to-the-business, fiber-to-the-desk, and the like. In each of these applications, the distribution terminal must be capable of interconnecting the optical fibers of the drop cables with the optical fibers of the distribution cable to establish the desired optical connections. For example, a distribution terminal utilized in a fiber-to-the-home, fiber-to-the-business, or fiber-to-the-desk application may be mounted on a distribution cable along with one or more drop cables such that certain optical fibers of the distribution cable extend uninterrupted through the terminal, while other optical fibers of the distribution cable are joined with optical fibers of the drop cables. In certain instances, the optical fibers of the drop cables may be joined directly to the optical fibers of the distribution cable at the access point using conventional splicing techniques. In other instances, the optical fibers of the drop cables and the optical fibers of the distribution cable are first spliced to a short length of optical fiber having an optical connector attached at the other end, referred to in the art as a "pigtail." The pigtails are then connected to opposite sides of an adapter to interconnect the drop cables with the distribution cable. As used herein, the term "connectorized" refers to an optical fiber that has been spliced to a pigtail at an access point. Optical fibers are connectorized to permit the optical fiber connections to be subsequently reconfigured at the access point without the optical fibers having to be first separated, then cleaned and polished, and then re-spliced to other optical fibers. In still other instances, the optical fibers of the drop cables may be connectorized at the time of manufacture, referred to herein as "pre-connectorized," and connected at the access point to optical fibers of the distribution cable that have been connectorized. The pre-connectorized optical fibers of the drop cables are interconnected with the connectorized optical fibers of the distribution cable utilizing one or more adapters in a known manner.

[0005] Typically, a distribution terminal, for example a conventional aerial splice closure, includes one or more splice trays, coupler trays and/or connector panels that facilitate the splicing or connecting of respective pairs of optical fibers. Most terminals house a large number of optical fiber connections, and thus, include a plurality of splice trays, coupler trays and/or connector panels stacked one upon another or stored in separate compartments within the terminal. The trays and panels are preferably secured within the terminal such that they are fixed in position once the terminal has been initially configured and is placed into service. The trays and panels should not shift or otherwise move once the terminal is placed into service since any shifting or other movement could harm the optical fiber connections. While the trays and panels are desirably fixed in position, the terminal is also preferably designed so that the trays and both sides of the panels can be readily accessed by a field technician during the initial configuration of the terminal in which the optical fiber connections are established and during any subsequent reconfiguration of the

terminal wherein at least some of the optical fiber connections are modified. In either instance, the trays and panels must be supported and securely retained in a convenient location that provides the field technician with access to the optical fiber connections housed within the terminal. Reconfiguring an aerial terminal is especially difficult, particularly in applications, such as previously discussed, where at least some of the optical fibers of the distribution cable extend uninterrupted through the terminal. In such instances, sometimes referred to as "taut sheath" applications, the terminal cannot be removed from the distribution cable to reconfigure the optical fiber connections on a work platform located on the ground. Accordingly, the terminal must be reconfigured from a ladder or from an aerial bucket that is positioned in close proximity to the terminal. It is known to provide a work platform on the ladder or aerial bucket. However, the work platform provided on the ladder or aerial bucket cannot always be positioned sufficiently close to the terminal, for example when the cover of the terminal interferes with the ladder or aerial bucket in the opened position. Furthermore, work platforms provided on ladders and aerial buckets typically are not suited for securely retaining the various sized trays and panels that may be housed within aerial terminals.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The present invention will be described in conjunction with the accompanying drawings in which like reference numerals represent the same or similar parts in the various views. The drawings, which are incorporated in and constitute a part of this specification, provide further understanding of the invention, illustrate various embodiments of the invention, and, together with the description, fully explain the principles and objectives thereof. More specifically:

[0007] **FIG. 1** is a perspective view of a distribution terminal constructed in accordance with the invention shown with the cover opened and the movable transition panel in a first position to provide access to one or more drop cables in the upper fiber management area;

[0008] **FIG. 2** is a perspective view of the terminal of **FIG. 1** shown with the cover opened and the movable transition panel in a second position to provide access to at least one distribution cable in the lower fiber management area;

[0009] **FIG. 3** is a perspective view of one end of a distribution terminal constructed in accordance with the invention shown with the cover opened and the cable port assemblies exploded for purposes of clarity;

[0010] **FIG. 4** is a perspective view of another distribution terminal constructed in accordance with the invention shown with the cover in the opened position and the movable transition panel removed for purposes of clarity;

[0011] **FIG. 5** is a detail perspective view of a movable transition panel constructed in accordance with the invention illustrating a method of routing one or more fiber optic drop cables for interconnection with at least one fiber optic distribution cable by direct splicing; and

[0012] **FIG. 6** is a detail perspective view of another movable transition panel constructed in accordance with the invention illustrating a method of routing one or more pre-connectorized fiber optic drop cables for interconnection with at least one fiber optic distribution cable.

