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(54) **ASSEMBLIES FOR MOUNTING ANTENNA CABLES**

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Related U.S. Application Data

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Publication Classification

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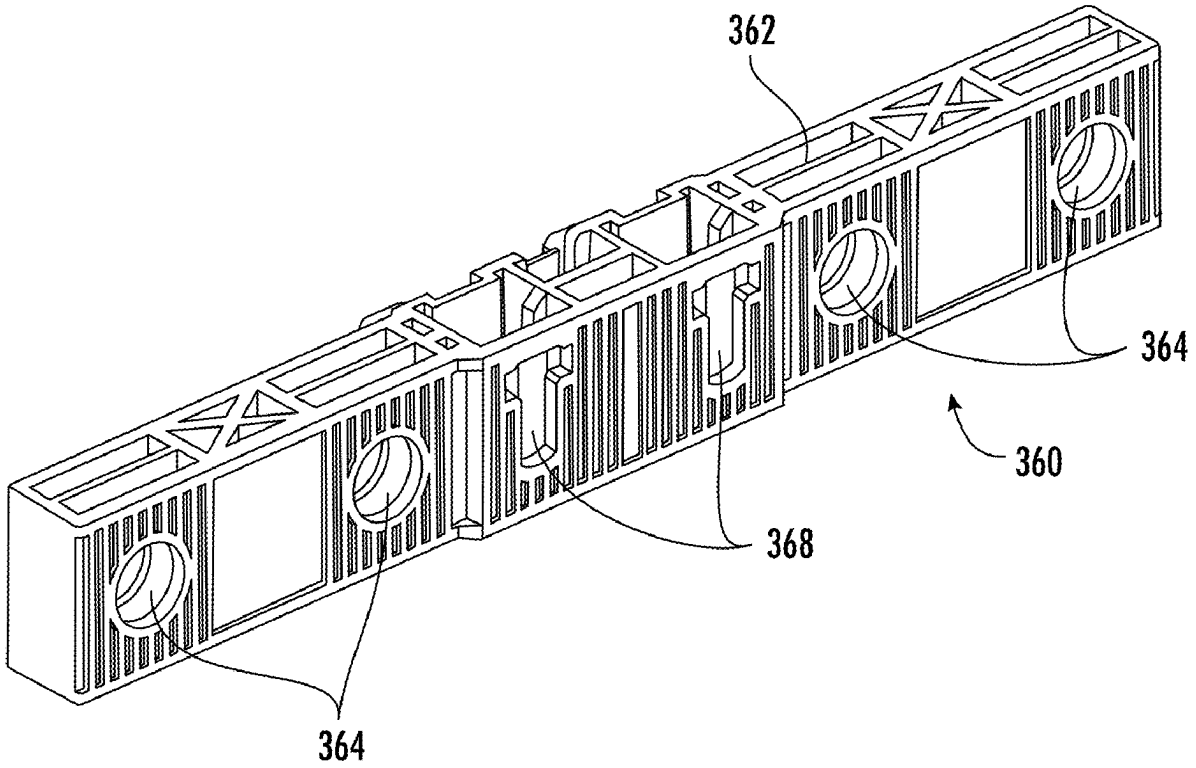
H01Q 1/12 (2006.01)

(52) **U.S. Cl.**
CPC ***H05K 5/0247*** (2013.01); ***H05K 5/0217*** (2013.01); *H01Q 1/1228* (2013.01)

(57) **ABSTRACT**

The present application is directed to an assembly for providing mounting locations for cable hangers for an antenna. The assembly includes a hanger panel having a generally rectangular skeletal base. The hanger panel includes a plurality of mounting holes spaced apart on opposing side surfaces along a length of the base and at least one securing mechanism coupled to and extending outwardly from an end of the base. The assembly further includes an adapter extension having a side wall comprising a recess. The hanger panel is secured to the side wall of the adapter extension by the at least one securing mechanism received within the recess.



