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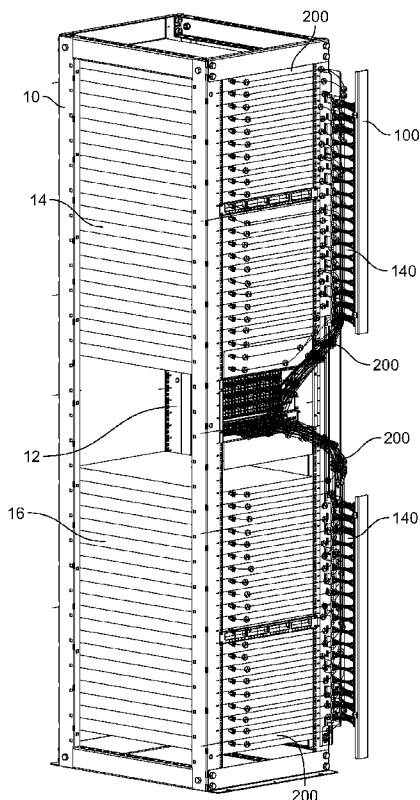


FIG. 3

(57) Abstract: A cable management assembly is disclosed that can be completely factory assembled and shipped to a site for later mounting directly to a telecommunications rack or cabinet. The cable management assembly includes a plurality of cables secured within a carrier assembly. In one aspect, the cables have different or customized individual lengths. The carrier assembly can include a bracket portion and a plurality of cable management members extending from the bracket portion. The plurality of cable management members can define a plurality of cable routing apertures through which at least some of the plurality of cables extend. The bracket portion is mountable to a telecommunications rack with the plurality of cables mounted within the carrier assembly.



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TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU,
TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE,
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CABLE MANAGEMENT ASSEMBLY

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is being filed on April 5, 2017 as a PCT International Patent Application and claims the benefit of U.S. Patent Application Serial No. 62/319,890, filed on April 8, 2016, the disclosure of which is incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

[0002] The present invention relates to cable management systems for telecommunications cables.

BACKGROUND OF THE INVENTION

[0003] Suppliers and users of structured connectivity communications systems in local area networks often have difficulty managing the cabling and demarcation and patching points such as in communications closets and computer rooms. Here, large numbers of data, voice, and video communications circuits, cables and connectors may be concentrated into small areas on relay racks and in communications cabinets resulting in congestion of cabling and connectors. Some connectivity systems attempt to ease the congestion of cabling and connectors by integrating cable management devices within and around the racks and cabinets. However, the use of such management devices generally requires manual routing of cables in the field, which can be time consuming and expensive. Minimizing the space consumed by the cable management systems, and managing the cable in an efficient manner are desired.

SUMMARY OF THE INVENTION

[0004] One aspect of the present disclosure relates to a cable management assembly including a plurality of cables secured within a carrier assembly. In one aspect, the cables have different or customized individual lengths. The carrier assembly can include a bracket portion and a plurality of cable management members extending from the bracket portion. The plurality of cable management members can define a plurality of cable routing apertures through which at least some of the plurality of cables extend. The

bracket portion is mountable to a telecommunications rack with the plurality of cables mounted within the carrier assembly.

[0005] A method for assembling a factory built cable management assembly is also disclosed. The method can include the steps of: providing a carrier assembly having a bracket portion from which a plurality of cable management members extend to define a plurality of cable mounting apertures, the bracket portion being configured for being field mounted to a telecommunications rack; providing a plurality of cables, wherein at least some of the cables have a different length than at least some of the other cables; and routing the plurality of cables within the carrier assembly and through at least some of the cable mounting apertures. Once the cable management assembly is built in the factory or assembly site, the assembly can be shipped to a site, where the assembly can be mounted to a telecommunications rack and the cables can be connected to the equipment supported therein.

[0006] A method of installing a telecommunications system is also disclosed. The method can include the steps of: providing a pre-assembled cable management assembly including a plurality of cables, some of which having lengths that are different than lengths of others of the plurality of cables, and a carrier assembly including a plurality of cable management members defining a plurality of cable routing apertures through which at least some of the plurality of cables extend; mounting the carrier assembly to a telecommunications rack to which telecommunications components are secured; and connecting the plurality of cables to the telecommunications components.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The accompanying drawings, which are incorporated in and constitute a part of the description, illustrate several aspects of the present disclosure. A brief description of the drawings is as follows:

[0008] Figure 1 is a side perspective view of an example cable management assembly in accordance with principles of the present disclosure;

[0009] Figure 2 is a front perspective view of the cable management assembly shown in Figure 1 mounted to a telecommunications rack;

[0010] Figure 3 is a side perspective view of a portion of the cable management assembly shown in Figure 1 mounted to a telecommunications rack, wherein cables of the cable management assembly are connected to telecommunications components mounted in the telecommunications rack;

[0011] Figure 4 is a side perspective view of a carrier assembly of the cable management assembly and telecommunications rack shown in Figure 3, wherein the cables and telecommunications components are not shown;

[0012] Figure 5 is an exploded side perspective view of the portion of the carrier assembly and telecommunications rack shown in Figure 4;

[0013] Figure 6 is a front side perspective view of the carrier assembly shown in Figure 4;

[0014] Figure 7 is a rear side perspective view of a portion of the carrier assembly shown in Figure 6;

[0015] Figure 8 is an exploded front side perspective view of the carrier assembly shown in Figure 6;

[0016] Figure 9 an exploded front side perspective view of a portion of the carrier assembly shown in Figure 6;

[0017] Figure 10 is a front perspective view of a bracket portion of the carrier assembly shown in Figure 6;

[0018] Figure 11 is a rear perspective view of a bracket portion of the carrier assembly shown in Figure 6;

[0019] Figure 12 is a top perspective view of a fastener of the carrier assembly shown in Figure 6;

[0020] Figure 13 is a side view of the fastener shown in Figure 12;

[0021] Figure 14 is a exploded front perspective view of a second example of a carrier assembly and a telecommunications cabinet; and

[0022] Figure 15 is a front perspective view of a portion of the carrier assembly and the telecommunications cabinet shown in Figure 14.

DETAILED DESCRIPTION

[0023] A cable management assembly 100 for a telecommunications rack or cabinet 10 for managing cable in and around telecommunications equipment racks and cabinets is disclosed. In one example, the rack or cabinet 10 is configured with a plurality of telecommunications components 12, 14, 16. The cable management assembly 100 manages cables 200 routed between the telecommunications components 12, 14, and 16. In the example shown, each of the plurality of cables 200 is routed between one of a plurality of first telecommunication components, configured as switches 12, and one of a plurality of second or third telecommunication components, configured as servers 14, 16. However, it should be understood that the rack or cabinet 10 can include any number and/or configuration of telecommunications components. In one example, the cables 200 are copper based telecommunications cables (i.e. Category 5 cables) and are provided with RJ type plugs that are connected to respective jacks of the servers 14, 16 and switch panels 12. In the example shown, individual RJ type plugs 210 are provided at the cable ends to be connected to the servers 14, 16 while RJ type plug packs 212 (e.g. an 8 plug pack) are provided at the cable ends to be connected to the switch panels 12. The cables 200 may also be color coded (or provided with other indicia) and grouped as such to aid in identifying which cables are routed to a particular switch panel 12. Many other types of assemblies, cables, and connectors are possible, such as fiber optic cables with LC, SC, and/or MPO connectors.

[0024] In one aspect, the cable management assembly 100 includes a carrier assembly 102 to which the plurality of cables 200 are secured. The cable management assembly 100 can be completely factory assembled and can be later mounted directly to the rack or cabinet 10 in the field via the carrier assembly 102. An example of a factory assembled cable management assembly 100 is shown at Figure 1, wherein it can be seen that one end of each of the cables 200 is centrally routed for connection to a jack associated with a switch panel 12 and the opposite end of each cable is routed for connection to a jack associated with a server 14, 16. As shown, each individual cable 200 is provided with a customized length such that the cable 200 can be routed from a first designated connection

point at the first telecommunication component 12 to a second designated connection point at the second or third telecommunications component 14, 16 without requiring slack management of the cable 200. Because the cables can be cut, terminated, and mounted to the carrier assembly 102 in a factory setting, considerable time savings results in comparison to installations where cables are cut to length and terminated in the field. The disclosed configuration is also advantageous over field installations that use cables of the same length, as significant slack management structures are required to manage the unneeded excess cable lengths for shorter runs.

[0025] As shown, the carrier assembly 102 can include a bracket portion 104, a plurality of cable management members 106, an upper or first cover 108, and a lower or second cover 110. The bracket portion 104 extends between a first end 112 and a second end 114 and has a pair of sidewalls 116, 118 extending from an end wall 120 to form a channel shape. In the mounted position shown, the first sidewall 116 is closer to the telecommunications components 12, 14, 16 than is a corresponding portion of the second sidewall 118. To provide an opening space for the cables 200 as they extend away from the bracket portion 104 and towards the telecommunications component 12. The first sidewall 116 has a notched section 122. It is noted that the carrier assembly 102 can be constructed and configured to mount to the opposite side (i.e. left side) of the rack 10 or to either side of the rear end of the rack 10 without departing from the concepts herein.