DETAILED DESCRIPTION OF VARIOUS EMBODIMENTS OF THE INVENTION

[0013] The present invention is described more fully hereinafter with reference to the accompanying drawings, in which various embodiments of the invention are shown. The invention may, however, be embodied in many different forms, and therefore, should not be construed as being limited to the embodiments described and shown herein. Illustrative embodiments are set forth herein so that this description will be thorough and complete, and will fully convey the intended scope of the invention while enabling those skilled in the art to make and practice the invention without undue experimentation.

[0014] Referring now to **FIGS. 1 and 2**, a distribution terminal **10** constructed in accordance with one embodiment of the invention is shown. The terminal **10** permits one or more fiber optic drop cables **12** to be easily and readily interconnected with at least one fiber optic distribution cable **16**. As is well known and understood in the art, each drop cable **12** comprises a flexible transport tube **13** containing one or more optical fibers **14 (FIG. 1)** connected to communications equipment at a subscriber's premises, such as a home or business. The distribution cable **16** may be a main distribution cable or a feeder cable and comprises at least one, and preferably, a plurality of flexible buffer tubes **17** containing a plurality of optical fibers **18 (FIG. 2)** connected to communications equipment from a service provider. In addition to receiving a variety of different types of cables, the terminal **10** may route, connect and store different types of optical fibers, such as loose buffered optical fibers and ribbon fiber. As such, the term "optical fibers" as used herein is intended to include all types of optical fibers, including loose buffered optical fibers, optical fibers in the form of a multi-fiber ribbon, individual optical fibers, or any other known expedient of a fiber optic cable. Additionally, the optical fibers may have various diameters, including for example diameters of 900 micron, 2 mm and 3 mm. The terminal **10** provides a convenient access point in a telecommunications network for a field technician to initially install and subsequently reconfigure the optical fiber connections between the drop cables **12** and the distribution cable **16** within the terminal. The terminal **10** may be a splice terminal, a patch terminal or the like, or any combination thereof, as will be described. Moreover, the terminal **10** may be installed in an aerial location, buried, or disposed in a larger enclosure, such as a ground pedestal. For purposes of example only, and not by way of limitation, the terminal **10** will hereinafter be described as an aerial terminal. As such, the base **20** may be provided with hangars (not shown) for suspending the terminal **10** from an aerial cable strand and/or brackets or straps (not shown) for securing the terminal **10** to a telephone pole, building, or other structure in a known manner. Although the terminal **10** depicted in the illustrated embodiments is an in-line terminal, it may have other configurations, such as a canister or "butt" type terminal, without departing from the intended spirit or scope of the invention.

[0015] The terminal **10** comprises a base **20** and a cover **50** each made of a lightweight, yet rigid material, such as aluminum, plastic or thermoplastic. The base **20** is generally

box-shaped and defines an interior cavity **21** for housing telecommunications hardware, such as splice trays, coupler trays and adapters, as will be described hereinafter. The base **20** may have any of a variety of shapes that is suitable for housing telecommunications hardware and for routing and interconnecting one or more fiber optic drop cables **12** with at least one fiber optic distribution cable **16**. The base **20** of the embodiments illustrated herein is generally rectangular in the lengthwise and widthwise directions and is elongated in the lengthwise dimension (relative to the widthwise dimension) between a pair of opposed, closed ends. Preferably, the depthwise dimension is substantially less than either the lengthwise dimension or the widthwise dimension to optimize access to the optical fiber connections and hardware at any location within the interior cavity **21** of the terminal **10**, as will be described. The cover **50** is attached to the base **20** and adapted to be opened and closed thereon. As shown, the cover **50** is generally rectangular and is hingedly affixed to the base **20** along the upper edge of one of the side walls **22** at one or more hinge locations **52**. However, the cover **50** may be slidably attached to the base **20** to selectively expose adjacent portions of the interior cavity **21** of the base **20**. Alternatively, the cover **50** may be removably attached to the base **20** to provide unobstructed access to the entire interior cavity **21**. The base **20** and/or the cover **50** is preferably provided with clasps **24**, **54** or other conventional means for securing the cover **50** to the base **20** in the closed configuration. Although not shown, the base **20** and/or cover **50** may also be provided with means for retaining the cover in the opened configuration. If necessary, the cover **50** may be provided with lengthwise and/or widthwise stiffening ribs **56** to strengthen and prevent distortion of the cover **50**.

