



(51) International Patent Classification:

H04Q 1/04 (2006.01) *H04Q 1/02* (2006.01)
H04Q 1/16 (2006.01) *H04Q 11/00* (2006.01)

(21) International Application Number:

PCT/US2016/042810

(22) International Filing Date:

18 July 2016 (18.07.2016)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

62/194,275 19 July 2015 (19.07.2015) US

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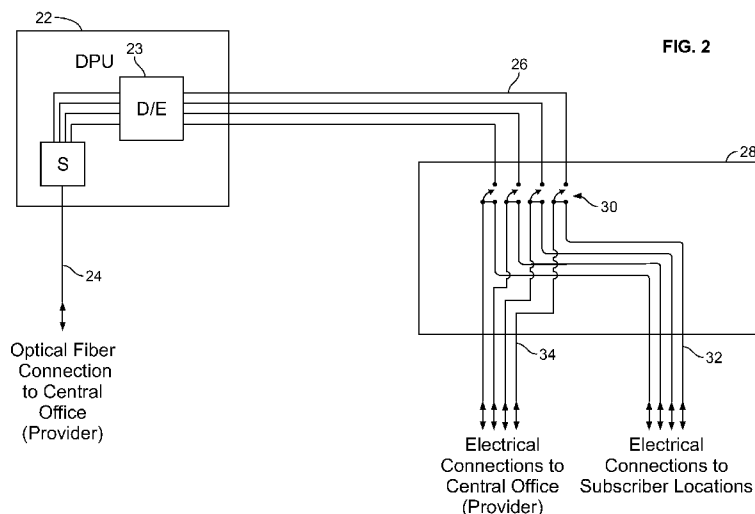
(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: SYSTEM FOR FIELD SWITCHING OF TELECOMMUNICATIONS SERVICES TO PROVIDE SERVICE UPGRADES OR OTHER SERVICE MODIFICATIONS



(57) Abstract: Aspects of the present disclosure relate to systems for readily facilitating making telecommunications service upgrades or other changes in service in the field. In certain examples, the system includes one or more environmentally sealed enclosures adapted for housing equipment (switching circuitry, optical-to-electrical conversion circuitry, etc.). The enclosures can be installed in hand-holes (i.e., pits) or other underground installation locations.

SYSTEM FOR FIELD SWITCHING OF TELECOMMUNICATIONS SERVICES TO PROVIDE SERVICE UPGRADES OR OTHER SERVICE MODIFICATIONS

CROSS-REFERENCE TO RELATED APPLICATION

5 This application is being filed on July 18, 2016 as a PCT International Patent Application and claims the benefit of U.S. Patent Application Serial No. 62/194,275, filed on July 19, 2015, the disclosure of which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

10 The present disclosure relates generally to telecommunications systems and systems for upgrading service options.

BACKGROUND

 Telecommunications systems typically employ a network of telecommunications cables capable of transmitting large volumes of data and voice signals over relatively long distances. The telecommunications cables can include fiber optic cables, electrical cables, or combinations of electrical and fiber optic cables. A typical telecommunications network also includes a plurality of telecommunications enclosures integrated throughout the network of telecommunications cables. The telecommunications enclosures are adapted to house and protect telecommunications components such as splices, termination panels, switches, optical-to-electrical converters, power splitters and wavelength division multiplexers. Telecommunications systems and technology are constantly changing constantly in the never ending pursuit of new and better services, faster signal speeds and greater bandwidth. Systems are needed for allowing telecommunications service to be efficiently and cost effectively upgraded or otherwise modified as needed.

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SUMMARY

 Aspects of the present disclosure relate to systems for readily facilitating making telecommunications service upgrades or other changes in service in the field. In

certain examples, the system includes one or more environmentally sealed enclosures adapted for housing equipment (switching circuitry, optical-to-electrical conversion circuitry, etc.). In certain examples, system upgrades can include switching from an electrical feed line coupled to a service provider's central office to a fiber optic feed line coupled to the service provider's central office.

A variety of additional inventive aspects will be set forth in the description that follows. The inventive aspects can relate to individual features and to combinations of features. It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the broad inventions and inventive concepts upon which the embodiments disclosed herein are based.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 schematically depicts a switching system in accordance with the principles of the present disclosure;

FIG. 2 schematically depicts another switching system in accordance with the principles of the present disclosure;

FIG. 3 schematically depicts a further switching system in accordance with the principles of the present disclosure;

FIG. 4 schematically depicts a further switching system in accordance with the principles of the present disclosure;

FIG. 5 shows a micro-duct arrangement that can be used with the switching system of FIG. 4;

FIG. 6 schematically depicts still another switching system in accordance with the principles of the present disclosure;

FIG. 7 is a transverse cross-sectional view of an example hybrid cable that can be used with the system of FIG. 6;

FIG. 8 schematically depicts a further switching system in accordance with the principles of the present disclosure;

FIG. 9 schematically depicts a further switching system in accordance with the principles of the present disclosure;

FIG. 10 depicts a first side of a switching and termination closure in accordance with the principles of the present disclosure;

FIG. 11 depicts an opposite second side of the switching and termination closure of FIG. 10 with a cable sealing unit removed;

FIG. 12 depicts a portion of the switching and termination closure of FIGS. 10 and 11 with all of the cable sealing units installed;

5 FIG. 13 depicts an interior of the switching and termination closure of FIGS. 10 and 11 including a potted switching unit and gel sealed termination blocks;

FIG. 14 depicts the potted switching unit of the switching and termination closure of FIG. 13;

FIG. 15 is an exploded view of the switching unit of FIG. 14;

10 FIG. 16 depicts a hinge end of another switching and termination closure in accordance with the principles of the present disclosure;

FIG. 17 depicts a latch end of the switching and termination closure of FIG. 16;

15 FIG. 18 shows the switching and termination closure of FIGS. 16 and 17 is a partially open configuration;

FIG. 19 depicts an interior of the switching and termination closure of FIG. 16;

20 FIG. 20 depicts another service upgrade system in accordance with the principles of the present disclosure, the system has a switching and termination enclosure that supports multiple subscribers and outputs multiple subscriber lines;

FIG. 21 is an exploded view of the switching and termination enclosure of the system of FIG. 20;

25 FIG. 22 depicts another service upgrade system in accordance with the principles of the present disclosure, the system has conversion enclosure coupled to a plurality of a switching and termination enclosures that each support a single subscriber (bit could also be configured to support more than one subscriber);

FIG. 23 is an exploded view of one of the switching and termination enclosures of the system of FIG. 22;

30 FIG. 24 shows another configuration for switching and termination enclosure in accordance with the principles of the present disclosure; and

FIG. 25 shows still another configuration for switching and termination enclosure in accordance with the principles of the present disclosure.

DETAILED DESCRIPTION

FIG. 1 illustrates a system 20 for upgrading telecommunications service in the field. The system a conversion enclosure 22 containing circuitry 23 for converting optical signals to electrical signals and for converting electrical signals into optical signals.

5 The optical signals are transmitted to and from the conversion enclosure 22 by an optical fiber line 24 and the electrical signals are transmitted to and from the conversion enclosure 22 by an upgrade line(s) 26 including at least one twisted wire pair. Where more than one upgrade line 26 is provided, the lines 26 can be encased within a common jacket (i.e., tube, cable jacket, sleeve) (see FIG. 3) or routed as separate twisted wire pairs (see FIG.

10 1). The system also includes a switching and termination closure 28 having a housing that contains switching circuitry 30 (see FIG. 2). The switching circuitry 30 can be connected to a subscriber line 32 including at least one twisted wire pair and also can be connected to the upgrade line 26. The switching circuitry 30 can further be connected to a service provider basic line 34 including at least one twisted wire pair. The switching circuitry 30

15 is operable in a first state where subscriber line 32 is connected to the service provider basic line 34 such that a first service (e.g., a basic service) is provided to the subscriber. The switching circuitry 30 is also operable in a second state where the subscriber line 32 is connected to the upgrade line 26 such that the subscriber is disconnected form the first service and connected to the upgrade line 26 such that a second service (e.g., an upgraded
20 service such as a faster service that may include extended fiber optic connectivity) is provided to the subscriber.

The conversion enclosure 22 and the switching and termination enclosure 28 can each include environmentally sealed protective housings. The conversion enclosure 22 can be factory assembled with the protective housing and all cable entrance
25 locations sealed. In certain examples, the protective housing of the conversion enclosure 22 is not intended or configured to be opened in the field. The switching and termination enclosure can have a protective housing designed to be re-enterable in the field. Example configurations for the conversion closure 22 are disclosed by U.S Provisional Patent Application Nos. 61/135,478; 62/155,944; 62/186,915; and 62/057,540, which are all
30 hereby incorporated by reference in their entirety. Example switching circuit and power routing configurations for the system 20 are disclosed by U.S Provisional Patent Application No. 62/194,140 which is hereby incorporated by reference in its entirety. Examples of ruggedized and sealed connectors and adapters that can be incorporated on

stub cables of the closures or onto the housings of the closures or elsewhere in the system are disclosed by U.S. Patent No. 7,744,288; U.S. Patent No. 7,686,519 and U.S. Patent Application Serial No. 14/360,383 which are all hereby incorporated by reference in their entireties.

5 In certain examples, the conversion enclosure 22 can include: 1) a fiber optic stub 36 (see FIG. 1) having a ruggedized single or multi-fiber connection port or connector 37 for connecting to the optical fiber line 24; or 2) a ruggedized fiber optic adapter (not shown) mounted to the conversion enclosure for receiving a ruggedized connector of the optical fiber line 24; or 3) a fiber optic stub 38 (see FIGS 5 and 8)
10 terminated by a non-ruggedized single or multi-fiber connector 40; or 4) a non-connectorized stub 42 (see FIG. 9) that is spliced to the optical fiber line 24; or 5) an optical fiber 44 (see FIGS. 4 and 6) that is routed between the conversion enclosure 22 and the switching and termination closure 28. The optical fiber 44 can be adapted for connection to the optical fiber line 24 at the switching and termination enclosure 28 can be
15 factory sealed relative to the conversion closure 22 so as to be part of a factory integrated stub assembly that is routed from the conversion closure 22 to the switching and termination closure 28.

 In certain examples, the optical fiber signals pass through the switching and termination closure 28 before being routed to the conversion closure 22 (e.g., see FIGS. 4
20 and 6). In certain examples, the upgrade line(s) 28 and the optical fiber 44 are routed between the conversion closure 22 and the switching and termination closure 28 by a hybrid fiber optic/electrical cable 50 (see FIGS. 6 and 7). In other examples, separate cables route the optical fiber 44 and the upgrade line(s) 28 between the closures 22, 28.

 The upgrade line(s) can carry electrical power from the switching and
25 termination closure 28 to the conversion closure 22 for use in powering the optical-to-electrical circuitry 23.

 In certain examples, the switching and termination enclosure 28 includes:
1) a fiber optic stub having a ruggedized single or multi-fiber connection port or connector for connecting to the optical fiber line 24 (not shown); or 2) a ruggedized fiber optic
30 adapter 52 mounted to the switching and termination enclosure for receiving a ruggedized connector 55 of the optical fiber line 24 and the non-ruggedized connector 40 of the optical fiber stub 38; or 3) a fiber optic stub terminated by a non-ruggedized single or

multi-fiber connector (not shown); or 4) a non-connectorized stub that is spliced to the optical fiber line (not shown).

