



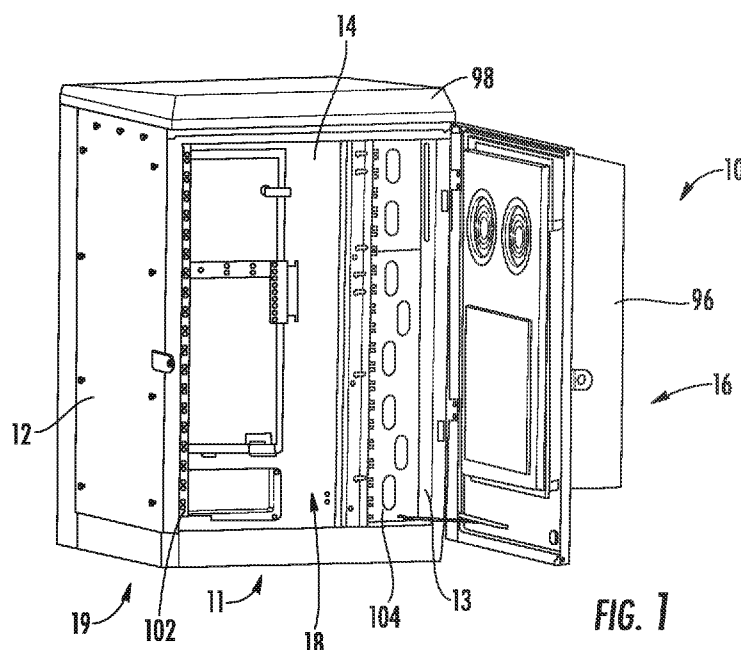
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(54) **Title:** OUTDOOR ELECTRONICS ENCLOSURE WITH MODULAR STRUCTURE



(57) **Abstract:** A modular electronics enclosure includes a rear frame, a first L-shaped piece and a second L-shaped piece joined to form a box-shaped shell having a floor, a ceiling, a rear wall and first and second opposed side walls that define an internal cavity. The first L-shaped piece includes a wall panel and a top panel that form the ceiling and the first side wall of the shell. The second L-shaped piece includes a wall panel and a bottom panel that form the floor and the second side wall of the shell. The rear frame forms the rear wall of the shell.

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OUTDOOR ELECTRONICS ENCLOSURE WITH MODULAR STRUCTURE

Related Application

[0001] The present application claims priority from and the benefit of U.S. Provisional Patent Application No. 62/718,459, filed August 14, 2018, the disclosure of which is hereby incorporated herein in its entirety.

Field of the Invention

[0002] The present invention relates generally to cabinets, and more specifically to electronics cabinets.

Background

[0003] Outdoor electronics cabinets have become popular in recent years. They can protect a wide range of electronic equipment including radios, multicarrier power amplifiers (MCPA), power supplies, batteries, and wireless cell site backhaul equipment. These cabinets can protect base station equipment from environmental conditions while minimizing operating expenses and energy consumption.

[0004] Electronics cabinets are typically offered in a limited number of configurations and sizes. It may be desirable to provide cabinets in more varied configurations.

Summary

[0005] As a first aspect, embodiments of the invention are directed to a modular electronics enclosure. The enclosure comprises: a rear frame, a first L-shaped piece and a second L-shaped piece joined to form a box-shaped shell having a floor, a ceiling, a rear wall and first and second opposed side walls that define an internal cavity. The first L-shaped piece includes a wall panel and a top panel that form the ceiling and the first side wall of the

shell. The second L-shaped piece includes a wall panel and a bottom panel that form the floor and the second side wall of the shell. The rear frame forms the rear wall of the shell.

[0006] As a second aspect, embodiments of the invention are directed to a modular electronics enclosure comprising: a rear frame, a first L-shaped piece and a second L-shaped piece joined to form a box-shaped shell having a floor, a ceiling, a rear wall and first and second opposed side walls that define an internal cavity. The first L-shaped piece includes a wall panel and a top panel that form the ceiling and the first side wall of the shell. The second L-shaped piece includes a wall panel and a bottom panel that form the floor and the second side wall of the shell. The rear frame forms the rear wall of the shell. The first and second pieces and the rear frame are joined with fasteners that are located in the internal cavity of the shell.

Brief Description of the Figures

[0007] **FIG. 1** is a front perspective view of a small cell modular cabinet according to embodiments of the invention, with the door in an open position.

[0008] **FIG. 2** is a rear perspective view of the cabinet of **FIG. 1**.

[0009] **FIG. 3** is a front view of the cabinet of **FIG. 1** with the door in a closed position.

[0010] **FIG. 4** is a rear view of the cabinet of **FIG. 1**.

[0011] **FIG. 5** is a right side view of the cabinet of **FIG. 1** with the door in a closed position.

[0012] **FIG. 6** is a left side view of the cabinet of **FIG. 1** with the door in a closed position.

[0013] **FIG. 7** is a front perspective view of the shell of the cabinet of **FIG. 1**.

[0014] **FIG. 8** is a front exploded perspective view of the shell of **FIG. 7**.

[0015] **FIG. 9** is an internal enlarged perspective view of the joint between the left wall and the floor of the cabinet of **FIG. 1**.

[0016] **FIG. 10** is an internal enlarged perspective view of the joints between the right wall, the rear wall and the ceiling of the cabinet of **FIG. 1**.

[0017] **FIG. 11** is a front perspective view of a cabinet according to alternative embodiments of the invention with the door in the open position, wherein the cabinet is configured to store one battery string.

[0018] **FIG. 12** is a front perspective view of a cabinet according to further embodiments of the invention with the door in the open position, wherein the cabinet is configured to store two battery strings.

[0019] **FIG. 13** is a front view of the cabinet of **FIG. 1**.

[0020] **FIG. 14** is a front view of the cabinet of **FIG. 11**.

[0021] **FIG. 15** is a front view of the cabinet of **FIG. 12**.

[0022] **FIG. 16** is a front view of a cabinet assembly that comprises two shells of **FIG. 7**, with one shell containing three battery strings and the other containing racks for equipment.

[0023] **FIG. 17** is a front perspective view of the cabinet assembly of **FIG. 16**.

[0024] **FIG. 18** is a rear perspective view of the cabinet of **FIG. 1** with the upper I/O panel removed.

[0025] **FIG. 19** is a left perspective view of the cabinet of **FIG. 1** showing one equipment rack mounted to a side wall.

[0026] **FIG. 20** is a perspective view of a battery tray used to support batteries in the cabinet of **FIG. 11**.

[0027] **FIG. 21** is a perspective view of the battery tray of **FIG. 20** installed within a cabinet of **FIG. 1**.

[0028] **FIG. 22** is a perspective view of a divider panel for use in the cabinet of **FIG. 1**.

[0029] **FIG. 23** is a perspective view of the divider panel of **FIG. 22** installed in the cabinet of **FIG. 1**.

Detailed Description

[0030] 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.

[0031] 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.

[0032] In addition, spatially relative terms, such as "under", "below", "lower", "over", "upper", "top", "middle", "bottom" and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is turned over, elements described as "under" or "beneath" other elements or features would then be oriented "over" the other elements or features. Thus, the exemplary term "under" can encompass both an orientation of over and under. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly.

[0033] Well-known functions or constructions may not be described in detail for brevity and/or clarity.

[0034] Referring now to the figures, a small cell modular cabinet, designated broadly at **10**, is illustrated in **FIGS. 1-10**. The cabinet **10** has a generally box-shaped shell **19**, with a floor **11**, left and right side walls **12, 13**, a rear wall **14**, and a ceiling **15**. A door **16** covers the front of the cabinet **10** but allows access to the internal cavity **18** of the cabinet **10**. The door **16** is attached via a hinge **18** that allows it to pivot between an open position (as shown in **FIGS. 1** and **11**), in which the cavity **17** is accessible, and a closed position (as shown in **FIGS. 5** and **6**), in which the door **16** blocks access to the cavity **17** and thereby protects equipment (such as radios, multicarrier power amplifiers (MCPA), power supplies, and wireless cell site backhaul equipment) and batteries stored therein.