[0026] Each of the first and second sidewalls 116, 118 includes connection points 124 to which the cable management members 106 can be attached. In one example, the connection points 124 are formed by apertures and notches within the sidewalls 116, 118 that enable a snap-fit connection with corresponding protrusions located on the cable management members 106. The cable management members 106 can be grouped together in a larger assembly that is attached to the sidewalls 116, 118 or can be provided as individual elements that are individually attached to the sidewalls 116, 118. Many possible configurations exist. For example, the cable management members 106 and the sidewalls 116, 118 can be integrally formed as a single part.

[0027] In the example shown, a first unit group 126 unit having 18 cable management members 106, formed from two separate sub units 126a, 126b, is mounted to the first sidewall 116 proximate the first end 112 and a second unit group 128 having 18 cable management members 106, formed from two separate sub units 128a, 128b, is mounted to

the first sidewall 116 proximate the second end 114 with a resulting gap 130 aligning with notched section 122 being formed. A third unit group 132 including three cable management members 106 is mounted to the second sidewall 118 proximate the first end 112 and opposite the unit group 126. A fourth unit group 134 including three cable management members 106 is mounted to the second sidewall 118 proximate the gap 130 and opposite the unit group 126. A fifth unit group 136 including three cable management members 106 is mounted to the second sidewall 118 proximate the gap 130 and opposite the unit group 128. A sixth unit group 138 including three cable management members 106 is mounted to the second sidewall 118 proximate the second end 114 and opposite the unit group 128. Although the example shown in the drawings shows a particular configuration of unit groups, the disclosure is not limited to any specific embodiment. Rather, many other arrangements are possible. For example, the entire length of the bracket portion 104 can be provided with cable management members along one or both of the sidewalls 116, 118.

[0028] As stated previously, the cable management assembly 100 can be provided with covers 108, 110. The first cover 108 can be provided and respectively attached to cable management members 106 associated with the first, third, and fourth unit groups 126, 132, 134. Similarly, the second cover 110 can be provided and respectively attached to cable management members 106 associated with the second, fifth, and sixth unit groups 128, 136, 138. The covers 108, 110 aid in securing the cables 200 within the carrier assembly 102 and also provide structural rigidity to the overall structure.

[0029] Each of the covers 108, 110 can be attached to the cable management member unit groups via fasteners 146. In the particular example shown, the fasteners 146 are provided as clips 146 which are shown in further detail at Figures 12 and 13. As shown, each clip has a first clip portion 148 for engaging with the cable management members 106 in a snap-fit manner. The first clip portion 148 includes a nose portion 148a which extends into a gap 106a between two adjacent cable management members 106. The first clip portion 148 also includes engagement portions 148b, 148c which snap over and engage with a top portion 106a of two adjacent cable management members 106. The engagement portions 148b, 148c are flared outwards at ends 148d, 148e to allow for the clip 146 to be positioned over and guided onto the cable management members 106. Each clip also has a second clip portion 150 for engaging with the bracket portion 104. As

shown the clip portion 150 defines a slot within which a protrusion extends for engaging in a snap-fit manner with the covers 108, 110.

[0030] When the example shown is assembled, an upper trunk 202 of cables 200 is routed from the gap 130 and between the first and fourth unit groups 126, 134. The cables 200 branch off from the upper trunk 202 in smaller groups. Some of the cables 200 branch off before the upper trunk 202 reaches the cable management members 106 while the remaining cables 202 branch off through the appropriate cable apertures 140 formed between the cable management members 106 associated with the first unit group 126. The third and fourth unit groups 132, 134 aid in retaining the upper trunk 202 within the carrier assembly 102 in conjunction with the cover 108. Once the cables 200 associated with the upper trunk 202 are adequately routed, the cables 200 can be bundled together and/or can be secured to the carrier assembly with banding 144, as is shown at Figure 1. In one method, the factory routing of the cables 200 is performed with the cable management members 106 mounted to the bracket portion 104 with the cover 108 removed such that the cables can be routed through the gaps 106a between the cable management members 106. The cable management members 106 are provided with sufficient flexibility such that they can be laterally deflected to increase the size of the gaps 106a. The cover 108 can be attached to the cable management members 106 after routing of the cables 200 is completed. A lower trunk 204 of cables 200 is shown as being similarly routed, but from the gap 130 towards the second and fifth unit groups 128, 136. While the above configuration is useful for a particular rack configuration, the disclosure is not limited to such an implementation. Rather, the location of the extension members 106 and the specific routing of the cables 200 can be provided in any configuration to match a desired installation for a particular rack 10 having telecommunications components that need to be interconnected.

[0031] Once factory assembled, the cable management assembly 100 can be shipped and then mounted to a telecommunications rack 10. To facilitate mounting, the end wall 120 can be provided with structures that allow for attachment to the rack 10. In the example shown, the bracket portion 104 is provided with hanger tabs 142 that align with corresponding apertures 11 in the rack 10. The hanger tabs 142 are integrally formed and bent from the bracket portion 104, but may be a separate component that is attached to the bracket portion 104. The bracket portion 104 is also provided with an aperture 143

through which fasteners, such as bolts can be inserted to further secure the bracket portion 104 to the rack 10. Alternatively, the rack 10 can be provided with studs, hanger elements, and/or protrusions and the bracket portion 104 can be provided with apertures configured with a corresponding shape for connection thereto, such as a keyhole slot. Once the cable management assembly 100 is mounted to the rack or cabinet 10, the cables 200 can then be connected to the telecommunications components mounted within the rack or cabinet 10.

[0032] One aspect of the present disclosure relates to a cable management assembly including a plurality of cables secured within a carrier assembly. In one aspect, the cables have different or customized individual lengths. The carrier assembly can include a bracket portion and a plurality of cable management members extending from the bracket portion. The plurality of cable management members can define a plurality of cable routing apertures through which at least some of the plurality of cables extend. The bracket portion is mountable to a telecommunications rack with the plurality of cables mounted within the carrier assembly.

[0033] In one embodiment, the cables are terminated patch cords with both ends terminated with telecommunications connectors, such as fiber, copper, or hybrid. In one embodiment, the carrier assembly includes a single vertical channel when mounted to a rack. In one embodiment, the carrier assembly includes access passages for cables to extend horizontally from the carrier assembly. In one embodiment, the cables are tied, affixed or attached to each other and/or to the carrier assembly before the carrier assembly is mounted to the rack. In one embodiment, the carrier assembly is mounted only on one side of the rack. In one embodiment, each of the cables connects a lower connection point to an upper connection point in the same rack. In one embodiment, the cables either connect a lower connection point to a middle portion with a first connection point, and/or an upper connection point to a middle portion with a second connection point, all in the same rack. In one embodiment, the cables have at least two different lengths from the carrier assembly when comparing cables in the same horizontal row. In one embodiment, the cables have the same lengths from the carrier assembly when comparing cables in the same horizontal row. In one embodiment, the cables extend from a multi-pack of terminated cables such as plugs to individual terminations such as plugs. In one embodiment, the carrier assembly is configured to be mounted to the rack when the carrier

assembly is full or at least partially full of cables. The mounting mechanism for mounting the carrier assembly to the rack is accessible for mounting the carrier assembly to the rack when the carrier assembly is full or at least partially full of cables. In one embodiment, the carrier assembly includes an exposed surface, such as a rear surface, facing a portion of the rack, wherein the exposed surface includes at least part of the mounting mechanism accessible for mounting the carrier assembly to the rack when the carrier assembly is full or at least partially full of cables.

[0034] A method for assembling a factory built cable management assembly is provided. The method can include the steps of: providing a carrier assembly having a bracket portion from which a plurality of cable management members extend to define a plurality of cable mounting apertures, the bracket portion being configured for being field mounted to a telecommunications rack; providing a plurality of cables, wherein at least some of the cables have a different length than at least some of the other cables; and routing the plurality of cables within the carrier assembly and through at least some of the cable mounting apertures. Once the cable management assembly is built in the factory, the assembly can be shipped to a site, where the assembly can be mounted to a telecommunications rack and the cables can be connected to the equipment supported therein at day 1 and/or at day 2. In one method, the carrier assembly is mounted vertically, and the cables extend vertically, and then horizontally to equipment when mounted to a rack.

[0035] A method of installing a telecommunications system is also provided. The method can include the steps of: providing a factory assembled cable management assembly including a plurality of cables, some of which having lengths that are different than lengths of others of the plurality of cables, and a carrier assembly including a plurality of cable management members defining a plurality of cable routing apertures through which at least some of the plurality of cables extend; mounting the carrier assembly to a telecommunications rack to which telecommunications components are secured; and connecting the plurality of cables to the telecommunications components at day 1 and/or at day 2. In one method, the carrier assembly is mounted vertically, and the cables extend vertically, and then horizontally to equipment when mounted to a rack.