In certain examples, the switching and termination closure 28 and the conversion enclosure 22 are positioned together within a further environmentally sealed housing 60.

Referring to FIGS. 10-15, in certain examples, the switching and termination closure 28 includes an environmentally sealed outer housing 70 that is re-enterable, a switching unit 71 positioned within the outer housing 70, and gel sealed termination blocks 72 positioned within the outer housing 70. The switching unit 71 can include a switching unit housing 74 containing a circuit board 76 sealed and secured within the switching unit housing 74 by potting. The switching unit 71 can also include the switching circuitry 30 supported on the circuit board 76. The switching circuitry 30 can include switches operable in first and second switch states. The switching unit 71 also can include first, second and third pluralities of twisted pair wire leads 77, 78 and 79 coupled to the circuit board at first ends and having second ends that are positioned outside the switching unit housing on stubs/pigtails formed by the twisted pair wire leads. The switches connect the first plurality of twisted pair wire leads 77 to the second plurality of twisted pair wire leads 78 when in the first switch states. The third plurality of twisted pair wire leads 79 are disconnected from the first plurality of twisted pair wire leads 77 when the switches are in the first switch states. The switches connect the first plurality of twisted pair wire leads 77 to the third plurality of twisted pair wire leads 79 when in the second switch states. The second plurality of twisted pair wire leads 78 being disconnected from the first plurality of twisted pair wire leads 77 when the switches are in the second switch states. The gel sealed termination blocks 72 are provided for connecting the second ends of the first, second and third plurality of twisted pair wire leads 77-79 to other twisted pair wires. For example, the first leads 77 can connect to the subscriber lines 32, the second leads 78 can connect to the service provider lines 34 and the third leads 79 can connect to the upgrade lines 26.

The sealed outer housing 70 can include first and second housing pieces 70a, 70b that enclose an interior of the sealed outer housing 70. The first and second 70a, 70b housing pieces can be movable relative to one another between open and closed positions. A perimeter seal can be defined between the first and second housing pieces 70a, 70b when the sealed outer housing 70 is in the closed position. The sealed outer

housing 70 can include at least one sealed port 80 for allowing at least one cable to be routed into to the sealed outer housing with a cable seal being formed between the cable and the outer housing. In certain examples, ports 80 can be provided for each of the lines 32, 34 and 26. The housing piece can be connected by fasteners, clamps, latches or other structures.

FIGS. 16-19 show an alternative housing 170 for the switching and termination closure 28. The housing 170 contains the switching unit 71 and the termination blocks 72. The housing 170 includes first and second housing pieces are connected by a hinge 171. Cable pass through seals for the lines 32, 34 and 26 are provided at the hinge 171. Cable sealing can be performed as disclosed by U.S. Patent No. 7,603,018 which is hereby incorporated by reference.

FIGS. 20 and 21 show a modified system where the switching and termination closure 28 has a dome-style housing 270 where all of the lines 32, 34, 36 are routed through a single gel block 272 mounted at one end of the dome. FIGS. 22 and 23 show a modified system where the conversion closure 22 is connected to a plurality of different switching and termination closures 28 each having a dome-style housing 270. In certain examples, each closure 28 corresponds to a single subscriber location.

FIGS. 24 and 25 show alternative housings 370, 470 for the switching and termination closure 28. Cable ports of the housings can be sealed by gel blocks actuated by threaded actuators that compress the gel of the gel blocks to provide sealing.

From the foregoing detailed description, it will be evident that modifications and variations can be made without departing from the spirit and scope of the disclosure.

WHAT IS CLAIMED IS:

1. A switching and termination closure comprising:
an environmentally sealed outer housing that is re-enterable;
a switching unit positioned within the outer housing, the switching unit including a switching unit housing containing a circuit board sealed and secured within the switching unit housing by potting, the switching unit also including switching circuitry supported on the circuit board, the switching circuitry including switches operable in first and second positions, the switching unit also including first, second and third pluralities of twisted pair wire leads coupled to the circuit board at first ends and having second ends that are positioned outside the switching unit housing, the switches connecting the first plurality of twisted pair wire leads to the second plurality of twisted pair wire leads when in the first positions, the third plurality of twisted pair wire leads being disconnected from the first plurality of twisted pair wire leads when the switches are in the first positions, the switches connecting the first plurality of twisted pair wire leads to the third plurality of twisted pair wire leads when in the second positions, the second plurality of twisted pair wire leads being disconnected from the first plurality of twisted pair wire leads when the switches are in the second positions;
gel sealed termination blocks positioned within the outer housing for connecting the second ends of the first, second and third plurality of twisted pair wire leads to other twisted pair wires.
2. The switching and termination closure of claim 1, wherein the sealed outer housing includes first and second housing pieces that enclose an interior of the sealed outer housing, the first and second housing pieces being movable relative to one another between open and closed positions, and wherein a perimeter seal is defined between the first and second housing pieces when the sealed outer housing is in the closed position.
3. The switching and termination closure of claim 2, wherein the sealed outer housing includes at least one sealed port for allowing at least one cable to be routed into to the sealed outer housing with a cable seal being formed between the cable and the outer housing.

4. The switching and termination closure of claim 3, wherein the first and second housing pieces are connected by a hinge, and wherein the cable seal is positioned adjacent the hinge.

5. The switching and termination closure of claim 1, wherein the first plurality of twisted pair wire leads are connected by the gel sealed termination blocks to subscriber twisted pair wires routed to subscriber locations, wherein the second plurality of twisted pair wire leads are connected by the gel sealed termination blocks to provider twisted pair wires routed to a service provider location, and wherein the third plurality of twisted pair wire leads are connected by the gel sealed termination blocks to upgrade twisted pair wires routed to a separate signal conversion enclosure containing optical-to-electrical conversion circuitry.

6. The switching and termination closure of claim 5, wherein the optical-to-electrical conversion circuitry of the signal conversion enclosure receives optical signals from a service provider location and converts the optical signals to electrical signals, and wherein the electrical signals are transmitted through the upgrade twisted pair wires to the gel sealed termination blocks.

7. The switching and termination closure of claim 6, wherein the optical-to-electrical conversion circuitry of the signal conversion enclosure receives electrical signals from the upgrade twisted pair wires and converts the electrical signals to optical signals directed back the service provider location.

8. A switching unit comprising:

a switching unit housing containing a circuit board sealed and secured within the switching unit housing by potting, the switching unit also including switching circuitry supported on the circuit board, the switching circuitry including at least one switch device operable in first and second switching state, the switching unit also including first, second and third twisted pair wire leads coupled to the circuit board at first ends and having second ends that are positioned outside the switching unit housing at the end of pigtails formed by the twisted pair wire leads, the switch device connecting the first twisted pair wire leads to the second twisted pair wire leads when in the first switching state, the third

twisted pair wire leads being disconnected from the first twisted pair wire leads when the switching device is in the first switching state, the switching device connecting the first twisted pair wire leads to the third twisted pair wire leads when in the second switching state, the second twisted pair wire leads being disconnected from the first twisted pair wire leads when the switching device is in the second switching state.

9. A system for upgrading telecommunications service in the field, the system comprising:

a conversion enclosure containing circuitry for converting optical signals to electrical signals and for converting electrical signals into optical signals, the optical signals being transmitted to and from the conversion enclosure by an optical fiber line and the electrical signals being transmitted to and from the conversion enclosure by an upgrade line including at least one twisted wire pair; and

a switching and termination closure housing containing switching circuitry, the switching circuitry being connected to a subscriber line including at least one twisted wire pair, the switching circuitry being connected to the upgrade line and the switching circuitry being connected to a service provider basic line including at least one twisted wire pair, the switching circuitry being operable in a first state where subscriber line is connected to the service provider basic line and being operable in a second state where the subscriber line is connected to the upgrade line.

10. The system of claim 9, wherein the conversion enclosure and the switching and termination enclosure are environmentally sealed.

11. The system of claim 10, wherein the conversion enclosure is factory assembled and sealed and is not intended or configured to be opened in the field.

12. The system of claim 11, wherein the conversion enclosure includes: 1) a fiber optic stub having a ruggedized single or multi-fiber connection port or connector for connecting to the optical fiber line; or 2) a ruggedized fiber optic adapter mounted to the conversion enclosure for receiving a ruggedized connector of the optical fiber line; or 3) a fiber optic stub terminated by a non-ruggedized single or multi-fiber connector; or 4) a non-connectorized stub that is spliced to the optical fiber line; or 5) an optical fiber that is

routed between the conversion enclosure and the switching and termination closure, the optical fiber being adapted for connection to the optical fiber line at the switching and termination enclosure.

13. The system of claim 9, wherein the optical fiber signals pass through the switching and termination closure housing before being routed to the conversion enclosure.

14. The system of claim 13, wherein the upgrade line and the fiber optic line are routed between the conversion enclosure and the switching and termination enclosure by a hybrid fiber optic/electrical cable.

15. The system of claim 14, wherein the upgrade line carries electrical power from the switching and termination enclosure to the conversion enclosure for use in powering the optical-to-electrical circuitry.

16. The system of claim 13, wherein the switching and termination enclosure includes:
1) a fiber optic stub having a ruggedized single or multi-fiber connection port or connector for connecting to the optical fiber line; or 2) a ruggedized fiber optic adapter mounted to the switching and termination enclosure for receiving a ruggedized connector of the optical fiber line; or 3) a fiber optic stub terminated by a non-ruggedized single or multi-fiber connector; or 4) a non-connectorized stub that is spliced to the optical fiber line.

17. The system of any of claims 9-16, wherein the switching and termination enclosure and the conversion enclosure are positioned together within a further environmentally sealed housing.