[0035] Referring to **FIGS. 7** and **8**, it can be seen that the shell **19** is formed of three different components: an L-shaped piece **30** that forms the ceiling **15** and the left side wall **12**, a second L-shaped piece **50** that forms the floor **11** and the right side wall **13**, and a back frame **70** that forms the rear wall **14**. The piece **30** includes a wall panel **32** and a top panel

34. A front lip 36 extends perpendicularly from the front edges of the wall panel 32 and top panel 34 (see FIGS. 9 and 10). Similarly, a rear lip 38 extends perpendicularly from the rear edges of the wall panel 32 and top panel 34. A bottom lip 40 extends inwardly from the lower edge of the wall panel 32, and a top lip 42 extends downwardly from the right edge of the top panel 34. A flange 46 (FIGS. 7 and 10) extends inwardly from the lower edge of the top lip 42.

[0036] The piece 50 includes a wall panel 52 and a bottom panel 54. A front lip 56 extends perpendicularly from the front edges of the wall panel 52 and bottom panel 54. Similarly, a rear lip 58 extends perpendicularly from the rear edges of the wall panel 52 and bottom panel 54. A bottom lip 60 extends upwardly from the left edge of the bottom panel 54, and a top lip 62 extends inwardly from the upper edge of the wall panel 52. A flange 64 extends inwardly from the upper end of the bottom lip 60.

[0037] The back frame 70 includes a rear panel 72 that has a large cut-out 74 and a smaller cut-out 76. Top, bottom and side panels 78, 80, 82, 84 extend forwardly from the edges of the rear panel 72. Flanges 86, 88, 90, 92 project inwardly from the edges of the top, bottom and side panels 78, 80, 82, 84.

[0038] It can also be seen in FIG. 1 that a cap 98 may be attached to the shell 19 to cover the top panel 34. The cap 98 may be slightly sloped as shown to facilitate the draining of rainwater and/or other environmental agents that may land thereon.

[0039] As can be seen in FIGS. 7 and 10, the pieces 30, 50 and the back frame 70 can be assembled into the shell 19 by abutting the respective lips and flanges and fastening them with screws or bolts inserted through holes in the lips and flanges. More specifically, the back frame 70 is attached to the piece 30 by fastening the flanges 86, 90 to the rear lip 38. The back frame 70 is attached to the piece 50 by fastening the flanges 88, 92 to the rear lip 58. The pieces 30, 50 are attached to each other by fastening the flange 64 to the bottom lip 40 and the top lip 62 to the flange 46 extending from the top lip 42 of the piece 30. Gaskets (which may be detachable or “pour in place” gaskets) may be interposed between some or all of these joints to provide a watertight seal to the shell 19. This arrangement enables the shell 19 to have no externally exposed fasteners, thereby improving security of the cabinet 10. The assembled cabinet 10 may be any size, but in some embodiments may have a cavity 17 that is 21 RU (“rack units, with each rack unit equal to about 1.75 inches) in height. In other embodiments, the cabinet may have a cavity that is equal to about 8, 14, 28 or 35 RU.

[0040] Also noteworthy is the sturdiness of construction. Conventional electronics cabinets employ a skeletal frame/lattice of beams and supports that serve as a foundation of the cabinet. Thin panels are attached to the beams to provide an enclosed shell. Thus, numerous parts (and attendant labor) are typically required to construct the shell, with the strength and rigidity of the shell provided largely by the skeletal frame. In contrast, the shell **19** comprises only three major components apart from fasteners: the pieces **30, 50** and the back frame **70**. In particular, the configuration of the back frame **70**, with its top, bottom and side panels **78, 80, 82, 84** being disposed generally perpendicularly to the rear panel **72**, imbue the back frame **70** with considerable strength and rigidity. As a result, the shell **19** can be constructed from the pieces **30, 50** and rear frame **70** alone, without an underlying skeletal frame.

[0041] As noted above, the door **16** is attached to the shell **19** via a hinge **18**, which can be of conventional construction. In many instances, a cooling unit **96** is mounted on the door **16**. The cooling unit **96** may be passive (e.g., directed vents) or active (e.g., fans or air conditioning) as desired or needed. The cooling unit **96** shown in **FIG. 1** is a heat exchanger.

[0042] Referring to **FIGS. 1** and **13**, it can be seen that equipment racks **102, 104** may be mounted within the cavity **17**; the racks **102, 104** are typically mounted via fasteners inserted through apertures in the wall panels **32, 52** of the pieces **30, 50**. The racks **102, 104** may be configured in any manner known to those of skill in this art. In some embodiments, the racks **102, 104** may have the capability to mount equipment that is either 19 or 23 inches in width; exemplary racks that provide this capability are discussed in U.S. Patent Publication No. 2017/0280580 to Mann, filed March 21, 2017, the disclosure of which is hereby incorporated herein. The racks **102, 104** may be single integrated components as shown in **FIGS. 1** and **13**, or may be divided into shorter units (e.g., one-third or two-thirds of the height of the shell **19**) to facilitate the division of the cabinet **10** into compartments (see discussion below). In some embodiments, the racks **102, 104** may be 21 RU in height to match the cabinet **10**, or may be divided into 7 RU units to enable the cavity **17** of the cabinet **10** to be divided into three compartments. Also, in some embodiments the racks **102, 104** include apertures **106** through which cables and cords can be routed and/or organized (see **FIG. 19**).

[0043] Referring now to **FIGS. 4** and **18**, the cutouts **74, 76** in the rear frame **70** are covered with input/output (I/O panels) **110, 112**. These may be mounted in any number of ways, including quarter-turn latches and the like. A bracket **114** may also be attached to the rear surface of the rear panel **72**. The bracket **114** may be used to facilitate pole mounting of

the enclosure, and can alternatively be mounted to either side wall of the shell **19**. The I/O panel **110** is removed in **FIG. 18** so that a gasket **116** can be seen.

[0044] Referring now to **FIGS. 5** and **6**, the rear frame **70** also includes two circular apertures **122**, **124** in the side panel **82**, and another circular aperture **126** in the side panel **84**. These apertures **122**, **124**, **126** provide potential pathways for cables entering and exiting the cabinet **10**. For example, four to six 4-guage cables may enter the cabinet **10** through the apertures **122**, **124** and a 3 inch conduit containing as many as six cables may exit the cabinet **10** through the aperture **126**.

[0045] Referring now to **FIGS. 1** and **11-15**, components within the cabinet **10** can be arranged in different ways, depending on need. The cabinet **10** shown in **FIGS. 1** and **13** is arranged with racks **102**, **104** extending the full height of the cabinet **10**, such that the cavity **17** can be populated with electronic equipment mounted to the racks **102**, **104**, such as the aforementioned radios, multicarrier power amplifiers (MCPA), power supplies, and wireless cell site backhaul equipment. **FIGS. 11** and **14** illustrate a cabinet **10'** that includes a string of batteries **140** mounted within a compartment **142** that occupies the lower third of the cabinet **10'**, and further includes electronic equipment mounted in a compartment **144** that occupies the upper two-thirds of the cabinet **10'**. **FIGS. 12** and **15** illustrate a cabinet **10''** that includes two strings of batteries **140** that occupy two compartments **142'**, **142''** in the lower two-thirds of the cabinet **10''** and electronic equipment in a compartment **144'** that occupies the upper one-third of the cabinet **10''**.