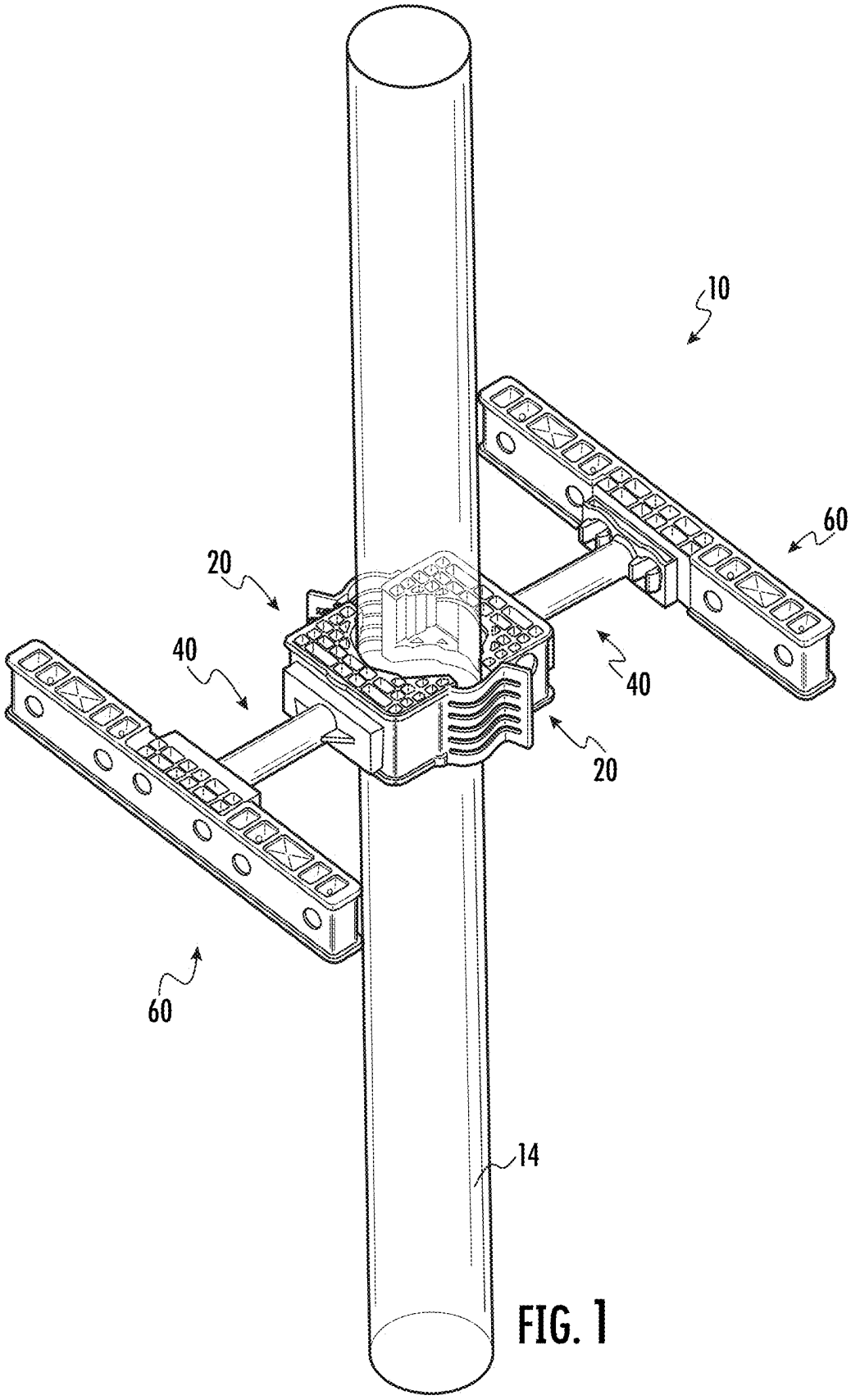


FIG. 1

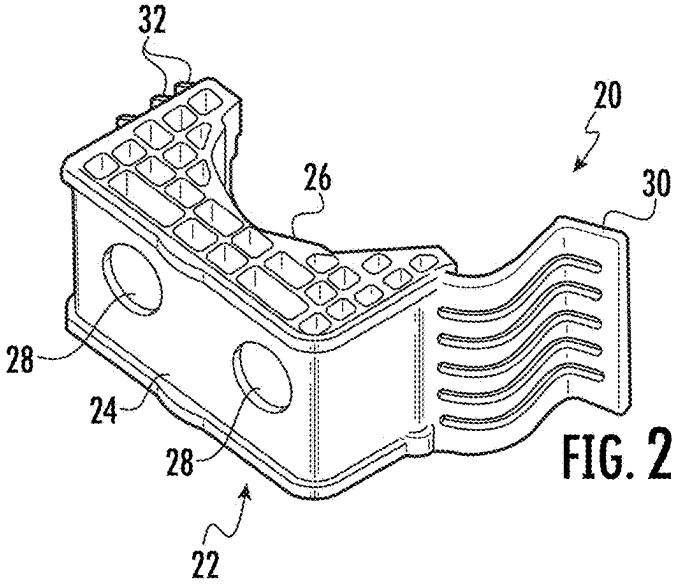


FIG. 2

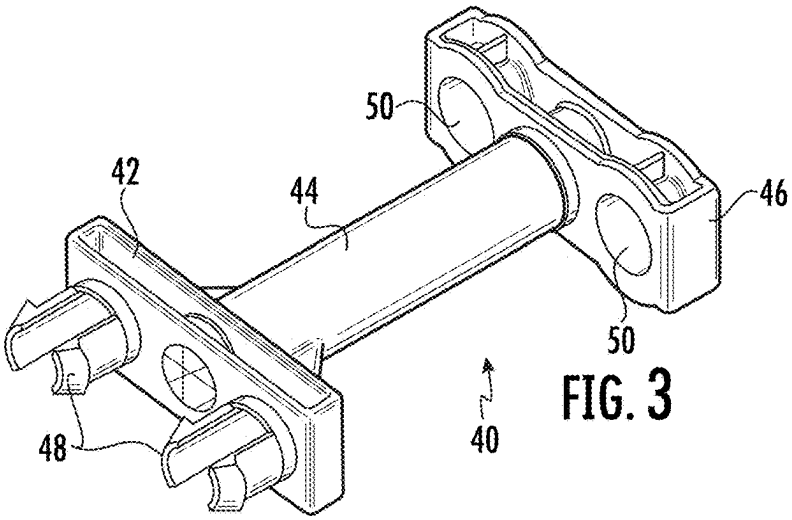


FIG. 3