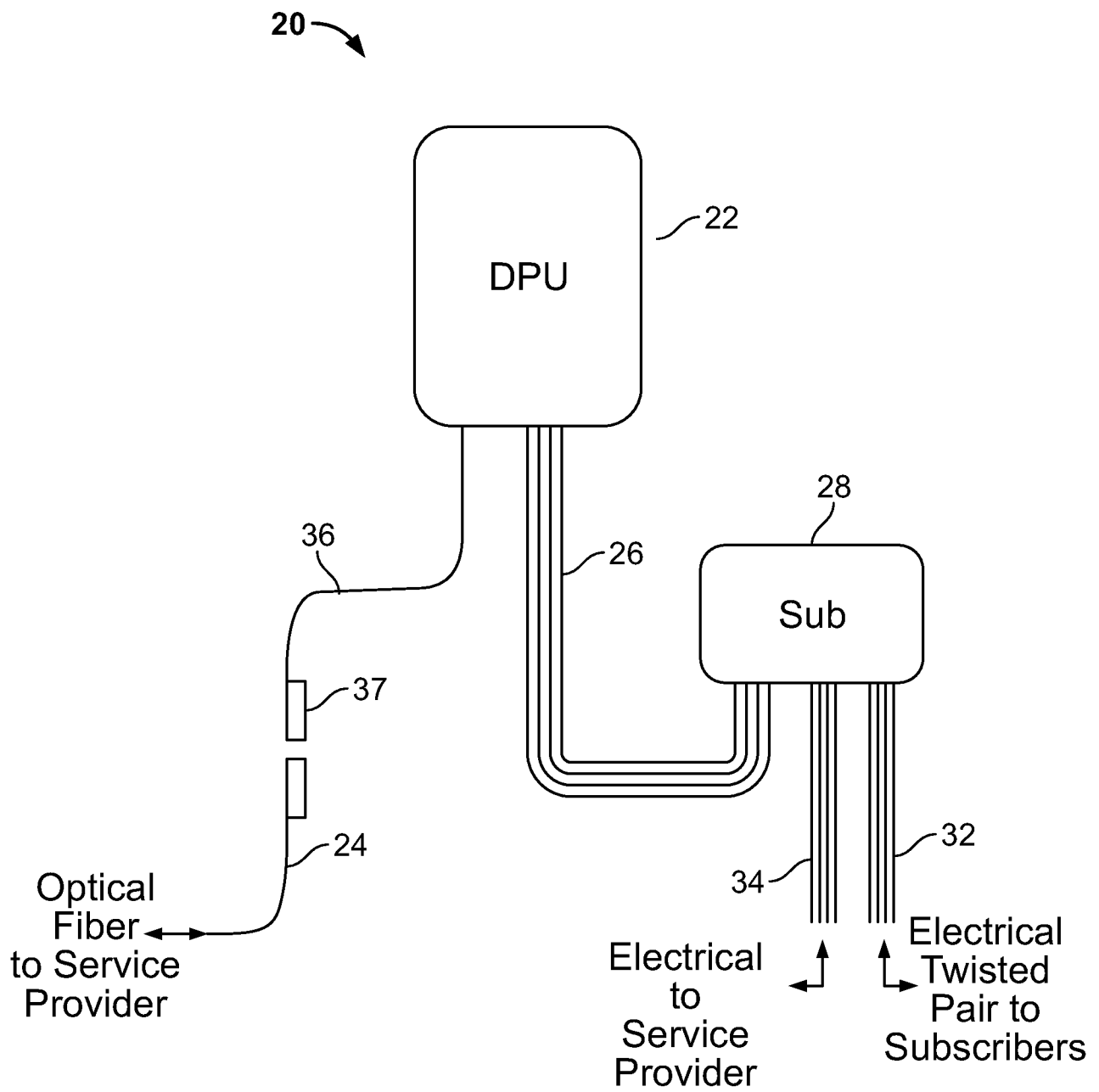


FIG. 1

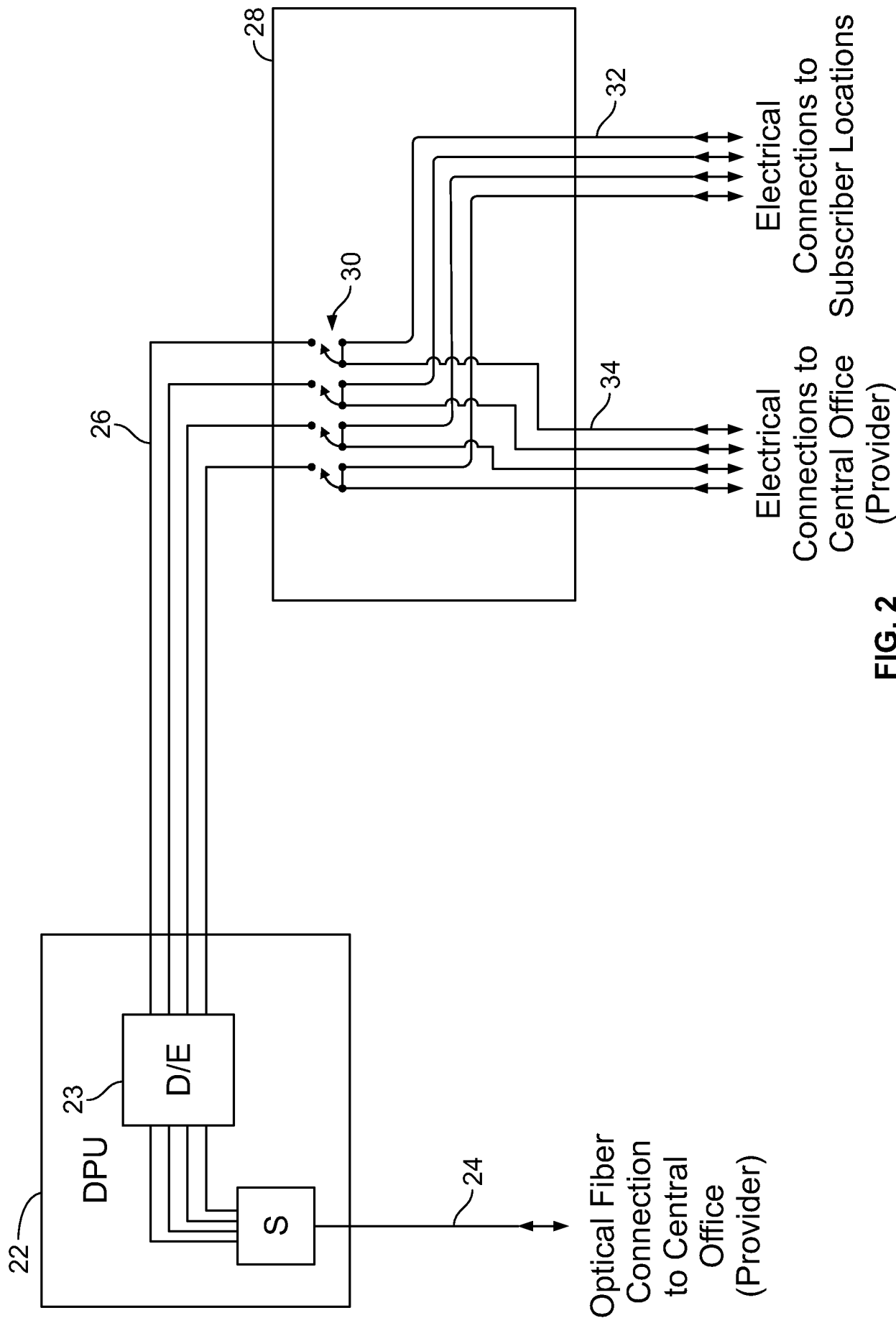


FIG. 2

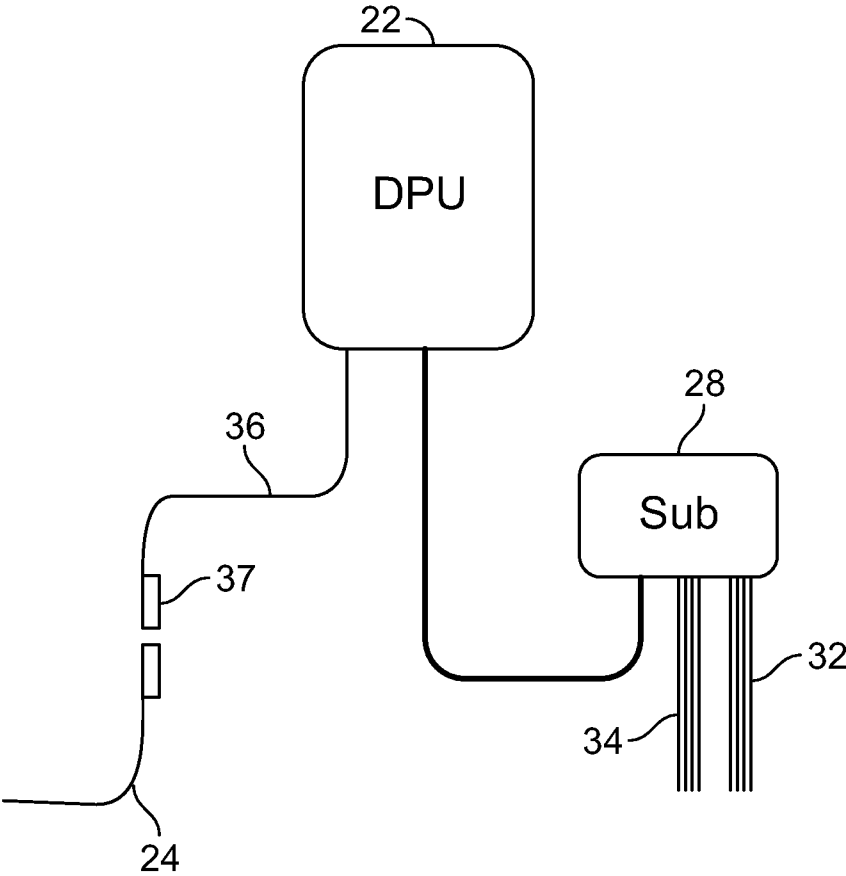


FIG. 3

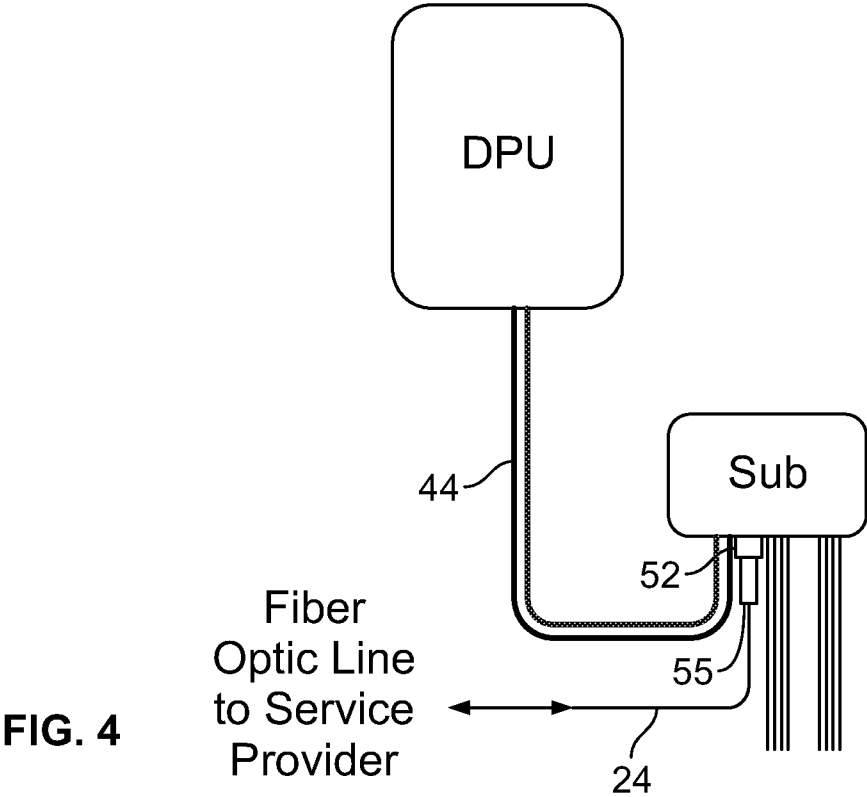


FIG. 4

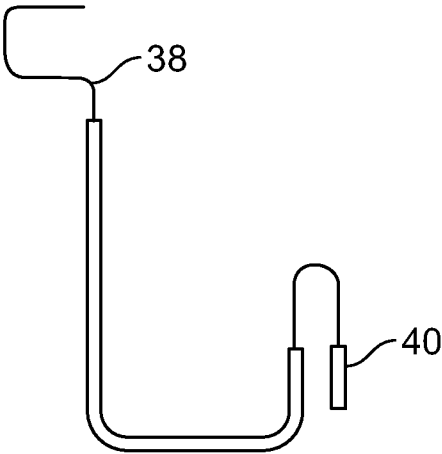