[0046] **FIGS. 16** and **17** illustrate another alternative configuration that includes a first cabinet **10a** stacked underneath a second cabinet **10b**. The lower cabinet **10a** is similar to the cabinet **10** illustrated above, but lacks the cap **98**, and is filled with three battery strings **140**. The upper cabinet **10b** is mounted onto the ceiling of the lower cabinet **10a** to form an integrated cabinet assembly.

[0047] Referring now to **FIGS. 20** and **21**, the cabinets discussed herein may include a battery tray **150** that supports a string of batteries (such as that shown at **140** in **FIG. 13**). The battery tray **150** includes a floor **151**, side walls **152**, a front rail **153** and a rear rail **154**. Batteries can be arranged between the side walls **152**, the front rail **153** and the rear rail **154**, supported by the floor **151**. The battery tray **150** can be mounted to the side walls **12**, **13** of the cabinet **10** via brackets **155** that are mounted via fasteners inserted into the holes for the racks **102**, **104**, and via fasteners that join the rear portions of the side walls **152** to the flanges

90, 92 of the rear frame 70. Typically, a separate battery tray 150 is employed with each battery string 140 (see separate trays 150 for battery strings 140 in FIGS. 16 and 17).

[0048] Referring now to FIGS. 22 and 23, any of the cabinets discussed herein may include one or more dividers 160 to separate the internal cavity thereof into compartments. The dividers 160 may be mounted between pieces of racks 102, 104, and may include glands 162 to permit the passage of cables between compartments. In some embodiments, particularly those with dividers 160, the cooling unit 96 may comprise two separate cooling units (e.g., two finned heat exchangers) that are separately operated and/or controlled; exemplary cooling units are discussed in U.S. Provisional Patent Application No. 62/550,886, filed August 28, 2017, the disclosure of which is hereby incorporated herein by reference in its entirety.

[0049] Those of skill in this art will also appreciate that other configurations are also possible. For example, in some embodiments the back frame may be formed with greater depth, which may allow the storage of additional components (such as server racks and the like). As another example, one or both of the L-shaped pieces 30, 50 may be modified to permit the mounting of an air conditioner or other cooling unit on the side of the unit. Other possibilities are also contemplated.

[0050] The foregoing is illustrative of the present invention and is not to be construed as limiting thereof. Although a few 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 modular electronics enclosure, comprising:
 - a rear frame, a first L-shaped piece and a second L-shaped piece joined to form a box-shaped shell having a floor, a ceiling, a rear wall and first and second opposed side walls that define an internal cavity;
 - wherein the first L-shaped piece includes a wall panel and a top panel that form the ceiling and the first side wall of the shell;
 - wherein the second L-shaped piece includes a wall panel and a bottom panel that form the floor and the second side wall of the shell; and
 - wherein the rear frame forms the rear wall of the shell.
2. The modular electronics enclosure defined in Claim 1, wherein the rear frame includes top, bottom and side panels, and wherein the top panel and one side panel are joined to the top panel and wall panel of the first L-shaped piece, and wherein the bottom panel and another side panel are joined to the bottom panel and wall panel of the second L-shaped piece.
3. The modular electronics enclosure defined in Claim 1 of Claim 2, further comprising a door hingedly attached to one of the wall panels of the first or second pieces.
4. The modular electronics enclosure defined in Claim 3, further comprising a cooling unit mounted to the door for cooling the internal cavity.
5. The modular electronics enclosure defined in any of Claims 1-4, wherein the rear frame includes an opening covered by an I/O panel.
6. The modular electronics enclosure defined in any of Claims 2-5, wherein at least one of the side panels of the rear frame includes an aperture for receiving a cable routed into the internal cavity.
7. The modular electronics enclosure defined in any of Claims 1-6, further comprising a battery tray mounted in the internal cavity and a battery string residing in the battery tray.

8. The modular electronics enclosure defined in any of Claims 1-7, further comprising a divider that divides the internal cavity into multiple compartments.

9. The modular electronics enclosure defined in any of Claims 1-8, wherein the rear frame, the first L-shaped piece and the second L-shaped piece are joined via flanges that abut each other in the internal cavity.

10. The modular electronics enclosure defined in any of Claims 1-9, further comprising electronics equipment mounted in the internal cavity.

11. The modular electronics enclosure defined in Claim 10, further comprising a battery string residing in the internal cavity.

12. The modular electronics enclosure defined in any of Claims 1-11, wherein the internal cavity is nominally 21 RU in height.

13. An assembly, comprising first and second modular electronics enclosures as defined in any of Claims 1-12, wherein the second modular electronics enclosure is vertically stacked on and above the first electronics enclosure.

14. The assembly defined in Claim 13, wherein the first modular electronics enclosure houses at least one battery string.

15. The assembly defined in Claim 14, wherein the second modular electronics enclosure houses electronic equipment.

16. A modular electronics enclosure, comprising:
a rear frame, a first L-shaped piece and a second L-shaped piece joined to form a box-shaped shell having a floor, a ceiling, a rear wall and first and second opposed side walls that define an internal cavity;
wherein the first L-shaped piece includes a wall panel and a top panel that form the ceiling and the first side wall of the shell;
wherein the second L-shaped piece includes a wall panel and a bottom panel that form the floor and the second side wall of the shell; and
wherein the rear frame forms the rear wall of the shell; and