[**0016**] **FIG. 1** shows the terminal **10** with the cover **50** hingedly affixed to the base **20** and opened thereon. The terminal **10** is mounted on at least one distribution cable **16** and one or more drop cables **12** in a known manner by a plurality of cable port assemblies **30** provided on the opposed end walls **23** of the base **20**. In the embodiment illustrated, the terminal **10** is mounted on a single fiber optic distribution cable **16** comprising a plurality of buffer tubes **17**, each of which contains a plurality of optical fibers **18**. A portion of the sheath of the distribution cable **16** is removed so that the buffer tubes **17** are exposed within the interior cavity **21** of the terminal **10**. At least one of the buffer tubes **17** is routed into a lower fiber management area **26** (**FIG. 2**), while the remainder of the buffer tubes **17** are routed to a slack storage area **60** where one or more coils of the remaining buffer tubes **17** are stored. The coils of unused buffer tubes **17** are stored in a plane generally perpendicular to the plane of the lower fiber management area **26**. Accordingly, the amount of space within the interior cavity **21** of the terminal **10** for interconnecting the optical fibers **14** of the drop cables **12** with the optical fibers **18** of the distribution cable **16** is maximized. The buffer tubes **17** are then routed from the slack storage area **60** out of the terminal **10** through one of the cable port assemblies **30** provided on the opposite end wall **23** of the terminal **10**. The configuration described above, in which at least some of the buffer tubes **17** of the distribution cable **16** extend uninterrupted through the terminal **10** while at least one of the buffer tubes **17** is made available for connection with one or more drop and/or feeder cables, is sometimes referred to in the art as a "taut sheath" application. As indicated by the broken lines in **FIGS. 1, 2** and **4**, a second optical, optical/electrical or electrical distribution cable **16'** may extend uninterrupted through the terminal **10** between the opposed end walls **23**. Alternatively, a portion of the sheath of the distribution cable **16'** may be removed and one or more of the buffer tubes of the distribution cable **16'** may be routed into the lower fiber management area **26** while the remaining buffer tubes are routed to the slack storage area **60** and then out of the terminal **10** through one of the cable port assemblies **30** provided on the opposite end wall **23** of the base **20**, as previously described.

[**0017**] In the embodiment illustrated, the terminal **10** is also mounted on a plurality, and more specifically, four fiber optic drop cables **12**. Each drop cable **12** comprises a transport tube **13** containing one or more optical fibers **14**. Typically, each transport tube **13** contains one, two or four optical fibers **14**. Thus, the four drop cables **12** shown in **FIGS. 1 and 2** can provide up to sixteen separate optical fiber connections, referred to herein as "fiber drops," to subscriber communications equipment. The terminal **10** may also be configured with up to eight drop cables **12** (see **FIGS. 3 and 4**) each containing one or two optical fibers **14**. Thus, the eight drop cables **12** shown in **FIGS. 3 and 4** can likewise provide up to sixteen separate fiber drops. The number of drop cables **12** is typically between one and eight and there is typically only one transport tube **13** within each drop cable **12**. However, it is conceivable that the terminal **10** could accommodate up to sixteen drop cables **12**. The number of fiber drops is typically between one and sixteen. However, depending on the number of drop cables **12**, the number of transport tubes **13** within each drop cable **12** and the number of optical fibers **14** within each transport tube **13**, theoretically, there is no limit to the number of fiber drops that the terminal **10** could accommodate. The sheaths of the drop cables **12** within the interior cavity **21** of the terminal **10** are removed to expose the transport tubes **13**. The transport tubes **13** are routed into an upper fiber management area **28** (**FIG. 1**) located medially between the lower fiber management area **26** and the cover **50** of the terminal **10**. With the cover **50** opened, the upper fiber management area **28** is nearer, and thus, is more easily and readily accessible to a field technician initially installing the terminal **10** at an access point in a telecommunication network or subsequently reconfiguring the optical fiber connections within the terminal **10**. For example, the field technician may rearrange the optical fiber connections between the optical fibers **14** of the drop cables and the optical fibers **18** of the distribution cable **16**. Alternatively, the field technician may introduce additional drop cables **12** without disturbing the previously installed drop cables and then interconnect the optical fibers **14** of the additional drop cables **12** with the same or different optical fibers **18** of the distribution cable **16**.

[**0018**] The transport tubes **13** are routed onto a transition panel **40** disposed within the interior cavity **21** of the terminal **10** in the upper fiber management area **28**. The transition panel **40** is movable relative to the base **20** to expose the lower fiber management area **26** to the field technician initially installing the terminal **10** or subsequently reconfiguring the optical fiber connections within the terminal **10** at an access point in a telecommunications network. Preferably, the transition panel **40** is hingedly attached to the base **20** and adapted to be rotated thereon between a stowed position for accessing the upper fiber management are **28**

and a deployed position for accessing the lower fiber management area **26** without disturbing the drop cables **12**. As shown, the transition panel **40** is rotatable relative to the base **20** through angle of about 110 degrees between the stowed position and the deployed position. The transition panel **40** is generally rectangular and is hingedly affixed to the base **20** along the upper edge of one of the side walls **22** at one or more hinge locations **42**. As shown, the hinge locations **42** are located on the side wall **22** opposite the hinge locations **52** that hingedly affix the cover **50** to the base **20**. However, the hinge locations **42** may be located on the same side wall **22** as the hinge locations **52**. Alternatively, the transition panel **40** may be slidably attached to the base **20** to selectively expose portions of the interior cavity **21** of the base **20**, or may be removably attached to the base **20** to provide unobstructed access to the interior cavity **21**. The base **20** is preferably provided with at least three hinge locations **42** along the side wall **22** so that the transition panel **40** may be positioned nearer the end wall **23** opposite the end wall **23** through which the drop cables **12** enter the terminal **10**. Accordingly, there is sufficient space provided in the upper fiber management area **28** to route the transport tubes **13** of the drop cables **12** between the cable port assemblies **30** and the transition panel **40**. Although not shown, the base **20** and/or the transition panel **40** may be provided with conventional means for securing the transition panel **40** to the base **20** in the closed configuration. Furthermore, the base **20** and/or transition panel **40** may be provided with conventional means for retaining the transition panel **40** in the opened configuration. If necessary, the transition panel **40** may also be provided with lengthwise and/or widthwise stiffening ribs to strengthen and prevent distortion of the transition panel **40**.