[0036] Referring to Figures 14 and 15, and alternative configuration of the cable management assembly 100' is shown. Where like or similar features or elements are

shown, corresponding or like reference numbers will be used where possible. Many of the concepts and features of the second embodiment are similar to the first embodiment. As such, the description for the first embodiment is applicable for the second embodiment. The description for the second embodiment will be limited to the differences between the first and second embodiments. The primary difference between the embodiments is that the carrier assembly 100' is configured as an integrally formed unit in which the bracket portion 104', the cable management members 106', and the covers 108', 110' are formed from a single sheet of material. Accordingly, the apertures 140' through which the cables 200 extend are formed as openings or slots through horizontal segments 106' extending between the bracket portion 104' and the covers 108', 110'. Also, the portion of material that forms the covers 108', 110' also extends across the gap 130' such that the gap 130' is enclosed. The carrier 102' of this embodiment is also formed with mounting apertures to engage with hanger tabs 11' on the cabinet 10' such that the carrier 102' can be mounted to the cabinet 10'. The carrier 102' further includes apertures 105' that receive the bolt heads associated with the rack 10 to allow the carrier 102' to be flush mounted against the rack 10.

[0037] Various modifications and alterations of this disclosure will become apparent to those skilled in the art without departing from the scope and spirit of this disclosure, and it should be understood that the scope of this disclosure is not to be unduly limited to the illustrative embodiments set forth herein.

WHAT IS CLAIMED IS:

1. A cable arrangement assembly for a telecommunications rack, the cable management assembly comprising:
 - (a) a plurality of cables, some of which having lengths that are different than lengths of others of the plurality of cables; and
 - (b) a carrier assembly including a bracket portion and a plurality of cable management members extending from the bracket portion, the plurality of cable management members defining a plurality of cable routing apertures through which at least some of the plurality of cables extend, the bracket portion being mountable to a telecommunications rack with the plurality of cables mounted within the carrier assembly.
2. The cable management assembly of claim 1, further comprising:
 - (a) a first cover connected to at least some of the plurality of cable management members.
3. The cable management assembly of claim 2, further comprising:
 - (a) a second cover connected to at least some of the plurality of cable management members.
4. The cable management assembly of claim 1, wherein the plurality of cables are copper based cables.
5. The cable management assembly of claim 4, wherein the plurality of cables are provided with RJ type connectors at both ends of each of the plurality of cables.
6. The cable management assembly of claim 1, wherein the bracket portion includes first and second sidewalls extending from an end wall of the bracket portion.
7. The cable management assembly of claim 6, wherein the plurality of cable management members includes a first plurality of cable management members extending from the first sidewall.

8. The cable management assembly of claim 7, wherein the plurality of cable management members includes a second plurality of cable management members extending from the second sidewall.
9. The cable management assembly of claim 8, further comprising:
 - (a) a first cover connected to at least some of the first plurality of cable management members and to at least some of the second plurality of cable management members.
10. The cable management assembly of claim 2, further comprising:
 - (a) a second cover connected to at least some of the plurality of cable management members.
11. The cable management assembly of claim 1, wherein the plurality of cable management members are separable components that are connected to the bracket portion.
12. The cable management assembly of claim 11, wherein the plurality of cable management members are connected to the bracket portion by a snap-fit connection.
13. A cable arrangement assembly for a telecommunications rack, the cable management assembly comprising:
 - (a) a plurality of cables, some of which having lengths that are different than lengths of others of the plurality of cables;
 - (b) a carrier assembly including a bracket portion and a plurality of cable management members extending from the bracket portion, the plurality of cable management members defining a plurality of cable routing apertures through which at least some of the plurality of cables extend, the bracket portion being mountable to a telecommunications rack with the plurality of cables mounted within the carrier assembly; and
 - (c) a cover connected to at least some of the plurality of cable management members, the first cover being connected to the cable management members at an end opposite from which the cable management members extend from the bracket portion.

14. The cable management assembly of claim 13, wherein the bracket portion includes first and second sidewalls extending from an end wall of the bracket portion.
15. The cable management assembly of claim 14, wherein the plurality of cable management members includes a first plurality of cable management members extending from the first sidewall.
16. The cable management assembly of claim 15, wherein the plurality of cable management members includes a second plurality of cable management members extending from the second sidewall.
17. The cable management assembly of claim 16, wherein the cover is connected to at least some of the first plurality of cable management members and to at least some of the second plurality of cable management members.
18. A method for assembling a cable management assembly comprising:
 - (a) providing a carrier assembly having a bracket portion from which a plurality of cable management members extend to define a plurality of cable mounting apertures, the bracket portion being configured for being field mounted to a telecommunications rack;
 - (b) providing a plurality of cables, wherein at least some of the cables have a different length than at least some of the other cables; and
 - (c) routing the plurality of cables within the carrier assembly and through at least some of the cable mounting apertures.
19. The method of claim 18, wherein the step of providing a plurality of cables includes providing a plurality of cables having RJ type connectors attached at both ends of each cable.
20. The method of claim 18, wherein the step of providing a carrier assembly includes providing at least one cover attached to at least some of the cable management members.

21. A method of installing a telecommunications system, the method comprising:
- (a) providing a factory assembled cable management assembly including:
 - i. a plurality of cables, some of which having lengths that are different than lengths of others of the plurality of cables; and
 - ii. a carrier assembly including a plurality of cable management members defining a plurality of cable routing apertures through which at least some of the plurality of cables extend;
 - (b) mounting the carrier assembly to a telecommunications rack to which telecommunications components are secured; and
 - (c) connecting the plurality of cables to the telecommunications components.
22. The method of claim 21, wherein the carrier assembly includes a mounting bracket having at least one hanger tab and wherein the step of mounting the carrier assembly includes engaging the at least one hanger tab with an aperture in the telecommunications rack.

