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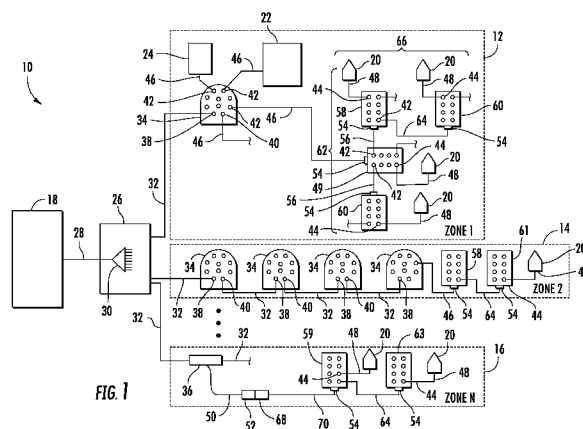
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(54) Title: RECONFIGURABLE MULTI-ZONED FIBER OPTIC NETWORK ARCHITECTURE HAVING FIBER OPTIC DEVICES



(57) Abstract: A fiber optic network having one or more zones is disclosed. Each zone of the fiber optic network includes one or more zone terminals (34) or devices. Such zone terminals or devices may be located at a mid-span access point of a distribution cable optically connected to a service provider's feeder cable. The zone terminal has a plurality of connector ports (45) with at least one adapter positioned within one of the plurality of connector ports (45). The adapter is configured to establish an optical connection with one or more optical fibers of the distribution cable. A multi-fiber optical connector is suitable for outside-plant installation, and the terminal is configured to extend optical service from a service provider toward at least one subscriber premises in a zone. The fiber optic terminal is reconfigurable based on at least one of, a number of subscriber premises in the zone, a geographical relationship of the subscriber premises in the zone, and a demographic make-up of the subscriber premises in the zone.

RECONFIGURABLE MULTI- ZONED FIBER OPTIC NETWORK ARCHITECTURE HAVING FIBER OPTIC DEVICES

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of priority to U.S. Provisional Application No. 61/151,686, filed on February 11, 2009, and U.S. Provisional Application No. 61/237,807, filed on August 28, 2009 the contents of both of which are relied upon and incorporated herein by reference in their entirety.

BACKGROUND

Technical Field

[0002] The present invention relates generally to fiber optic devices, and more particularly to fiber optic devices arranged in multi-zoned distribution network architectures, which may be reconfigured to meet optical communication service requirements.

Technical Background

[0003] Optical fiber is increasingly being used for a variety of broadband applications including voice, video and data transmissions. As a result of the ever-increasing demand for broadband communications, telecommunication and cable media, service providers and/or operators are expanding their fiber optic networks to increase their networks' capacity and reach to provide more services, applications and information to more subscribers. To facilitate this capacity and reach, the fiber optic networks must employ additional fiber optic cable, hardware and components resulting in increased installation time, cost and maintenance. This results in the fiber optic networks becoming more complex, requiring architectures that allow for the most efficient delivery of fiber optic service to the subscriber. These architectures may be configured by employing fiber optic network devices, such as optical terminals, for example, in branches of the fiber optic network. The fiber optic network devices act to optically interconnect the fiber optic cables of the branch, separate or combine optical fibers in multi-fiber cables,

and/or split or couple optical signals, as may be necessary for the configuration of the architecture.

SUMMARY OF THE DETAILED DESCRIPTION

[0004] Embodiments disclosed in the detailed description include a fiber optic terminal, comprising an enclosure having a wall defining an interior cavity and a plurality of connector ports disposed through the wall. At least one adapter positions within one of the plurality of connector ports. The at least one adapter has an interior end accessible from within the interior cavity and an exterior end accessible external to the enclosure. The adapter is configured to establish an optical connection between at least one optical fiber attached to a first multi-fiber optical connector inserted in the interior end, and one or more respective optical fibers in a second multi-fiber optical connector inserted in the exterior end. The one or more respective optical fibers are optically connected to one or more optical fibers of a distribution cable. The second multi-fiber optical connector may be suitable for outside-plant installation. The terminal is configured to extend optical service from a service provider toward at least one subscriber premises in a zone. Additionally the fiber optic terminal is reconfigurable based on at least one of, a number of subscriber premises in the zone, a geographical relationship of the subscriber premises in the zone, and a demographic make-up of the subscriber premises in the zone.

[0005] The configuring may include splicing hardware positioned in the enclosure. The at least one optical fiber attached to the first multi-fiber optical connector may route to the splicing hardware and connect to a respective pigtail optical fiber. The configuring may also include one or more 1 X N splitters. An optical signal carried by the optical fiber in the first fiber optic cable may be split into N optical signals where N may be 4, 8, 16 and 32. The N optical signals may be carried by a respective number of optical fibers.

[0006] Embodiments disclosed in the detailed description also include a fiber optic network having one or more zones. The fiber optic network may be a public network or a private network. Each zone of the fiber optic network includes one or more zone terminals or devices. Such zone terminals or devices may be located at a mid-span access point of a distribution cable optically connected to a service provider's feeder cable. The zone terminal has a plurality of connector ports with at least one adapter

positioned within one of the plurality of connector ports. The adapter is configured to establish an optical connection with one or more optical fibers of the distribution cable. The second multi-fiber optical connector is suitable for outside-plant installation, and the terminal is configured to extend optical service from a service provider toward at least one subscriber premises in a zone. The fiber optic terminal is reconfigurable based on at least one of, a number of subscriber premises in the zone, a geographical relationship of the subscriber premises in the zone, and a demographic make-up of the subscriber premises in the zone.

[0007] In this way, the service provider can initially configure the zone for the current number of subscribers, for example single family units, to be connected to the fiber optic network. As an example, this may be 30% of the subscribers, referred to as a 30% take rate. The service provider can defer the cost for the rest of the current and/or future subscribers. Only at the time the demand for optical communication service changes, for example increasing to a 50% or higher take rate level, does the service provider incur the cost to reconfigure the zone to meet that 50% or higher take rate. Additionally, the reconfiguration may be done at minimal cost and labor, particularly since the optical components and hardware may employ plug and play connections.

BRIEF DESCRIPTION OF THE FIGURES

[0008] **FIG. 1** is an exemplary schematic diagram of a portion of a multi-zoned fiber optic network architecture having exemplary zone terminals and a mid-span access point attached to distribution cables;

[0009] **FIG. 2** is a schematic diagram of an exemplary zone terminal having connector ports and a splice tray included in the multi-zoned fiber network architecture of **FIG. 1**;

[0010] **FIG. 3** is a schematic diagram of an exemplary zone terminal having connector ports included in the multi-zoned fiber network architecture of **FIG. 1**;

[0011] **FIG. 4** is a schematic diagram of an exemplary branch-connected terminal included in the multi-zoned fiber network architecture of **FIG. 1**;

[0012] **FIG. 5** is a schematic diagram of an exemplary series-connected terminal included in the multi-zoned fiber network architecture of **FIG. 1**;

[0013] **FIG. 6** is a schematic diagram of an exemplary series-connected terminal included in the multi-zoned fiber network architecture of **FIG. 1**, and wherein a 1X4 splitter is disposed in the series-connected terminal;

[0014] **FIG. 7** is a schematic diagram of an exemplary drop terminal included in the multi-zoned fiber network architecture of **FIG. 1**;

[0015] **FIG. 8** is a schematic diagram of an exemplary drop terminal included in the multi-zoned fiber network architecture of **FIG. 1**, and wherein a 1X8 splitter is disposed in the drop terminal;

[0016] **FIG. 9** is a schematic diagram of an exemplary drop terminal included in the multi-zoned fiber network architecture of **FIG. 1**, and wherein a 1X4 splitter is disposed in the drop terminal;

[0017] **FIG. 10** is a perspective view of a zone terminal having a plurality of connector ports according to an exemplary embodiment;

[0018] **FIG. 11** is a perspective view of the zone terminal of **FIG. 10** with the cover in an opened position;

[0019] **FIG. 12** is a view of an optical terminal which may be used as a branch-connected terminal, according to an exemplary embodiment;

[0020] **FIG. 13** is a view of an optical terminal which may be used as a series-connected terminal, according to an exemplary embodiment; and

[0021] **FIG. 14** is a view of an optical terminal which may be used as a drop terminal, according to an exemplary embodiment.

DETAILED DESCRIPTION

[0022] Reference will now be made in detail to the embodiments, examples of which are illustrated in the accompanying drawings, in which some, but not all embodiments are shown. Indeed, the concepts may be embodied in many different forms and should not be construed as limiting herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Whenever possible, like reference numbers will be used to refer to like components or parts.

[0023] To facilitate the description of the various embodiments, the terms “optical terminal,” “fiber optic terminal,” “zone terminal,” “branch-connected terminal”,

and/or “series-connected terminal” may be used. It should be understood that as used herein these terms are not limited to any specific type, style, structure, construction or arrangement of fiber optic network device. Accordingly, for purposes herein “optical terminal,” “fiber optic terminal,” “zone terminal,” “branch-connected terminal,” and/or “series-connected terminal” shall mean and include, but not be limited to, devices and/or structures which may typically be referred to as a local convergence point, a fiber distribution hub, a fiber distribution cabinet, a splitter cabinet, a multiport, a fiber terminal, a multiple dwelling closure, a local convergence cabinet, a pedestal, a network access point, a distribution closure, and the like.

[0024] The terms “fiber optic cables” and/or “optical fibers” include all types of single mode and multi-mode light waveguides, including one or more optical fibers that may be upcoated, colored, buffered, ribbonized and/or have other organizing or protective structure in a cable such as one or more tubes, strength members, jackets, or the like. Likewise, other types of suitable optical fibers include bend-insensitive optical fibers, or any other expedient of a medium for transmitting light signals. An example of a bend-insensitive optical fiber is ClearCurve[®] Multimode fiber commercially available from Corning Incorporated.

[0025] Further, as used herein and well known and understood in the art, “feeder cable” shall mean and include any one or more of fiber optic cables from a central office of a telecommunications service provider or operator, or a transport cable from a head end of cable media service provider or operator. The term “distribution cable” shall mean any cable optically connected to a feeder cable or a transport cable, either directly or through a fiber optic component, including, but not limited to, a splitter, and used to further distribute the optical services toward a subscriber premises. The term “branch cable,” “sub-branch cable,” “series cable,” “tether cable,” and/or “stub cable” shall mean and include any fiber optic cable that may optically connect, directly or indirectly, to and/or extend from a distribution cable and/or a feeder cable for the purpose of optically connecting the distribution cable to a drop cable. The term “drop cable” shall mean and include a fiber optic cable extending to a subscriber premises. The feeder cable, distribution cable, branch cable, sub-branch cable, series cable, tether cable, stub cable and/or drop cable may be any type of fiber optic cable having one or more optical fibers.

[0026] The drop cable may be, “pre-connectorized” to be readily connected to and disconnected from a drop port of an optical terminal. At the other end, the drop cable may be optically coupled to optical fibers within a conventional closure or optical network terminal (ONT), such as, but not limited to, a network interface device (NID) of the types available from Corning Cable Systems LLC of Hickory, N.C. In the exemplary embodiments shown and described herein, the drop cables extend from a closure located at a subscriber premises and are optically coupled through the drop ports of an optical terminal to optical fibers of the distribution cable, either directly or indirectly through a branch cable, a sub-branch cable, a series cable, a tether cable, and/or a stub cable, or other optical components, such as a splitter. Additionally, the optical fibers of the distribution cable may be optically connected to the feeder cable, and, thus, to the central office. As such, the optical terminal provides an accessible interconnection terminal for readily connecting, disconnecting or reconfiguring distribution cables, branch cables, sub-branch cables, series cables, tether cables, stub cables and/or drop cables, and optical components and hardware in the optical network, and, thereby reconfiguring the architecture of the optical network.

[0027] The terms connect, interconnect, and couple shall be understood to mean, without limitation, the passage, flow, transmission, or the like of an optical signal between one or more of optical cables, optical fibers, components, and/or connectors, or the like and one or more of optical cables, optical fibers, components, and/or connectors, or the like; whether or not by direct or indirect physical connection, to establish optical communication or connectivity thereby. The optical terminal may be adapted to accommodate a variety of connector types, such as but not limited to simplex and/or duplex SC, LC, DC, FC, ST, SC/DC, MT-RJ, MTP, MPO connectors. Further, the optical terminal may be adapted to accommodate ruggedized connectors for outside plant installations. Examples of such ruggedized connectors include, OptiTap® or OptiTip® connectors available from Corning Cable Systems LLC of Hickory, N.C.

[0028] For purposes herein, reference to “upstream” shall mean in the direction toward the central office. Reference to “downstream” shall mean in a direction toward the subscriber premises. It should be understood, though, that using the terms “upstream” or “downstream” does not indicate the direction in which the optical signals are

transmitted or carried in the optical fibers. Thus, an optical signal may be transmitted in both the upstream and/or the downstream direction.

[0029] Embodiments disclosed in the detailed description include a fiber optic terminal, comprising an enclosure having a wall defining an interior cavity and a plurality of connector ports disposed through the wall. At least one adapter positions within one of the plurality of connector ports. The at least one adapter has an interior end accessible from within the interior cavity and an exterior end accessible external to the enclosure. The adapter is configured to establish an optical connection between at least one optical fiber attached to a first multi-fiber optical connector inserted in the interior end, and one or more respective optical fibers in a second multi-fiber optical connector inserted in the exterior end. The one or more respective optical fibers are optically connected to one or more optical fibers of a distribution cable. The second multi-fiber optical connector may be suitable for outside-plant installation. The terminal is configured to extend optical service from a service provider toward at least one subscriber premises in a zone. Additionally the fiber optic terminal is reconfigurable based on at least one of, a number of subscriber premises in the zone, a geographical relationship of the subscriber premises in the zone, and a demographic make-up of the subscriber premises in the zone.

