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(71) Applicant: **COMMSCOPE TECHNOLOGIES LLC**
[US/US]; 1100 CommScope Place SE, Hickory, North Carolina 28602 (US).

(72) Inventors: **JOSHI, Aviral**; 401 E 32nd Street, Apartment 305, Chicago, Illinois 60616 (US). **VACCARO, Ronald, A.**; 343 River Haven Drive, Taylorsville, North Carolina 28681 (US). **RAJPAL, Taig, S.**; 1541 N Bell Avenue, Unit 1, Chicago, Illinois 60622 (US).

(74) Agent: **CANNON, James, R.**; Myers Bigel, P.A., P.O Box 37428, Raleigh, North Carolina 27627 (US).

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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.

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(54) Title: HANGER ASSEMBLY FOR MOUNTING MULTIPLE CABLES

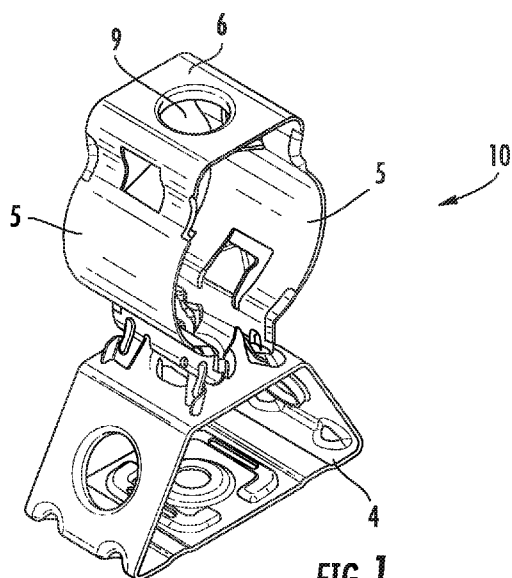


FIG. 1

(57) Abstract: A cable hanger assembly according to embodiments of the invention includes: a mounting substrate, the mounting substrate including a plurality of holes configured to receive clips; and a plurality of clips, each of the clips configured to receive a cable and mount in one of the plurality of holes of the mounting substrate.



HANGER ASSEMBLY FOR MOUNTING MULTIPLE CABLES

Related Application

[0001] The present application claims priority from and the benefit of U.S. Provisional Patent Application No. 62/447,929, filed January 19, 2017, the disclosure of which is hereby incorporated herein in its entirety.

Field of the Invention

[0002] The present invention relates generally to devices for supporting cables and, in particular, to hangers for securing cables to support structures.

Background of the Invention

[0003] Cable hangers are commonly used to secure cables to structural members of antenna towers and or along tunnel walls. Generally, each cable is attached to a structural member by cable hangers mounted at periodically-spaced attachment points.

[0004] Antenna towers and/or tunnels may be crowded due to the large numbers of cables required for signal-carrying. Over time, as systems are added, upgraded and/or expanded, installation of additional cables may be required. To conserve space, it may be desirable for each set of cable hangers to secure more than a single cable. Certain cable hangers have been constructed to secure multiple cables; other cable hangers have a stackable construction that permits multiple cable hangers to be interlocked extending outwardly from each mounting

point/structural member. Stacked and multiple-cable-type cable hangers significantly increase the number of cables mountable to a single attachment point.

[0005] One popular stackable cable hanger is discussed in U.S. Patent No. 8,191,836 to Korczak, the disclosure of which is hereby incorporated herein by reference in its entirety. One such cable hanger, designated broadly at **10**, is shown in **FIGS. 1** and **2**. The hanger **10** includes curved arms **5** that extend from a flat base **6**. Locking projections **7** extend from the free ends of the arms **5**. As can be seen in **FIGS. 1** and **2**, the locking projections **7** are inserted into a reinforced hole **8** in a tower structure **4** to mount the hanger **10** thereon. The base **6** of the hanger **10** includes a reinforced hole **9** that can receive the projections of another hanger **10** to mount a second cable.

[0006] As can be best seen in **FIG. 2**, the arms **5** include arcuate sections **14** that together generally define a circle within which a cable can reside. Two cantilevered tabs **12** extend radially inwardly and toward the base **6** at one end of the arcuate sections **14**, and two cantilevered tabs **16** extend radially inwardly and toward the base **6** from the opposite ends of the arcuate sections **14**. The cantilevered tabs **12**, **16** are deployed to deflect radially outwardly when the hanger **10** receives a cable for mounting; this deflection generates a radially inward force from each tab **12**, **16** that grips the jacket of the cable.

[0007] Hangers can be “stacked” onto each other by inserting the locking projections **7** of one hanger into the large hole **9** of the next hanger. One variety of cable hanger of this type is the SNAP-STAK® hanger, available from CommScope, Inc. (Joliet, Illinois).

[0008] The SNAP-STAK® hanger is offered in multiple sizes that correspond to the outer diameters of different cables. This arrangement has been suitable for use with RF coaxial cables, which tend to be manufactured in only a few different outer diameters; however, the arrangement has been less desirable for fiber optic cables, which tend to be manufactured in a much greater variety of diameters. Moreover, fiber optic cables tend to be much heavier than coaxial cables (sometimes as much as three times heavier per unit foot), which induces greater load and stress on the hangers.