[**0019**] For purposes of example only, and not by way of limitation, a particular configuration of optical fiber connections and telecommunications hardware is illustrated in **FIGS. 1 and 2**. As best shown in **FIG. 1**, transport tubes **13** of drop cables **12** converge at routing clip **44** on the generally planar outer surface of transition panel **40**. For purposes of clarity, only a representative one of the transport tubes **13** and the routing thereof within the upper fiber management area **28** is shown beyond routing clip **44** on transition panel **40** and will be described herein. It will be readily apparent and well understood by one of ordinary skill in the art that the remaining transport tubes **13** are routed in substantially the same manner as the representative transport tube **13** shown and described herein. The transport tube **13** is routed clockwise around the outer surface of the transition panel **40** and through a series of routing guides **45** to a conventional splice tray **46**. Inside the splice tray **46**, each optical fiber **14** within the transport tube **13** is spliced to a pigtail **15** in any known manner, such as by fusion or mechanical splicing. The pigtail **15** exits the splice tray **46** and is routed counterclockwise through the routing guides **45** to a transition adapter **48** mounted within an opening **49** **(FIG. 5)** formed through the transition panel **40**. Transition panel **40** comprises a plurality of transition adapters **48**. Preferably, transition panel **40** comprises between one and four transition adapters **48**, each of which is adapted to receive between one and four pigtails **15**. As shown, transition panel **40** comprises a total of four transition adapters **48**, each of which is adapted to receive between one and four pigtails **15**. Accordingly, up to sixteen optical fibers **14** from transport tubes **13** of drop cables **12** may be interconnected with the optical fibers **18** of the distribution cable **16**. For example, in the configuration illustrated herein, each of the four drop cables **12** may comprise a single transport tube **13** containing four optical fibers **14** that are spliced to four pigtails **15** inside splice tray **46**. Thus, a total of sixteen connectorized fiber drops are terminated to transition adapters **48** on transition panel **40**. It should be noted that transition adapters **48** may be reversed in the lengthwise direction within openings **49** on transition panel **40** to accommodate pigtails **15** from either, or both, directions within internal cavity **21** of base **20**. For example, transition adapters **48** may be reversed when the transition panel **40** is positioned nearer the right-hand side of terminal **10** and drop cables **12** enter the terminal **10** through the opposite end wall **23**.

[**0020**] As best shown in **FIG. 2**, one of the buffer tubes **17** of distribution cable **16** is routed into the lower fiber management area **26** while the remaining buffer tubes **17** of distribution cable **16** are routed into the slack storage area **60**, as previously described. The active buffer tube **17** is routed counterclockwise within the interior cavity **21** defined by base **20** through a series of routing guides **25** to a conventional splice tray **27**. Inside the splice tray **27**, the optical fibers **18** within the buffer tube **17** are spliced to pigtails **19** in any known manner, such as by fusion or mechanical splicing. For purposes of clarity, only a representative one of the optical fibers **18** exiting splice tray **27** and terminating in pigtail **19** routed within lower fiber management area **26** is shown and will be described herein. It will be readily apparent and well understood by one of ordinary skill in the art that the remaining optical fibers **18** terminating in pigtails **19** are spliced and routed in substantially the same manner as the representative optical fiber **18** shown and described herein. Upon exiting the splice tray **27**, the optical fiber **18** is routed clockwise through the routing guides **25** to the underside of the transition adapter **48** mounted within the opening **49** formed through the transition panel **40**. As previously described, transition panel **40** preferably comprises between one and four transition adapters **48**, each of which is adapted to receive between one and four pigtails **19**. Accordingly, up to sixteen optical fibers **18** from buffer tubes **17** of distribution cable **16** may be interconnected with the optical fibers **14** of drop cables **12** by connecting pigtails **19** to pigtails **15** of the connectorized fiber drops terminated to transition adapters **48** on the outer surface of transition panel **40**. Obviously, more than one splice tray **27** may be provided in lower fiber management area **26** to accommodate splicing the optical fibers **18** of distribution cable **16** to pigtails **19**. Preferably, a plurality of splice trays **27**, for example between one and four, are positioned within the lower fiber management area **26** in stacked relationship by splice tray holders **29**. Splice trays **27** may be retained, for example, by threaded posts and wing nuts that engage splice trays **27** in a known manner. Likewise, a plurality of splice trays **46**, for example between one and four, are positioned in stacked relationship on transition panel **40** and retained in a known manner, such as by threaded posts and wing nuts that engage the splice trays **46** through openings **47**.