[0030] The configuring may include splicing hardware positioned in the enclosure. The at least one optical fiber attached to the first multi-fiber optical connector may route to the splicing hardware and connect to a respective pigtail optical fiber. The configuring may also include one or more 1 X N splitters. An optical signal carried by the optical fiber in the first fiber optic cable may be split into N optical signals where N may be 4, 8, 16 and 32. The N optical signals may be carried by a respective number of optical fibers.

[0031] Embodiments disclosed in the detailed description include a fiber optic network having one or more zones. The fiber optic network may be a public network or a private network. Each zone of the fiber optic network includes one or more zone terminals or devices. Such zone terminals or devices may be located at a mid-span access point of a distribution cable optically connected to a service provider's feeder cable. The zone terminal has a plurality of connector ports with at least one adapter positioned within one of the plurality of connector ports. The adapter is configured to establish an

optical connection with one or more optical fibers of the distribution cable. The second multi-fiber optical connector is suitable for outside-plant installation, and the terminal is configured to extend optical service from a service provider toward at least one subscriber premises in a zone. The fiber optic terminal is reconfigurable based on at least one of, a number of subscriber premises in the zone, a geographical relationship of the subscriber premises in the zone, and a demographic make-up of the subscriber premises in the zone.

[0032] In this way, the service provider can initially configure the zone for the current number of subscribers, for example single family units, to be connected to the fiber optic network. As an example, this may be 30% of the subscribers, referred to as a 30% take rate. The service provider can defer the cost for the rest of the current and/or future subscribers. Only at the time the demand for optical communication service changes, for example increasing to a 50% or higher take rate level, does the service provider incur the cost to reconfigure the zone to meet that 50% or higher take rate. Additionally, the reconfiguration may be done at minimal cost and labor, particularly since the optical components and hardware may employ plug and play connections.

[0033] Referring now to **FIG. 1**, there is shown a fiber optic network **10** having a zoned distribution architecture. In **FIG. 1**, multiple zones are shown, “Zone 1” **12**, “Zone 2” **14** and “Zone N” **16**. It should be understood that the fiber optic network may have an architecture based on any number of zones, including 1 zone and any multiple of zones, which is indicated by the designation “Zone N” **16**. Each zone is a portion of the fiber optic network **10** and may be configured and reconfigured, as necessary, to facilitate the provision of optical communication service from the service provider to subscribers within the zone. The configuring and reconfiguring may be based on geographical relationship of the subscriber premises in the zone, demographic make-up of the subscriber premises in the zone. This may be accomplished by providing optical connectivity from the central office **18** to the subscriber premises, which may be a single family unit **20**, a multiple dwelling unit (MDU) **22** or a commercial building **24**, which shall include, without limitation, educational, institutional buildings, and the like, and combinations thereof. Additionally, the MDU **22** and/or the commercial building **24** may

comprise a plurality of buildings and/or structures, including, but not limited to, buildings and/or structures organized into a campus.

[0034] Configuring and/or reconfiguring a zone may involve, without limitation, providing different types and quantity of optical terminals and fiber optic cables. The optical terminals provide intermediate points or nodes for providing and accessing optical components and the fiber optic cables. Thus, configuring a zone may involve the manner in which the optical terminals and/or optical components are interconnected by the fiber optic cables. In this manner, the optical terminals and optical components may be provisioned, configured and interconnected in the fiber optic network **10** to facilitate providing optical service to the subscribers in the zone. Additionally, if the quantity and types of subscribers change over time, the zone may be reconfigured. In this manner, the optical terminals, optical components and fiber optic cables in that particular zone, may be accessed and changed without having to access or change the optical terminals, optical components and/or fiber optic cables in another zone or portion of the fiber optic network **10**. In this manner, one or more zones in the fiber optic network may be independently reconfigurable. As mentioned above, the zone may include optical components and solutions which employ plug and play connections, which may result in minimal costs and labor to reconfigure the zone.

[0035] In the embodiment shown in **FIG. 1**, an optical terminal in the form of a fiber distribution hub (FDH) **26** is positioned in the fiber optic network **10** downstream from the central office **18**. The FDH **26** receives a feeder cable **28** extended from the central office **18**. In this manner, the optical components in the FDH **26** may be optically connected to the equipment in the central office **18**. The feeder cable **28** may be connectorized. The optical components in the FDH **26** may include, but not be limited to, one or more distribution splitters **30**. Typically, the feeder cable **28** is a multi-fiber optical cable, having for example 12-24 optical fibers. One or more of the optical fibers in the feeder cable **28** may be optically connected to one or more of the distribution splitters **30**. The distribution splitters **30** may split the optical signals carried by the optical fibers in the feeder cable **28** into multiple split optical signals. As examples, the distribution splitter **30** may be any ratio of split, including, without limitation 1X4, 1X8, 1X16, 1X32, 2X4, and 2X8.

[0036] The split optical signals may then be carried by one or more distribution cables **32**, each having multiple optical fibers. The distribution cable **32** may have any number of optical fibers. As non-limiting examples, a distribution cable **32** may have 12, 24, 48, 72 or 96 optical fibers. In the embodiment shown in **FIG. 1**, three distribution cables **32** extend from the FDH **26** to a respective zone, “Zone 1” **12**, “Zone 2” **14**, and “Zone N” **16** of the fiber optic network **10**. Although three distribution cables **32** are shown in **FIG. 1**, it should be understood that any number of distribution cables **32** may extend from the FDH **26** to respective zones. Each distribution cable **32** extends optical communication service to the respective zone.

[0037] The distribution cables **32** extend to optical devices in the respective zones. In the embodiment shown in **FIG. 1**, the distribution cables **32** extending to “Zone 1” **12** and “Zone 2” **14** each extends from the FDH **26** to a zone terminal **34**. While in “Zone N” **16**, the distribution cable **32** extends from the FDH **26** to a mid-span access point **36**. It should be understood, though, that either or both “Zone 1” **12** and “Zone 2” **14** can have a mid-span access point **36**, and “Zone N” **16** can have a zone terminal **34**. The zone terminal **34** has an upstream cable port **38** and a downstream cable port **40**. The distribution cable **32** may enter or connect to the zone terminal **34** at the upstream cable port **38**. In certain configurations, the distribution cable **32** may exit or connect to the zone terminal **34** at the downstream cable port **40** to allow the distribution cable **32** to continue downstream from the zone terminal **34**. The upstream cable port **38** and the downstream cable port **40** may provide for the distribution cable to pass directly into the zone terminal **34**. Alternatively, a multi-fiber connector adapter (not shown) may be seated in one or both of the upstream cable port **38** and the downstream cable port **40**. In this manner, the distribution cable **32** may have a multi-fiber connector at its end (not shown) which may be received by the multi-fiber connector adapter.

[0038] The zone terminal **34** may also have other connector ports. In **FIG. 1**, the zone terminal **34** in “Zone 1” **12** is shown as having eight other connector ports, but the zone terminal **34** may have any number of other connector ports, including as non-limiting examples 12 and 16. Depending on the particular configuration of the zone terminal **34**, a multi-fiber adapter or a single fiber adapter may be seated in the connector port. The connector ports may act as branch ports **42** or drop ports **44**. Branch cables **46**

connect to the branch ports **42** at the connector adapter and extend to other optical terminals downstream. Drop cables **48** connect to the drop ports **44** and extend to subscriber premises. In **FIG. 1**, three branch cables **46** are shown extending from respective the branch ports **42** in the zone terminal **34** in “Zone 1” **12**. One branch cable **46** extends to the multiple dwelling unit (MDU) **22** and another branch cable **46** extends to the commercial building **24**. These branch cables may connect to optical terminals (not shown) in the MDU **22** and commercial building **24**. One or more drop cables **48** may then extend from the optical terminals. Although not shown in **FIG. 1**, the configuration of “Zone 1” **12** may be such that a drop cable **48** may also extend from the zone terminal **34** to, for example, a single family unit **20**. The branch cables **46** may extend from the zone terminal **34** to another optical terminal in the zone. In “Zone 1” **12**, one of the branch cables **46** extends from the zone terminal **34** to branch-connected terminal **49**. The branch cables **46** in this embodiment may have, for example, 12 optical fibers. However, the branch cable **46** may have any number of optical fibers based on the configuration of the architecture of “Zone 1” **12**. Although the zone terminal **34** in “Zone 1” **12** in **FIG. 1** is shown with a certain configuration of connector ports, it should be understood that the zone terminal **34** may be initially configured and subsequently reconfigured with any number or combination of types of connector ports.

[0039] In “Zone 1” **12**, the fiber optic network **10** includes other optical terminals downstream from the zone terminal **34**. As mentioned above, one of the branch cables **46** extends from the zone terminal **34** to the branch-connected terminal **49**. The branch cable **46** enters into or connects with the branch-connected terminal **49** at a network port **54**. Sub-branch cables **56** extend from branch ports **42** in the branch-connected terminal **49** to a series-connected fiber optic terminal **58** and to a drop terminal **60**, respectively. The sub-branch cables **56** enter into or connect with the series-connected terminal **58** and the drop terminal **60** at respective network ports **54**. In the embodiment shown in **FIG. 1** for “Zone 1” **12**, the sub-branch cables **56** may have four optical fibers each. However, the sub-branch cable **56** may have any number of optical fibers based on the configuration of the architecture of “Zone 1” **12**.

[0040] The arrangement of the branch-connected terminal **49** with the series-connected terminal **58** and the drop terminal **60** forms a branched network segment **62**.

The branched network segment **62** may be utilized in providing service to subscriber premises in cases where the branch-connected terminal **49** may be located somewhat centrally among a cluster of subscriber premises. The series-connected terminal **58** and the drop terminal **60** may be positioned at or near opposite ends of the cluster of subscriber premises. This positioning may then facilitate the routing of drop cables **48** to the subscriber premises. This is illustrated in the embodiment in **FIG. 1**, by the drop cables **48** extending from drop ports **44** in the branch-connected terminal **48**, the series-connected terminal **58** and the drop terminal **60** to single family units **20**. It should be noted that it is not necessary that a branch network segment be arranged as shown in **FIG. 1** with a series-connected terminal **58** and a drop terminal **60**. As such, a branched network segment **62** may include any type or number of optical terminals.

[0041] Continuing with the “Zone 1” **12**, a series cable **64** extends from the branch port **42** of the series-connected fiber optic terminal **58** to another drop terminal **60**. The series cable **64** enters into or connects with the drop terminal **60** at the network port **54**. The arrangement of the series-connected fiber optic terminal **58** connected to the drop terminal **60** by the series cable **64** forms a series network segment **66**. Although in **FIG. 1**, only one series-connected fiber optic terminal **58** is shown in the series network segment **66**, a series network segment **66** may include more than one series-connected fiber optic terminal **58**. The series cable **64** in this embodiment may have four to eight optical fibers. However, the series cable **64** may have any number of optical fibers based on the configuration of the architecture of “Zone 1” **12**. The series network segment **66** may be utilized in providing service to subscriber premises in cases where the subscriber premises are not clustered in a manner that may facilitate a branched network segment **62** and/or are spaced at longer distances apart.

[0042] An example of a different network configuration is shown in “Zone 2” **14** of **FIG. 1**. In “Zone 2” **14** multiple zone terminals **34** are connected in series along a length of the distribution cable **32**. The distribution cable **32** extends to and from each zone terminal **32** at the upstream cable port **38** and the downstream cable port **40**. Branch cable **46** may extend from one or more branch port **42** of a zone terminal **34** to a series-connected terminal **58**. The branch cable **46** in this embodiment may have four to eight optical fibers. However, the branch cable **46** may have any number of optical fibers

based on the configuration of the architecture of “Zone 2” 14. Although in **FIG. 1** only one series-connected terminal 58 is shown in “Zone 2” 14, that is only for ease of discussing the configuration of “Zone 2” 14. Therefore, it should be understood that any number of series-connected terminals 58 may be optically connected to each of the zone terminals 34. For example, four series-connected terminals 58 may be optically connected by branch cables 46 to each zone terminal 34. Series cable 64 may extend from one or more branch port 42 on the series-connected terminal 34 to a drop terminal 61. The series cable 64 in this embodiment may have a single optical fiber. However, the series cable 64 may have any number of optical fibers based on the configuration of the architecture of “Zone 2” 14. Although in **FIG. 1** only one drop terminal 61 is shown in “Zone 2” 14, that is only for ease of discussing the configuration of “Zone 2” 14. Therefore, it should be understood that any number of drop terminals 61 may be optically connected to each of the series-connected terminals 58. For example, eight drop terminals 61 may be optically connected by series cables 64 to each series-connected terminal 58. Drop cables 48 may extend from one or more drop ports 44 on the drop terminals 61 to subscriber premises, for example, a single family unit 20. In this manner, the architecture of “Zone 2” 14 may provide optical communication service to up to 385 single family units 20, or more.

[0043] Continuing with reference to **FIG. 1**, a mid-span access point 36 is shown in “Zone N” 16. At the mid-span access point 36, a certain number of optical fibers is separated out from the other optical fibers in the distribution cable 32. The separated out optical fibers are contained in a tether cable 50 which extends from the mid-span access point 36. The tether cable 50 may be terminated by a single fiber or multi-fiber tether connector 52 based on the configuration of “Zone N” 16. Alternatively or additionally, the tether cable 50 may extend to another optical terminal in “Zone N” 16 to optically connect that optical terminal to the distribution cable 32. The distribution cable 32, less the optical fibers separated out into the tether cable 50 continues downstream. Additional mid-span access points 36 may be located on the distribution cable 32 as the distribution cable extends downstream. A mid-span access point may also be located at the downstream end of the distribution cable 32. It should be noted that a zone may have both zone terminals 34 and mid-span access points 36.