[0009] Multiple approaches to addressing this issue are offered in co-assigned and co-pending U.S. Patent Publication No. 2016/0281881 to Vaccaro, the disclosure of which is hereby incorporated herein by reference in full. One cable hanger discussed in this publication is shown in **FIGS. 3** and **4** and designated broadly at **610** therein. The cable hanger **610** is somewhat

similar to the cable hanger 10, inasmuch as it has a base 606, curved arms 605 and locking projections 607 that resemble those of the hanger 10 discussed above. However, the cable hanger 610 also has flex members 618 that define chords across the arcuate sections 614 of the arms 605. As can be seen in FIG. 4, cantilevered gripping members 612, 616 extend from the flex members 618 and into the cable-gripping space S within the arms 605. It can also be seen in FIG. 3 that the flex members 618 are tripartite, with two vertically offset horizontal runs 618a, 618c merging with the arcuate sections 614 of the arms 605 and a vertical run 618b extending between the horizontal runs 618a, 618c. The gripping members 612, 616 extend from opposite sides of the vertical run 618b and are vertically offset from each other.

[0010] In use, the cable hanger 610 is employed in the same manner as the cable hanger 10; a cable is inserted into the space S between the arms 605, which are then closed around the cable as the locking projections 607 are inserted into a mounting hole. The cantilevered gripping members 612, 616 can help to grip and to center the cable within the space S. The presence of the flex members 618, which are fixed end beams rather than cantilevered tabs, can provide additional gripping force beyond that of the cable hanger 10.

[0011] In view of the foregoing, it may be desirable to provide additional configurations of cable hangers to enable a technician to adapt to different cable sizes and mounting conditions.

Summary

[0012] As a first aspect, embodiments of the invention are directed to a cable hanger assembly. The assembly comprises: a mounting substrate, the mounting substrate including a plurality of holes configured to receive clips; and a plurality of clips, each of the clips configured to receive a cable and mount in one of the plurality of holes of the mounting substrate.

[0013] In some embodiments, the cable hanger assembly is employed in combination with a plurality of cables mounted to the mounting substrate, wherein each of the cables is mounted with a respective one of the plurality of clips.

[0014] As a second aspect, embodiments of the invention are directed to a cable hanger assembly comprising: a mounting substrate, the mounting substrate having a main panel, wherein a plurality of holes configured to receive clips are located in the main panel; and a plurality of clips, each of the clips configured to receive a cable and mount in one of the plurality of holes of the mounting substrate.

[0015] As a third aspect, embodiments of the invention are directed to a cable hanger assembly comprising: a mounting substrate, the mounting substrate including a base, a pair of arms attached to the base, and locking features attached to free ends of the arms, wherein each of the arms includes a plurality of holes configured to receive clips; and a plurality of clips, each of the clips configured to receive a cable and mount in one of the plurality of holes of the mounting substrate.

Brief Description of the Figures

- [0016] FIG. 1 is a perspective view of a prior art cable hanger.
- [0017] FIG. 2 is a top view of the prior art cable hanger of FIG. 1.
- [0018] FIG. 3 is a perspective view of another prior art cable hanger.
- [0019] FIG. 4 is a top view of the cable hanger of FIG. 3.
- [0020] FIG. 5 is a front view of a mounting substrate of a cable hanger assembly according to embodiments of the invention.
- [0021] FIG. 6A is a top view of a clip to be used with the cable hanger assembly of FIG. 5.
- [0022] FIG. 6B is a top view of an alternative clip to be used with the cable hanger assembly of FIG. 5.
- [0023] FIG. 7 is a top view of the mounting substrate of FIG. 5 mounted on a mounting structure with clips of FIG. 6A inserted therein to hold cables.
- [0024] FIG. 8 is a top view of a mounting substrate of a cable hanger assembly according to alternative embodiments of the invention, with clips of FIG. 6A inserted therein to hold cables.
- [0025] FIG. 9 is a side view of the mounting substrate of FIG. 8.
- [0026] FIG. 10 is a top view of two cable hanger assemblies of FIG. 8 mounted in a stacked fashion.

Detailed Description

[0027] The present invention is described with reference to the accompanying drawings, in which certain embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments that are pictured and described herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to

those skilled in the art. It will also be appreciated that the embodiments disclosed herein can be combined in any way and/or combination to provide many additional embodiments.

[0028] Unless otherwise defined, all technical and scientific terms that are used in this disclosure have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. The terminology used in the below description is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used in this disclosure, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will also be understood that when an element (e.g., a device, circuit, etc.) is referred to as being "attached", "connected" or "coupled" to another element, it can be directly connected or coupled to the other element or intervening elements may be present. In contrast, when an element is referred to as being "directly attached", "directly connected" or "directly coupled" to another element, there are no intervening elements present.

[0029] Referring now to the drawings, a cable hanger assembly **110** according to embodiments of the invention is shown in **FIGS. 5-7**. The assembly **110** includes a mounting substrate **120** and a plurality of clips **130**. These are described in greater detail below.

[0030] The mounting substrate **120** includes a generally square, generally flat main panel **122** with four side edges **123**. In the main panel **122**, sixteen mounting holes **124** define a 4x4 grid, although other numbers, sizes and arrangements of holes **124** may also be suitable. Locking features **126** (which may take the form of the locking projections **107**, **607** discussed above) are located in the central portion of the main panel **122**. The locking features **126** are configured to be inserted into a mounting hole (typically nominally $\frac{3}{4}$ inch in diameter) of a mounting structure such as an antenna tower or the like.