[**0021**] As best shown in **FIG. 3**, terminal **10** is mounted on a plurality of drop cables **12** and at least one distribution cable **16** by cable port assemblies **30** located in end walls **23** of base **20**. The cable port assemblies **30** located in the end walls **23** typically receive at least one fiber optic distribution

cable **16** that extends through the terminal **10** and the ends of one or more fiber optic drop cables **12**. As illustrated, four drop cables **12** are received within port assembly **31** and four drop cables **12** and two distribution cables **16** are received within port assembly **33**. Although not illustrated herein, the distribution cables **16** exit the terminal **10** through port assembly **34** located in the end wall **23** of base **20** opposite port assembly **33**. In the illustrated embodiment, port assembly **32** is unused. However, port assembly **32** may be utilized in the event that it is desired to reverse the direction that the drop cables **12** enter the terminal **10**. Furthermore, port assembly **32** and/or port assembly **34** may each be configured to receive up to four additional drop cables **12** to expand the capacity of the terminal **10**. Port assembly **31** has a plurality of semi-circular recesses formed in base **20** and a corresponding plurality of semi-circular recesses formed in cap **35**. One or more drop cables **12** are received within the semi-circular recesses formed in the base **20**. The cap **35** engages the base **20** such that the semi-circular recesses of the cap **35** are aligned with the semi-circular recesses of the base **20** and the drop cables **12** are retained in a sealed manner between the base **20** and the cap **35**. Preferably, base **20** and cap **35** each has four semi-circular recesses formed therein that permit additional drop cables **12** to be installed in the terminal **10** without disturbing the drop cables **12** previously installed. If less than four drop cables **12** are disposed between the base **20** and the cap **35**, any empty recesses may be fitted with a plug (not shown) so that the terminal **10** remains rain proof.

[**0022**] Port assembly **33** has a pair of larger diameter semi-circular recesses formed in the base **20** and a corresponding pair of larger diameter semi-circular recesses formed in spacer **36**. At least one distribution cable **16**, for example a 25-mm diameter sheathed cable, is received within the larger diameter semi-circular recesses formed in the base **20**. The spacer **36** engages the base **20** such that the larger diameter semi-circular recesses of the spacer **36** are aligned with the larger diameter semi-circular recesses of the base **20** and the distribution cable **16** is retained in a sealed manner between the base **20** and the spacer **36**. Preferably, base **20** and spacer **36** each has two larger diameter semi-circular recesses formed therein that permit an additional distribution cable **16** to be installed in the terminal **10** without disturbing the distribution cable **16** previously installed. If only one distribution cable **16** is disposed between the base **20** and the spacer **36**, the empty recess may be fitted with a plug (not shown) so that the terminal **10** remains rain proof. Port assembly **33** further comprises a cap **37** that engages the spacer **36** in the same manner that cap **35** engages base **20** to retain and seal up to four additional drop cables **12**. Accordingly, cap **37** engages spacer **36** such that the additional drop cables **12** are retained in a sealed manner between the spacer **36** and the cap **37**. Preferably, spacer **36** and cap **37** each have four smaller diameter semi-circular recesses formed therein that permit additional drop cables **12** to be installed in the terminal **10** without disturbing the drop cables **12** previously installed. If less than four additional drop cables **12** are disposed between the spacer **36** and the cap **37**, any empty recesses may be fitted with a plug (not shown) so that the terminal **10** remains rain proof. As shown, port assembly **32** is unused and comprises a plug **38** that engages the base **20** so that the terminal **10** remains rain proof. As previously mentioned, however, port assembly **32** may be configured similar to port assembly **31** to retain in a sealed manner up to four additional drop cables **12**. As shown, port assembly **34** engages base **20** to retain in a sealed manner any distribution cable **16** that exits the terminal **10** through the end wall **23** opposite the port assembly **33**. Although not shown, strain relief devices may be provided on any of the port assemblies **31**, **32**, **33**, **34** within the interior **21** of the base **20** to strain relieve the drop cables **12** and/or the distribution cables **16** adjacent the end walls **23** of the terminal **10**.