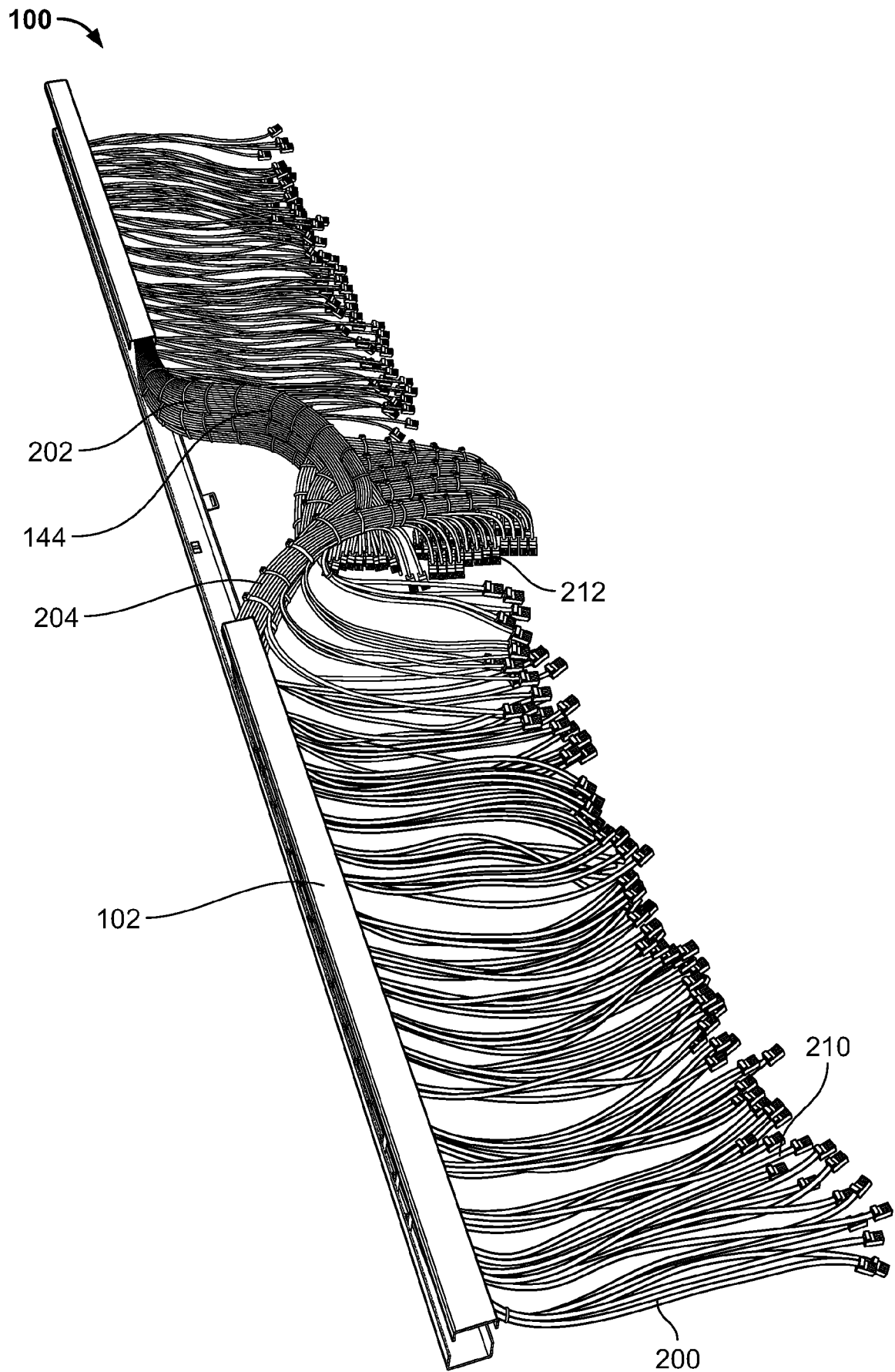


FIG. 1

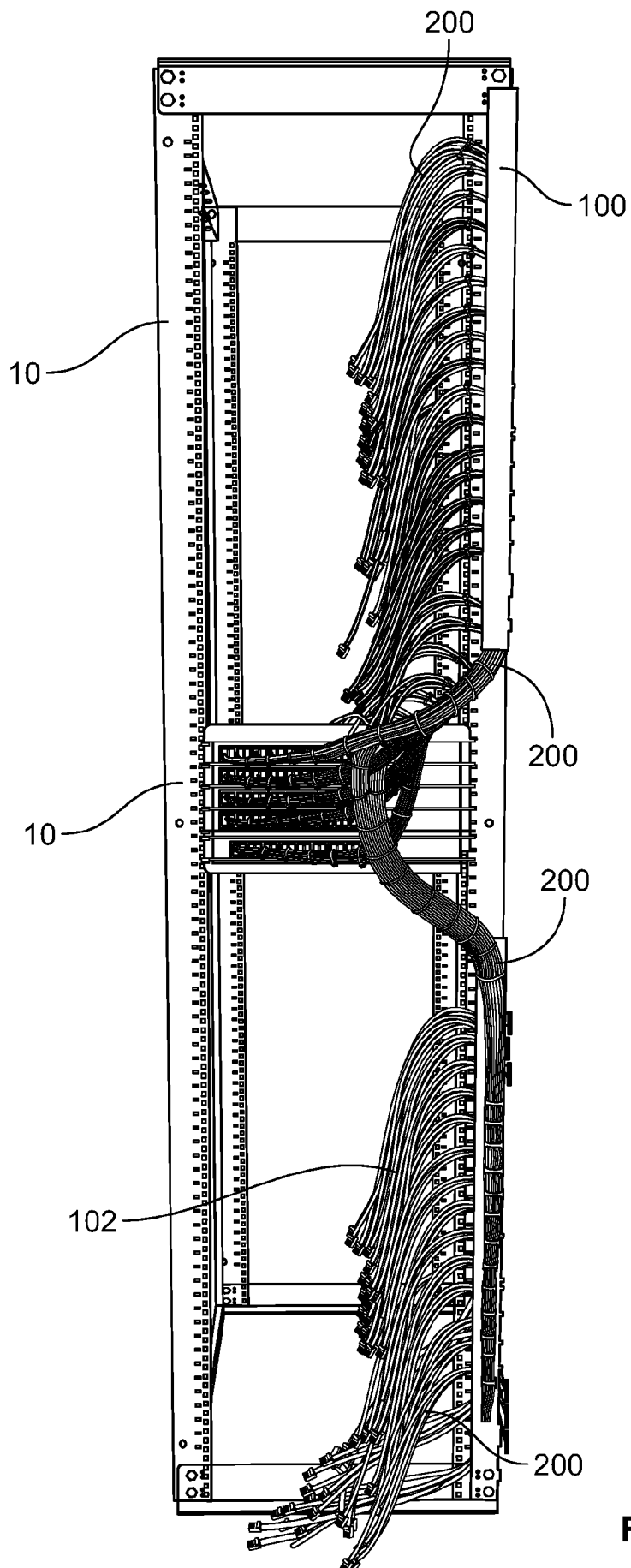


FIG. 2

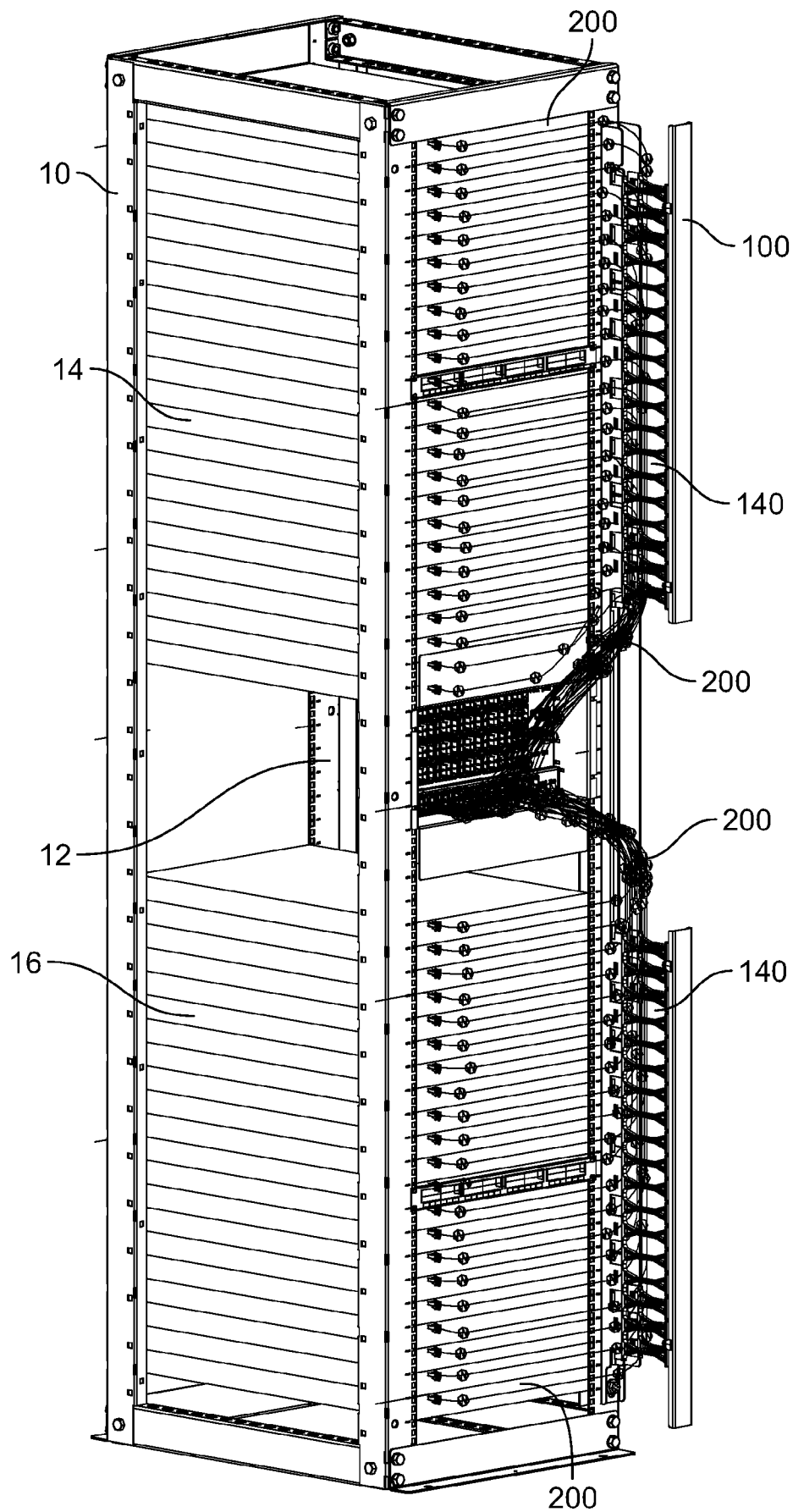


FIG. 3

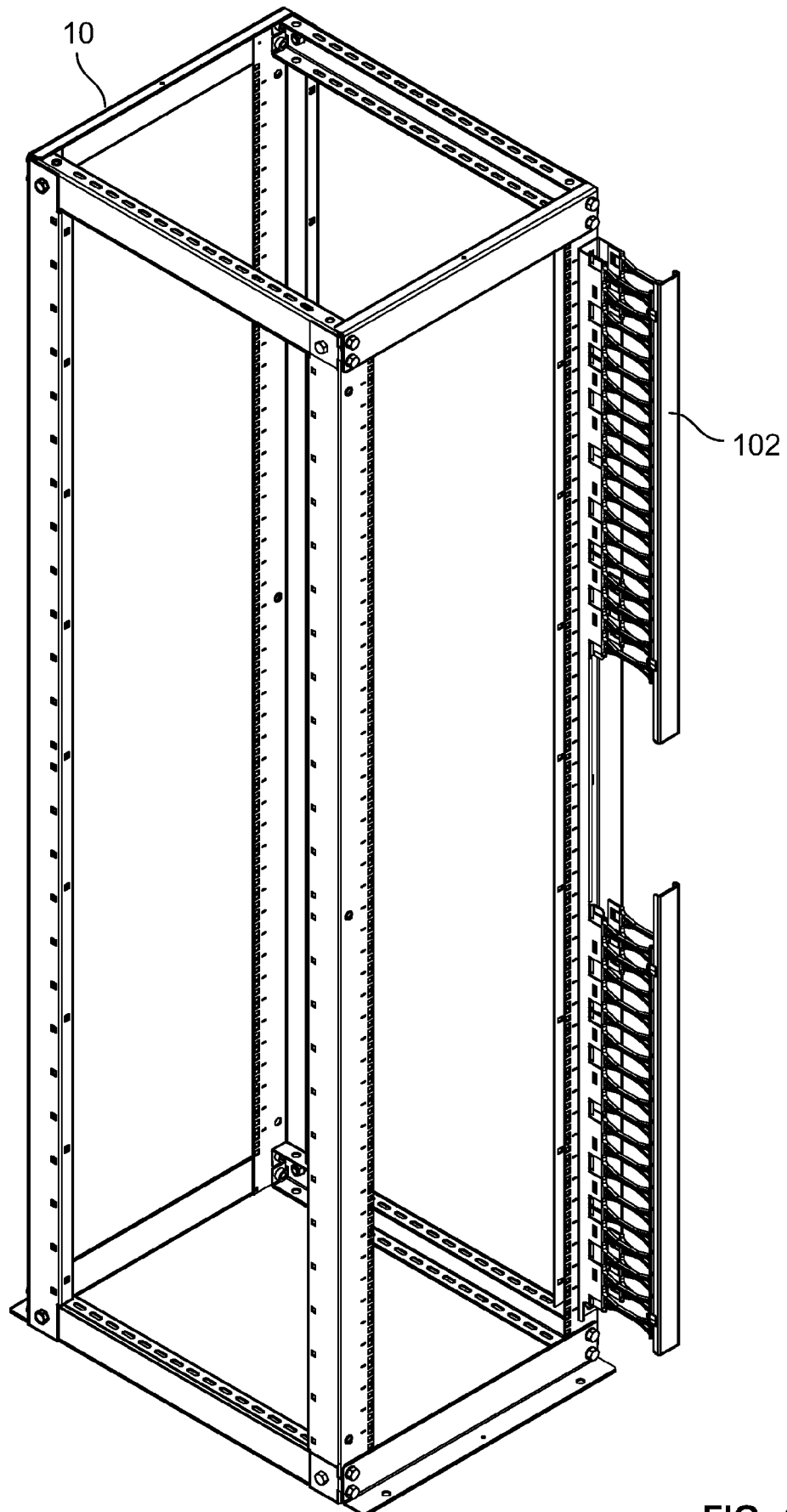