[0031] Those skilled in this art will appreciate that the mounting substrate **120** discussed above is typically formed of a metallic material, such as steel, and may be formed as a monolithic member (often from a flat blank stamped from sheet steel and bent into a desired shape).

[0032] Referring now to **FIG. 6A**, a clip **130** is shown therein. The clip **130** is generally U-shaped, with two arms **131** that merge into a central base **132** (as shown in **FIG. 6A**, the base **132** may be somewhat wider than the distance between the arms **131**). A locking feature, such as a hook **134**, is located on the end of each arm **131**. Gripping barbs **135** are located on the base

132 and extend radially inwardly. (Alternatively, gripping features other than barbs may be employed, such as the lances **135'** on clip **130'** shown in **FIG. 6B**, or ridges, edges, nubs, dimples and the like, that enhance gripping of a cable, facilitate insertion of a cable, or both. Examples of such features are described in co-assigned and co-pending U.S. Patent Application No. 15/335,614, filed October 27, 2016, the disclosure of which is hereby incorporated herein in its entirety.)

[0033] Those skilled in this art will appreciate that the clips **130**, **130'** discussed above should be formed of a flexible, resilient material, such as a metallic material (e.g., steel) or a polymeric material, and may be formed as a monolithic member (often from a flat blank stamped from sheet steel and bent into a desired shape or via injection molding).

[0034] As can be seen in **FIG. 7**, in use the mounting substrate **120** is mounted to a mounting structure **170**, such as an antenna tower, by inserting the locking features **126** into a mounting hole **172** in the mounting structure **170**. The locking features **126** are deflected toward each other from a relaxed state, then inserted into the hole **172** (typically $\frac{3}{4}$ inch) in the mounting structure **170** in the deflected condition. The locking features **126** exert outward pressure on edges of the hole and maintain the cable hanger **110** in a mounted position on the mounting structure **170**.

[0035] A cable **150** can then be mounted onto the mounting substrate **120** by capturing the cable **150** in the base portion **132** of the clip **130** and inserting the hooks **134** of the clip **130** into one of the holes **124** in the mounting substrate **120**. The clips **130** extend away from the main panel **122** in a direction generally opposite that of the locking features **126**. The presence of the hooks **134** secures the clip **130** in place, and the barbs **135** of the clip **130** assist in gripping the cable **150**. The process can be repeated with additional cables **150** and additional clips **130** (**FIG. 7** shows four cables **150** mounted on the mounting substrate **120**).

[0036] Those skilled in this art will appreciate that other variations of the mounting substrate **120** may also be suitable. For example, the number, size and locations of the holes **124** may vary: the holes may be single or dual slots; more or fewer holes **124** may be included; the holes **124** may be larger or smaller, or may vary in size within the same mounting substrate **120**; and the holes **124** may be located in different locations on the main panel **122** (for example, offset from each other) or even in the side edges **123**. The side edges **123** may be formed differently, or some or all of the side edges **123** may be omitted entirely. The mounting substrate **120** not not

be square, but could be rectangular, circular, oval, or a number of other shapes. Other variations are also contemplated.

[0037] Referring now to **FIGS. 8-10**, another cable hanger assembly, designated broadly at **210**, is shown therein. The assembly **210** includes a mounting substrate **220** that is somewhat similar to the cable hangers **10**, **610** discussed above, with a base **206**, arms **205** that extend from ends of the base **206**, and locking projections **207** on the arms **205**. The arms **205** are tripartite, with serially merging segments **205a**, **205b**, **205c**; as can be seen in **FIG. 8**, the segments **205a** and **205c** and generally parallel with each other and perpendicular to the segment **205b**, and the locking projections **207** extend from segments **205c**. A mounting hole **209** is present in the base **206**.

[0038] It can be seen in **FIG. 9** that each segment **205a** of the arms **205** includes three holes **212**. As shown in **FIG. 8**, the holes **212** are configured to receive clips **230** similar to clips **130**, **130'** discussed above. Each of the clips **230** can capture and secure a cable **250** to the mounting substrate **220**. The cables **250** can either be secured within the perimeter of the mounting substrate **220** or outside of the perimeter (both are shown in **FIG. 8**).

[0039] Referring now to **FIG. 10**, it can be seen that the mounting substrates **220** are “stackable.” More specifically, the locking projections **207'** of a second mounting substrate **220'** can be inserted into the mounting hole **209** of a first mounting substrate **220** that is mounted to a mounting structure **270**. Additional mounting substrates **220** can be further stacked. Each of the mounting substrates **220** can be used for the mounting of multiple cables with clips **230**.

[0040] Those skilled in this art will appreciate that other variations of the mounting substrate **220** may be suitable. For example, any or all of the segments **205a**, **205b**, **205c** of the arms **205** and/or the base **206** may include curved or bent portions as desired. All of the clips **230** may be inserted internally (*i.e.*, within the periphery of the mounting substrate **220**) or externally (*i.e.*, outside of the periphery of the mounting substrate **220**), or some clips **230** may be inserted internally and others externally. The mounting substrate **220** may lack the mounting hole **220**, in which case the mounting substrate **220** may not be stackable; in such an instance, additional holes may be present in the base **206** for the mounting of more clips **230**. Other variations may also be possible.

[0041] It should also be appreciated that different sizes of clips **130, 130', 230** may be used on the same mounting substrate **120, 220**, and/or different sizes of cables may be mounted to a single mounting substrate **120, 220**.