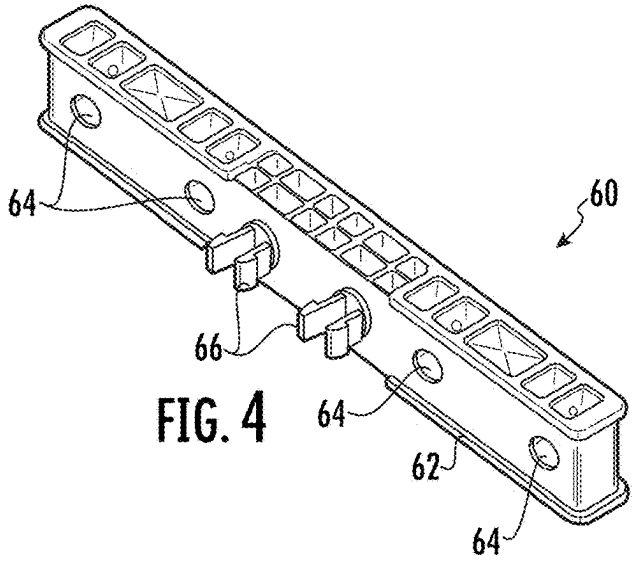


FIG. 4

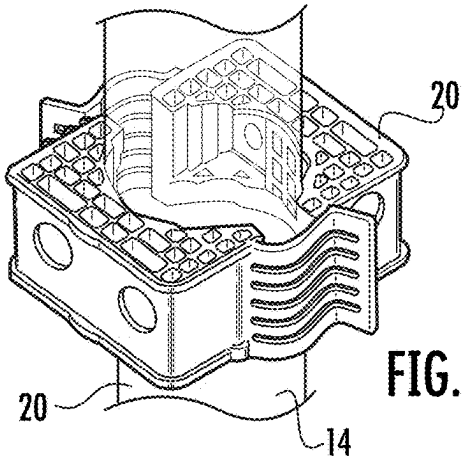


FIG. 5

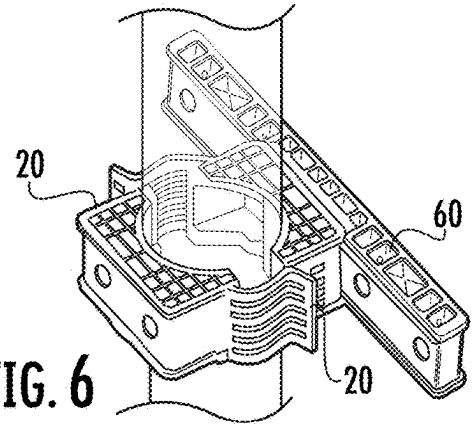


FIG. 6

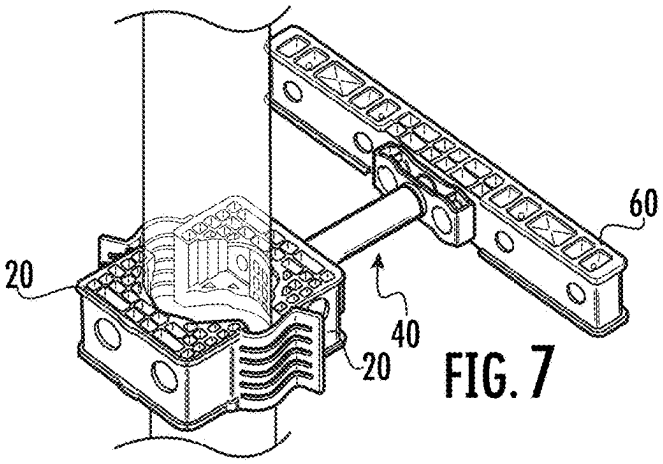