FIG. 4

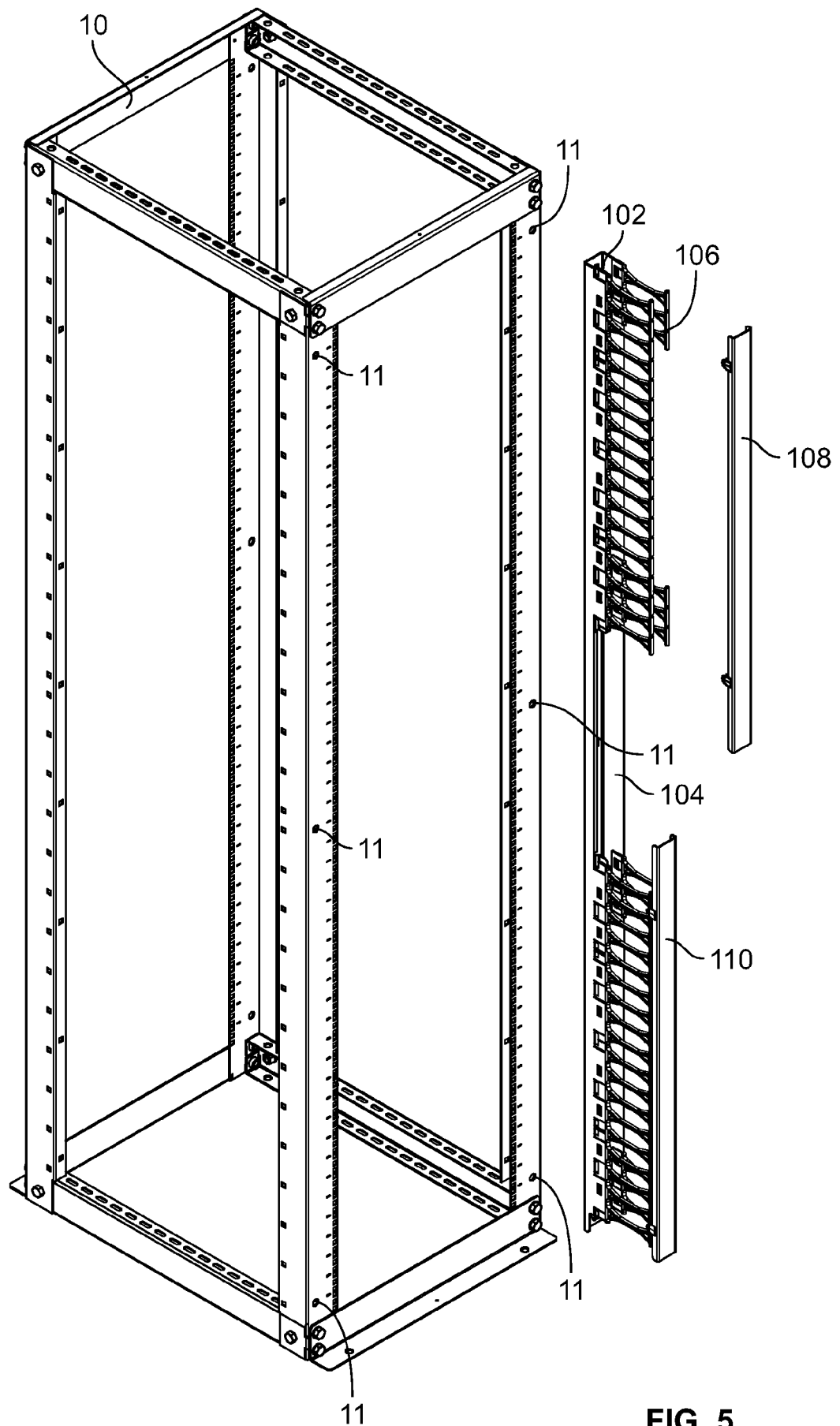


FIG. 5

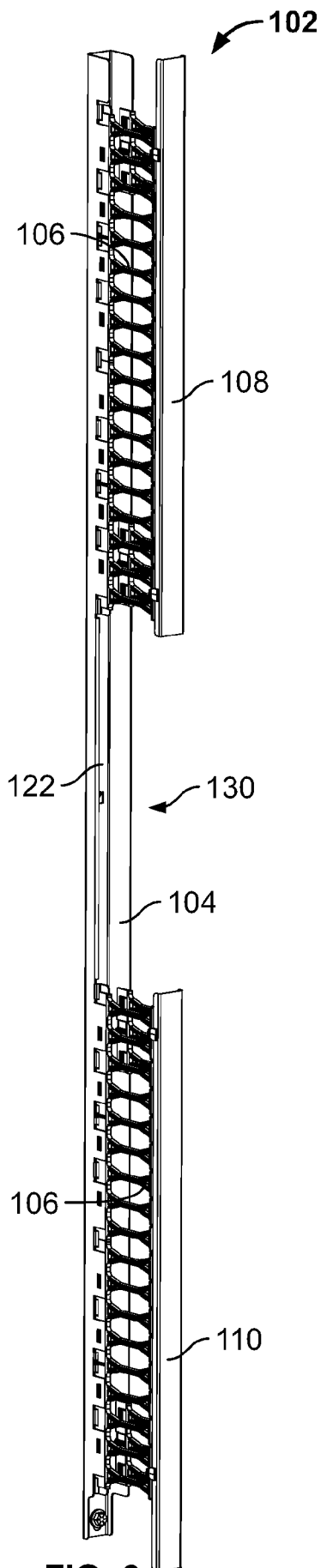


FIG. 6

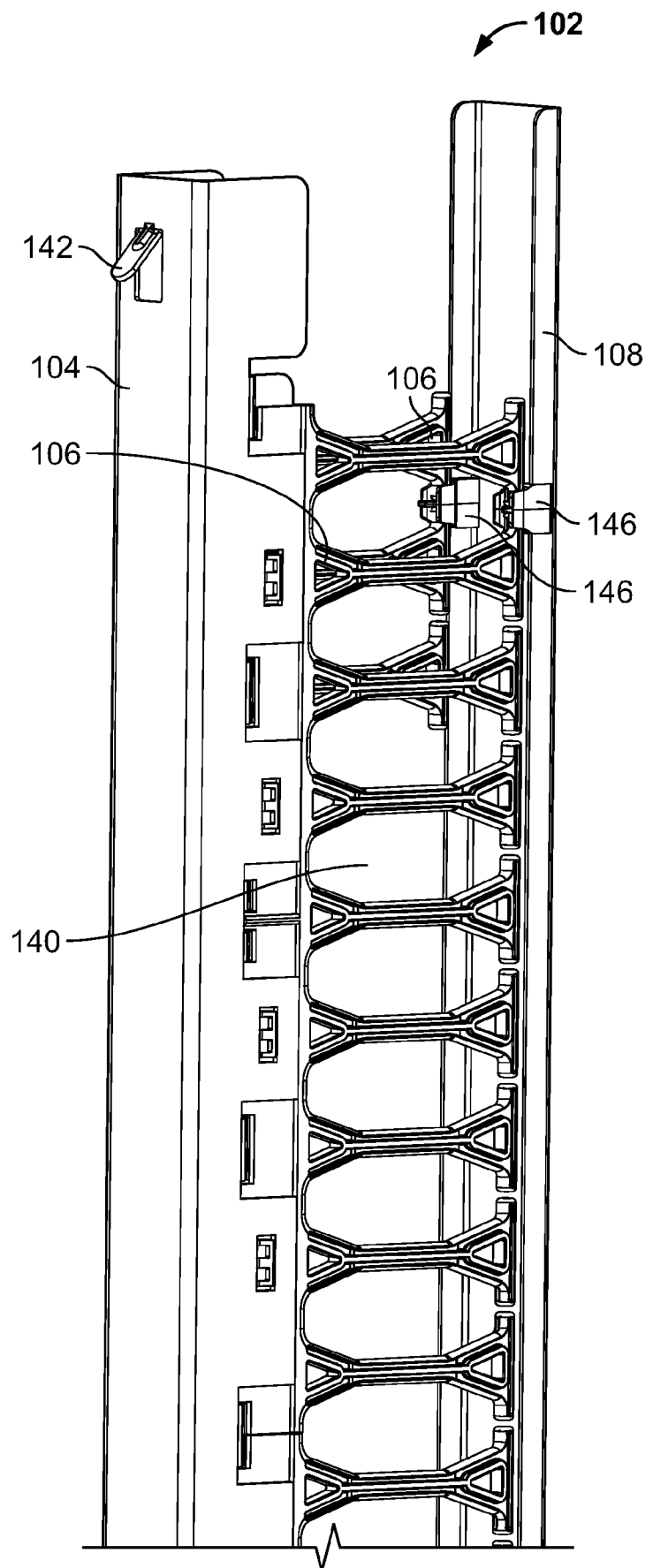


FIG. 7