[0042] The foregoing is illustrative of the present invention and is not to be construed as limiting thereof. Although exemplary embodiments of this invention have been described, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included within the scope of this invention as defined in the claims. The invention is defined by the following claims, with equivalents of the claims to be included therein.

That Which is Claimed is:

1. A cable hanger assembly, comprising:
a mounting substrate, the mounting substrate including a plurality of holes configured to receive clips; and
a plurality of clips, each of the clips configured to receive a cable and mount in one of the plurality of holes of the mounting substrate.
2. The cable hanger assembly defined in Claim 1, wherein the mounting substrate further comprises locking features that enable the mounting substrate to be mounted in a hole in a mounting structure.
3. The cable hanger assembly defined in Claim 1 or Claim 2, wherein each of the plurality of clips includes a gripping feature configured to enhance grip on a cable.
4. The cable hanger assembly defined in any of Claims 1-3, wherein each of the holes in the mounting substrate is located in a common surface.
5. The cable hanger assembly defined in any of Claims 1-4, wherein at least some of the holes in the mounting substrate are located on different mounting surfaces.
6. The cable hanger assembly defined in any of Claims 1-5, wherein the mounting substrate includes a hole configured to receive locking features of a second mounting substrate.
7. The cable hanger assembly defined in any of Claims 1-6, in combination with a plurality of cables mounted to the mounting substrate, each of the cables mounted with a respective one of the plurality of clips.
8. The cable hanger assembly defined in Claim 7, wherein at least some of the plurality of cables have a different diameter than at least some others of the plurality of cables.

9. A cable hanger assembly, comprising:

a mounting substrate, the mounting substrate having a main panel, wherein a plurality of holes configured to receive clips are located in the main panel; and

a plurality of clips, each of the clips configured to receive a cable and mount in one of the plurality of holes of the mounting substrate.

10. The cable hanger assembly defined in Claim 9, wherein the plurality of holes are arranged in a grid on the main panel.

11. The cable hanger assembly defined in Claim 9 or Claim 10, wherein the mounting substrate further comprises locking features that enable the mounting substrate to be mounted in a hole in a mounting structure.

12. The cable hanger assembly defined in Claim 11, wherein the locking features extend generally perpendicularly away from the main panel in a first direction, and wherein the clips are configured to mount on the main panel and extend away from the main panel in a second direction that is generally opposite to the first direction.

13. The cable hanger assembly defined in any of Claims 9-12, wherein each of the plurality of clips includes a gripping feature configured to enhance grip on a cable.

14. The cable hanger assembly defined in any of Claims 9-13, in combination with a plurality of cables mounted to the mounting substrate, each of the cables mounted with a respective one of the plurality of clips.

15. The cable hanger assembly defined in Claim 14, wherein at least some of the plurality of cables have a different diameter than at least some others of the plurality of cables.

16. A cable hanger assembly, comprising:

a mounting substrate, the mounting substrate including a base, a pair of arms attached to the base, and locking features attached to free ends of the arms, wherein each of the arms includes a plurality of holes configured to receive clips; and

a plurality of clips, each of the clips configured to receive a cable and mount in one of the plurality of holes of the mounting substrate.