FIG. 7

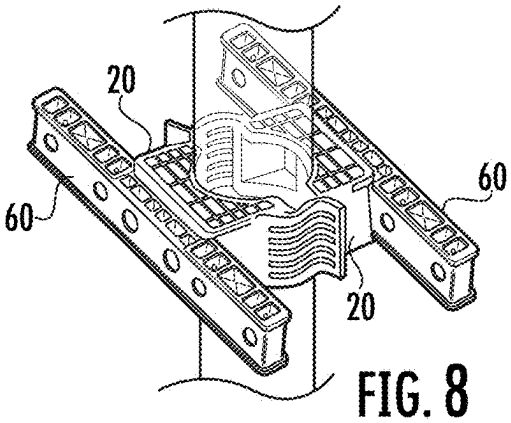


FIG. 8

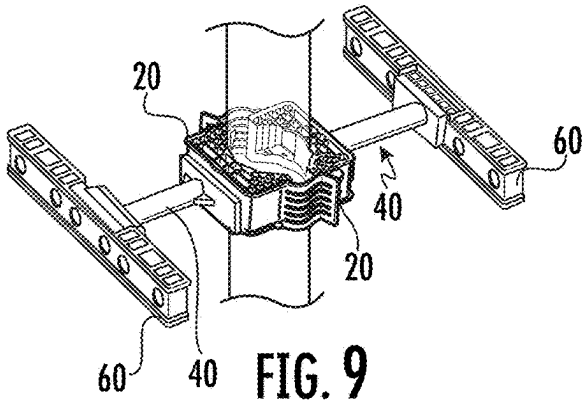


FIG. 9

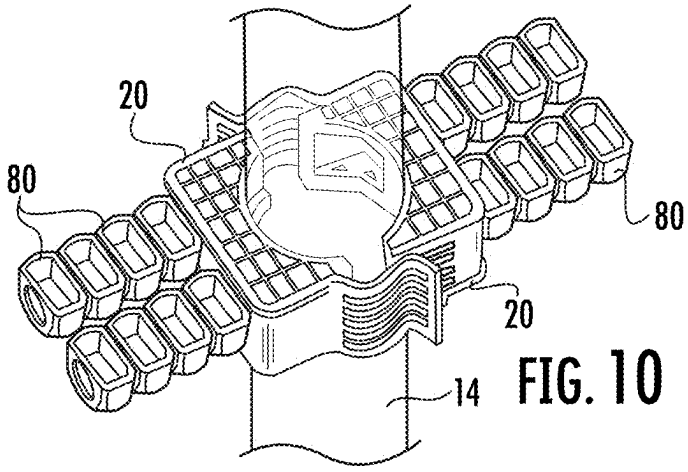