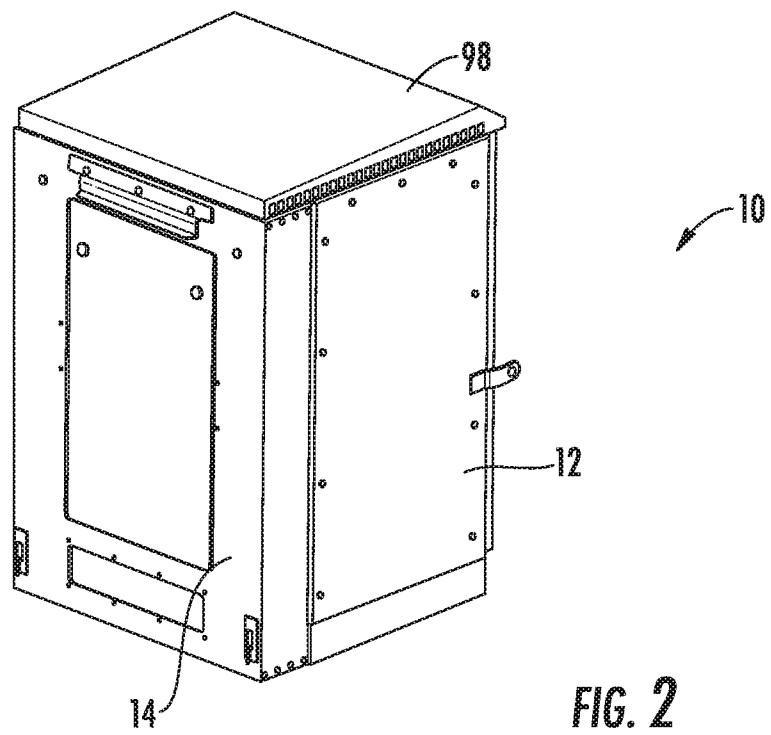
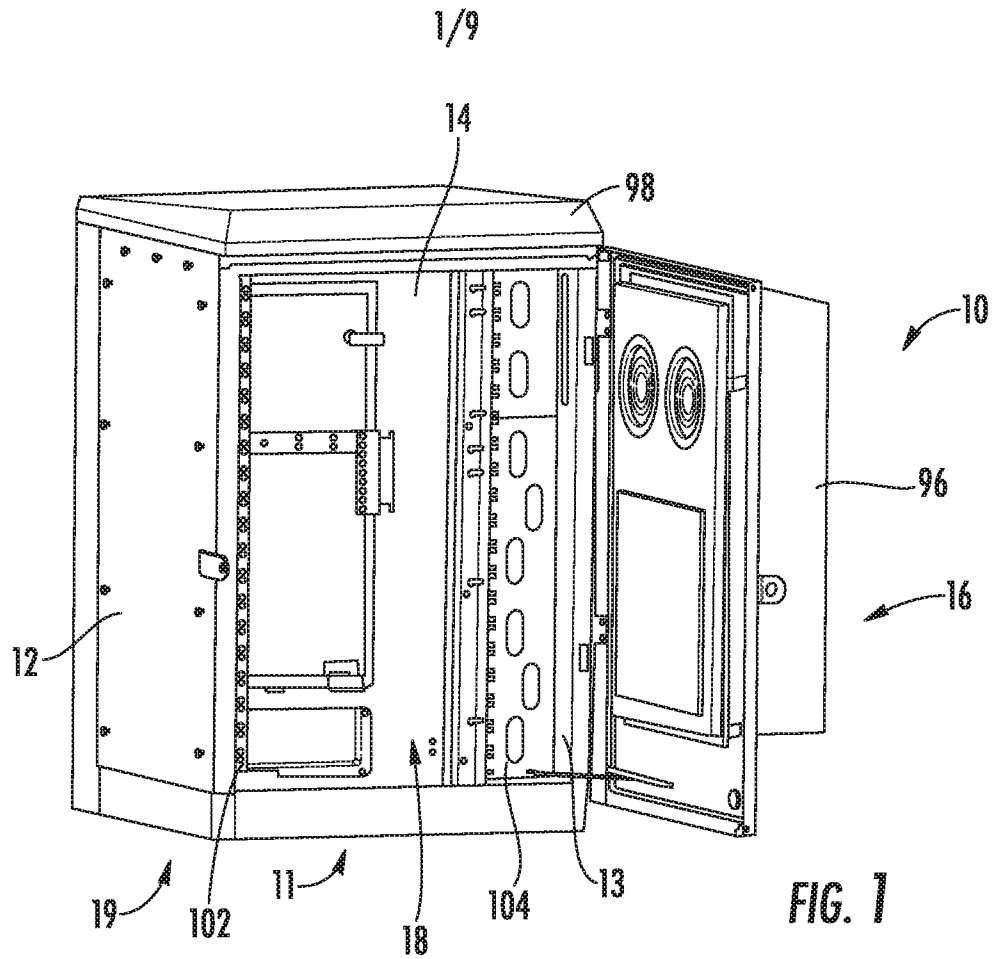
wherein the first and second pieces and the rear frame are joined with fasteners that are located in the internal cavity of the shell.

17. The modular electronics enclosure defined in Claim 16, wherein the rear frame includes top, bottom and side panels, and wherein the top panel and one side panel are joined to the top panel and wall panel of the first L-shaped piece, and wherein the bottom panel and another side panel are joined to the bottom panel and wall panel of the second L-shaped piece.

18. The modular electronics enclosure defined in Claim 16 or Claim 17, further comprising a door hingedly attached to one of the wall panels of the first or second pieces.

19. The modular electronics enclosure defined in Claim 18, further comprising a cooling unit mounted to the door for cooling the internal cavity.

20. The modular electronics enclosure defined in any of Claims 16-19, wherein the internal cavity is nominally 21 RU in height.



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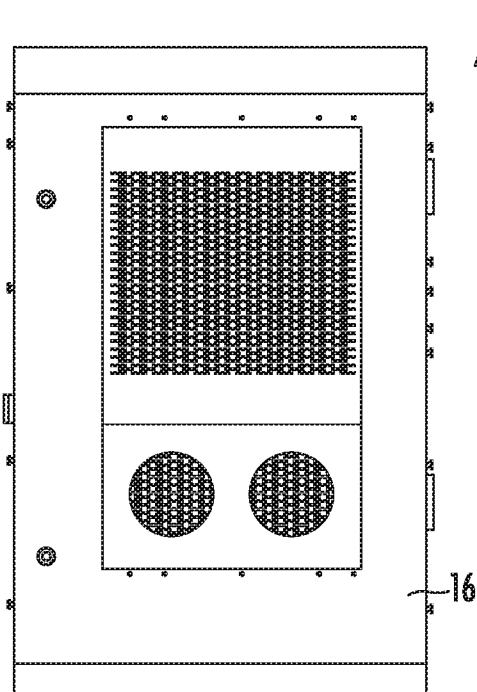