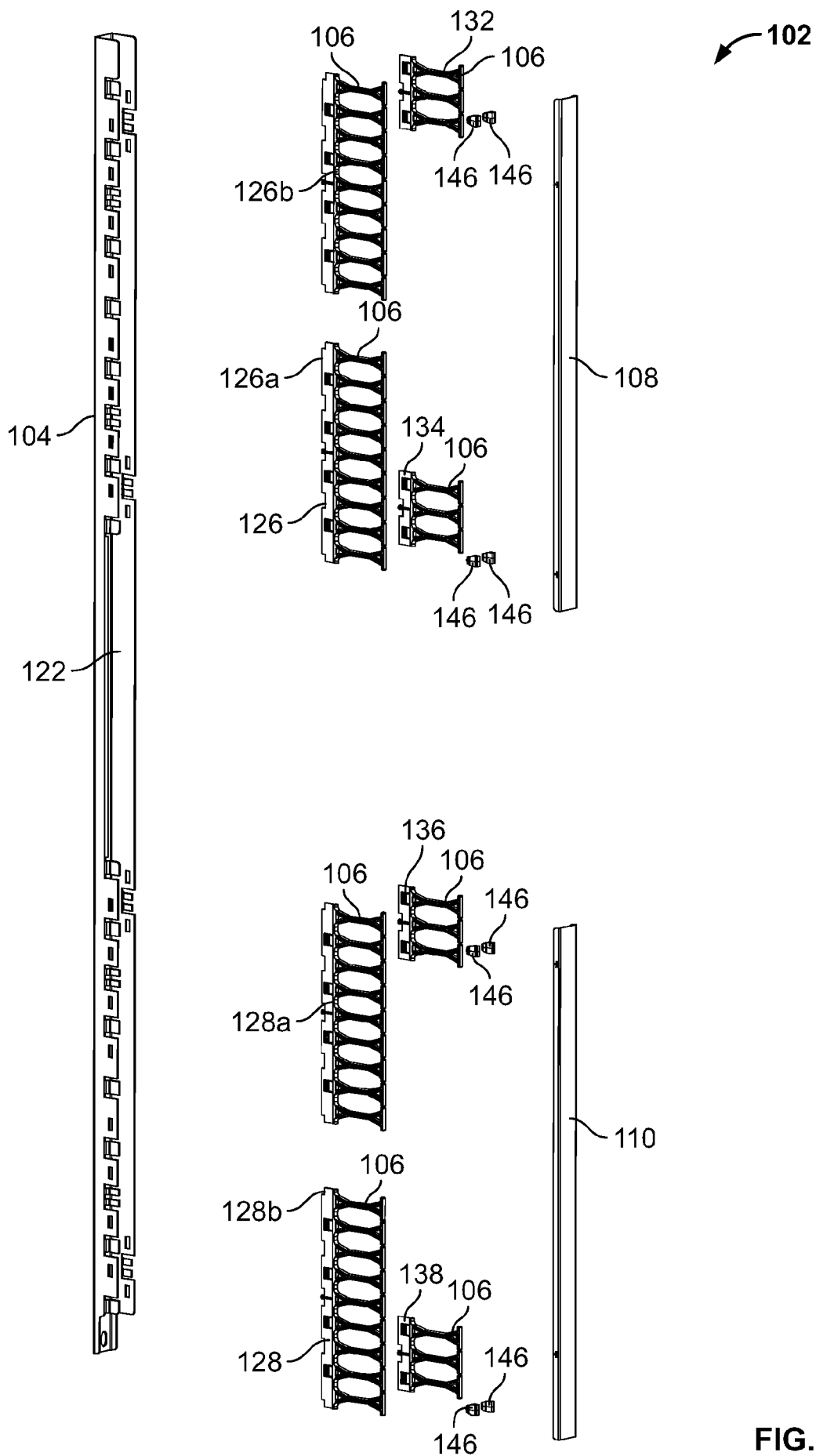


FIG. 8

102

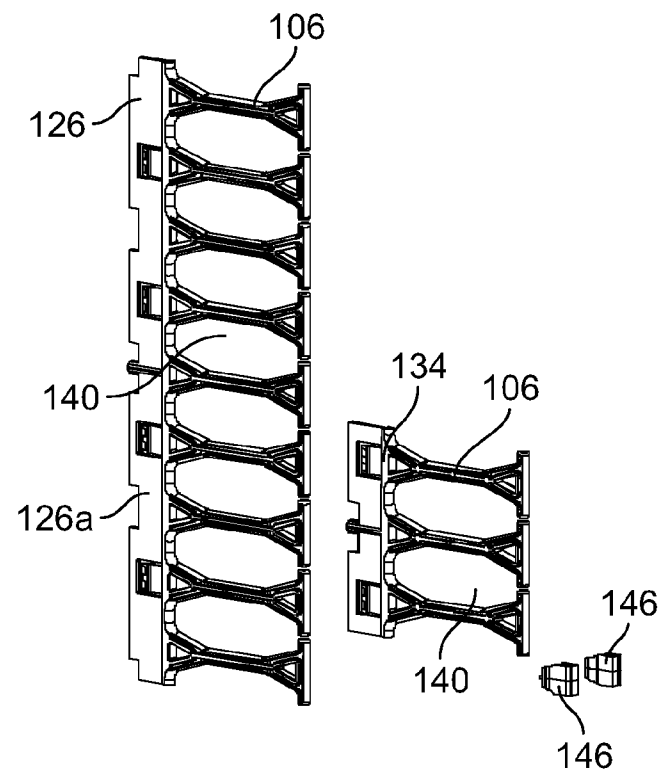
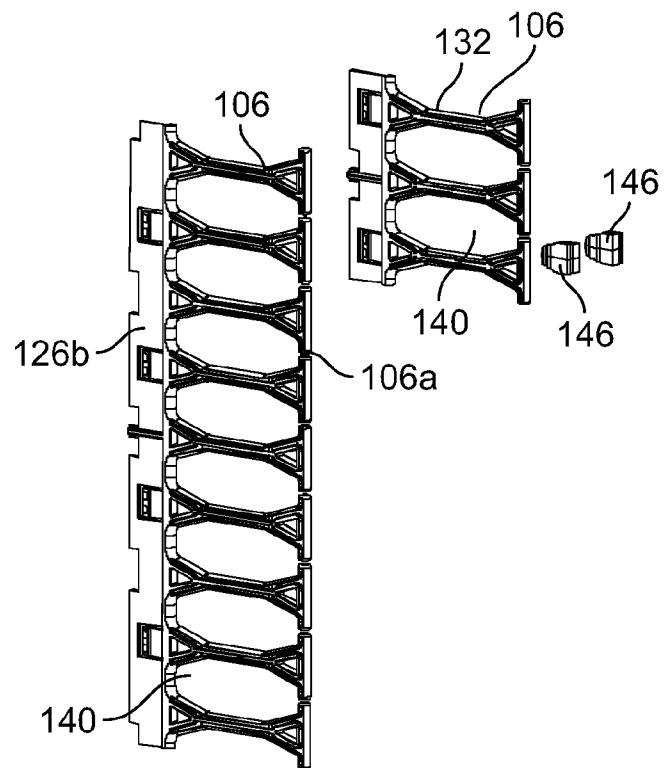
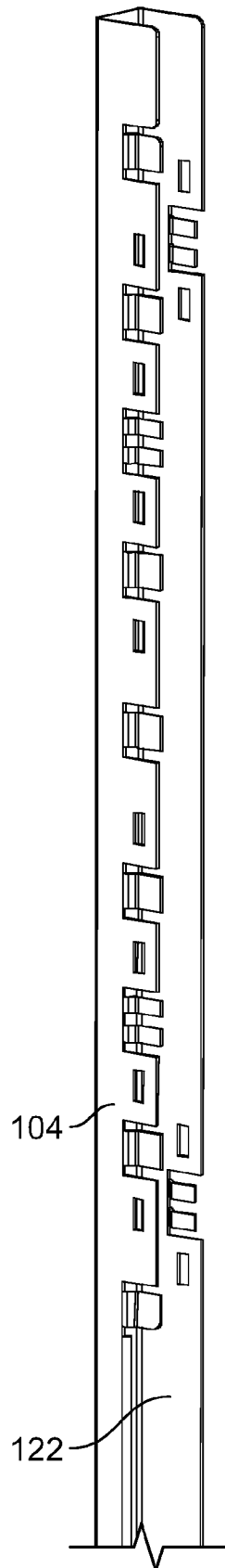