[**0023**] Another distribution terminal **70** constructed in accordance with the invention is shown in **FIG. 4**. The terminal **70** is shown with the cover **50** in the opened position and the movable transition panel **40** removed from the interior cavity **21** of the base **20** for purposes of clarity. Terminal **70** illustrates an alternative configuration of the lower fiber management area **26**, and more particularly, an alternative means for routing the optical fibers **18** of the distribution cable **16** to the optical fibers **14** of the drop cables **12**. The configuration of the upper fiber management area **28** is the same as shown in **FIGS. 1 and 2** and previously described with the exception that the terminal **70** is mounted on eight drop cables **12**, which enter the terminal **70** through port assemblies **31** and **33** in the manner shown in **FIG. 3**. The distribution cable **16** comprises a plurality of buffer tubes **17**, one of which is routed into the lower fiber management area **26** while the remaining buffer tubes **17** are routed into the slack storage area **60**. The buffer tube **17** in the lower fiber management area **26** is routed in a counterclockwise direction into splice tray **27**. Inside splice tray **27**, at least two of the optical fibers **18** within the buffer tube **17** of the distribution cable **16** are spliced to pigtails **72**. Pigtails **72** are connected to pigtails **73** through coupler adapter **74** positioned within the interior cavity **21** of base **20**. Pigtails **73** are routed in a counterclockwise direction from coupler adapter **73**, for example through routing guides **25**, to coupler tray **76** positioned on top of splice tray **27**. Inside coupler tray **76**, each of the two optical fibers **18** within the buffer tube **17** of the distribution cable **16** are split into four separate optical fibers and spliced to pigtails **19**. Pigtails **19** are routed from coupler tray **76** to transition adapters **48** on the underside of transition panel **40**, as previously described. Pigtails **19** are connected to pigtails **15** through transition adapters **48** to interconnect the optical fibers **14** of drop cables **12** with the optical fibers **18** of distribution cable **16**. Terminal **70** preferably comprises a plurality of splice trays **27** and coupler trays **76**, for example between one and four, that are positioned within the lower fiber management area **26** in stacked relationship by splice tray holders **29**. Splice trays **27** and coupler trays **76** may be retained in a known manner, such as by threaded posts and wing nuts that engage the splice trays **27** and coupler trays **76** through openings **77**. Of course, the optical fibers **18** of the distribution cable **16** may be routed directly to one or more coupler trays **76**, split and spliced directly to pigtails **19**. However, the use of splice trays **27** and coupler adapter **74** permit quick installation and removal of coupler trays **76** within lower fiber management area **26** of terminal **10**. Accordingly, coupler trays **76** may be spliced by the field technician, connectorized by the field technician (i.e., field-terminated), or pre-connectorized (i.e., factory-terminated).

[**0024**] **FIGS. 5 and 6** illustrate alternative methods of routing one or more fiber optic drop cables **12** onto transition panel **40** in the upper fiber management area **28** for interconnection with at least one fiber optic distribution cable **16**

configured as shown in **FIGS. 1 and 2**. In particular, **FIG. 5** is a detail view of movable transition panel **40** showing a representative drop cable **12** having a transport tube **13** that is routed from the upper fiber management area **28** of terminal **10** onto transition panel **40** through routing clip **44**. In this alternative configuration, splice tray **27** and transition adapters **48** are removed and the transport tube **13** is routed counterclockwise along one of the tracks of X-shaped raceway **47** to the routing guide **45** opposite routing clip **44**. Raceway **47** ensures that the minimum bend radius of the optical fibers is not exceeded. The transport tube **13** is next routed along routing guide **45** to one of the openings **49** formed through the transition panel **40**. The transport tube **13** passes through the transition panel **40** into the lower fiber management area **26** within interior cavity **21** of base **20** and is routed into splice tray **27**. Inside splice tray **27**, the optical fibers **14** of drop cables **12** are interconnected with the optical fibers **18** of the distribution cable **16** by direct splicing in any known manner, such as by fusion or mechanical splicing. **FIG. 6** is a detail view of movable transition panel **40** showing a representative drop cable **12** having at least one pre-connectorized optical fiber **14** that terminates in pigtail **15**. The optical fiber **14** is routed from the upper fiber management area **28** of terminal **10** onto transition panel **40** through routing clip **44**. In this alternative configuration, splice tray **27** is removed and the optical fiber **14** is routed counterclockwise along one of the tracks of X-shaped raceway **47** to the routing guide **45** opposite routing clip **44**. Raceway **47** ensures that the minimum bend radius of the optical fibers is not exceeded. The optical fiber **14** is next routed along routing guide **45** to one of the transition adapters **48** positioned within openings **49** formed through the transition panel **40**. The optical fiber **14** terminates in pigtail **15** that is connected to pigtail **19** of distribution cable **16** through transition adapter **48**. As previously described, the pigtails **19** are spliced to the optical fibers **18** of distribution cable **16** inside splice tray **27**. Accordingly, the optical fibers **14** of the drop cables **12** are interconnected with the optical fibers **18** of the distribution cable **16**. The configuration illustrated in **FIG. 6** permits the optical fiber connections within terminal **10** to be easily and readily reconfigured once the terminal **10** has been initially configured and placed into service. Accordingly, the drop cables **12** and the distribution cable **16** may be spliced by the field technician, connectorized by the field technician (i.e., field-terminated), or pre-connectorized (i.e., factory-terminated).