FIG. 3

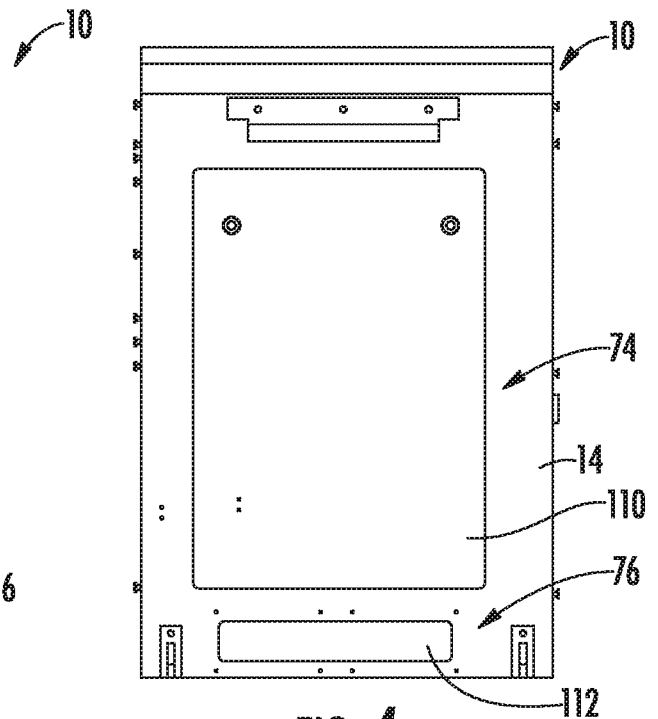


FIG. 4

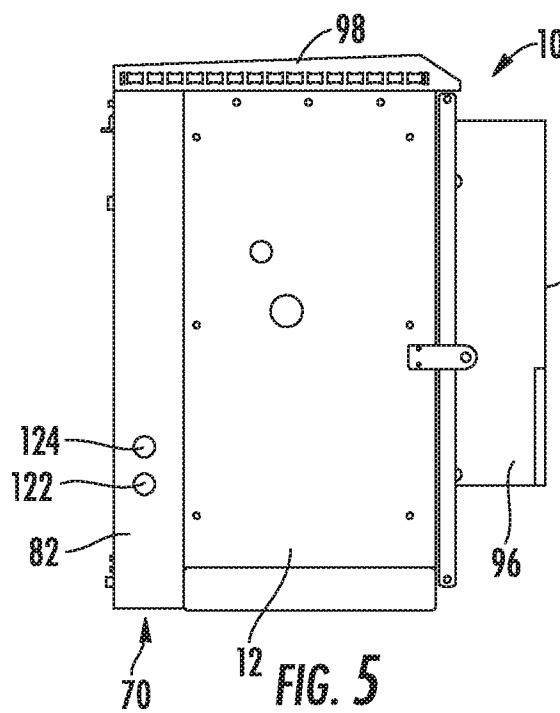


FIG. 5

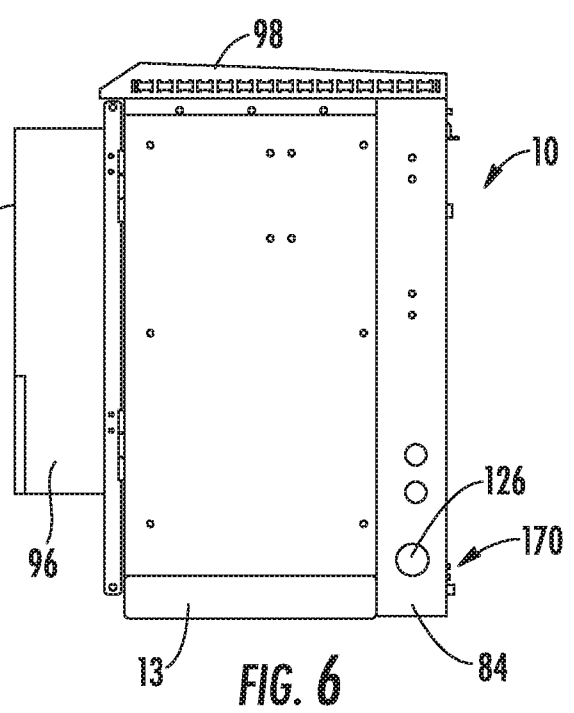
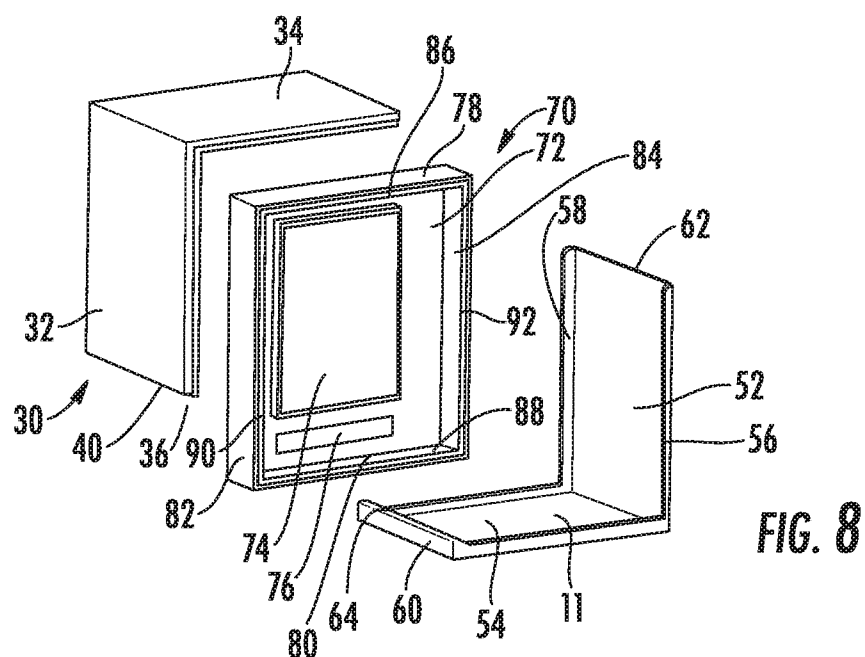
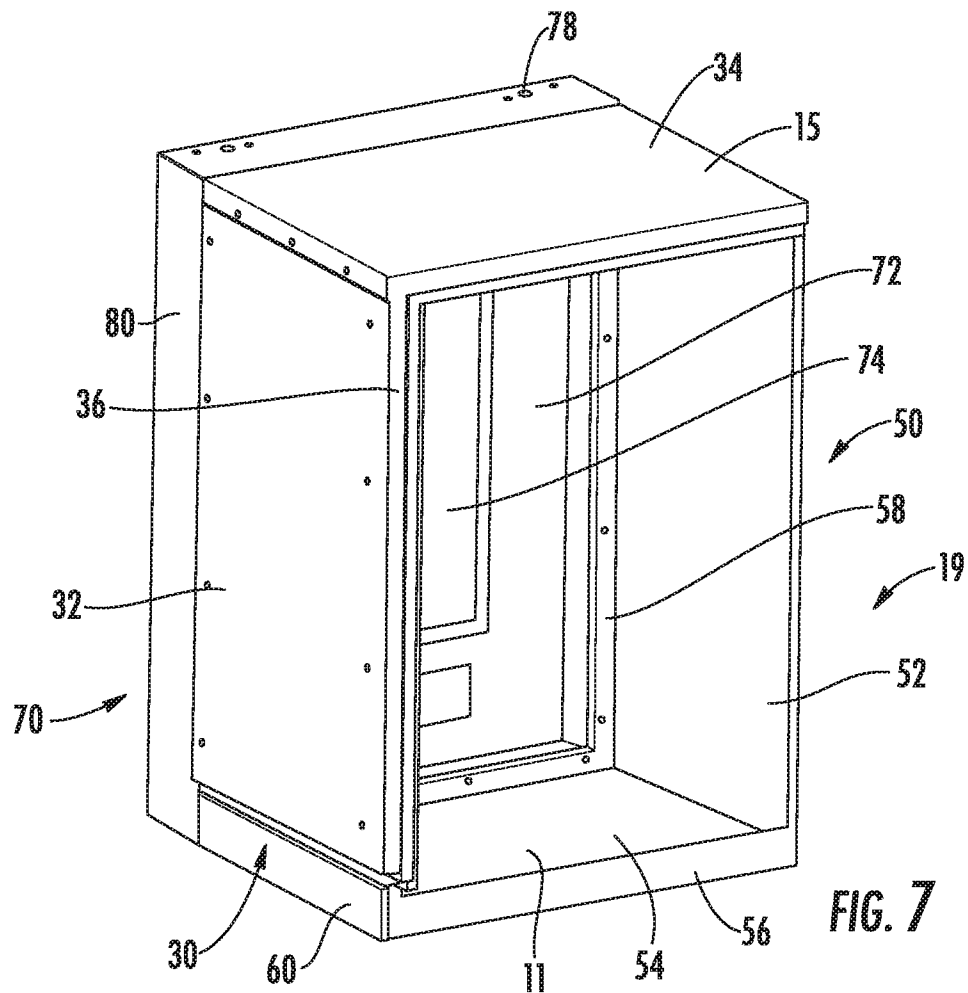


FIG. 6

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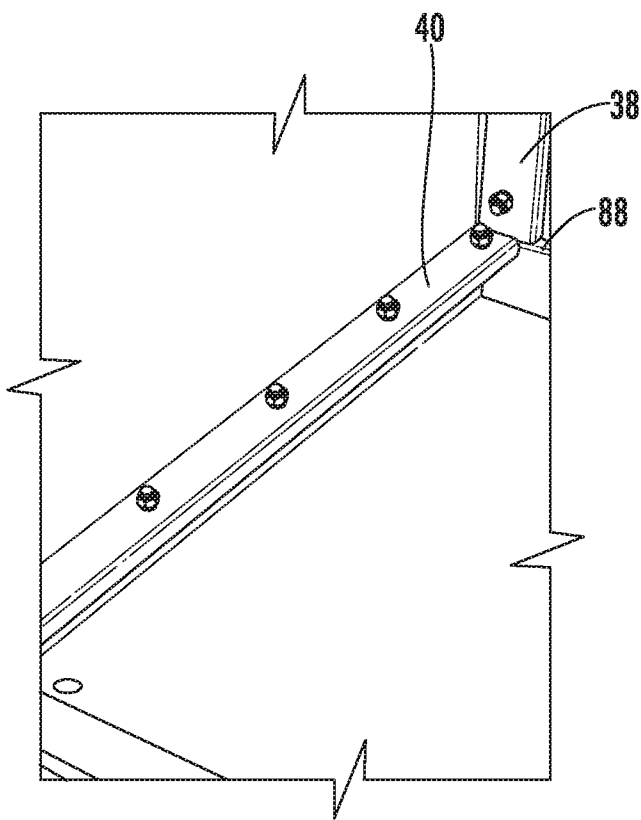