FIG. 9

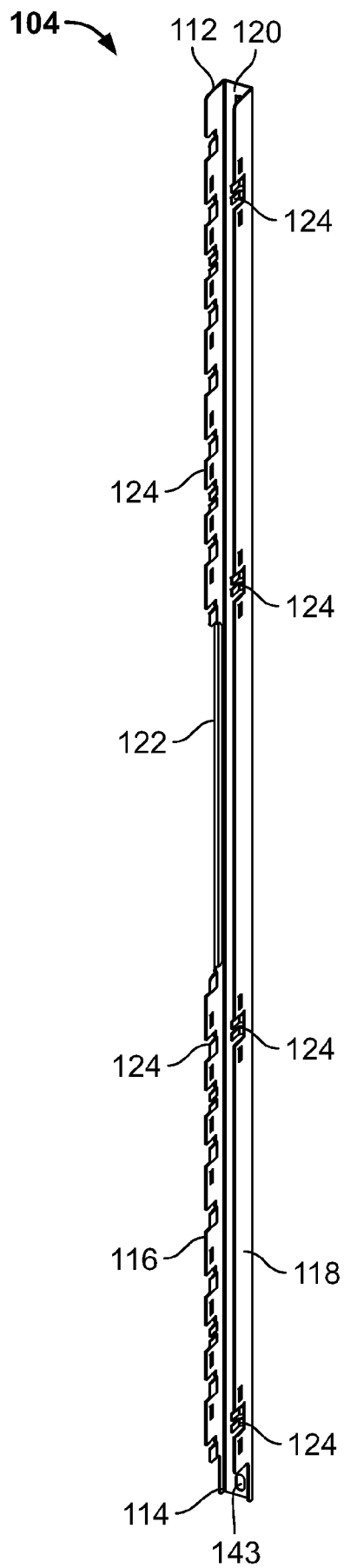


FIG. 10

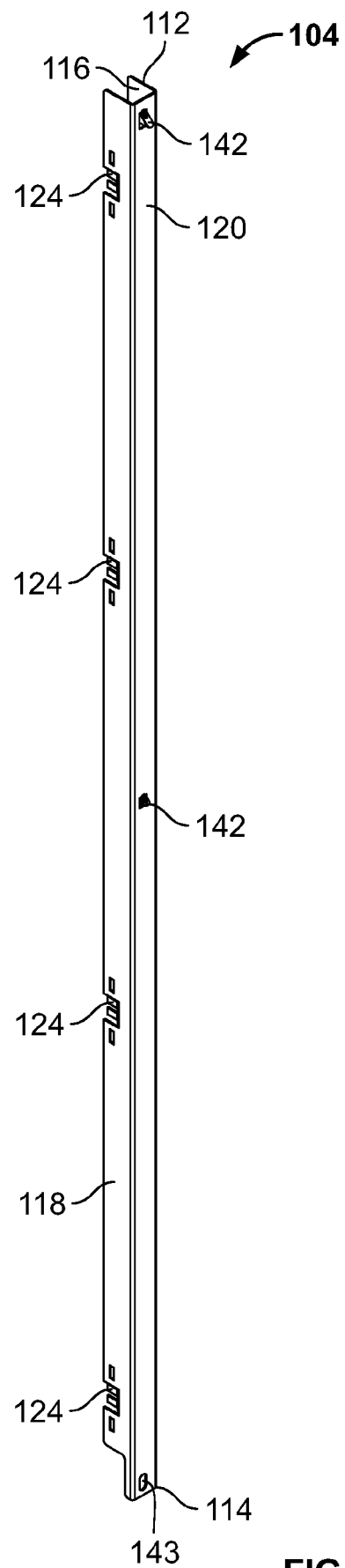


FIG. 11

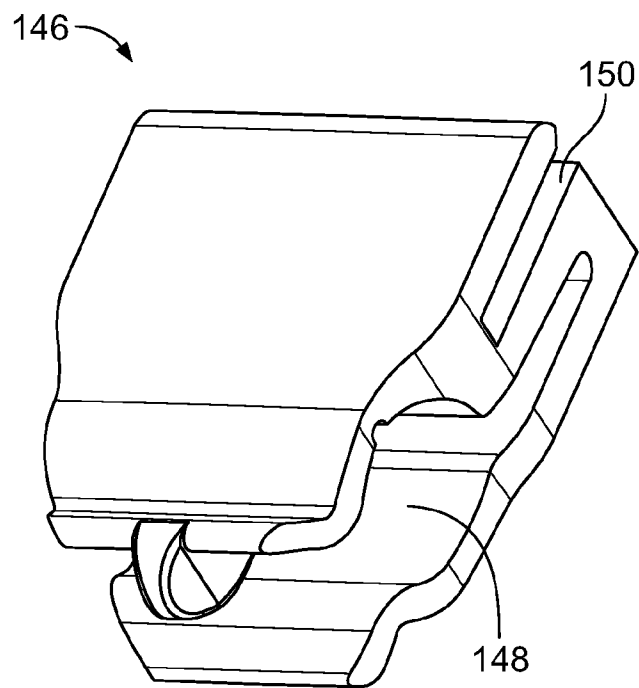


FIG. 12

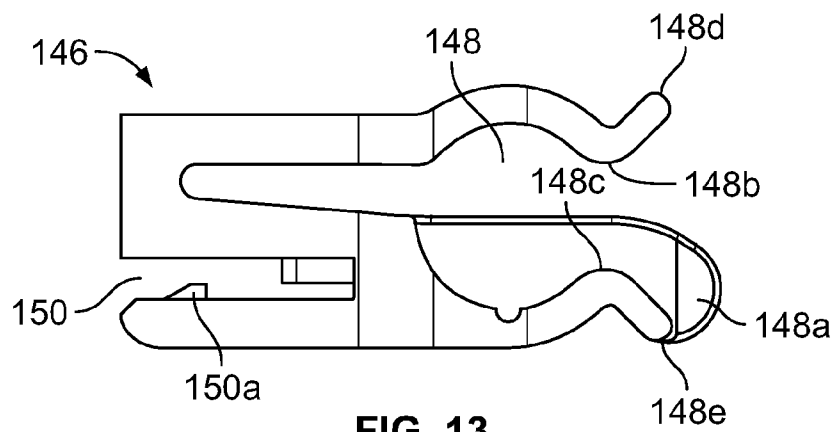


FIG. 13

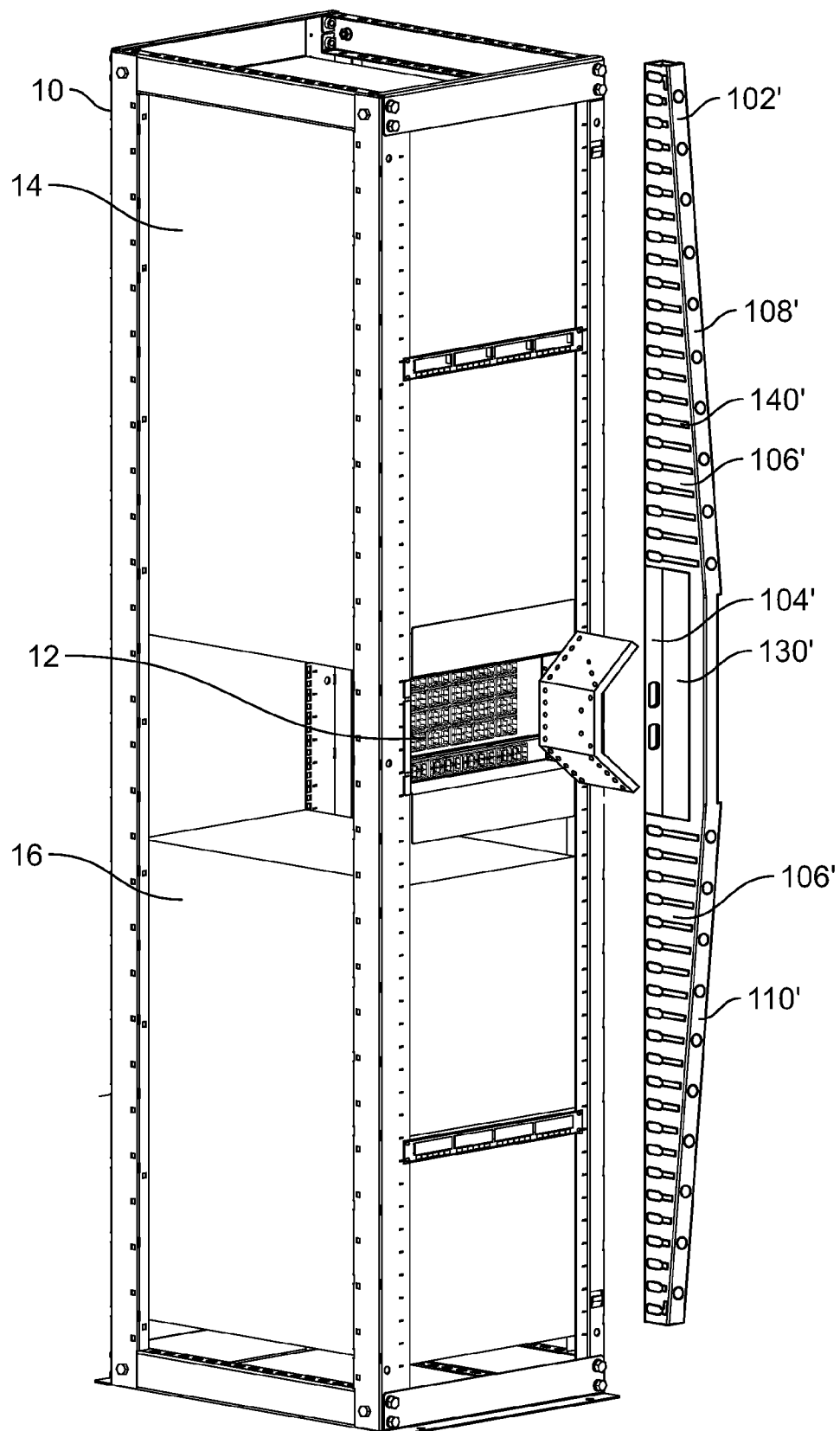


FIG. 14

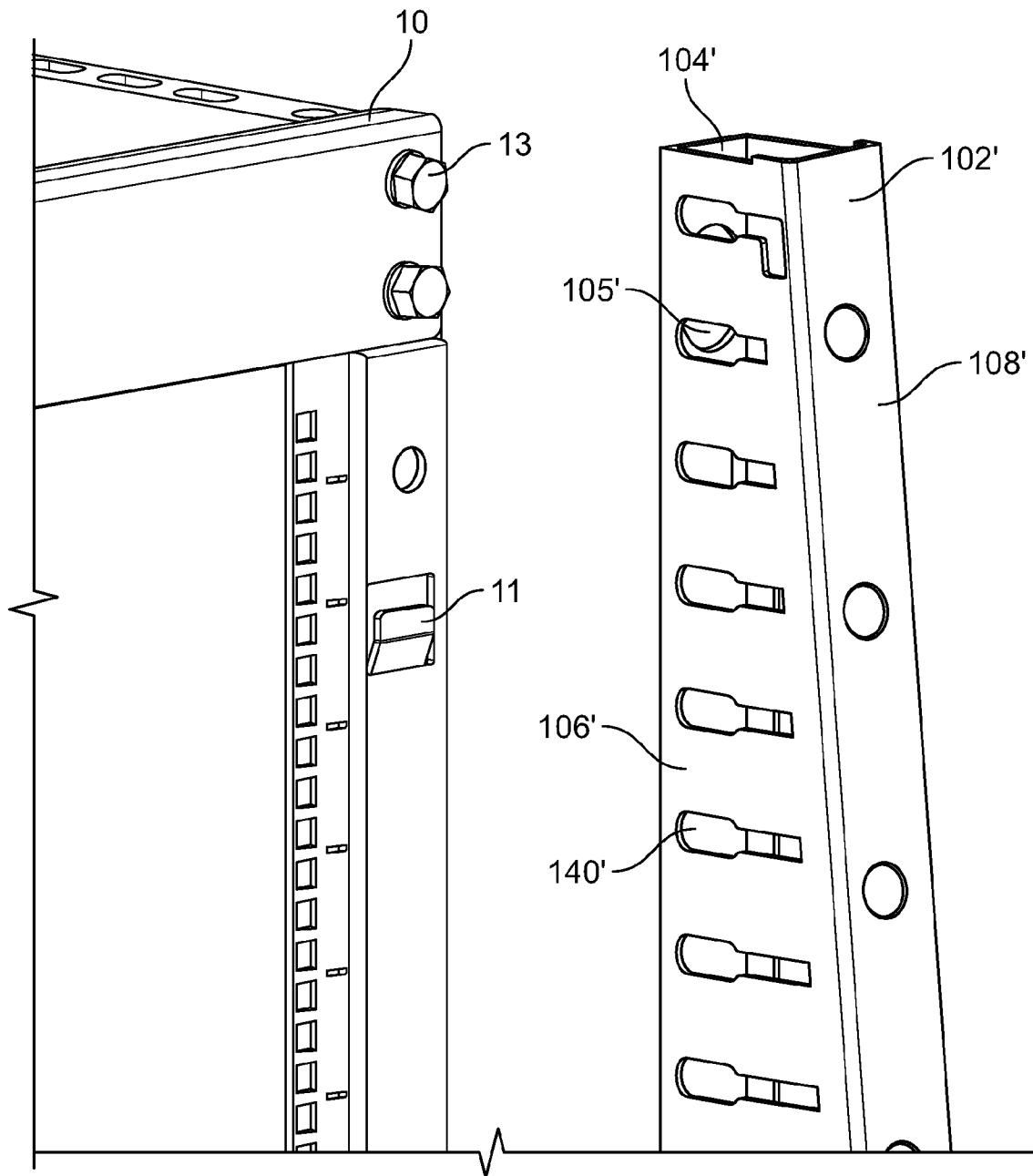


FIG. 15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2017/026138**A. CLASSIFICATION OF SUBJECT MATTER****H04Q 1/06(2006.01)i, H04Q 1/02(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 1/06; A47F 7/00; H02G 3/02; B23P 11/00; G02B 6/46; H05K 5/03; G02B 6/00; H02B 1/20; H04Q 1/02

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: telecommunication rack, cable, management, arrangement

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2011-0155674 A1 (PAUL ALLAN KNIGHT et al.) 30 June 2011 See paragraphs [0018], [0028]-[0031], [0042] and figures 1, 4.	1-22
Y	CN 105322472 A (A-RACK ENCLOSURE SYSTEM CO., LTD.) 10 February 2016 See paragraphs [0029]-[0032], [0035], claims 1-2 and figures 2-4, 8.	1-22
Y	US 2010-0296789 A1 (WADE WOMACK et al.) 25 November 2010 See paragraph [0023] and figure 7.	4-5, 19
A	US 2012-0267991 A1 (SAMUEL J. ADDUCCI et al.) 25 October 2012 See paragraphs [0108]-[0113] and figures 14A, 15A-16B.	1-22
A	US 2011-0262097 A1 (KEVIN L. HRUBY et al.) 27 October 2011 See paragraphs [0037]-[0047] and figures 1, 5-7.	1-22



Further documents are listed in the continuation of Box C.



See patent family annex.

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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

"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

28 June 2017 (28.06.2017)

Date of mailing of the international search report

17 July 2017 (17.07.2017)

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

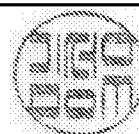


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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2017/026138

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