FIG. 5

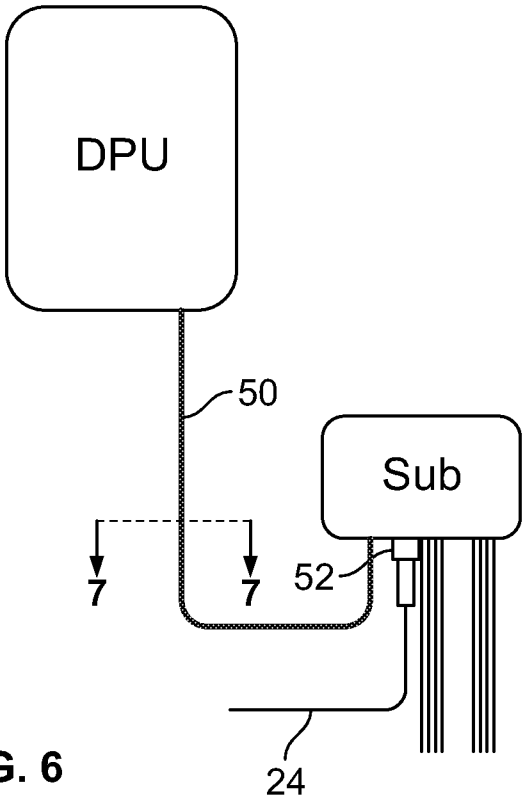


FIG. 6

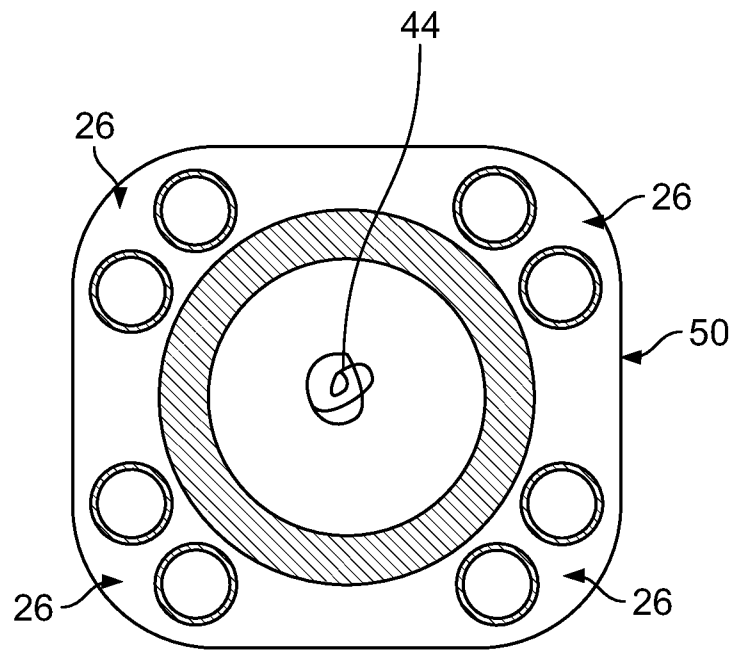


FIG. 7

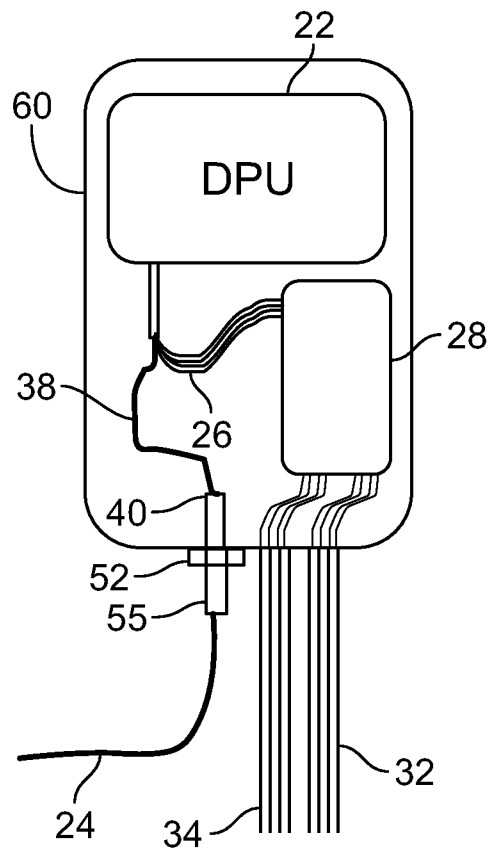
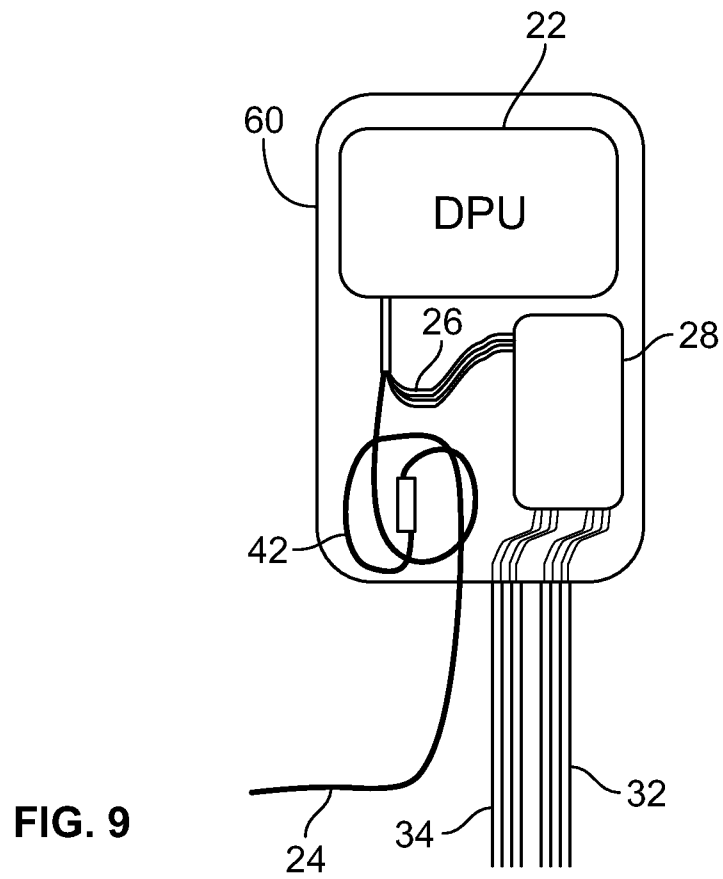
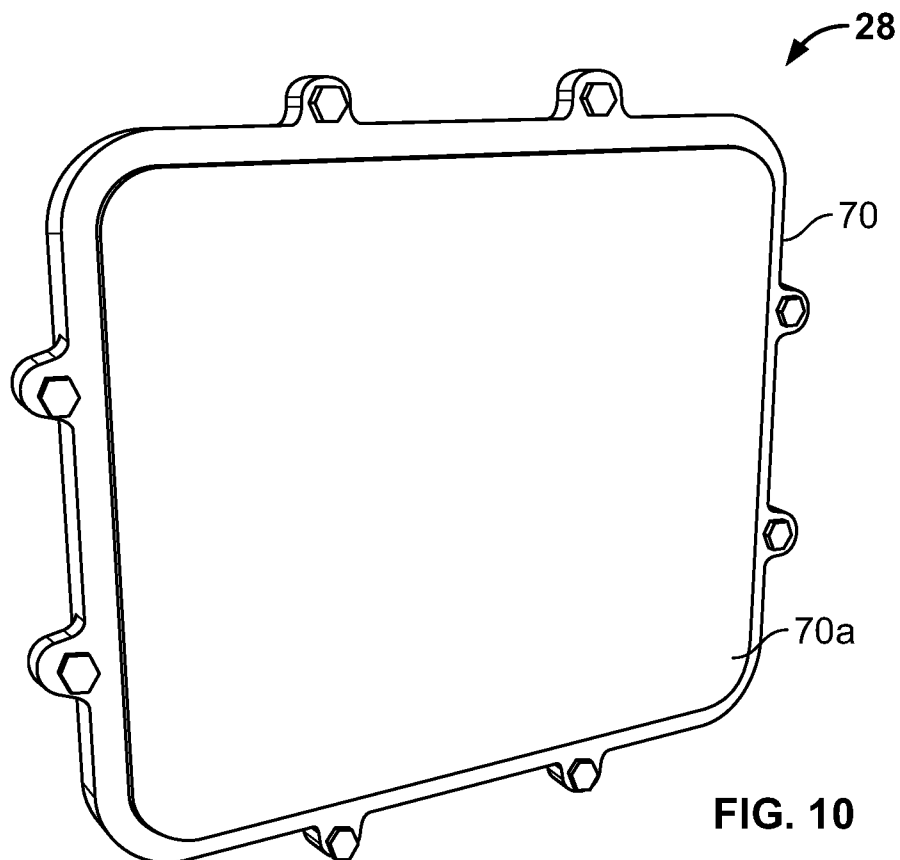