[0044] In the configuration of “Zone N” 16, the tether connector 52 connects to a stub connector 68 attached to the end of a stub cable 70. The stub connector may be single fiber or multi-fiber based on the configuration of “Zone N” 16. Accordingly, the stub cable 70 may have a single optical fiber or multiple optical fibers. The stub cable 70 extends from network port 54 of series-connected terminal 59. Series cable 64 extends from branch port 42 on the series-connected terminal 59 to the network port 54 of the drop terminal 63. Drop cables 48 may extend from drop ports 44 in the series-connected terminal 59 and the drop terminal 60 to subscriber premises, for example single family units 20. In the configuration of “Zone N” 16, the tether connector 52, stub connector 68, series-connected terminal 58 and drop terminal 60 may be co-located in one enclosure, for example a pedestal enclosure. This configuration provides a convenient, reconfigurable and expandable network access point to meet the current and future subscriber demand for optical communication service in “Zone N” 16.

[0045] It should be noted that the network port 54 may provide for the branch cable 46, the sub-branch cable 56, the series cable 64, and the stub cable 70 to pass directly into the branch-connected fiber optic terminal 48, the series-connected terminal 58 and/or the drop terminal 60, as the case may be. Alternatively, a multi-fiber or single fiber connector adapter (not shown in FIG. 1) may be seated in the network port 54. In this manner, the branch cable 46, the sub-branch cable 56, the series cable 64, and/or the stub cable 70 may have a multi-fiber or single fiber connector at its end (not shown in FIG. 1) which may be received by the multi-fiber or single fiber connector adapter.

[0046] Referring now to FIG. 2, there is shown a schematic diagram of the zone terminal 34 in “Zone 1” 12 of FIG. 1. The zone terminal 34 has an enclosure 35 which defines an interior 37. The distribution cable 32 connects to the zone terminal 34 at the upstream cable port 38. The upstream cable port 38 and the downstream cable port 40 extend through the enclosure 35. In the embodiment shown in FIG. 2 a multi-fiber adapter 72 is seated in the upstream cable port 38. The end of the distribution cable 32 external to the zone terminal 34 may be terminated with a ruggedized multi-fiber optic connector 74, for example an OptiTip connector, which may be received by the multi-fiber adapter 72 at an external end. A multi-fiber connector 76, for example an MTP connector, may be received by the multi-fiber adapter 72 at an internal end in the interior

37. In such case, the multi-fiber adapter 72 will provide for the mating of an OptiTip connector with the MTP connector.

[0047] Optical fibers 78 are connected to the multi-fiber connector 76 and, therefore, are optically connected to the optical fiber of the distribution cable 32. The optical fibers 78 route in the interior 37 of the zone terminal 34 with certain of the optical fibers 80 connecting to a splicing hardware 82, which may be, for example, a splice tray. Other optical fibers 84 route to the downstream port 40. In this embodiment, the downstream port 40 does not have an adapter, and therefore the optical fibers 84 are included in a jacketed portion of the distribution cable 32 exiting from the zone terminal 34 through the downstream port 40.

[0048] The optical fibers 80 connecting to the splicing hardware 82 are spliced to pigtail optical fibers 86. The pigtail optical fibers 86 route from the splicing hardware 82 to branch ports 42 which extend through the enclosure wall of the zone terminal 34. The pigtail optical fibers 86 are terminated with a multi-fiber connector 76 which is received by a multi-fiber adapter 72 seated in the branch port 42 in the interior 37. Branch cable 46 may be terminated with a ruggedized multi-fiber optic connector 74. The ruggedized multi-fiber optic connector 74 is received by the multi-fiber adapter 72 external to the zone terminal 34. In this manner, the pigtail optical fibers 86 are optically connected to the optical fibers of the branch cable 46 through the multi-fiber adapter 72. The branch cables 46 may then extend to the MDU 22, commercial building 24 and branch-connected terminal 49 as shown in “Zone 1” 12 in FIG. 1. Additionally or alternatively, the zone terminal 34 may include one or more 1XN optical splitters. Further, the splice hardware 82, optical splitter, and/or other components may be cassette mounted for ease of and minimal cost installation. In this manner, for example, a cassette splitter may be mounted in the zone terminal but not connected until the zone needs to be reconfigured do to a change in subscriber take rate. At that time, the service provider can just connect the cassette splitter to provide for optical communication service to additional subscribers.

[0049] Referring now to FIG. 3, there is shown a schematic diagram of the zone terminal 34 in “Zone 2” 14 of FIG. 1. The zone terminal 34 in “Zone 2” 14 is configured differently than the zone terminal 34 in “Zone 1” 12. In the embodiment shown in FIG.

3, the distribution cable 32 enters the interior 37 of the zone terminal 34 through the upstream cable port 38. The jacket of the distribution cable 32 may be stripped off in the interior 37 such that the optical fibers 78 of the distribution cable 32 may be loose to facilitate routing within the interior 37 as necessary to configure the zone terminal 34. In FIG. 3, certain optical fibers 80 of the distribution cable 32 route to the branch ports 42. In this embodiment, the zone terminal 34 is shown as having eight branch ports 42. Four to eight optical fibers 80 terminated with a multi-fiber optic connector 76 may be routed to each branch port 42. As discussed above with respect to the pigtail optical fibers 86 shown in FIG. 2, the optical fibers 80 may be terminated with a multi-fiber connector 76 and be optically connected to the optical fibers of the branch cable 46 through the multi-fiber adapter 72. Each branch cable 46 may be terminated with a ruggedized multi-fiber connector 74 which is received by the multi-fiber adapters 72 in each branch port 42. Each branch cable 46 then extends to a respective series-connected terminal 58 as shown in "Zone 2" 14 in FIG. 1.

[0050] Referring now to FIGS. 4 and 5, there are shown schematic diagrams of the branch-connected terminal 49 and the series-connected terminal 58, respectively. FIGS. 4 and 5 will be discussed together as the branch-connected terminal 49 and the series-connected terminal 58 have similar, although not identical, configurations. The branch-connected terminal 49 and series-connected terminal 58 each has an enclosure 88 defining an interior 90. The branch cable 46 enters the branch-connected terminal 49 (FIG. 4) and the sub-branch cable 64 enters series-connected terminal 58 (FIG. 5) through network port 54 in their respective enclosures 88. The jacket of the branch cable 46 may be stripped off in the interior 90 such that the optical fibers 92 of the branch cable 46 may be loose to facilitate routing within the interior 90 as necessary to configure the branch-connected terminal 49. In FIG. 4, the optical fibers 92 of the branch cable 46 are shown routed to two branch ports 42 and four drop ports 44. Four to eight optical fibers 92 may be terminated with the multi-fiber connector 76 and routed at each branch port 42. The multi-fiber connector 76 is received by a multi-fiber adapter 72 seated in the branch ports 42. Sub-branch cables 56 may be terminated with ruggedized multi-fiber optic connectors 74 and received by the multi-fiber adapter 72. In this manner, the

optical fibers **92** may be optically connected to the optical fibers of the sub-branch cable **56** through the multi-fiber adapter **72**.

[0051] The sub-branch cable **56** may then extend to the series-connected terminal **58** (**FIG. 5**). In **FIG. 5**, the optical fibers **100** of the sub-branch cable **56** are shown routed to one branch port **42** and four drop ports **44**. Four to eight optical fibers **100** may be terminated with the multi-fiber connector **76** and routed to the branch port **42**. The multi-fiber connector **76** is received by a multi-fiber adapter **72** seated in the branch port **42**. Series cable **64** may be terminated with ruggedized multi-fiber optic connectors **74** and received by the multi-fiber adapter **72**. In this manner, the optical fibers **100** may be optically connected to the optical fibers of the series cable **64** through the multi-fiber adapter **72**.

[0052] Referring again to **FIG. 4**, the optical fiber **92** routed to the drop ports **44** in the branch-connected terminal **49** may be terminated with a single fiber connector **96**, for example an SC connector. The connector **96** may be received by an optical adapter **94** seated in the drop port **44**. A drop cable **48** may be terminated by a ruggedized single fiber connector **98**, for example, an OptiTap connector. The drop cable **48** may thereby be optically connected to the optical fiber **92** of the branch cable **46**. Similarly, with reference to **FIG. 5**, the optical fiber **100** routed to the drop ports **44** in the series-connected terminal **60** may be terminated with a single fiber connector **96**, for example an SC connector. The connector **96** may be received by an optical adapter **94** seated in the drop port **44**. A drop cable **48** may be terminated by a ruggedized single fiber connector **98**, for example, an OptiTap connector. The drop cable **48** may thereby be optically connected to the optical fiber **100** of the sub-branch cable **56**.

[0053] It should be noted that the configuration of the branch-connected terminal **49** and/or a series-connected terminal **58** may involve the seating of a multi-fiber adapter **72** in a drop port **44** in order to accept multi-fiber connectors **74** and ruggedized multi-fiber connector **76**. In such case, the manner in which the optical fibers connect at the drop port **44** will be the same as that described above with regard to the branch port **42**. Additionally, the branch-connected terminal **49** and series-connected terminal **58** may have any number and combination of branch ports **42** and drop ports **44** with any number of optical fibers routed to each, both based on the configuration of the zone.

[0054] Referring now to **FIG. 6**, there is shown a schematic diagram of an embodiment of a series-connected terminal **59** included in the configuration of “Zone N” **16** in **FIG. 1**. The series-connected terminal **59** has an enclosure **88** defining an interior **90**. In the embodiment shown in **FIG. 6**, the stub cable **70** has two optical fibers **102** and enters the series-connected terminal **59** through the network port **54** in the enclosure **88**. The jacket of the stub cable **70** may be stripped off in the interior **90** such that the optical fibers **102** of the stub cable **70** may be loose to facilitate routing within the interior **90** as necessary to configure the series-connected terminal **59**. One of the optical fibers **102** of the stub cable **70** routes to a branch port **42**. In **FIG. 6**, the optical fiber **102** routed to the branch port **42** may be terminated with a single fiber connector **96**. Since only a single optical fiber **102** is routed to the branch port **42**, the branch port may be configured in the same manner as a drop port **44**, with a single fiber optical adapter **94** seated in the branch port **42**. The connector **96** may be received by the adapter **94** in the interior **90**. The adapter **94** may receive external to the enclosure **88** a ruggedized single fiber connector **98** terminating the end of a series cable **64**. The series cable **64** may thereby be optically connected to the optical fiber **92** of the stub cable **70**. The series cable **64** may then route to a drop terminal **61** (**FIG. 8**) to provide expansion ability to “Zone N” **16** if it becomes necessary to reconfigure “Zone N” **16**.

[0055] The other optical fiber **102** of the stub cable **70** routes to a 1X4 splitter **104**. The optical signal in the optical fiber **102** is split into four optical signals each of which is carried by a pigtail optical fiber **106**. Each of the pigtail optical fibers **106** is terminated with a connector **98** and routes to respective drop ports **44**. The pigtail optical fiber **106** optically connects to the drop cable **48** through the adapter **94** seated in the drop port **44** in the same manner as described above with respect to drop ports **44**. It should be noted that the stub cable **70** may have any number of optical fibers **120**. Accordingly, more than one optical fiber **120** may route to the branch port **42**. The branch port **42** may then be configured with a multi-fiber adapter **72** to accept multi-fiber connectors **74**, **76**.

[0056] Referring now to **FIGS. 7, 8 and 9**, there are shown schematic diagrams of drop terminals **60**, **61** and **63**, respectively. Each drop terminals **60**, **61** and **63** has an enclosure **108** defining an interior **110**. The series cable **64** may have a single optical fiber or any number of optical fibers such as four to eight optical fibers. The series cable

64 enters the drop terminal **60**, **61** and **63** through the network port **54** in the enclosure **108**. The jacket of the series cable **64** may be stripped off in the interior **110** such that the optical fibers **112** of the series cable **64** may be loose to facilitate routing within the interior **110** as necessary to configure the drop terminals **60**, **61** and **63**.

[0057] **FIG. 7** illustrates the drop terminal **60** included in the configuration of “Zone 1” **12**. In **FIG. 7** the series cable **64** has eight optical fibers **112**. Each of the optical fibers **112** routes to respective drop ports **44** for connection to a drop cable **48**. The drop cables **48** may then extend to subscriber premises, such as a single family unit **20**. **FIG. 8** shows drop terminal **61** included in the configuration of “Zone 2” **14**. In **FIG. 8**, series cable **64** has one optical fiber **112**. The optical fiber **112** routes to a 1X8 splitter **114** whereupon the optical signal in the optical fiber **112** is split into eight optical signals. Each optical signal is carried by one pigtail optical fiber **116** thereby resulting in eight pigtail optical fibers **116** each of which routes to a drop port **44** for connection to a drop cable **48**. The drop cables **48** may then extend to subscriber premises, such as a single family unit **20**. **FIG. 9** shows a drop terminal **63** included in the configuration of “Zone N” **16**. Similar to the drop terminal **61** in **FIG. 8**, drop terminal **63** has a splitter. In **FIG. 9**, though, the splitter is a 1X4 splitter **118** which splits the optical signal carried by the optical cable **112** into four optical signals. Each optical signal is carried by one pigtail optical fiber **120** thereby resulting in four eight pigtail optical fibers **120** each of which routes to a drop port **44** for connection to a drop cable **48**. The drop cables **48** may then extend to subscriber premises, such as a single family unit **20**.

[0058] Although optical splitters are included in the embodiment shown in **FIGS. 6, 8 and 9** illustrating series-connected terminal **59**, drop terminal **61** and drop terminal **63**, it should be understood that the zone terminal **34**, branch-connected terminal **49**, and other series-connected and drop terminals may include one or more splitters. Additionally, the optical splitters may provide for any ratio of splitting including, without limitation 1X4, 1X6, 1X8, 1X16 and 1X32. Further, a plurality of optical splitters may be connected in a cascaded fashion with the output of one splitter connected to the input of another splitter. Also, although the splicing hardware **82** is shown in the embodiment of zone terminal **34** in **FIG. 1**, it should be understood that splicing hardware **82**, as well as any other fiber optic components, including but not limited to routing guides, slack

storage, and wave division multiplexers, may be included in branch-connected terminal **49**, series-connected terminal **58**, **59** and drop terminal **60**, **61**, **63**. Further, the optical splitters, and/or other components, may be cassette mounted for ease of and minimal cost installation. In this manner, for example, a cassette splitter may be mounted in the branch-connected and/or series connected terminals but not connected until the zone needs to be reconfigured do to a change in subscriber take rate. At that time, the service provider can just connect the cassette splitter to provide for optical communication service to additional subscribers.