FIG. 9

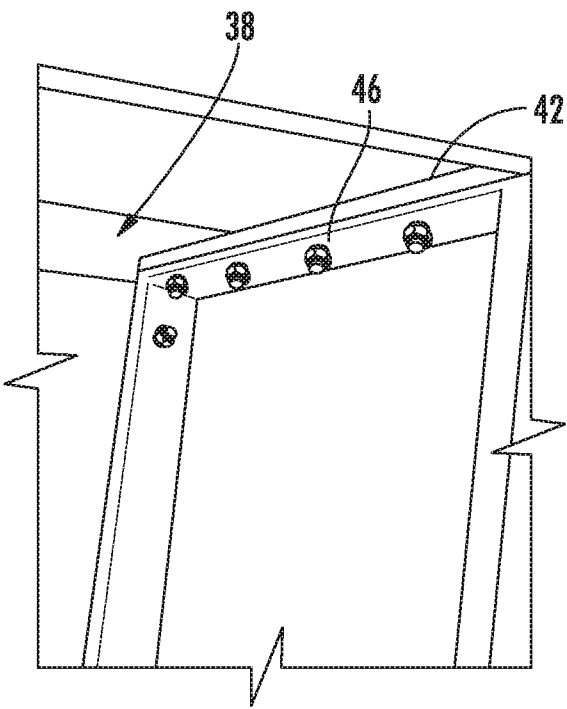


FIG. 10

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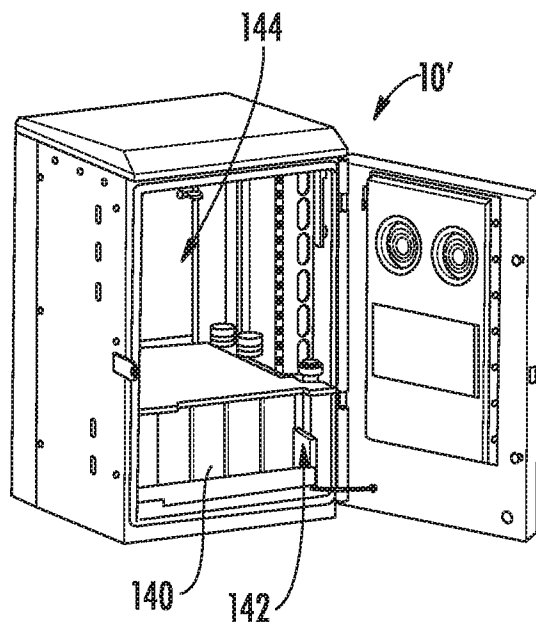


FIG. 11

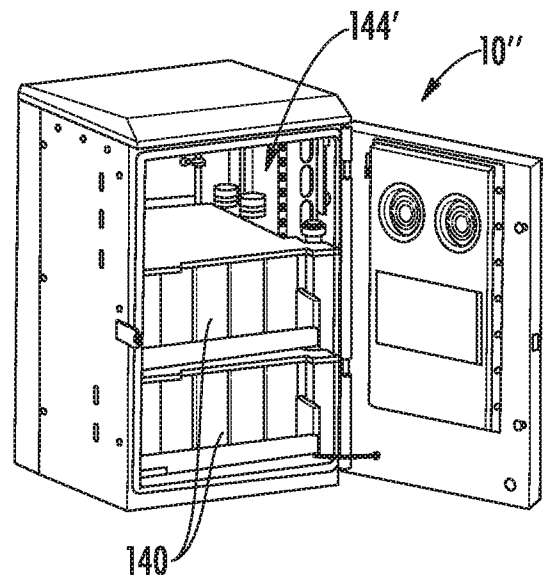


FIG. 12

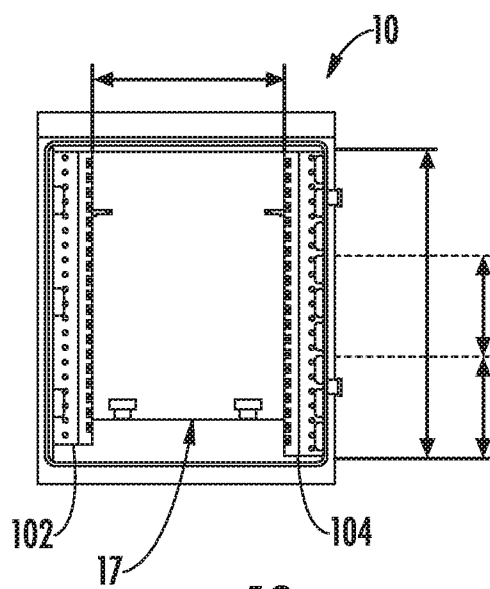


FIG. 13

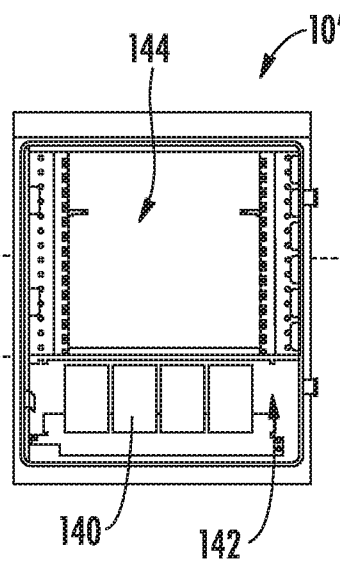


FIG. 14

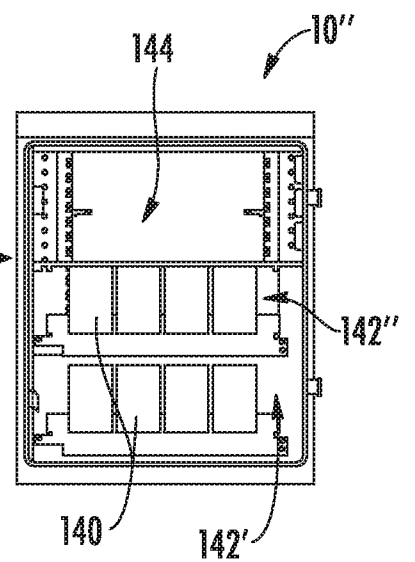


FIG. 15

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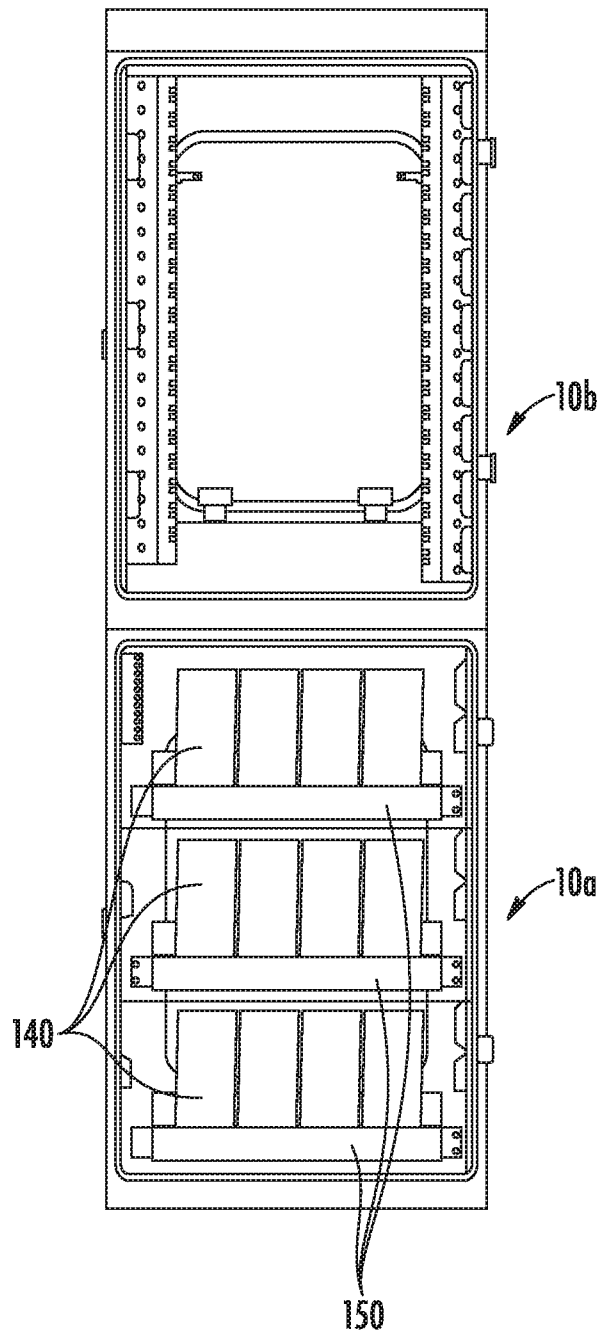