FIG. 8



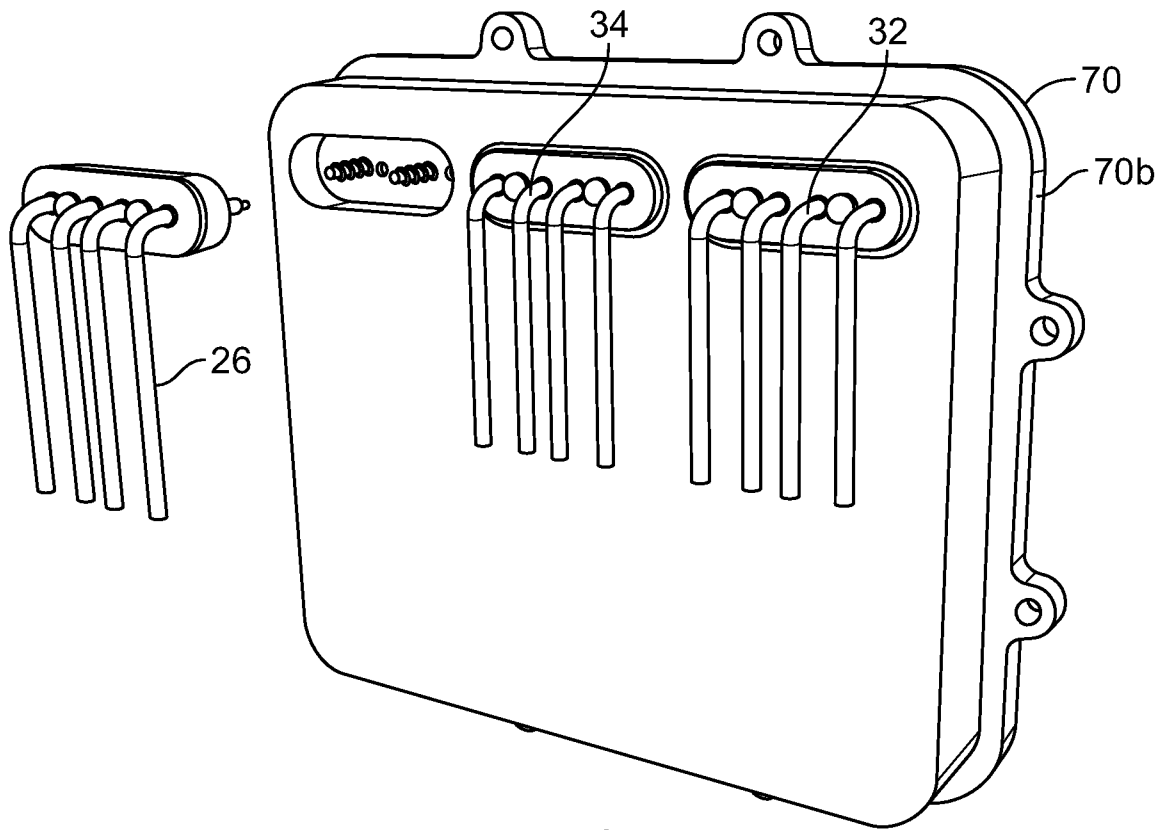


FIG. 11

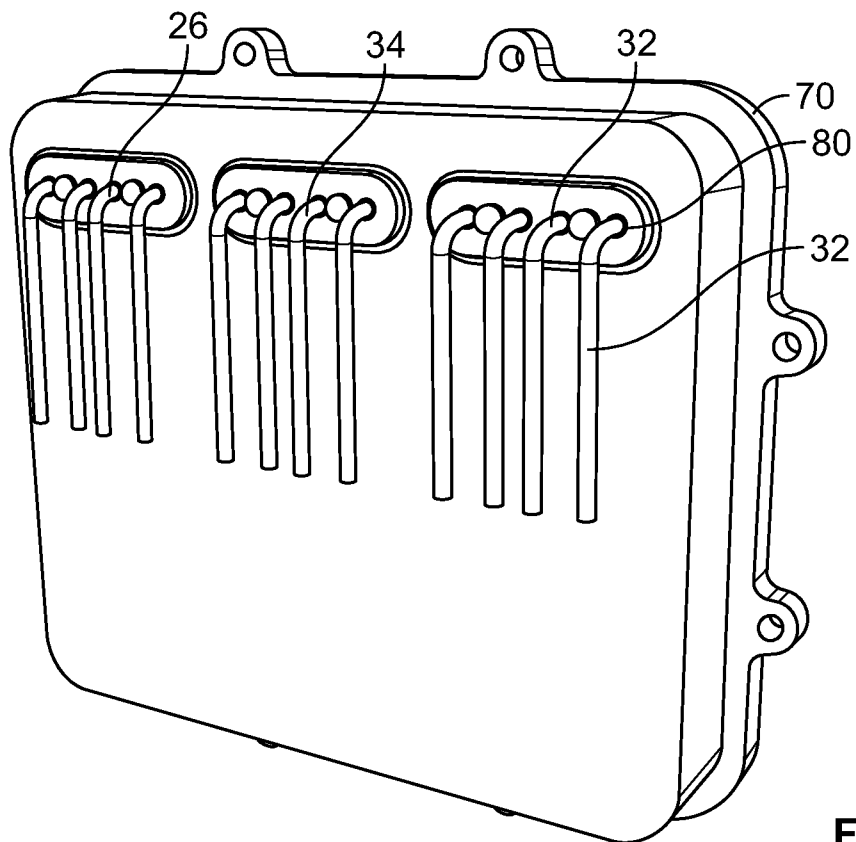


FIG. 12

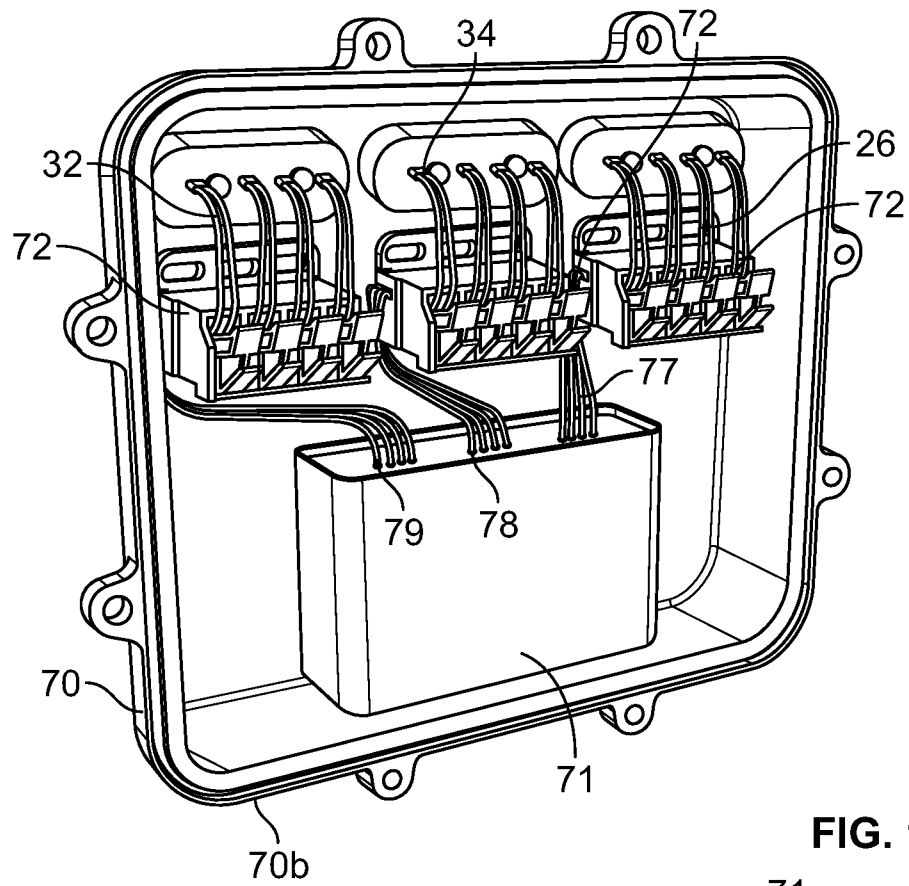


FIG. 13

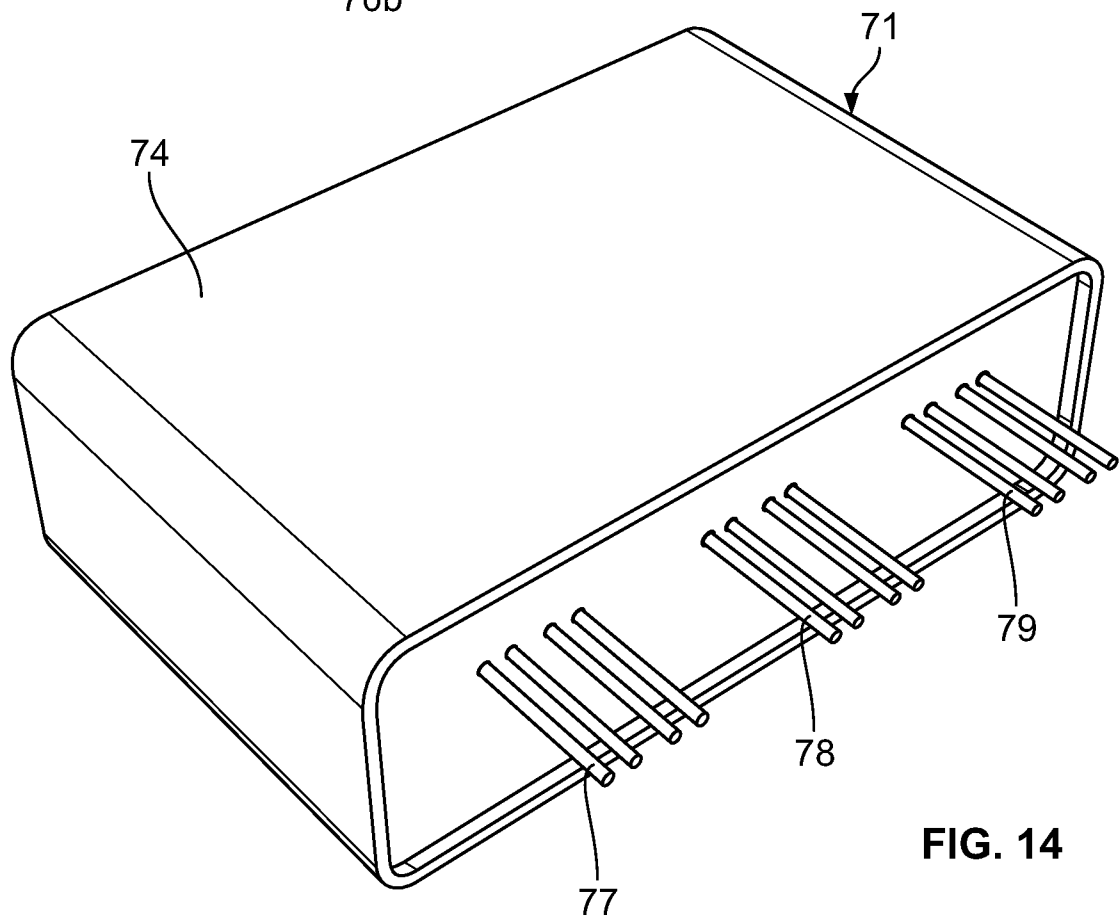
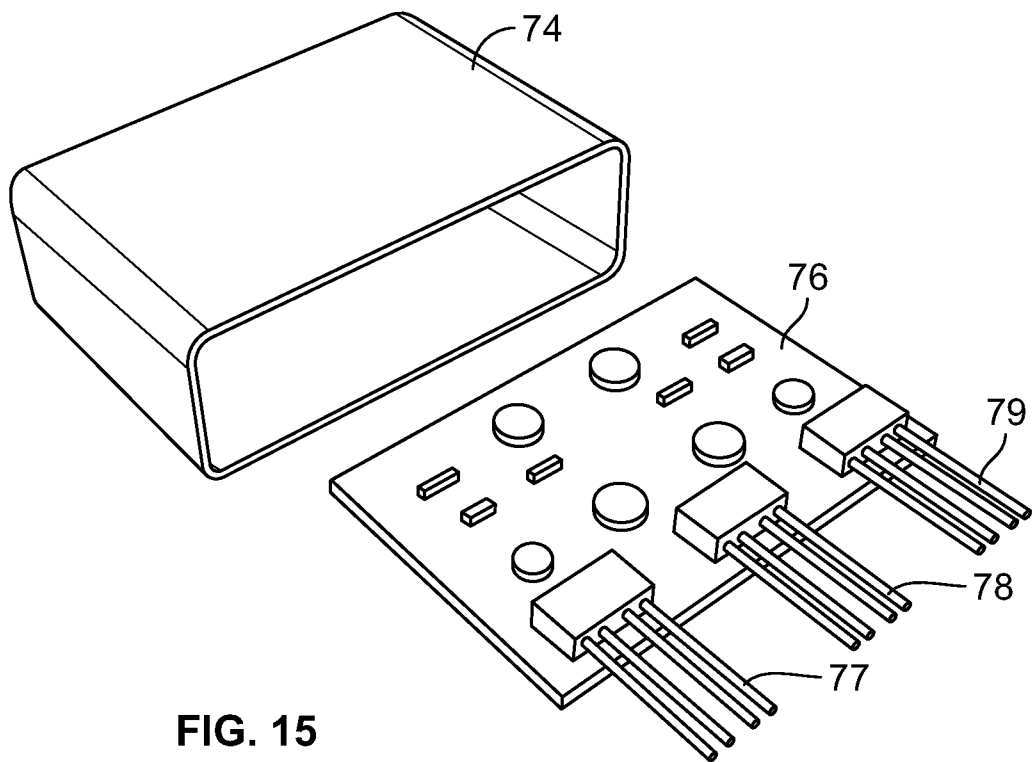
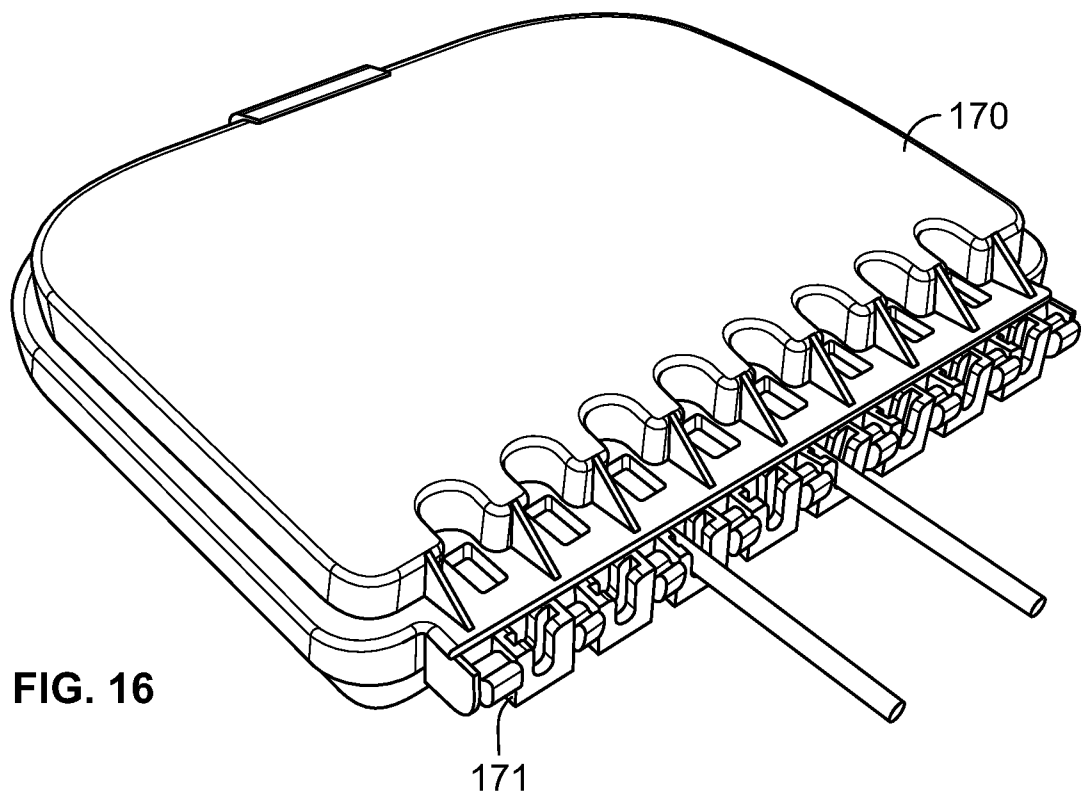