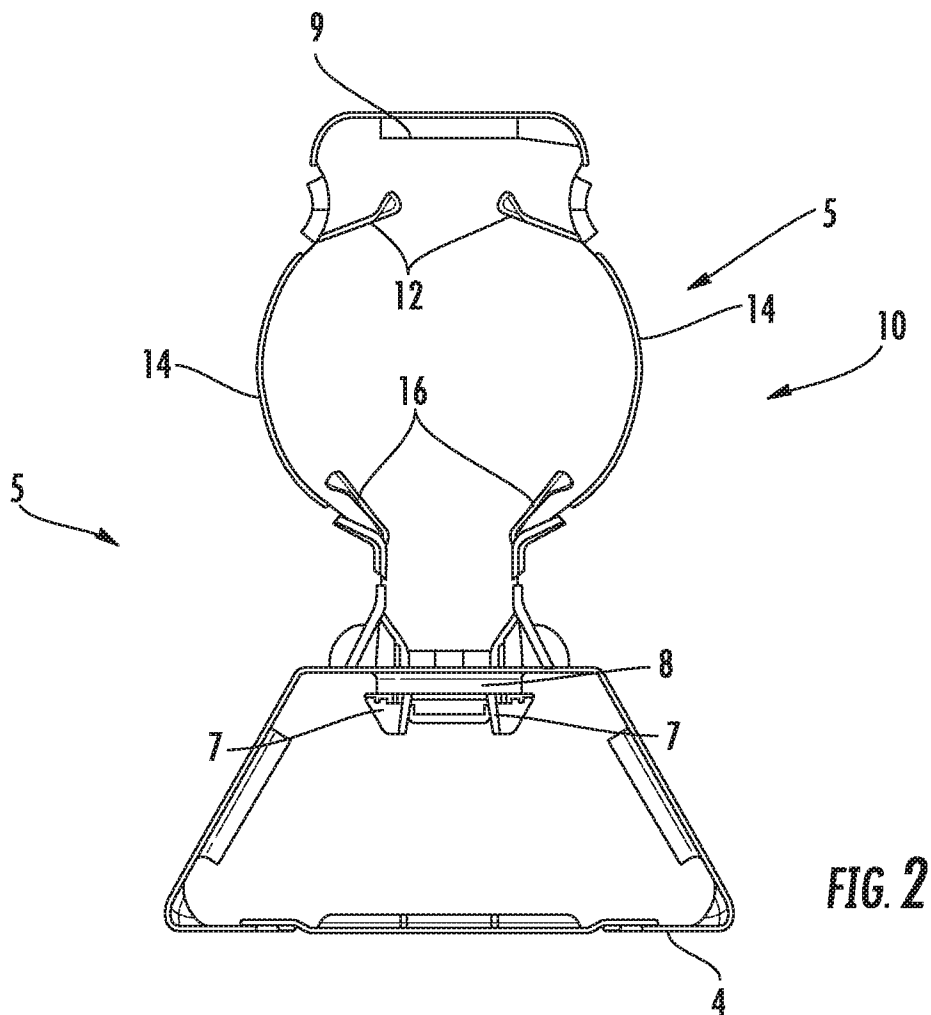
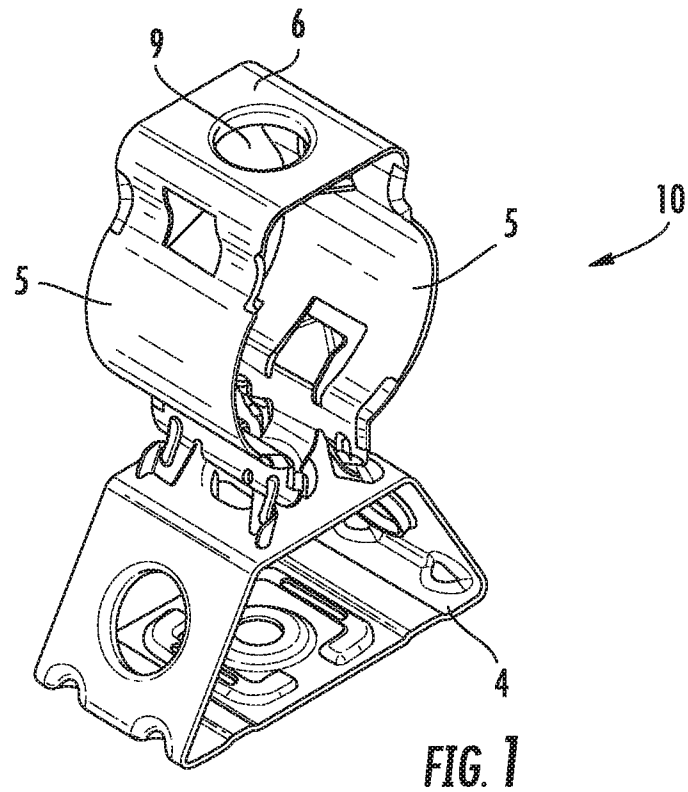
17. The cable hanger assembly defined in Claim 16, wherein each of the plurality of clips includes a gripping feature configured to enhance grip on a cable.

18. The cable hanger assembly defined in Claim 16 or Claim 17, wherein the base of the mounting substrate includes a hole configured to receive locking features of a second mounting substrate.

19. The cable hanger assembly defined in Claim 18 in combination with a second cable hanger assembly, the second cable hanger assembly including a second mounting substrate and second locking features, the second locking features being inserted into the hole in the base.

20. The cable hanger assembly defined in any of Claims 16-19, in combination with a plurality of cables mounted to the mounting substrate, each of the cables mounted with a respective one of the plurality of clips.

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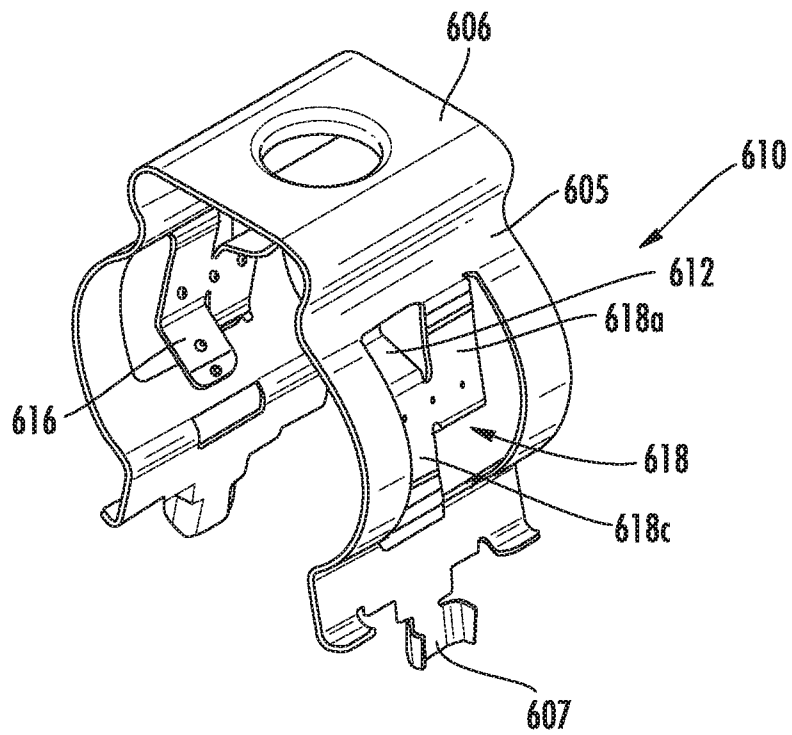