[0059] Referring now to **FIGS. 10** and **11**, the zone terminal **34** is shown. The zone terminal **34** comprises an enclosure **35** having a base **122** and a cover **124** each made of a lightweight, yet rigid material, such as aluminum, plastic or thermoplastic. **FIG. 10** shows the cover **124** in a closed position, while **FIG. 11** shows the cover **124** in an opened position. The base **122** and the cover **124** together are generally “lunch pail” shaped and define an interior **37**. The cover **124** may have any shape that is suitable for housing a plurality of branch ports **42** and/or drop ports **44** located within an external wall of the enclosure **35**. As shown, the cover **124** is generally arcuate and dome-shaped and is hingedly affixed to the base **122** along the upper edge of one of the sidewalls at one or more hinge locations and secured to the base **122** at openings **126** that receive threaded screws or bolts, or other known fasteners to secure the cover **124** in the closed position. A sealing gasket (not shown) may also be disposed between the base **122** and the cover **124** to provide a seal against environmental elements such as wind-driven rain.

[0060] The embodiment of the zone terminal **34** shown in **FIGS. 10** and **11** may be installed in a below grade location, for example, within a hand-hole or vault, an aerial location, for example, on a telephone pole, or in an above ground location. The base **122** and an end wall **128** (removed from the base **122** in **FIG. 9**) define the upstream cable port **38** and downstream cable port **40** for receiving at least one distribution cable **32** through the wall of the enclosure **35**. As shown, the end wall **128** is inserted into grooves defined by the base **122** and secured in place around the distribution cable **32** (not shown in **FIGS. 10** and **11**). Fasteners (not shown), such as threaded screws or bolts, may be used to secure the end wall **128** to the base **122**. The fasteners may only be accessed

when the cover **124** is in an opened position. The base **122** and the end wall **128** may also be provided with a water-blocking gel material that provides a sealing function.

[0061] Referring specifically to **FIG. 11**, the zone terminal **34** is illustrated with the cover **124** opened to show the interior **37** of the enclosure **35** and its contents. Although not shown, the distribution cable **32** enters the zone terminal **34** through the upstream cable port **38** located within one or both end walls **128** and exits the zone terminal **34** through a downstream cable port **40** located within the same and/or opposed end wall **128**. The distribution cable **32** may be secured to one or more cable brackets positioned adjacent to the appropriate cable ports **38**, **40** and secured by the base **122** or end wall **128**. The cable bracket may define a notch along its length for securing a conventional cable tie, strap, hose clamp or other fastening mechanism around the distribution cable in a known manner. The cable bracket also aids in retaining the zone terminal **34** in place in a desired position along the length of the distribution cable **32**. A plurality of hardware mounting features **130** may be located on the interior **37** for fastening optical hardware, such as optical fiber storage trays, splice trays, splitters, routing guides, fiber organizers, etc., to the interior **37**. A slack basket (not shown) may be fastened to the hardware mounting features **130** and operable for receiving and storing slack lengths of optical fibers and/or optical fiber buffer tubes. A strain relief bracket **132** may also be secured to the interior **37** using the hardware mounting features **130**. The strain relief bracket **132** (which may also be a part of a splice tray) provides strain relief for the optical fibers entering and exiting, for example, splice hardware **82** such as a splice tray. Splice trays are used when terminated or preterminated optical fibers are spliced in the field, such as when one or more optical fibers of the distribution cable **32** are accessed in the field to create a mid-span access location and spliced to interconnect the distribution cable with one or more branch cables **46**, sub-branch cables **56**, series cables **64** and/or drop cables **48**, which hereinafter shall be referred to collectively as preconnectorized cables.

[0062] The connectors (not shown) of the connectorized optical fibers are routed within the interior **37** and connected to the branch ports **42** and/or cable ports **44** (hereinafter referred to collectively as connector ports **45**) on the inside of the enclosure **35**. Although not shown, strain relief devices may be provided for any of the optical

fibers within the interior 37 to strain relieve the optical fibers adjacent the distribution cable 32. With the cover 124 opened as shown in FIG. 11, the interior 37 is readily accessible to a field technician initially installing the connectorized optical fibers into the respective connector ports 45. The field technician may create and route additional connectorized optical fibers to unused connector ports 45, or remove or rearrange optical connections between existing connectorized optical fibers and the connector ports 45. Once the zone terminal 34 is initially installed, the field technician may also add, remove or rearrange optical connections between optical fibers of the preconnectorized cables and the respective connector ports 35 from the exterior of the zone terminal 34 without the need for entering the enclosure 35. Since the zone terminal 34 does not have to be entered to connect, disconnect or reconfigure preconnectorized cables, additional preconnectorized cables can be connected without disturbing the previously installed preconnectorized cables or the contents of the zone terminal 34.

[0063] A shelf 134 may be used to mount conventional splicing hardware 82, such as a splice tray, or other optical components, including, without limitation, a splitter, within the interior 37. The splicing hardware 82 may be used to splice terminated or preterminated optical fibers 80 of the distribution cable 32 to pigtail optical fibers 86. The splice hardware 82 may be mounted to either the top or bottom surface of the shelf 134, or as shown, within a slot provided on the shelf 134. As shown, the shelf 134 is secured by conventional fasteners to an interior wall of the base 122 at one or more locations.

[0064] The embodiment of the zone terminal 34 illustrated in FIGS. 10 and 11 comprises eight connector ports 45 for receiving up to eight connectorized optical fibers on the inside of the zone terminal 34 and up to eight pre-connectorized cables on the outside of the zone terminal 34. Although the eight connector ports 45 are shown arranged in an arcuate pattern, it is envisioned that the zone terminal 34 may be designed to accommodate any desired number of connector ports 45, for example, one, two, three, four, six, eight, etc., on one or both ends of the zone terminal 34. Further, the upstream cable port 38 and the downstream cable port 40 may be connector ports 45. Thus, it is conceivable that the zone terminal 34 may accommodate any desired number of pre-

connectorized cables. Furthermore, the dimensions and overall size of the connection closure **20** will vary depending on the number of connector ports **34** utilized.

[0065] The connector ports **45** may also include multi-fiber adapters **74** and/or single fiber adapters **94** (not shown) for aligning and maintaining the mating connectors in physical contact. The connector ports **45** further provide an environmental seal at the interface between the connectorized optical fibers of the distribution cable **32** and the pre-connectorized cables. Unused connector ports **45** may be covered and sealed with a removable cap or plug **136** until the connector port **45** is needed.

[0066] Turning now to **FIGS. 12, 13 and 14**, exemplary embodiments of optical terminals that may be used as a branched-connected terminal **49**, series-connected terminals **58, 59** and drop terminals **60, 61, 63**, respectively are shown. As shown in **FIGS. 12, 13 and 14**, the optical terminals comprise a base **142** and a cover **144** each made of a lightweight, yet rigid material, such as plastic, thermoplastic, composite or aluminum material. The base **142** and the cover **144** define an enclosure having an exterior surface **146**. The exterior surface **146** is provided with a plurality of angled or sloped surfaces **148**. One or more angled surfaces **148** may have a branch port **42** or a drop port **44**. The base **142** may have any of a variety of shapes that is suitable for housing fiber optic hardware, including but not limited to splitters and splicing hardware **82** and for routing and connecting optical fibers of the branch cable **46**, sub-branch cable **56** and/or series cable **64**. However, by way of example only, the base **142** of this embodiment is generally rectangular and is elongated in the lengthwise direction relative to the widthwise direction.

[0067] A network port **54** is disposed through the exterior surface **146**. Although the network **54** may be at any position through the exterior surface, in the embodiment shown, the network port **54** is disposed in an end wall **150** of the base **142**. The branch network port **54** is operable for receiving a cable assembly **152** comprising the branch cable **46**, sub-branch cable **56** or series cable **64** depending on whether the optical terminal is used a branched-connected terminal **49**, series-connected terminals **58, 59** and drop terminals **60, 61, 63**, respectively. The cable assembly **152** is inserted through the network port **54**. The cable assembly **152** may be any type of assembly or structure that provides for the entrance of a fiber optic cable into the optical terminal, and the sealing of

the cable as it enters the optical terminal. Additionally, the cable assembly 152 may provide strain relief to the cable as is known in the art. Alternatively, a ruggedized multi-fiber connector 74 (not shown) may be used to connect the branch cable 46, sub-branch cable 56 or series cable 64 to the optical terminal. In such case, instead of the cable assembly 152 as depicted in FIGS. 12, 13, 14, the ruggedized multi-fiber connector 74 may be connected to a multi-fiber adapter 72 seated within the network port 54. Another multi-fiber connector 76 (not shown) may be used to connect to the multi-fiber adapter 72 in the interior, thereby optically connecting the optical fibers of the branch cable 46, sub-branch cable 56 or series cable 64 to optical fibers disposed within the optical terminal.

[0068] The cover 144 is adapted to be attached to the base 142 such that the optical terminal is re-enterable to provide ready access to the interior, particularly in the field, if necessary to reconfigure the optical fibers of the branch cable 46, sub-branch cable 56 or series cable 64. The base 142 and cover 144 may be provided with a fastening mechanism such as, but not limited to, clasps, fasteners, threaded bolts or screws and inserts, or other conventional means for securing the cover 144 to the base 142 in the closed configuration. However, the cover 144 may be slidably attached to the base 142 to selectively expose portions of the interior of the base 142. Alternatively, the cover 144 may be hingedly attached to the base 142 at one or more hinge locations (not shown) to allow the cover 144 and base 142 to remain secured to one another in the opened configuration. A gasket (not shown) may be disposed between a peripheral flange provided on the base 142 and the interior of the cover 144. Alternatively, in certain locations the service provider may determine that it is not desirable that optical terminal be enterable in the field, and, therefore, may decide to fasten the base 142 to the cover 144 by welding, for example using an epoxy type of weld.

[0069] A sub-branch cable 56 or series cable 64 terminated with ruggedized multi-fiber connectors 74 may also extend from a branch connector port 42. In such a case, a multi-fiber adapter 72 may be seated in the branch port 42. Alternatively or additionally, if the sub-branch cable 56 and/or the series cable 64 has only a single optical fiber, they may be terminated with ruggedized single fiber connectors 96 may also extend from a branch port 42. In such a case, a single fiber adapter 94 may be seated in the

branch connector port **42**. Further, a single fiber drop cable **48** terminated with a ruggedized single fiber connector **96** may extend from a drop port **44**. In such a case, a single fiber adapter **94** may be seated in the drop port **42**. In the case of a multi-fiber drop cable **48**, the drop cable **48** may be terminated with a ruggedized multi-fiber connector **74**. In such a case, a multi-fiber adapter **72** may be seated in the drop port **42**. The branch cable **46**, sub-branch cable **56**, series cable **64** and drop cable **48** may be connectorized or pre-connectorized with any suitable ruggedized connector, for example, an OptiTap® or OptiTip® connector available from Corning Cable Systems LLC of Hickory, N.C.

[0070] Many other modifications and embodiments of the invention set forth herein will come to mind to one skilled in the art to which the 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 and that modifications and other embodiments are intended to be included within the scope of the appended claims. It is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

What is claimed is:

1. A fiber optic terminal, comprising:
 - an enclosure having a wall defining an interior cavity and a plurality of connector ports disposed through the wall, wherein the enclosure receives a distribution cable optically connected to a service provider's optical feeder cable;
 - at least one adapter positioned within one of the plurality of connector ports, wherein the at least one adapter has an interior end accessible from within the interior cavity and an exterior end accessible external to the enclosure, and wherein the adapter is configured to establish an optical connection between at least one optical fiber attached to a first multi-fiber optical connector inserted in the interior end, and one or more respective optical fibers in a second multi-fiber optical connector, wherein the respective one or more respective optical fibers are optically connected to one or more optical fibers of the distribution cable, and wherein the second multi-fiber optical connector is suitable for outside-plant installation, and wherein the terminal is configured to extend optical service from a service provider toward at least one subscriber premises in a zone, and wherein the fiber optic terminal is reconfigurable based on at least one of, a number of subscriber premises in the zone, a geographical relationship of the subscriber premises in the zone, and a demographic make-up of the subscriber premises in the zone.
2. The terminal of claim 1, wherein the configuring includes splicing hardware positioned in the enclosure, wherein the at least one optical fiber attached to the first multi-fiber optical connector routes to the splicing hardware and connects to a respective pigtail optical fiber.
3. The terminal of claim 1, wherein the configuring includes a 1 X N splitter, and wherein an optical signal carried by the optical fiber in the first fiber optic cable is split into N optical signals, and wherein at least one of the N optical signals is carried by the respective optical fiber in the second fiber optic cable.
4. The terminal of claim 3, wherein N equals one of 4, 8, 16 and 32.