FIG. 14



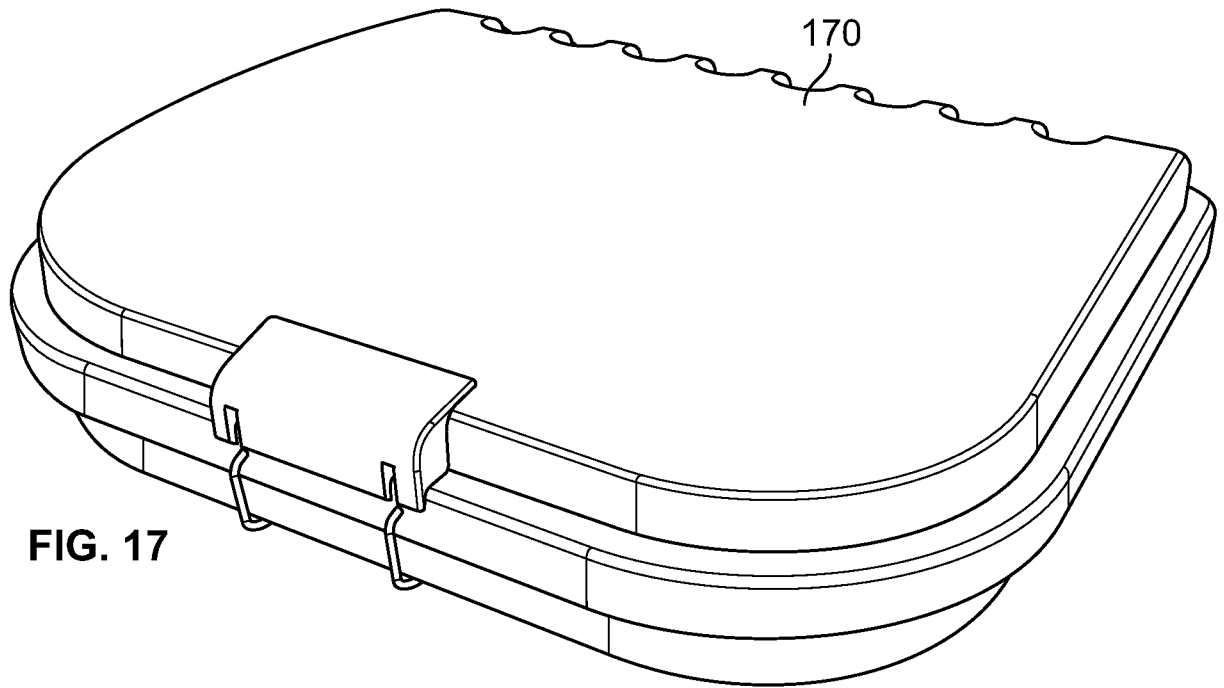


FIG. 17

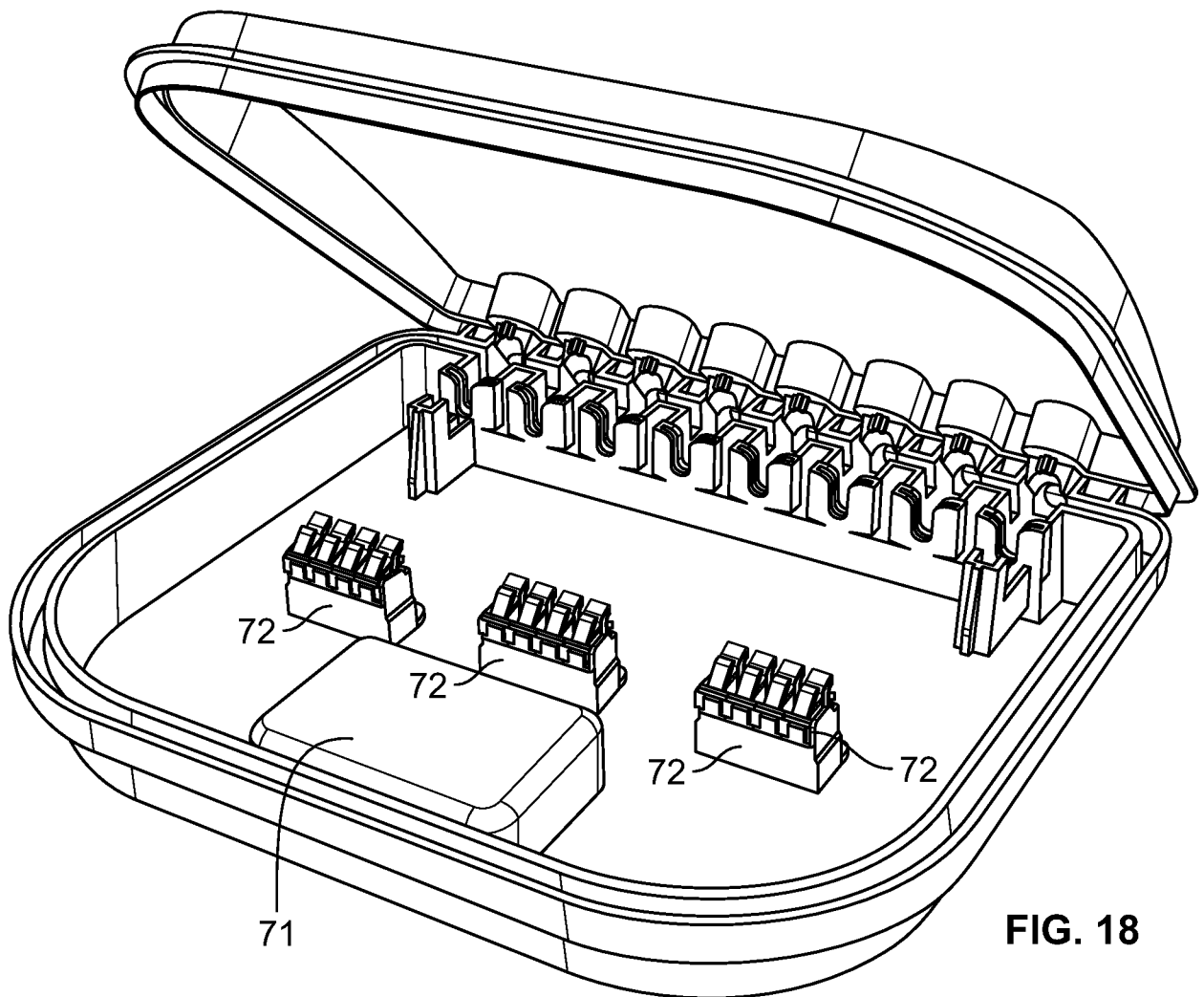


FIG. 18

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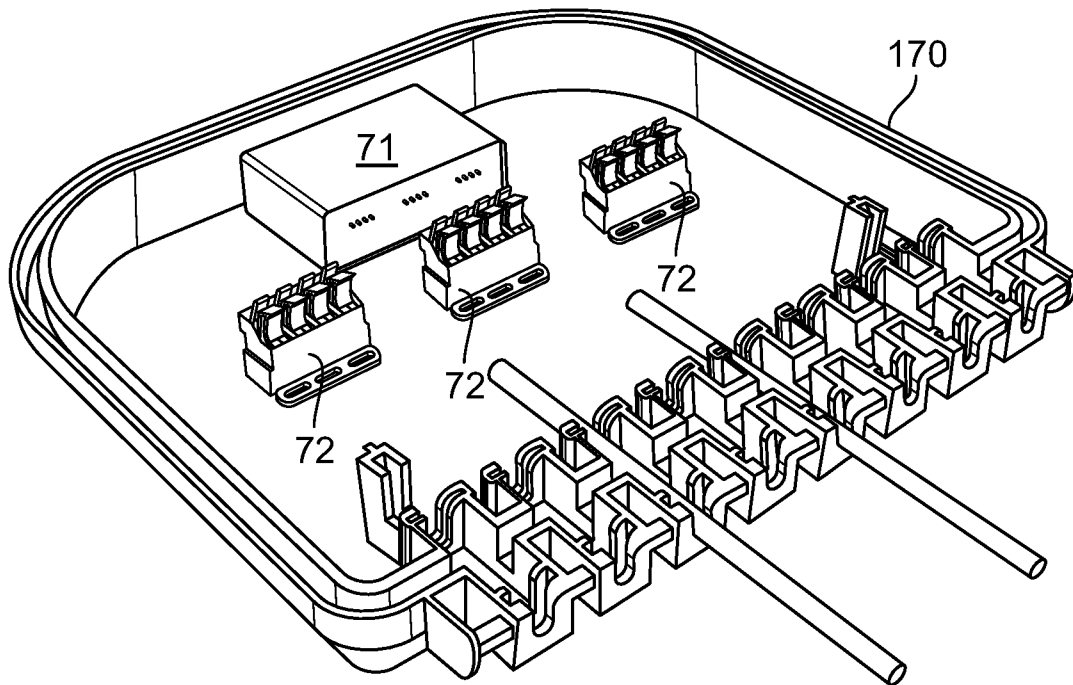