FIG. 3

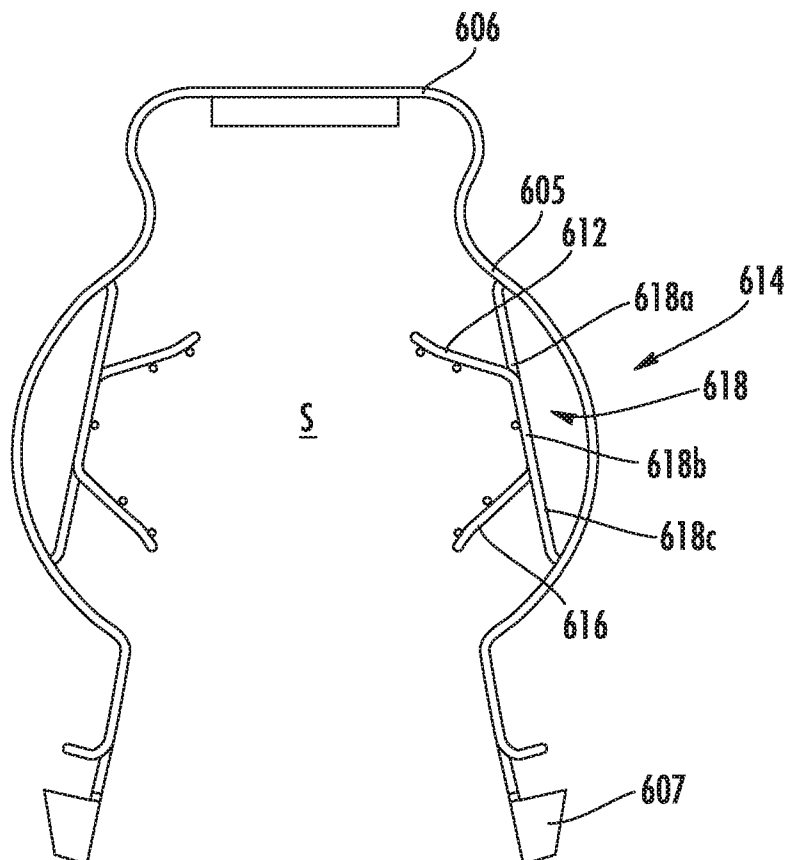


FIG. 4

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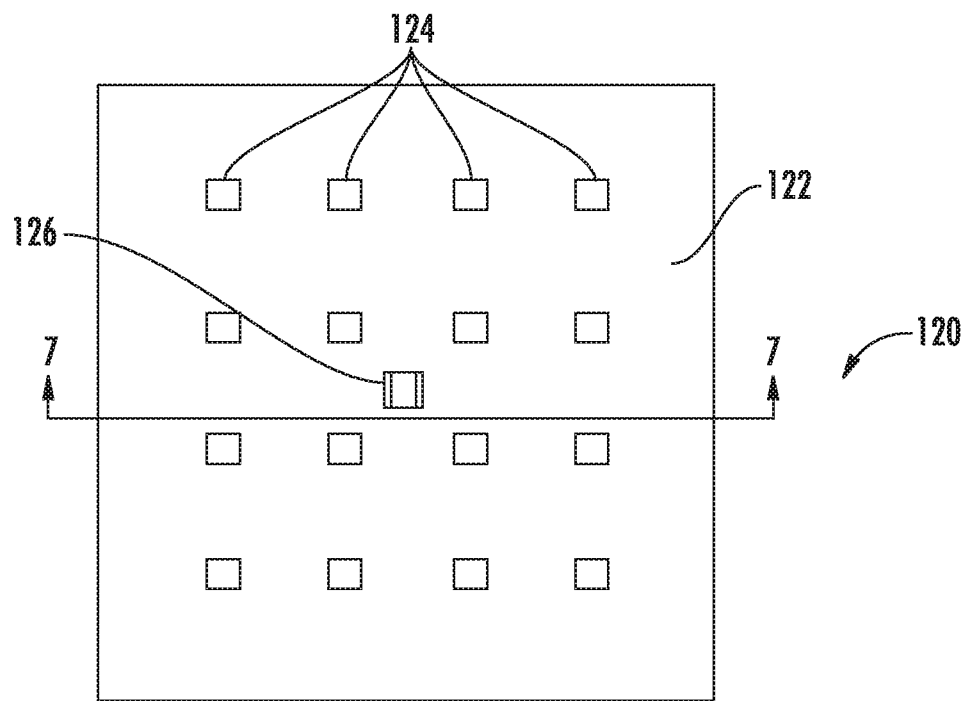