5. The terminal of claim 3 or 4, further comprising a plurality of 1 X N splitters.
6. The terminal of claim 5 wherein the at least two of the plurality of 1 X N splitters are interconnected in a cascaded arrangement wherein an output of one of the at least two 1 X N splitters optically connects to an input of another of the at least two 1 X N splitters.
7. The terminal of claim 1, wherein the second fiber optic cable extends to a second fiber optic terminal.
8. The terminal of claim 1, wherein the second fiber optic cable is a drop cable extending to equipment at the subscriber's premises.
9. The terminal of claim 1, wherein the demographic make-up comprises at least one multiple dwelling unit.
10. The terminal of claim 1, wherein the demographic make-up comprises at least one single family dwelling.
11. The terminal of claim 1, wherein the demographic make-up comprises at least one commercial building.
12. The terminal of claim 1, wherein the terminal provides for plug and play connection.
13. A multi-zoned fiber optic network, comprising:
 - a first zone, wherein the first zone is configured to provide optical service from an optical service provider to at least one subscriber premises in the first zone, the first zone, comprising, at least one first terminal having an enclosure having a wall defining an interior cavity and a plurality of connector ports disposed through the wall, and at least one adapter positioned within one of the plurality of connector ports, wherein the at least

one adapter has an interior end accessible from within the interior cavity and an exterior end accessible external to the enclosure, and wherein the adapter is configured to establish an optical connection between at least one optical fiber in a first multi-fiber optical connector attached to the end of a first fiber optic cable and inserted in the interior end, and one or more respective optical fibers in a second multi-fiber optical connector, wherein the one or more respective optical fibers are optically connected to one or more optical fibers of a first distribution cable, and wherein the second multi-fiber optical connector is suitable for outside-plant installation, and

wherein the first zone is reconfigurable based on at least one of, a number of subscriber premises in the first zone, a geographical relationship of the subscriber premises in the first zone, and a demographic make-up of the subscriber premises in the first zone; and

a second zone, wherein the second zone is configured to provide optical service from an optical service provider to at least one subscriber premises in the second zone, the second zone, comprising, at least one second terminal having an enclosure having a wall defining an interior cavity and a plurality of connector ports disposed through the wall, and at least one adapter positioned within one of the plurality of connector ports, wherein the at least one adapter has an interior end accessible from within the interior cavity and an exterior end accessible external to the enclosure, and wherein the adapter is configured to establish an optical connection between one or more respective optical fiber in a third multi-fiber optical connector, wherein the one or more respective optical fibers are optically connected to one or more optical fibers of a second distribution cable attached to the end of a third fiber optic cable and inserted in the interior end, and one or more respective optical fibers in a fourth multi-fiber optical connector, wherein the one or more respective optical fibers are optically connected to one or more optical fibers of a second distribution cable, and wherein the fourth multi-fiber optical connector is suitable for outside-plant installation, and

wherein the second zone is reconfigurable based on at least one of, a number of subscriber premises in the second zone, a geographical relationship of the subscriber premises in the second zone, and a demographic make-up of the subscriber premises in the second zone.

14. The fiber optic network of claim 13, wherein the demographic make-up comprises at least one multiple dwelling unit.

15. The fiber optic network of claim 13, wherein the demographic make-up comprises at least one single family dwelling.

16. The fiber optic network of claim 13, wherein the demographic make-up comprises at least one commercial building.

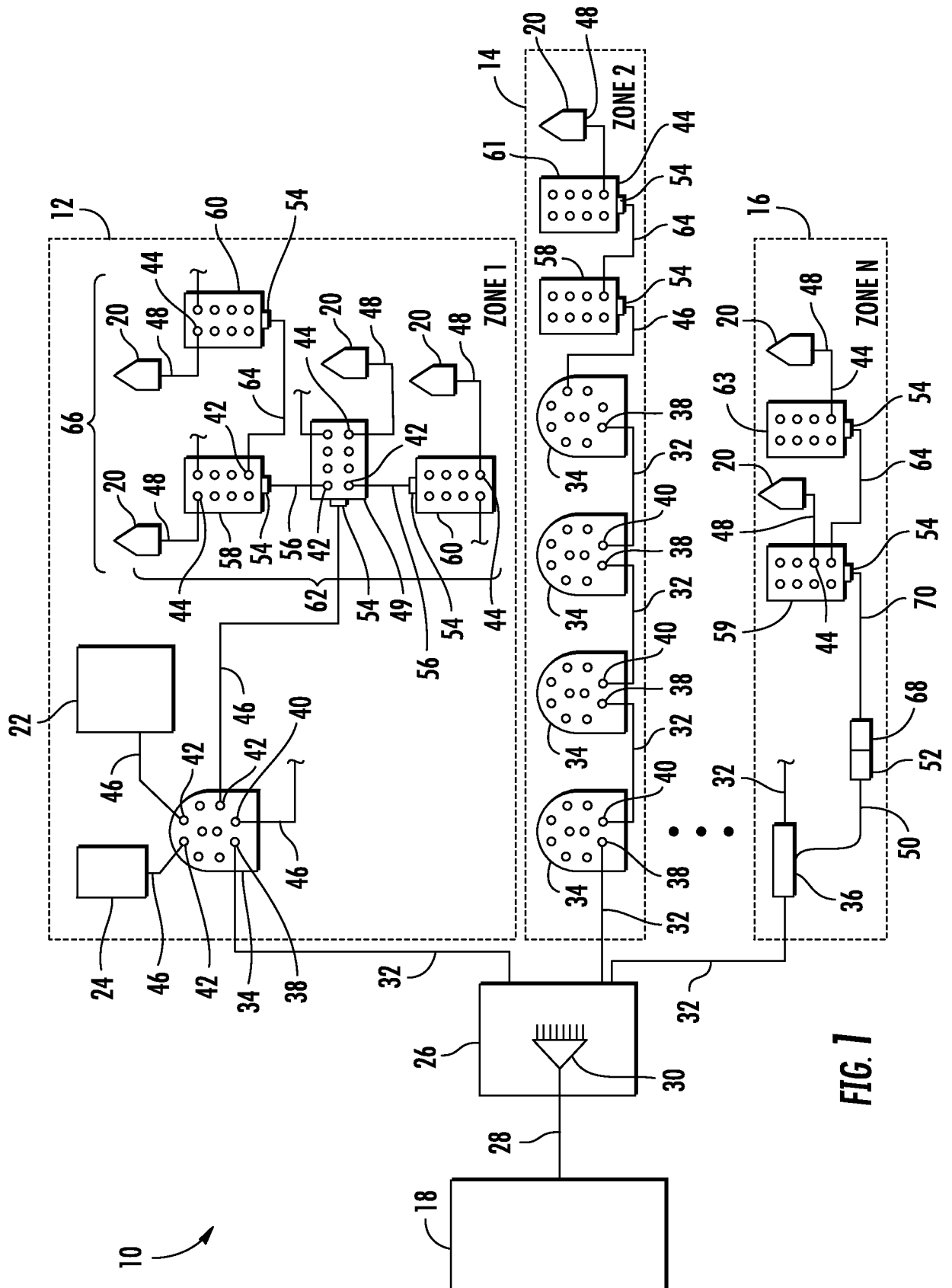
17. The fiber optic network of claim 13, wherein the first zone is reconfigured by including a plurality of first terminals.

18. The fiber optic network of claim 13 or 17, wherein the first zone is reconfigured by including a 1 X N splitter in the first terminal, wherein an optical signal carried by the optical fiber in the first fiber optic cable is split into N optical signals, and wherein at least one of the N optical signals is carried by the respective optical fiber in the second fiber optic cable.

19. The fiber optic network of claim 13, wherein the second zone is reconfigured by including a plurality of second terminals.

20. The fiber optic network of claim 13 or 19, wherein the second zone is reconfigured by including a 1 X N splitter in the second terminal, wherein an optical signal carried by the optical fiber in the third fiber optic cable is split into N optical signals, and wherein at least one of the N optical signals is carried by the respective optical fiber in the fourth fiber optic cable.

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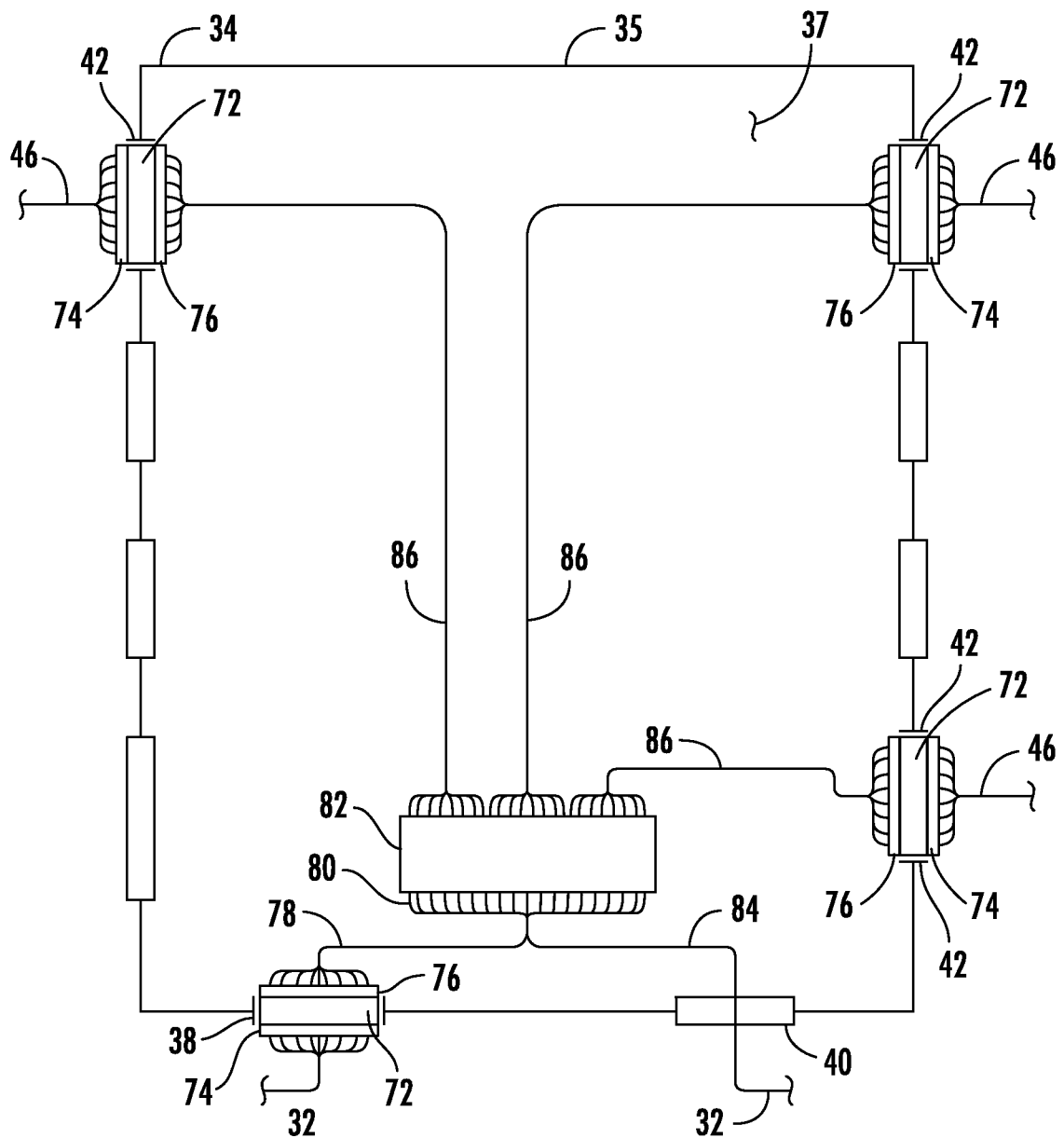
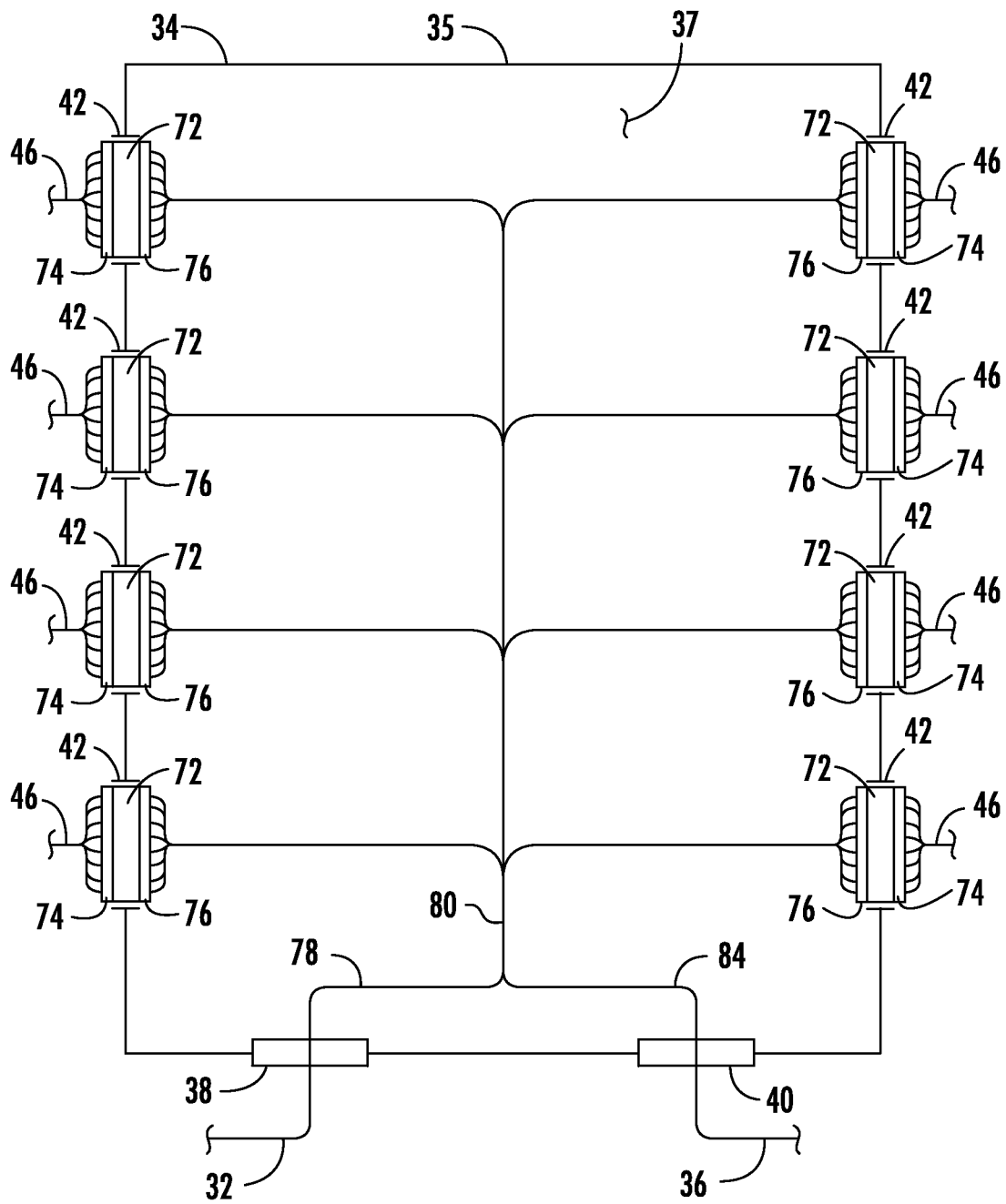