FIG. 19

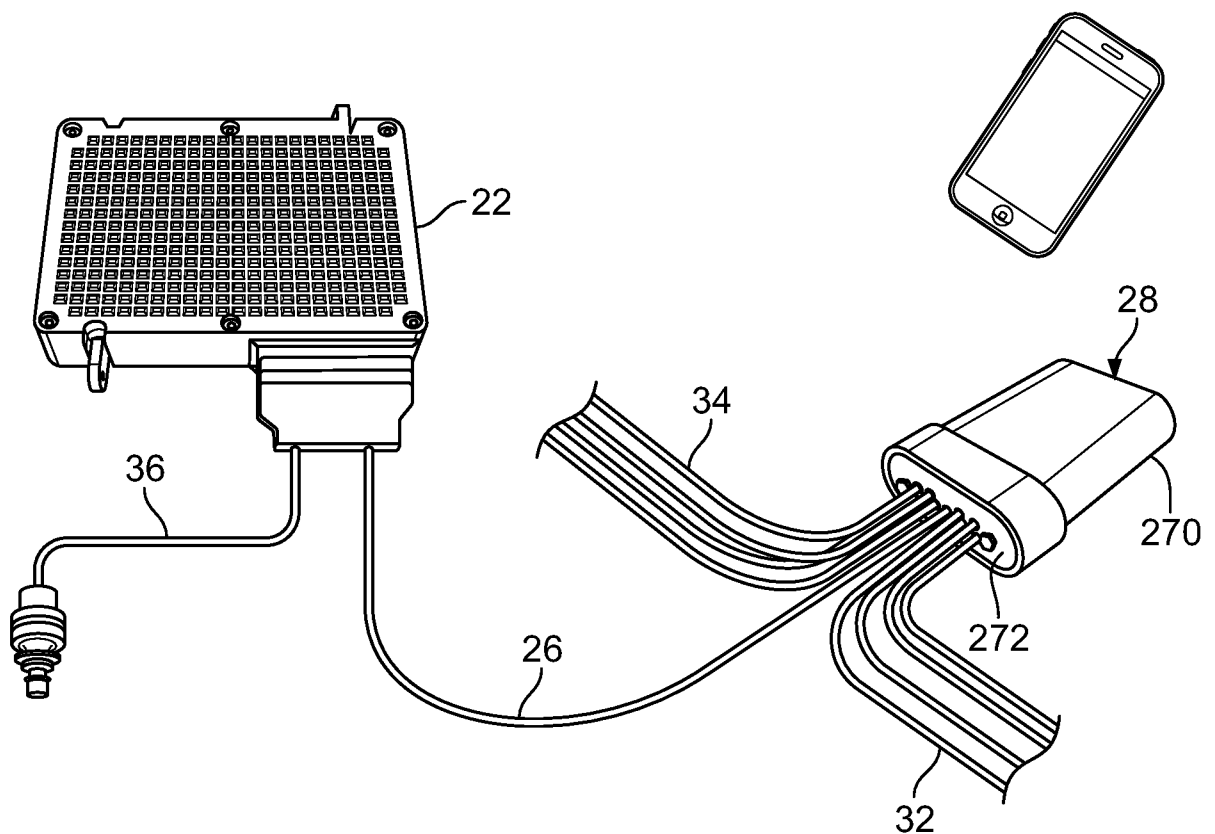


FIG. 20

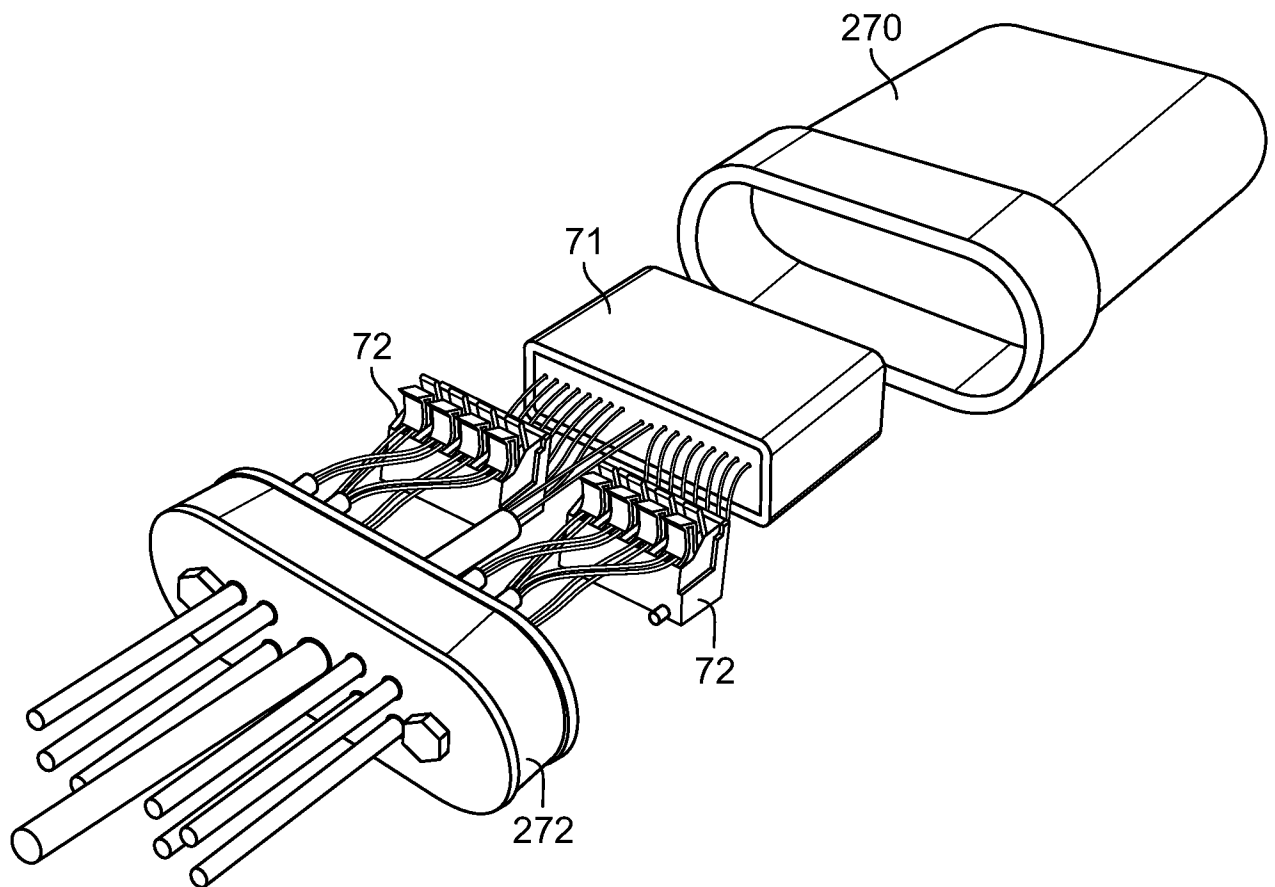


FIG. 21

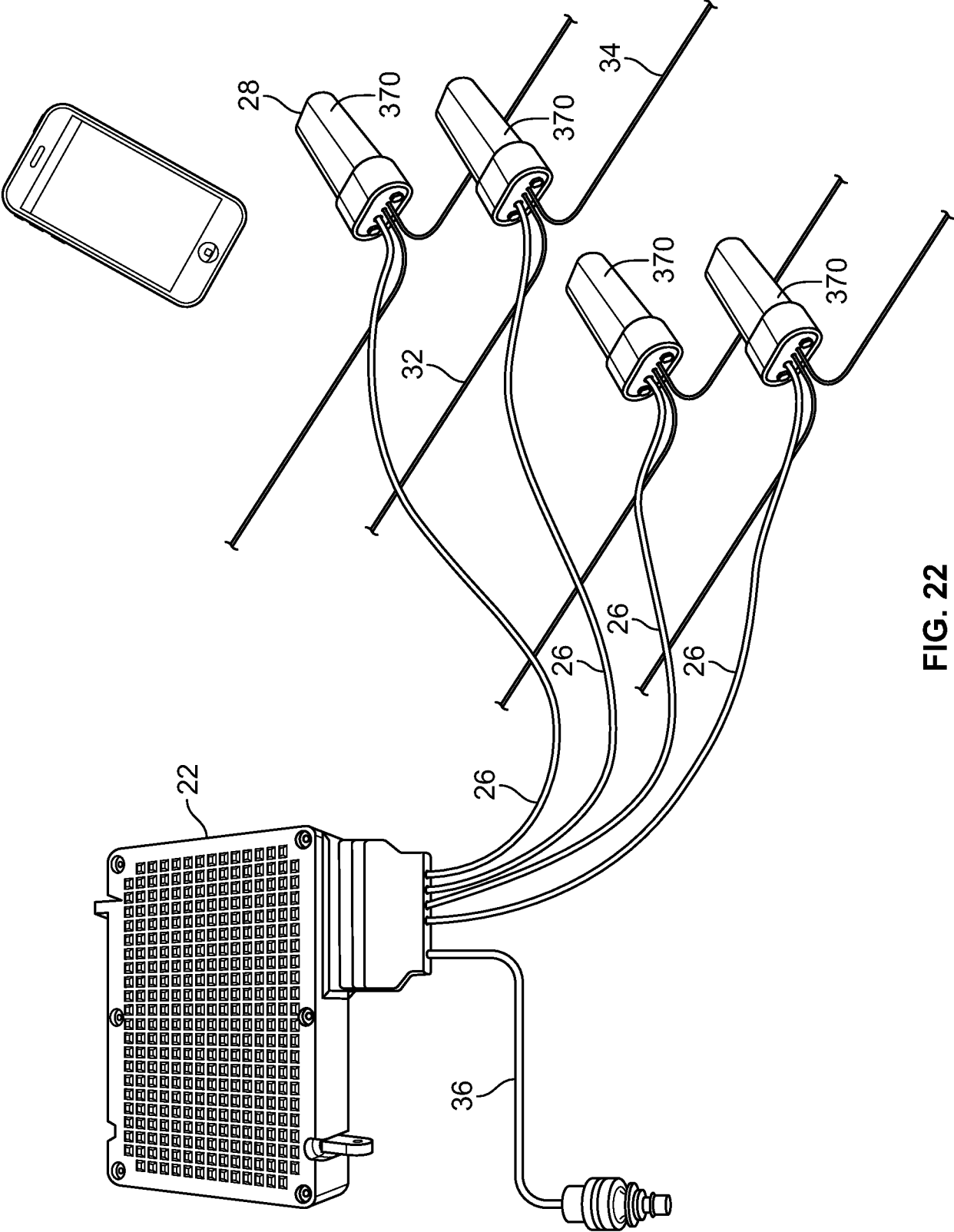
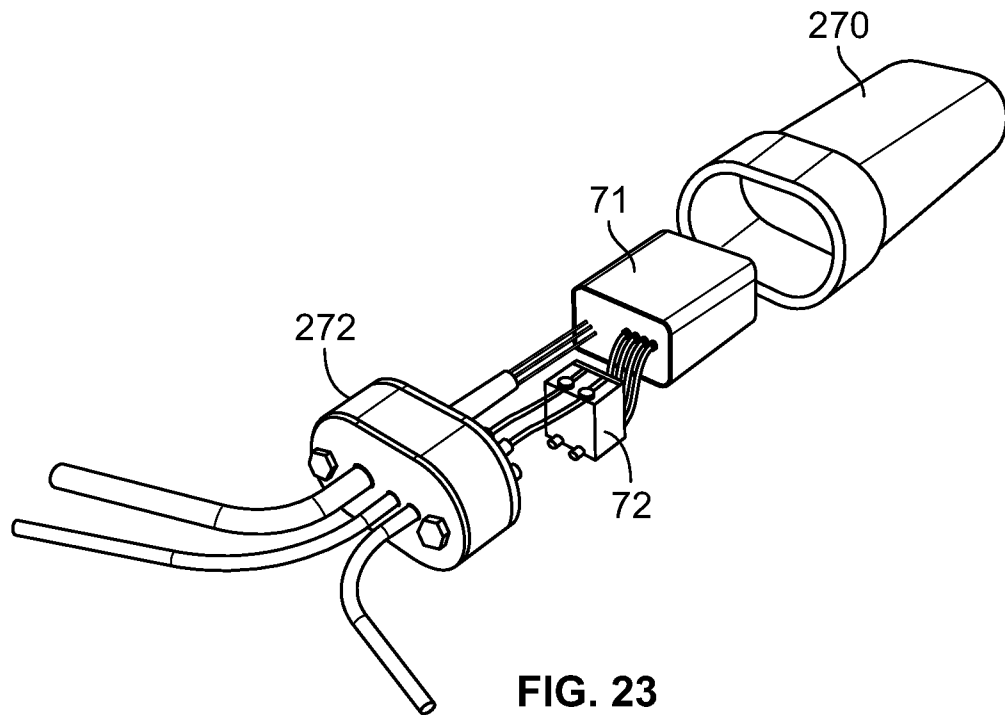
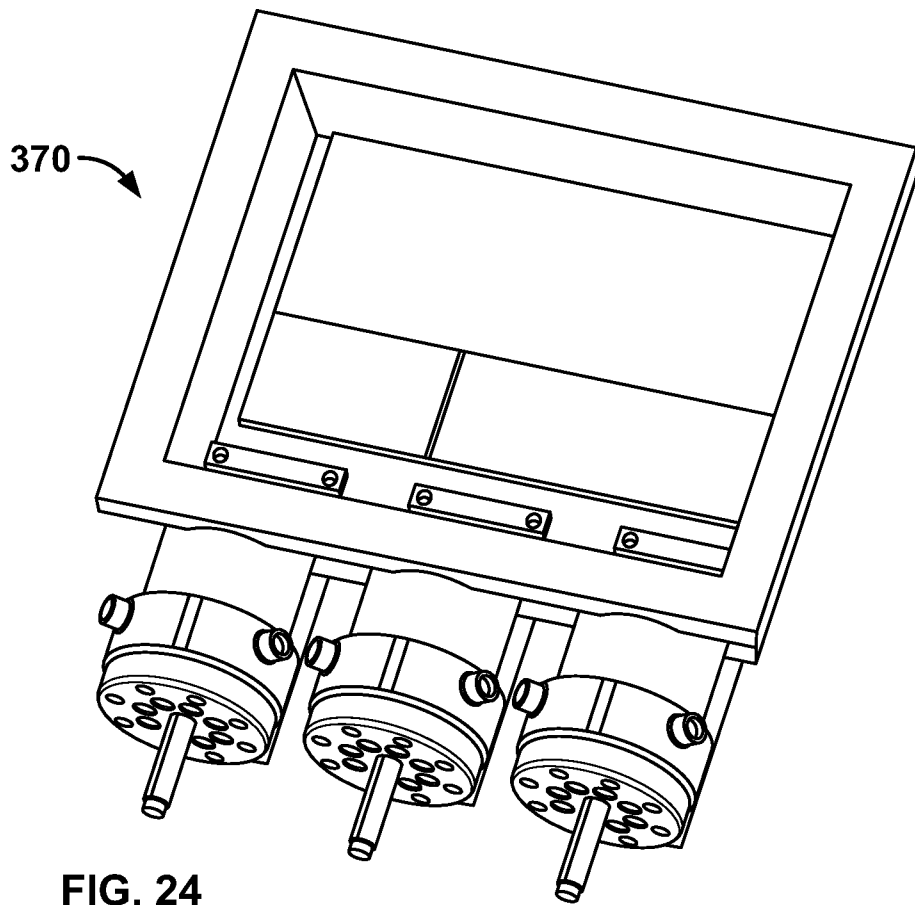


FIG. 22



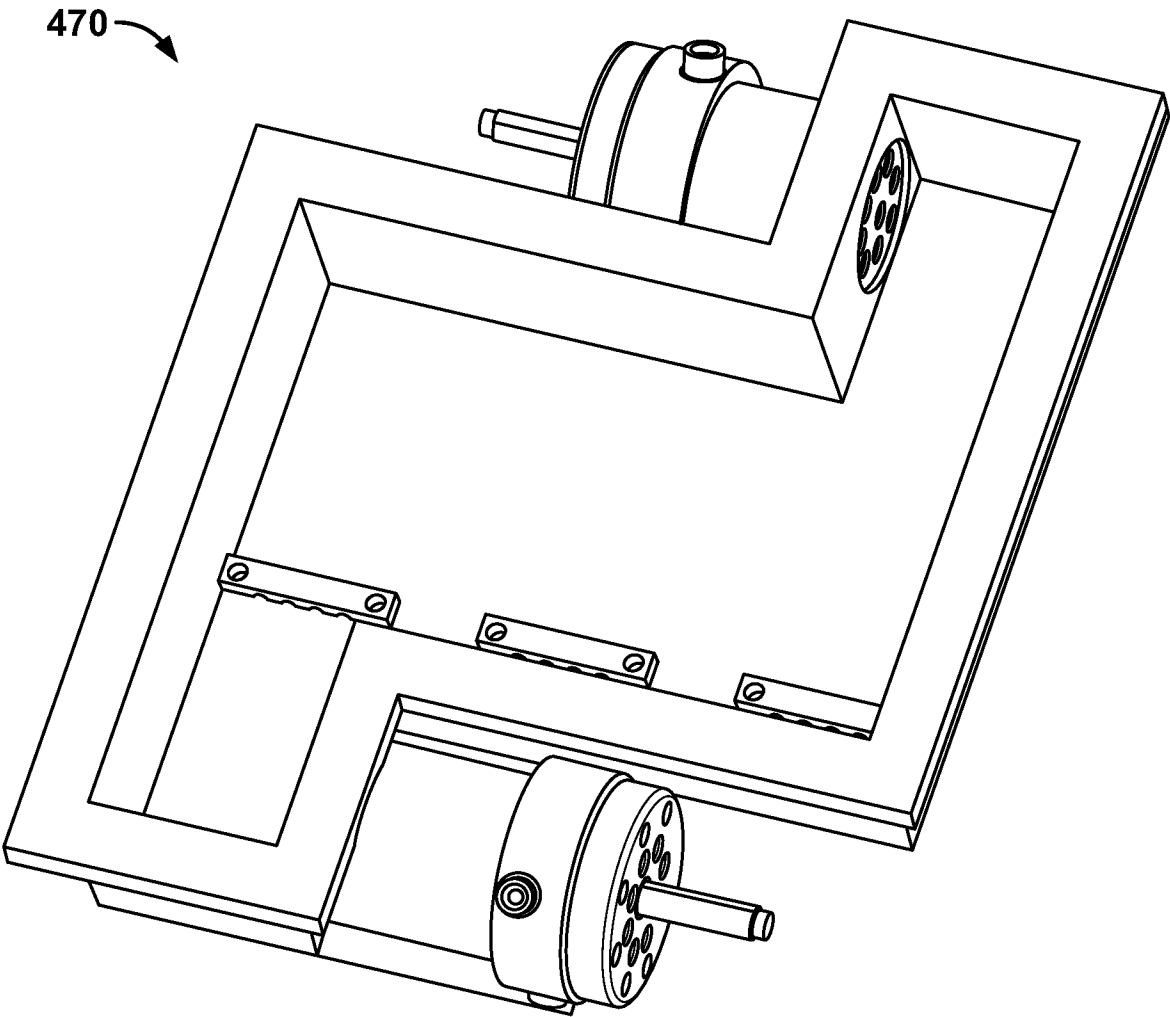


FIG. 25

A. CLASSIFICATION OF SUBJECT MATTER**H04Q 1/04(2006.01)i, H04Q 1/16(2006.01)i, H04Q 1/02(2006.01)i, H04Q 11/00(2006.01)i**

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)

H04Q 1/04; H01R 4/24; H04M 1/00; H04B 10/06; H04B 10/29; H04B 10/25; H04L 12/28; H04Q 1/16; H04Q 1/02; H04Q 11/00

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: switch, converter, termination, closure, wire, line, subscriber, upgrade, service provider

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6795552 B1 (ANDREW G. STANUSH et al.) 21 September 2004 See column 5, lines 2-36, claim 1 and figures 1, 5.	1-17
A	US 2006-0063417 A1 (ZIWEI LIU et al.) 23 March 2006 See paragraphs [0037]-[0038], claim 1 and figure 2.	1-17