FIG. 16

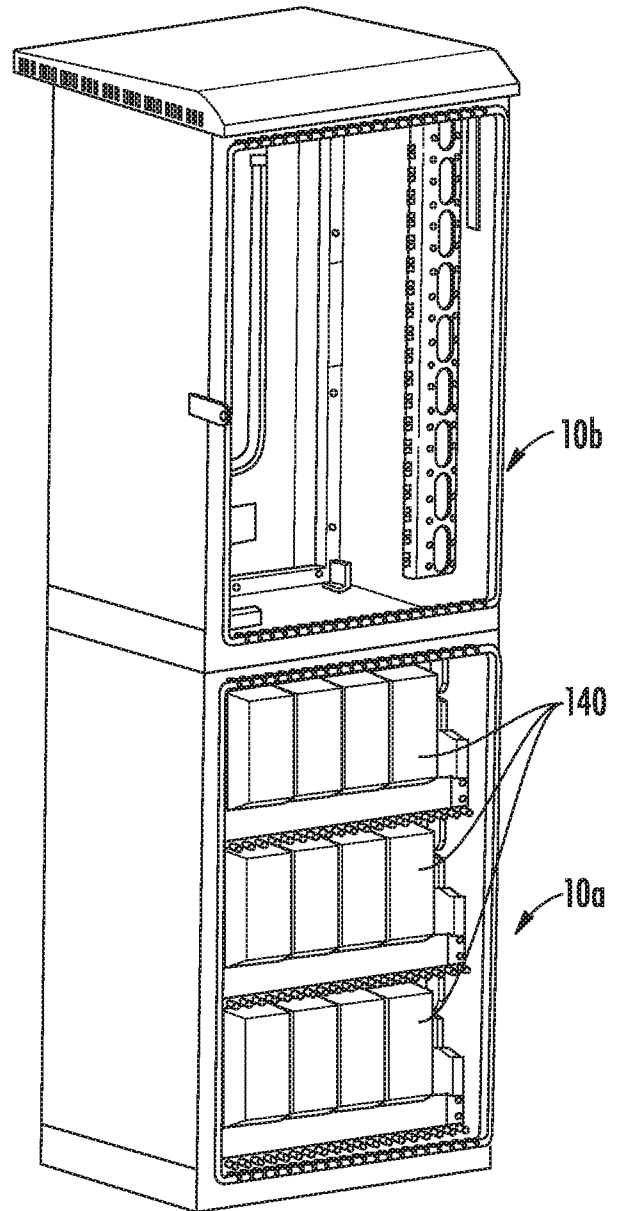


FIG. 17

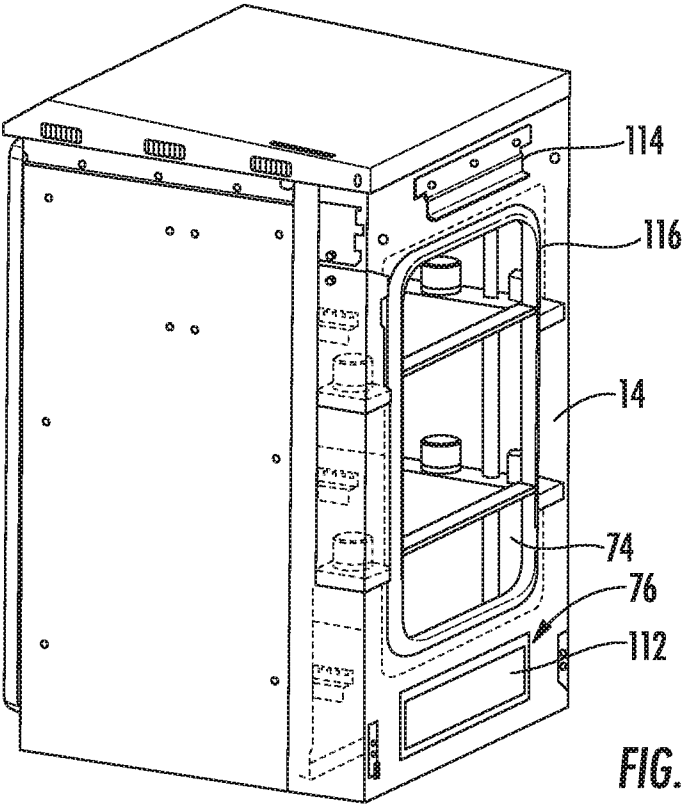


FIG. 18

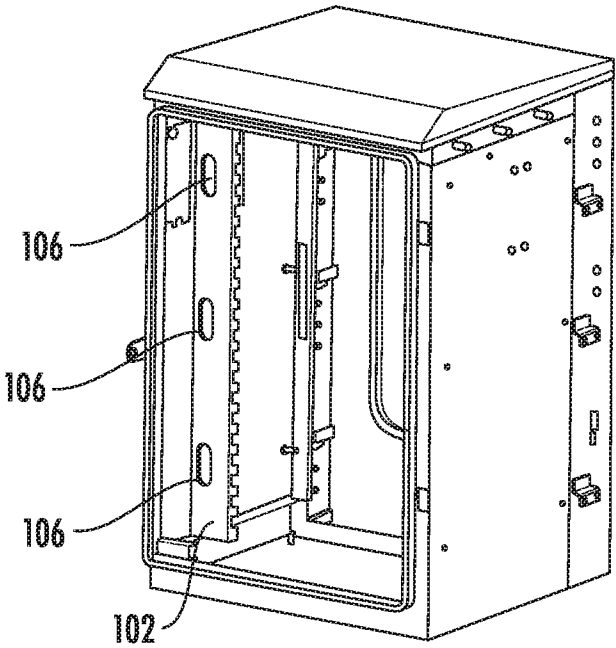


FIG. 19

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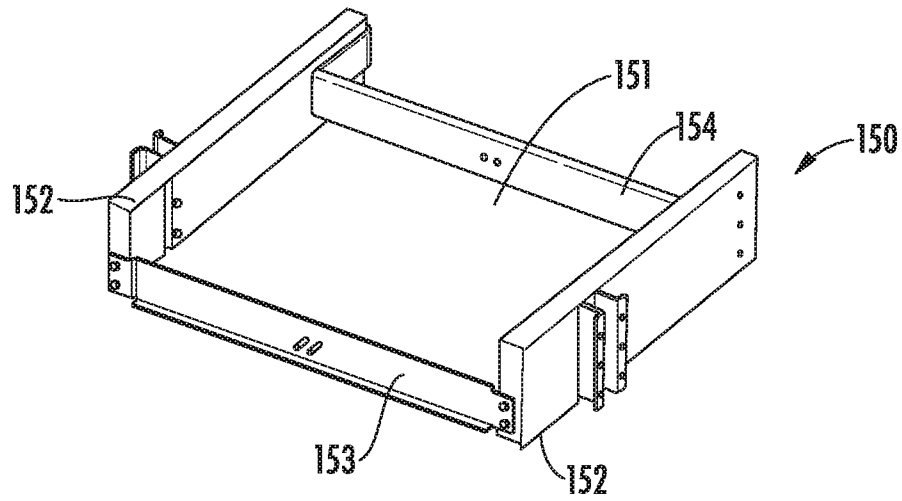