FIG. 2

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**FIG. 3**

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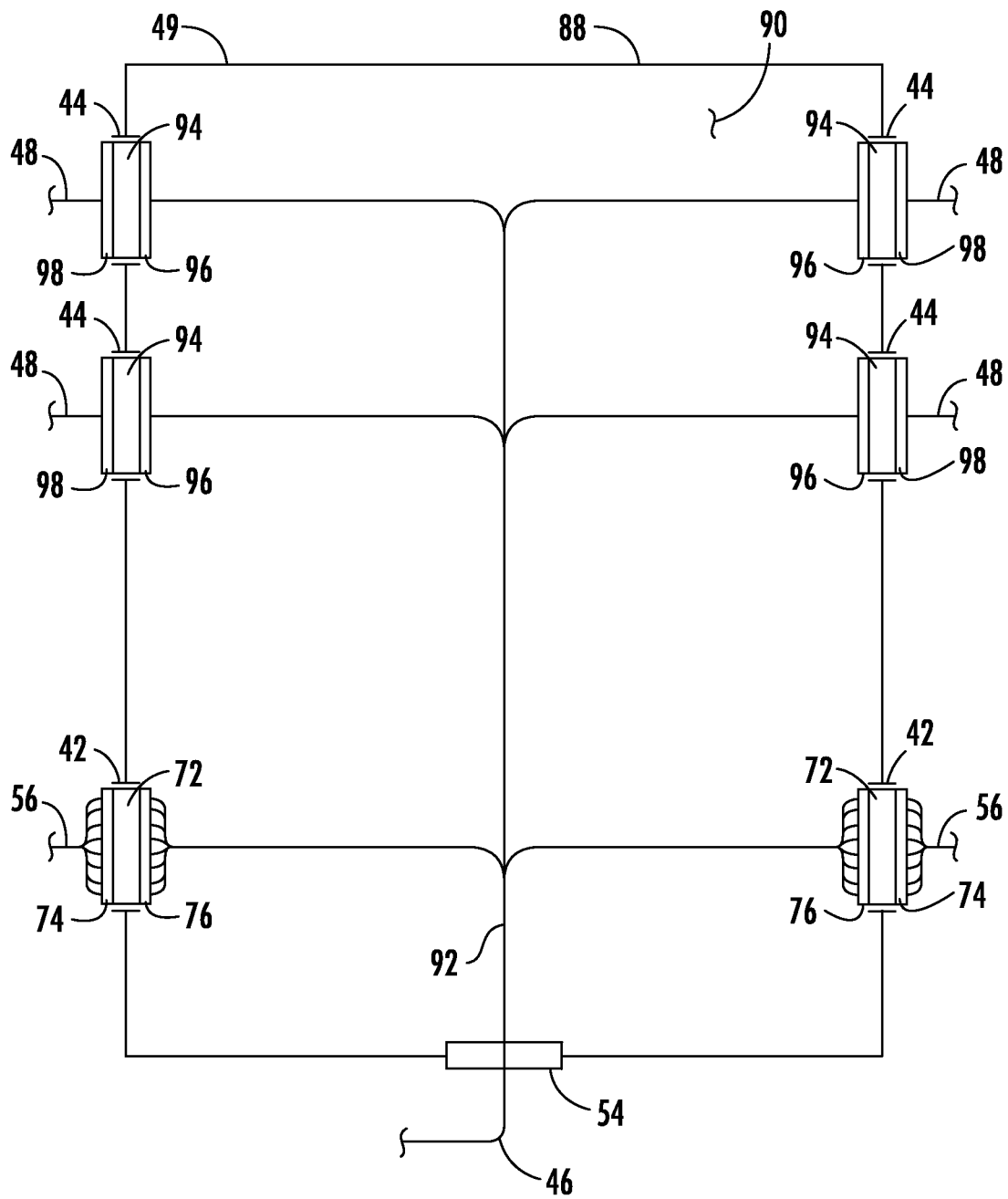


FIG. 4

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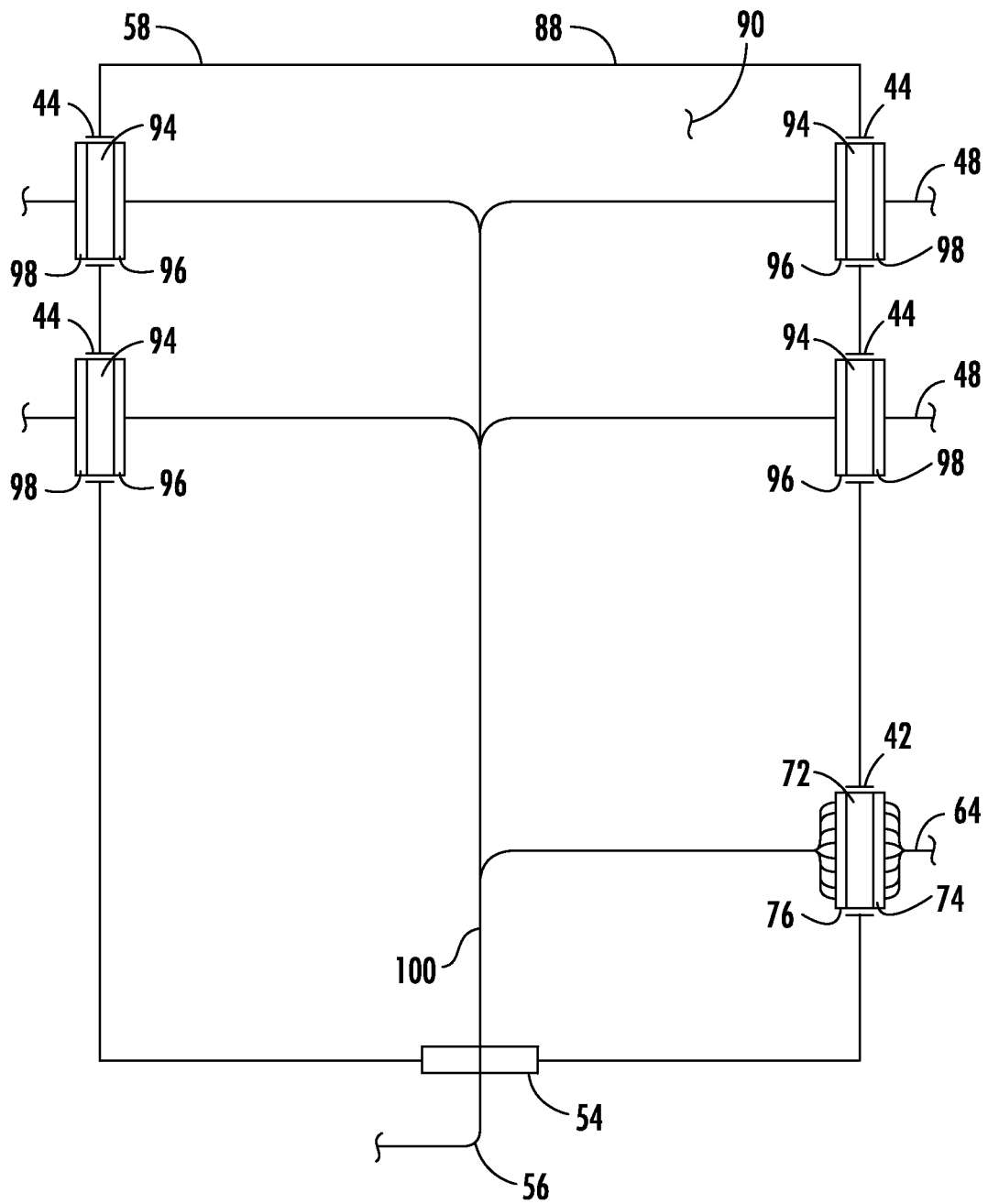
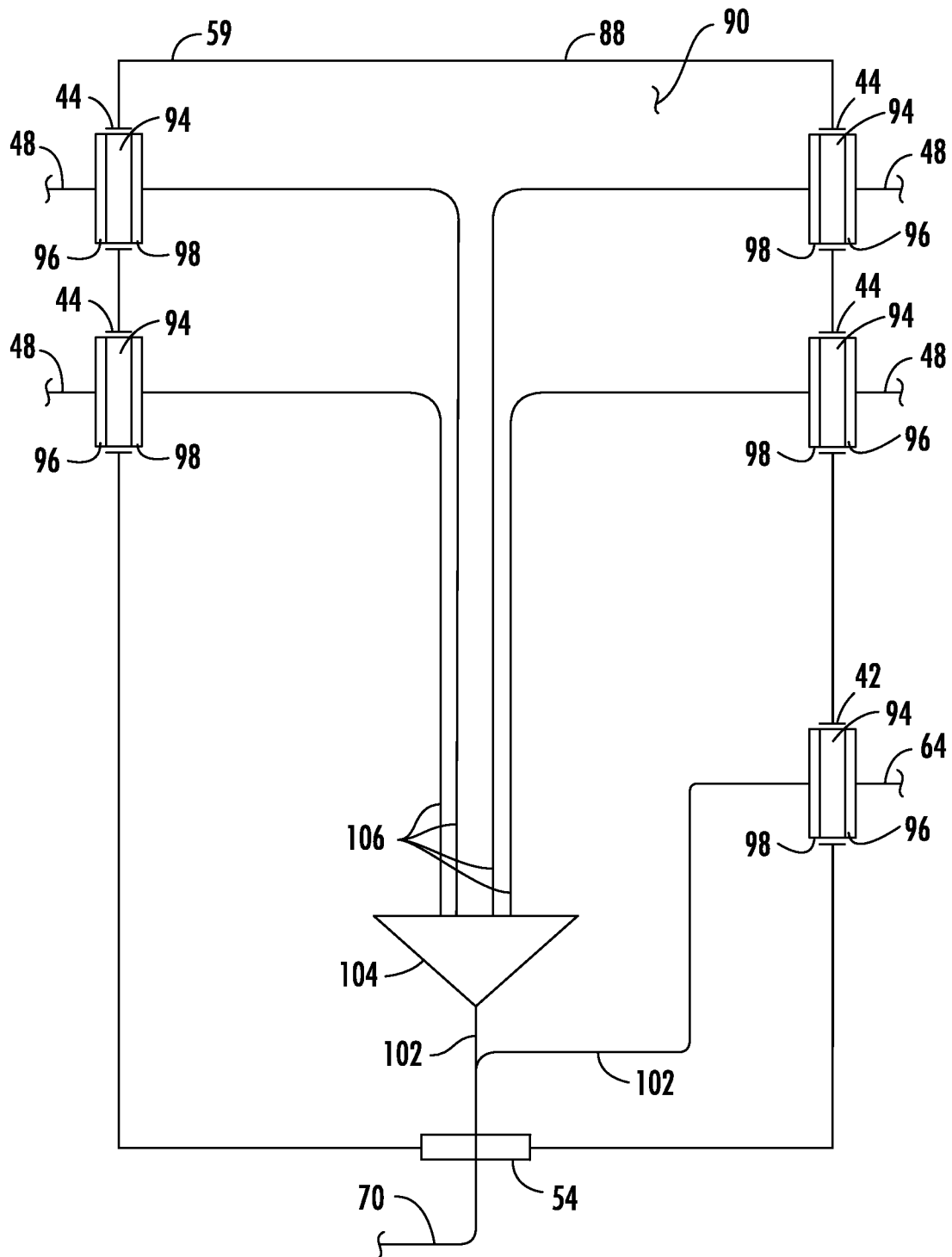
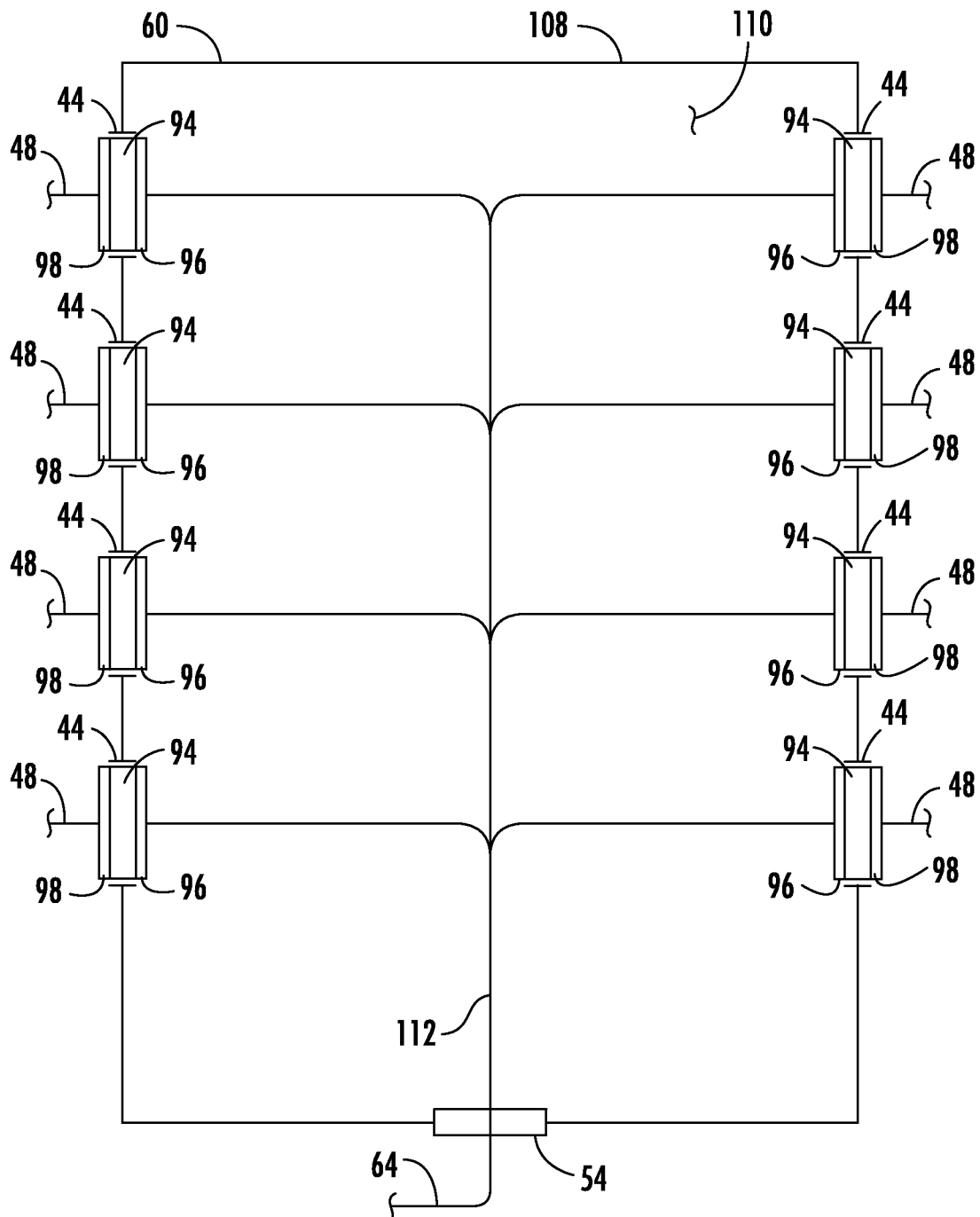