A	WO 2015-066329 A1 (TYCO ELECTRONICS UK LTD. et al.) 07 May 2015 See paragraphs [0029], [0036]-[0039], claim 1 and figure 4.	1-17
A	US 2009-0060530 A1 (MARK R. BIEGERT et al.) 05 March 2009 See paragraphs [0093]-[0112] and figure 6.	1-17
A	US 7773744 B1 (DANIEL M. JOFFE) 10 August 2010 See column 7, line 51 - column 8, line 46 and figure 3.	1-17



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search

14 October 2016 (14.10.2016)

Date of mailing of the international search report

20 October 2016 (20.10.2016)

Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2016/042810

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6795552 B1	21/09/2004	EP 1109412 A2 EP 1109412 A3	20/06/2001 16/10/2002
US 2006-0063417 A1	23/03/2006	CA 2577804 A1 CA 2577804 C CN 101018827 A MX 2007002708 A US 7540759 B2 WO 2006-036529 A1	06/04/2006 30/10/2012 15/08/2007 16/05/2007 02/06/2009 06/04/2006
WO 2015-066329 A1	07/05/2015	None	
US 2009-0060530 A1	05/03/2009	US 2009-0060531 A1 US 8401387 B2 US 8433195 B2	05/03/2009 19/03/2013 30/04/2013
US 7773744 B1	10/08/2010	None	