FIG. 5

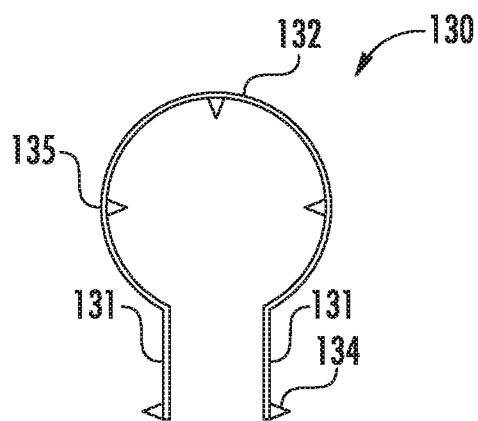


FIG. 6A

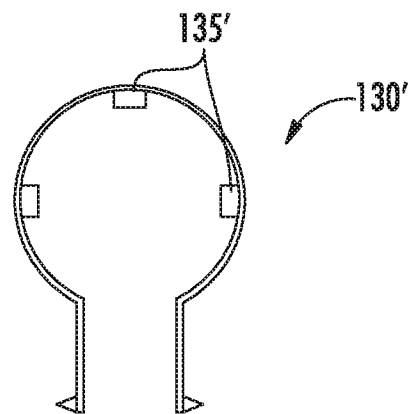


FIG. 6B

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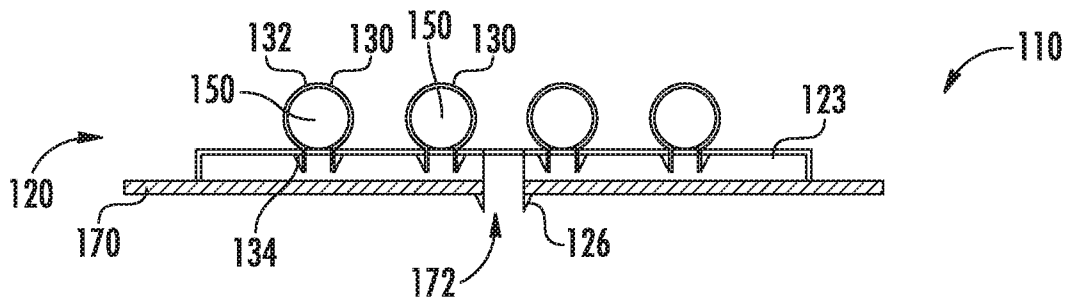


FIG. 7

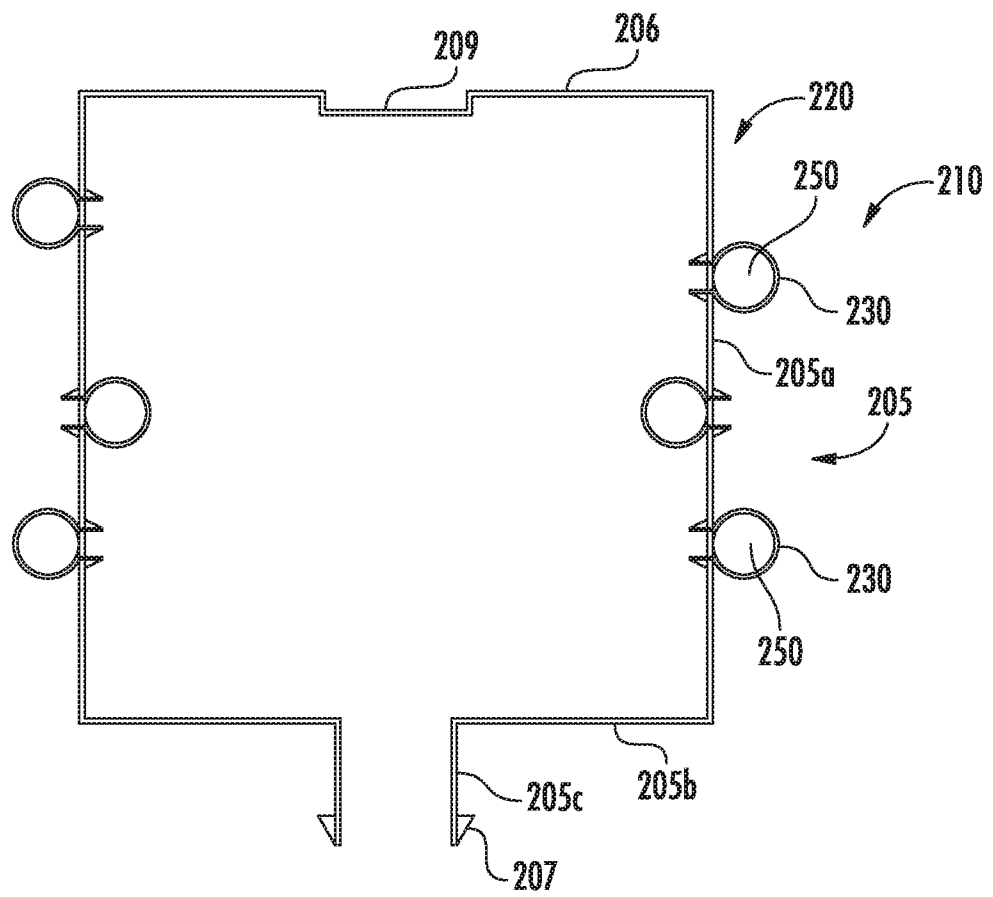


FIG. 8

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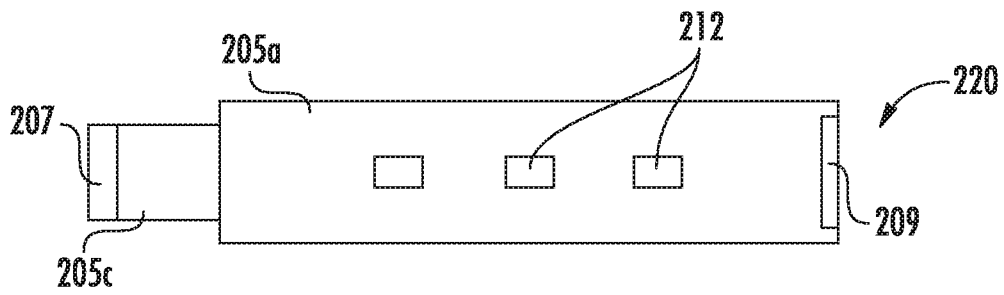