FIG. 5

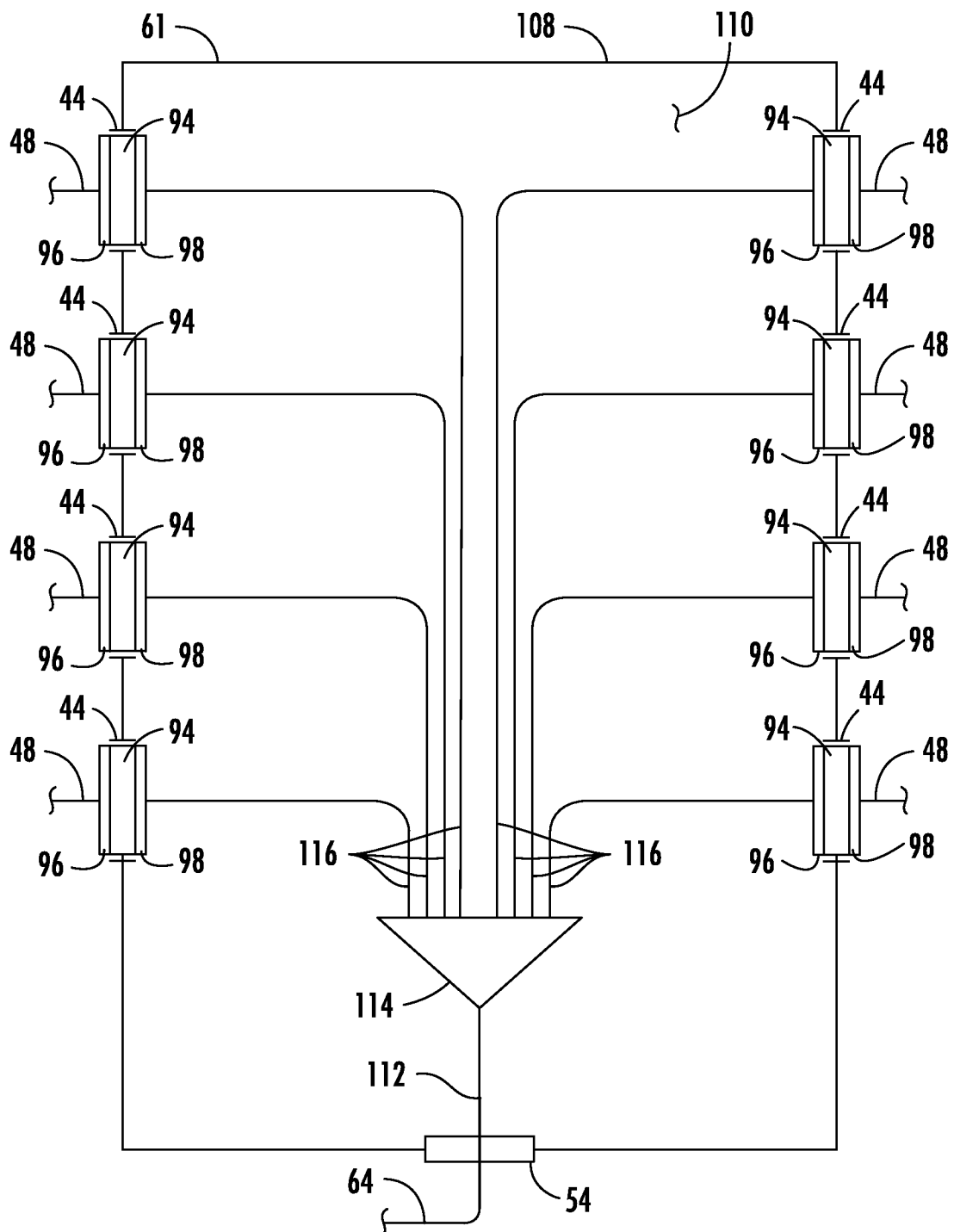
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**FIG. 6**

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**FIG. 7**

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**FIG. 8**

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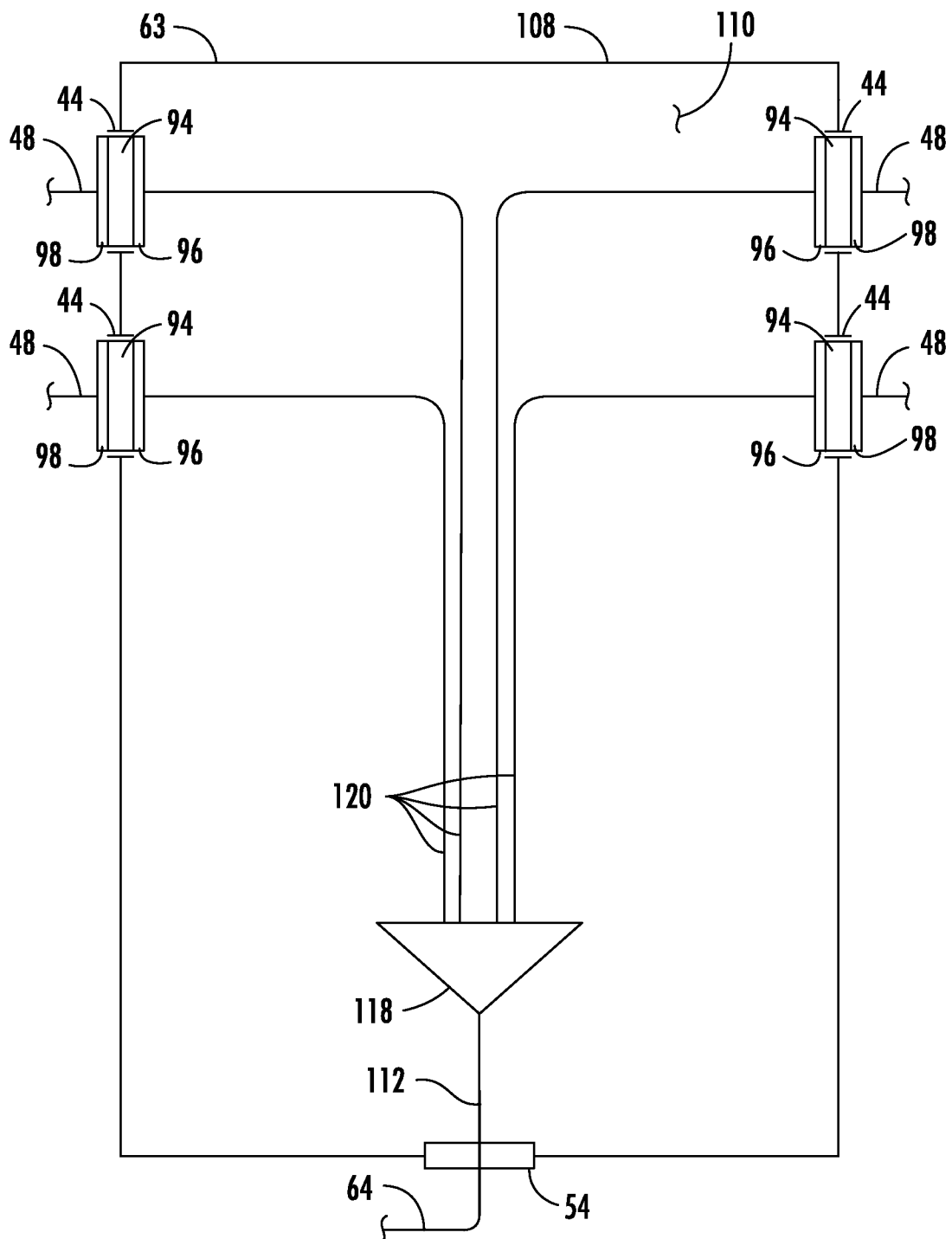


FIG. 9

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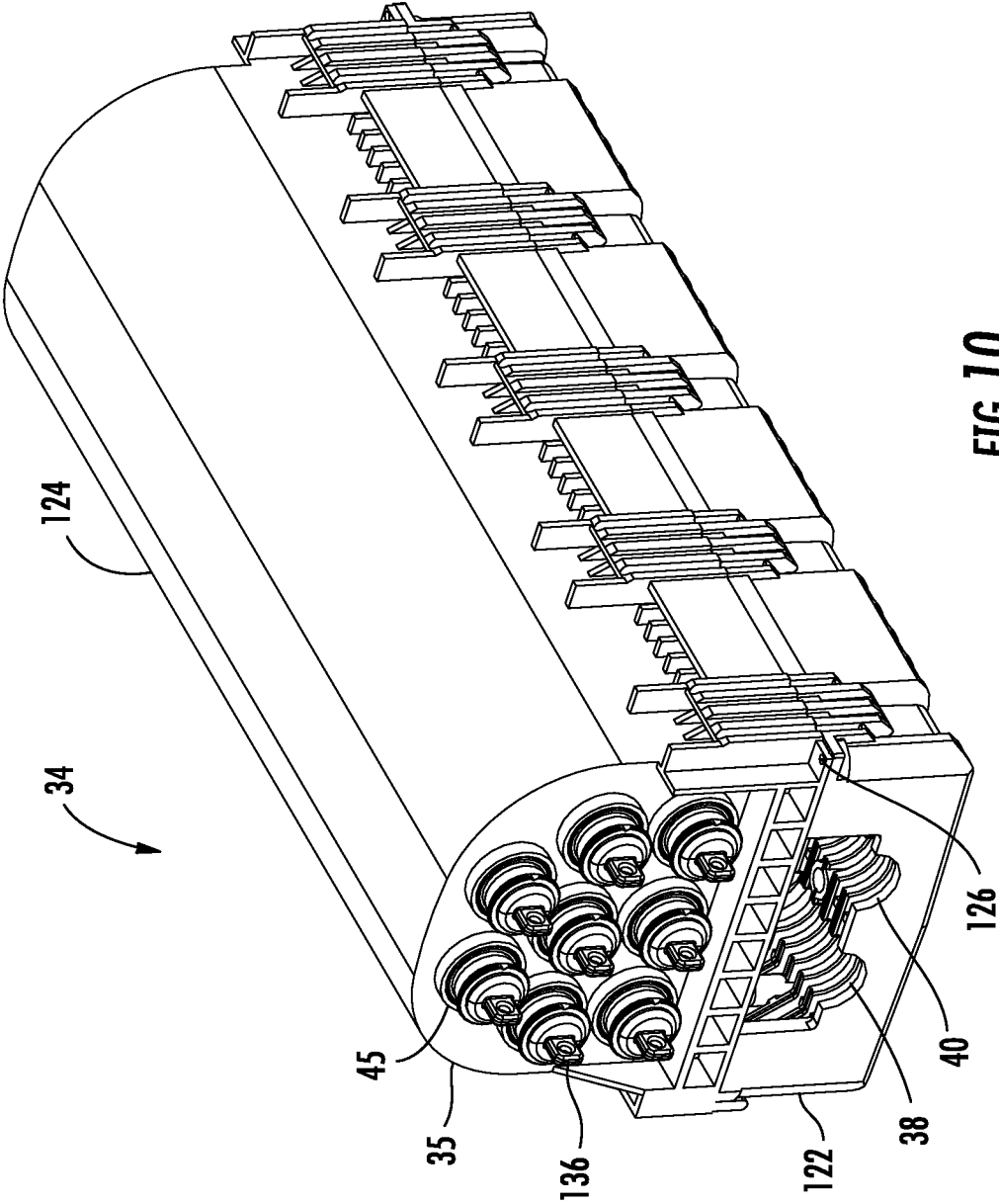