[**0025**] The illustrative embodiments of a distribution terminal according to the invention shown and described herein provide a number of significant advantages over previously known distribution terminals, such as conventional splice closures. For purposes of example only, and not by way of limitation, a distribution terminal constructed in accordance with the invention provides a field technician with substantially greater access to the optical fiber connections between the drop cables and the distribution cable within the terminal. In particular, the drop cables are routed to telecommunications hardware, such as splice trays and transition adapters, on a movable transition panel located in the upper fiber management area. The distribution cable is routed to telecommunications hardware, such as splice trays, coupler trays and coupler adapters, within the lower fiber management area. The lower fiber management area is easily and readily accessible by rotating the transition panel from a stowed position to a deployed position. It should be noted that the drop cables in the illustrated embodiments converge at a common routing clip adjacent to one of the hinge locations such that the transport tubes of the drop cables are substantially parallel to the axis of rotation of the transition panel. Accordingly, the rotatable transition panel separates the distribution cable from the drop cables without the need to strain relieve the transport tubes adjacent the transition panel. Furthermore, the lengthwise dimension of the transition panel is only about two-thirds the lengthwise dimension of the terminal. At least two pairs of hinge locations are provided on the terminal so that the transition panel may be located nearer the end wall of the terminal that is opposite the end wall through which the drop cables enter the terminal. Thus, the slack in the transport tubes or optical fibers of the drop cables may be maintained as the transition panel is rotated between the stowed position and the deployed position. The unused or "express" buffer tubes of the distribution cable are routed to the slack storage area and coiled in a plane that is substantially perpendicular to the plane of the lower fiber management area. Accordingly, the space available within the lower fiber management area for routing the active buffer tube of the distribution cable and for making optical fiber connections is maximized.

[**0026**] Obviously, a distribution terminal constructed in accordance with the invention permits numerous configurations of telecommunications hardware and associated methods for routing fiber optic drop cables to be interconnected with a distribution cable. For purposes of example only, and not by way of limitation, a distribution terminal constructed in accordance with the invention may be configured to route optical fibers of the drop cables from the transition panel in the upper fiber management area to one or more splice trays in the lower fiber management area for direct splicing to certain optical fibers of the distribution cable. Alternatively, the optical fibers of the drop cables may be routed to one or more splice trays on the transition panel and spliced to pigtails. Similarly, the optical fibers of the distribution cable are routed to one or more splice trays and spliced to pigtails. The connectorized pigtails of the drop cables are then connected to the connectorized pigtails of the distribution cable through transition adapters provided on the transition panel. Alternatively, the optical fibers of the drop cables may be "pre-connectorized" and routed directly to the transition adapters for connection to the connectorized pigtails of the distribution cable. Alternatively yet, the optical fibers of the distribution cable may be first routed to one or more splice trays and spliced to pigtails, as previously described. Thereafter, the splice tray pigtails are connected to coupler tray pigtails from a coupler tray positioned on top of the splice tray in the lower fiber management area through one or more coupler adapters. The coupler tray pigtails are next split inside the coupler tray into multiple pigtails that connect to the pigtails of the drop cables through the transition adapters, as previously described. Of course, the optical fibers of the distribution cable may be routed directly to one or more coupler trays and spliced to directly to the pigtails that are connected to the pigtails of the drop cables through the transition adapters.

[**0027**] Many modifications and other embodiments of the invention will come to mind to one skilled in the art to which this invention pertains having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the invention is not to be limited to the specific embodiments disclosed

herein and that further modifications and other embodiments are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

That which is claimed is:

1. An optical fiber distribution terminal for interconnecting one or more drop cables with at least one distribution cable, the terminal comprising:

a base defining a lower fiber management area for receiving and routing the distribution cable and an upper fiber management area for receiving and routing the drop cables; and

a panel disposed within the base, the panel separating the lower fiber management area from the upper fiber management area and movable relative to the base to provide access to the distribution cable in the lower fiber management area.

2. A distribution terminal according to claim 1 wherein the base comprises opposed end walls and further comprising at least one cable port assembly disposed in an end wall for retaining the one or more drop cables and the distribution cable between the base and the cable port assembly.

3. A distribution terminal according to claim 2 wherein the at least one cable port assembly comprises a first port assembly for retaining the one or more drop cables between the base and the first port assembly and a second port assembly for retaining the distribution cable between the base and the second port assembly.

4. A distribution terminal according to claim 3 wherein the first port assembly comprises a first cap for retaining the one or more drop cables between the base and the first cap and wherein the second port assembly comprises a spacer for retaining the distribution cable between the base and the spacer and a second cap for retaining one or more additional drop cables between the spacer and the second cap.

5. A distribution terminal according to claim 1 wherein the distribution cable comprises a plurality of buffer tubes each containing one or more optical fibers and further comprising a slack storage area disposed within the base, the slack storage area storing at least some of the buffer tubes of the distribution cable.

6. A distribution terminal according to claim 5 wherein the plane defined by the buffer tubes stored in the slack storage area is generally perpendicular to the plane defined by the lower fiber management area.

7. A distribution terminal according to claim 1 further comprising at least one splice tray disposed within the lower fiber management area for splicing at least one optical fiber of the distribution cable to at least one optical fiber of the one or more drop cables.