FIG. 9

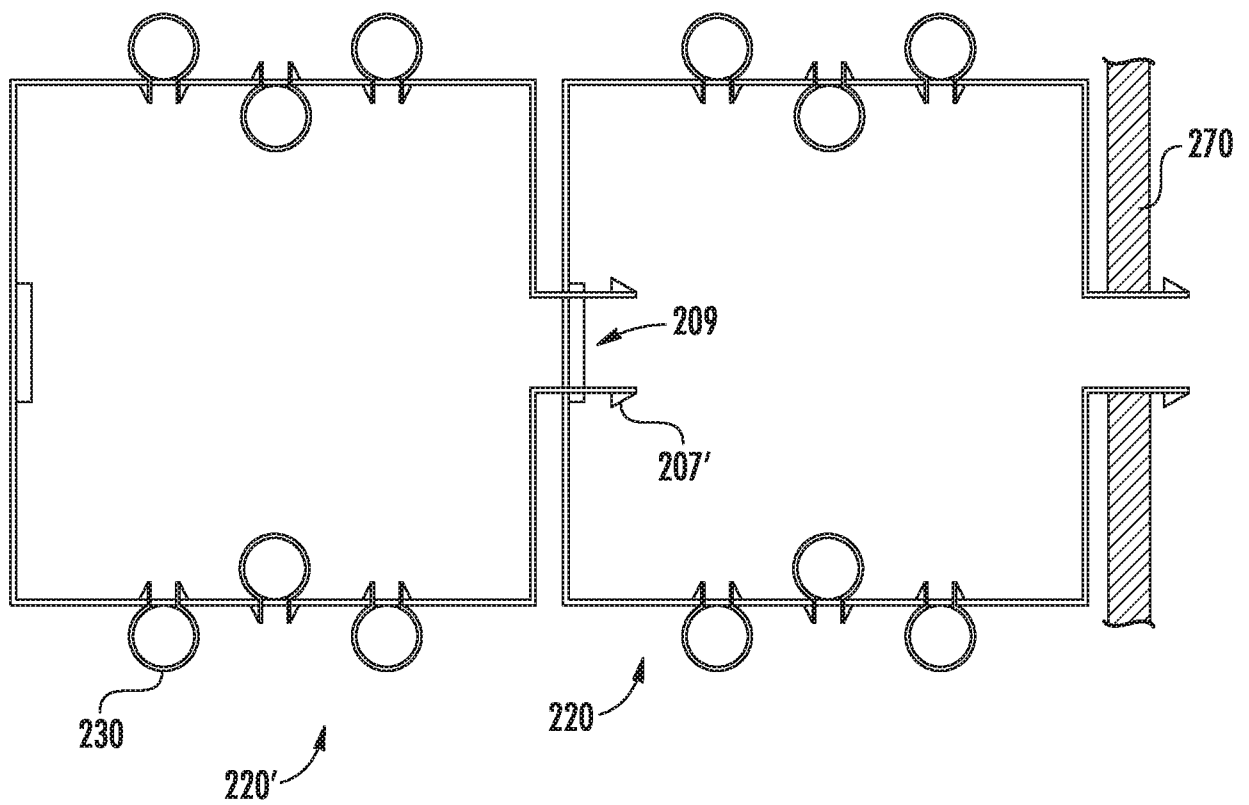


FIG. 10

A. CLASSIFICATION OF SUBJECT MATTER**H02G 3/32(2006.01)i, H02G 15/00(2006.01)i**

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

B. FIELDS SEARCHEDMinimum documentation searched (classification system followed by classification symbols)
H02G 3/32; H02G 15/007; F16L 3/10; F16L 3/12; H02G 1/00; H04B ; F16B 5/06; F16L 3/22Documentation 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 modelsElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & keywords: cable, hanger, clip, hole, lock, substrate**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2015-0136473 A1 (AFSHIN JAFARI et al.) 21 May 2015 See paragraphs 13, 33-34, and figure 1.	1,9-10
Y		2-3, 11-12, 16-19
Y	US 2016-0281883 A1 (COMMSCOPE TECHNOLOGIES LLC) 29 September 2016 See paragraphs 19, 22, and figures 3, 6.	2, 11-12, 16-19
Y	US 2010-0084520 A1 (TATSUYA OHNO) 08 April 2010 See paragraph 20, and figure 1.	3, 17
A	WO 02-095956 A2 (ANDREW CORPORATION) 28 November 2002 See pages 7-8, and figure 5.	1-3, 9-12, 16-19
A	JP 2012-002323 A (NIFCO INC.) 05 January 2012 See paragraphs 25-37, and figure 1.	1-3, 9-12, 16-19



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"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

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

17 April 2018 (17.04.2018)

Date of mailing of the international search report

17 April 2018 (17.04.2018)

Name and mailing address of the ISA/KR

International Application Division

Korean Intellectual Property Office

189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea

Facsimile No. +82-42-481-8578

Authorized officer

CHOI, Sang Won

Telephone No. +82-42-481-8291



INTERNATIONAL SEARCH REPORTInternational application No.
PCT/US2017/068510**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 8,15
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
Claims 8, 15 are regarded to be unclear because the claims refer to multiple dependent claims which do not comply with PCT Rule 6.4(a).
3. ☒ Claims Nos.: 4-7,13-14,20
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of any additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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