FIG. 10

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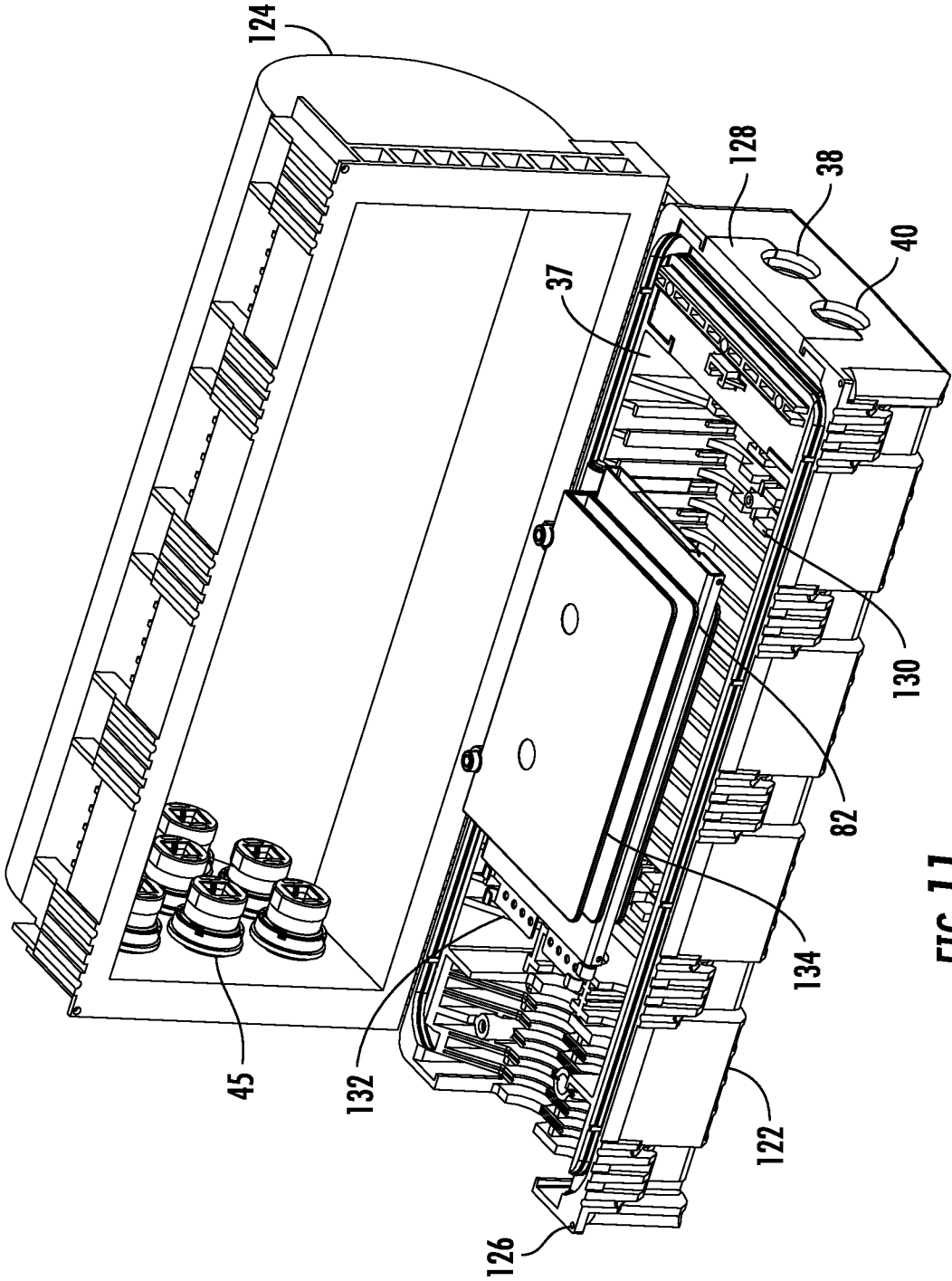


FIG. 11

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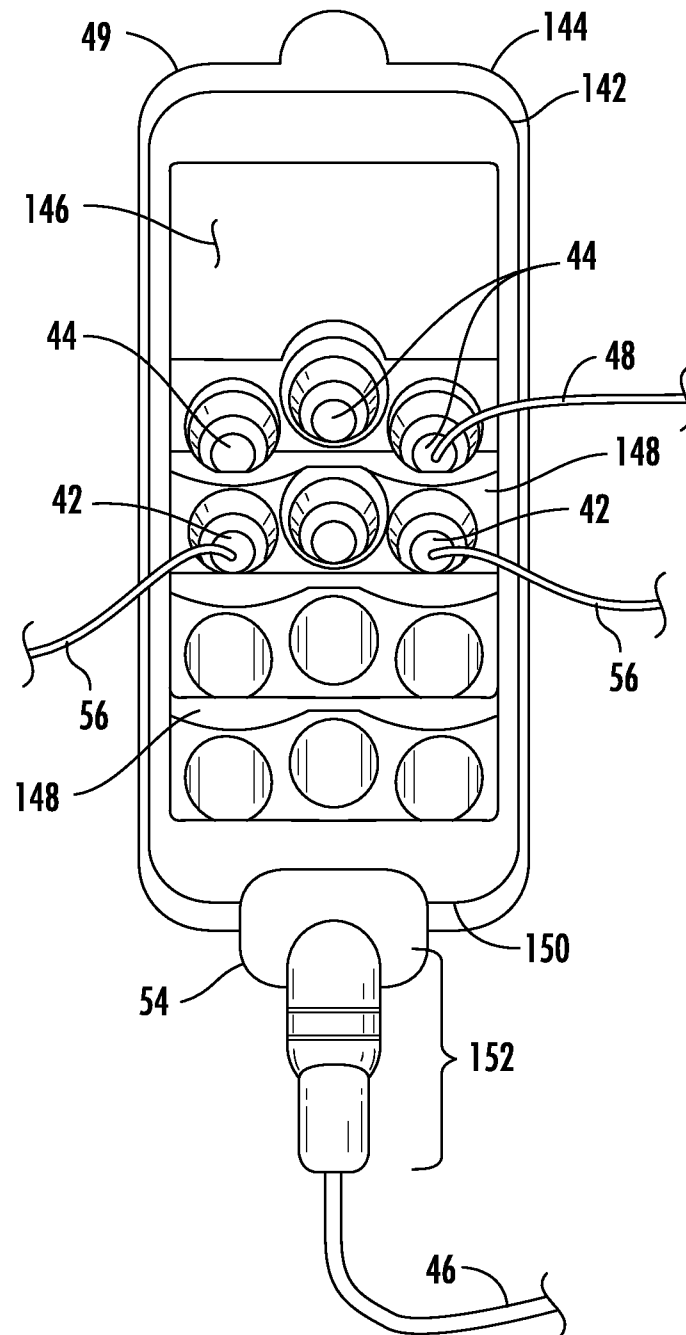


FIG. 12

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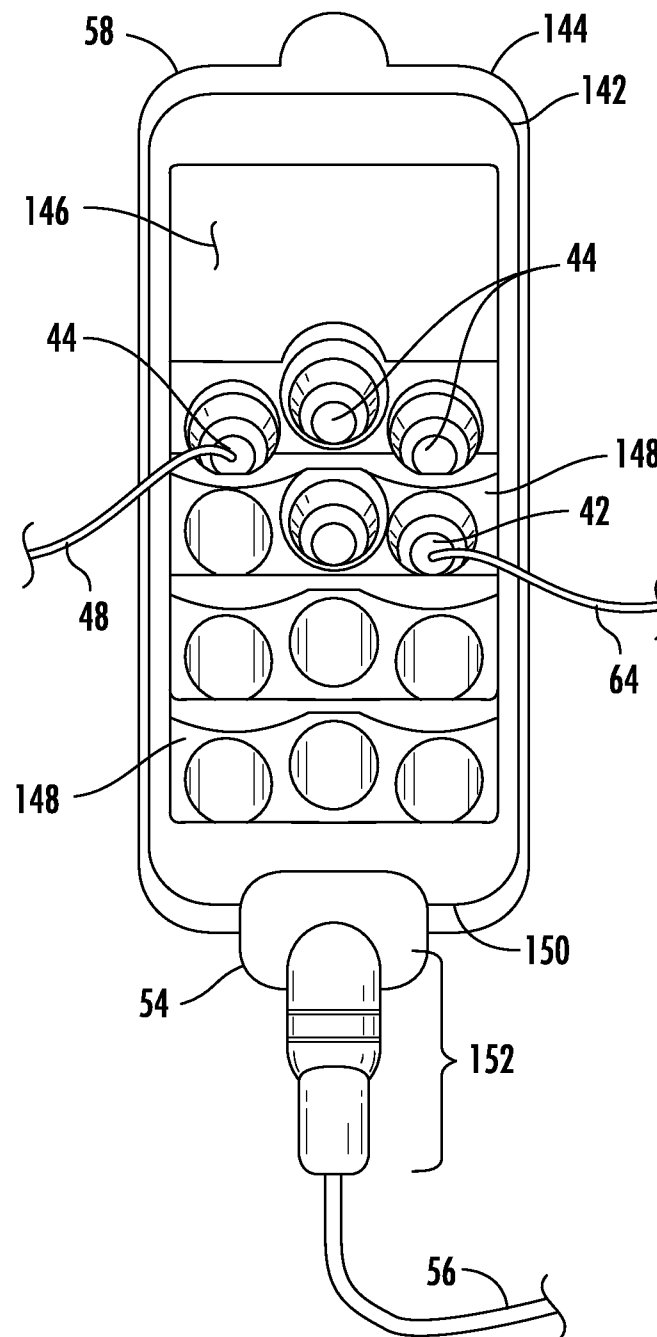


FIG. 13

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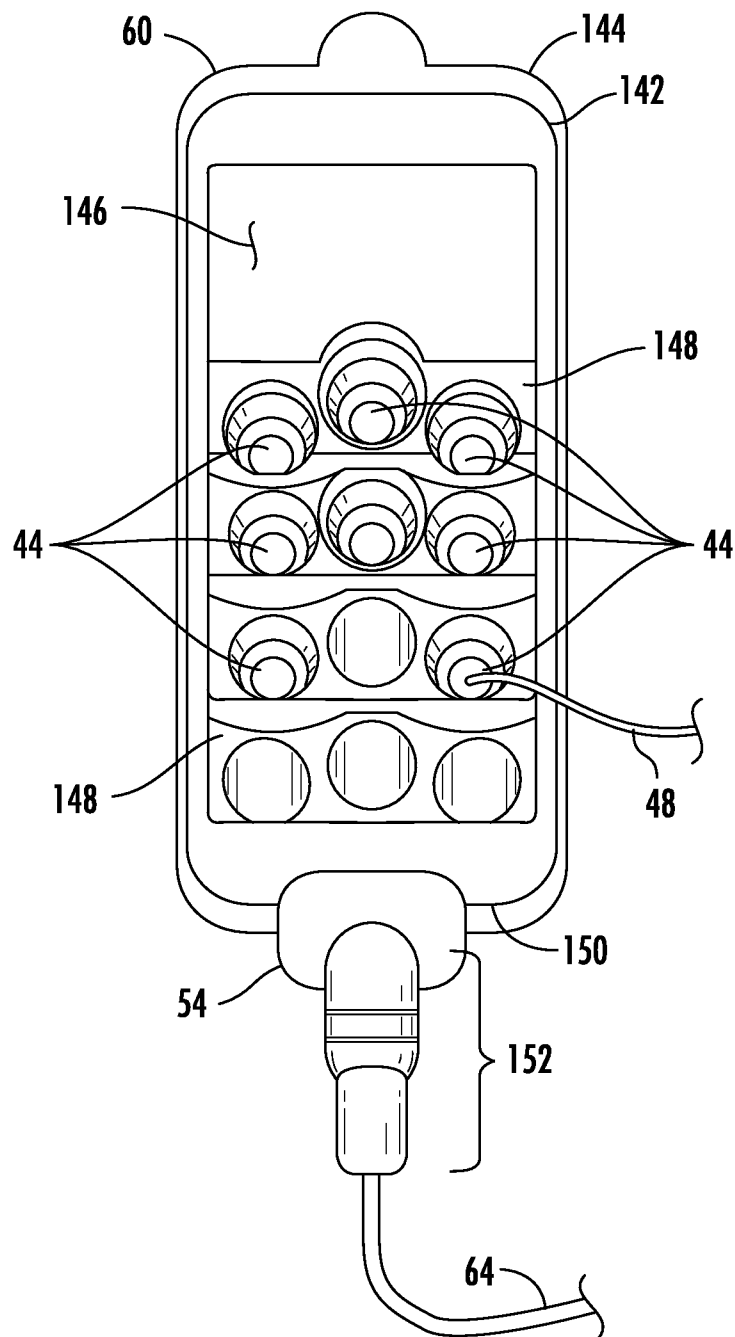


FIG. 14

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2010/023901

A. CLASSIFICATION OF SUBJECT MATTER
INV. G02B6/44 H04B10/20
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G02B H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2006/165366 A1 (FEUSTEL CLAY A [US] ET AL) 27 July 2006 (2006-07-27) abstract paragraphs [0004] - [0006], [0010], [0016] - [0025] figures 1-4 claims 10,11	1-20
X	US 2008/069511 A1 (BLACKWELL CHOIS A JR [US] ET AL BLACKWELL JR CHOIS A [US] ET AL) 20 March 2008 (2008-03-20) paragraphs [0028] - [0030], [0033], [0034], [0038], [0039], [0041], [0042] figures 1-11	1,2,13
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☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search

4 June 2010

Date of mailing of the international search report

11/06/2010

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Moroz, Alexander

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2010/023901

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

International application No

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