8. A distribution terminal according to claim 1 further comprising

at least one splice tray disposed within the lower fiber management area for splicing at least one optical fiber of the distribution cable to at least one optical fiber terminating in a first pigtail;

at least one splice tray disposed within the upper fiber management area for splicing at least one optical fiber of the one or more drop cables to at least one optical fiber terminating in a second pigtail; and

at least one transition adapter disposed within the upper fiber management area for connecting the first pigtail to the second pigtail.

12. A distribution terminal according to claim 1 further comprising

at least one splice tray disposed within the lower fiber management area for splicing optical fibers of the distribution cable to at least one optical fiber terminating in a first pigtail;

at least one splice tray disposed within the upper fiber management area for splicing optical fibers of the one or more drop cables to a plurality of optical fibers each terminating in a second pigtail;

at least one coupler tray disposed within the lower fiber management area, the coupler tray having at least one optical fiber terminating in a third pigtail and a plurality of optical fibers each terminating in a fourth pigtail;

at least one coupler adapter disposed within the lower fiber management area for connecting the third pigtail to the first pigtail; and

at least one transition adapter disposed within the upper fiber management area for connecting the fourth pigtails to the second pigtails.

13. A distribution terminal according to claim 1 further comprising

at least one coupler tray disposed within the lower fiber management area, the coupler tray having a plurality of optical fibers each terminating in a first pigtail;

at least one splice tray disposed within the upper fiber management area for splicing optical fibers of the one or more drop cables to a plurality of optical fibers each terminating in a second pigtail; and

at least one transition adapter disposed within the upper fiber management area for connecting the first pigtails to the second pigtails.

14. An optical fiber distribution terminal comprising:

a base defining a lower fiber management area for receiving and routing at least one distribution cable and an upper fiber management area for receiving and routing one or more drop cables; and

means disposed within the base for separating the lower fiber management area from the upper fiber management area and for selectively accessing the lower fiber management area without disturbing the routing of the drop cables in the upper fiber management area.

15. A distribution terminal according to claim **14** wherein the means for separating and for selectively accessing comprises a movable panel disposed within the upper fiber management area, the panel movable between a stowed position to provide access to the routing of the one or more drop cables in the upper fiber management area and a deployed position to provide access to the routing of the distribution cable in the lower fiber management area without disturbing the routing of the one or more drop cables in the upper fiber management area.

16. A distribution terminal according to claim **14** further comprising at least one splice tray disposed within the lower

fiber management area for splicing at least one optical fiber of the distribution cable to at least one optical fiber of the one or more drop cables.

17. A distribution terminal according to claim **14** further comprising

at least one splice tray disposed within the lower fiber management area for splicing at least one optical fiber of the distribution cable to at least one optical fiber terminating in a first pigtail;

at least one splice tray disposed within the upper fiber management area for splicing at least one optical fiber of the one or more drop cables to at least one optical fiber terminating in a second pigtail; and

at least one transition adapter disposed within the upper fiber management area for connecting the first pigtail to the second pigtail.

18. A distribution terminal according to claim **14** further comprising

at least one splice tray disposed within the lower fiber management area for splicing optical fibers of the distribution cable to at least one optical fiber terminating in a first pigtail;

at least one splice tray disposed within the upper fiber management area for splicing optical fibers of the one or more drop cables to a plurality of optical fibers each terminating in a second pigtail;

at least one coupler tray disposed within the lower fiber management area, the coupler tray having at least one optical fiber terminating in a third pigtail and a plurality of optical fibers each terminating in a fourth pigtail;

at least one coupler adapter disposed within the lower fiber management area for connecting the third pigtail to the first pigtail; and

at least one transition adapter disposed within the upper fiber management area for connecting the fourth pigtails to the second pigtails.

19. A distribution terminal according to claim **14** further comprising

at least one coupler tray disposed within the lower fiber management area, the coupler tray having a plurality of optical fibers each terminating in a first pigtail;

at least one splice tray disposed within the upper fiber management area for splicing optical fibers of the one or more drop cables to a plurality of optical fibers each terminating in a second pigtail; and

at least one transition adapter disposed within the upper fiber management area for connecting the first pigtails to the second pigtails.

20. An optical fiber distribution terminal for interconnecting one or more drop cables with at least one distribution cable, the terminal comprising:

a base defining a lower fiber management area for receiving and routing the distribution cable and an upper fiber management area for receiving and routing the one or more drop cables;

a transition panel movably attached to the base for separating the lower fiber management area from the upper fiber management area and for transitioning optical fiber connections between the one or more drop cables and the distribution cable, the transition panel movable between a stowed position to provide access to the upper fiber management area and a deployed position to provide access to the lower fiber management area.

21. An optical fiber distribution terminal for interconnecting optical fibers at a network access point, the terminal comprising:

a base defining a lower compartment for receiving and routing a distribution cable and an upper compartment for receiving and routing one or more drop cables;

a panel movably attached to the base and disposed within the upper compartment, the panel movable between a first position to provide access to the drop cables in the upper compartment and a second position to provide access to the distribution cable in the lower compartment without the need to strain relieve the drop cables adjacent the panel.

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