FIG. 20

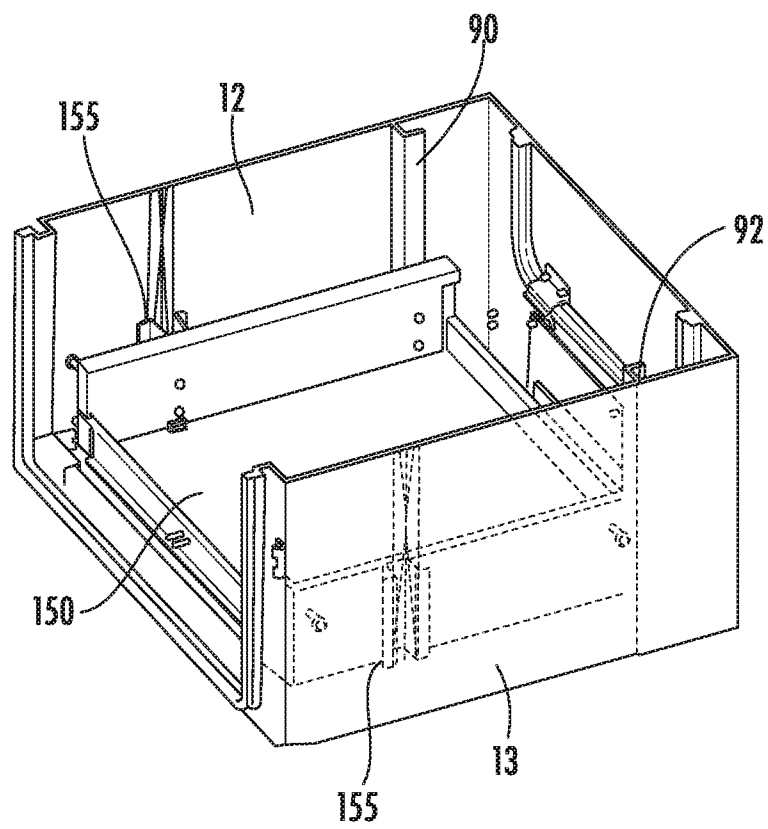
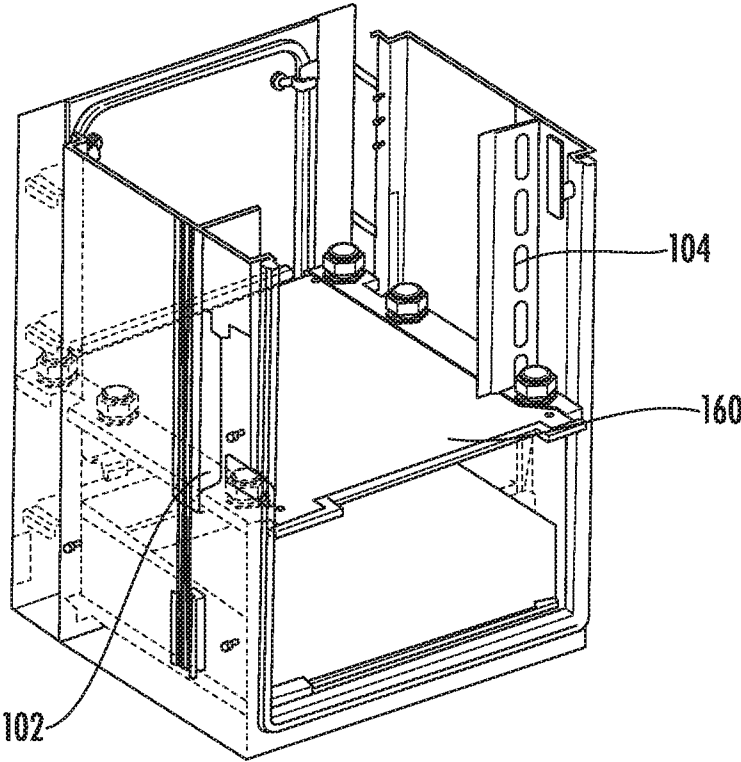
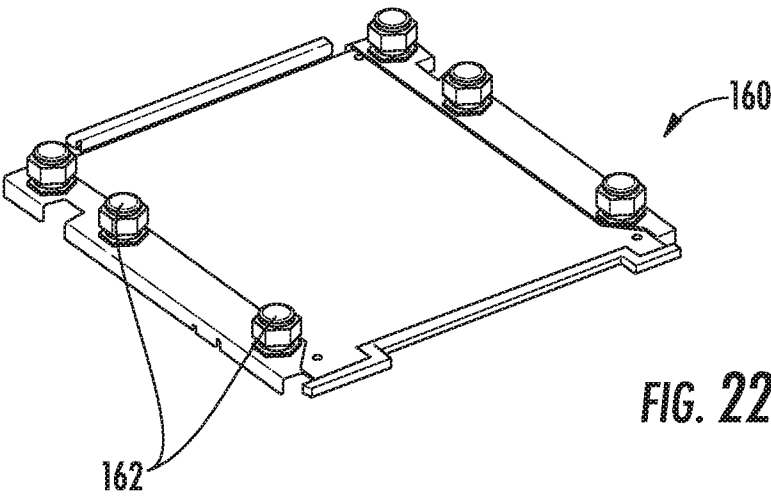


FIG. 21



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2019/043335

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.: 11,14-15
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 11,14-15 refer to multiple dependent claim which does not comply with PCT Rule 6.4(a) (PCT Article 6).

3. ☒ Claims Nos.: 5-10,12-13,20
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

International application No.
PCT/US2019/043335**A. CLASSIFICATION OF SUBJECT MATTER****H05K 7/18(2006.01)i, H05K 5/02(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)

H05K 7/18; B29C 45/00; H02B 1/30; H05K 5/00; H05K 5/02; H05K 7/14; H05K 7/20; H05K 9/00

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: modular electronics enclosure, frame, L-shaped piece, box-shaped shell, fastener, door, cooling unit

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 06-079180 U (KIKUSUI ELECTRONICS CORP.) 04 November 1994 See paragraphs [0012]-[0017] and figures 1-2.	1-2, 16-17
Y		3-4, 18-19
Y	US 2009-0185346 A1 (JOHN ALAN CAIRO et al.) 23 July 2009 See paragraphs [0038]-[0039] and figures 6-9.	3-4, 18-19
A	JP 2004-006546 A (IWATSU ELECTRIC CO., LTD.) 08 January 2004 See paragraphs [0012]-[0018] and figure 1.	1-4, 16-19
A	JP 2009-158649 A (NITTO ELECTRIC WORKS LTD.) 16 July 2009 See paragraphs [0016]-[0017] and figures 1-2.	1-4, 16-19
A	JP 08-008547 A (SANYO ELECTRIC CO., LTD.) 12 January 1996 See paragraphs [0008]-[0010] and figure 1.	1-4, 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

"D" document cited by the applicant in the international application

"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

13 November 2019 (13.11.2019)

Date of mailing of the international search report

13 November 2019 (13.11.2019)

Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2019/043335

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 06-079180 U	04/11/1994	JP 2566937 Y2	30/03/1998
US 2009-0185346 A1	23/07/2009	US 7796376 B2	14/09/2010
JP 2004-006546 A	08/01/2004	None	
JP 2009-158649 A	16/07/2009	JP 4906116 B2	28/03/2012
JP 08-008547 A	12/01/1996	JP 2940794 B2	25/08/1999