FIG. 10

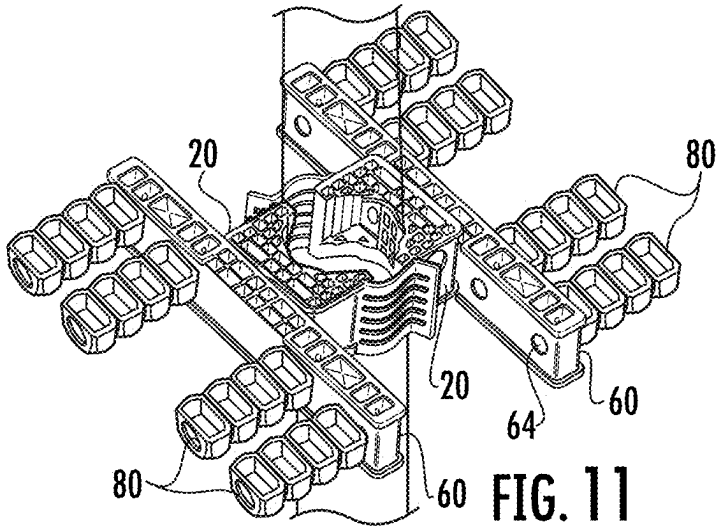


FIG. 11

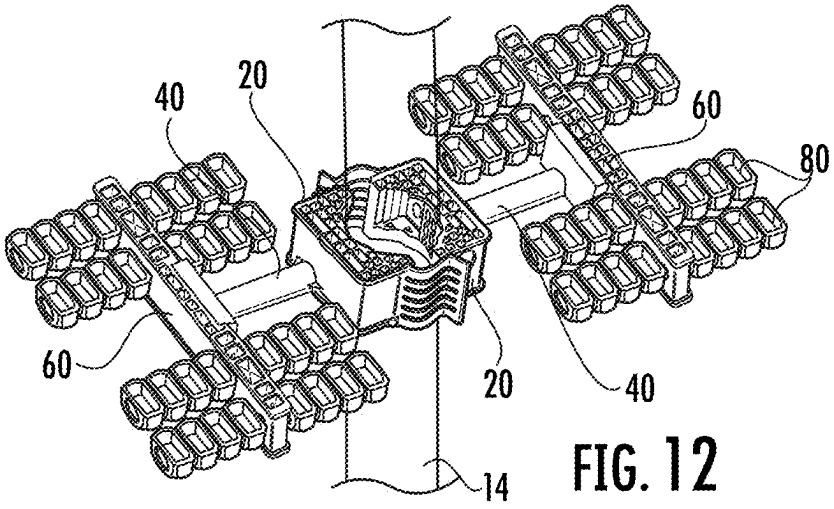


FIG. 12

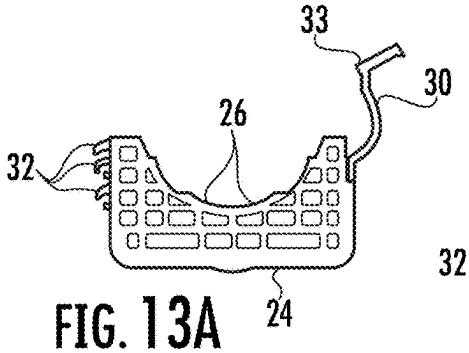


FIG. 13A

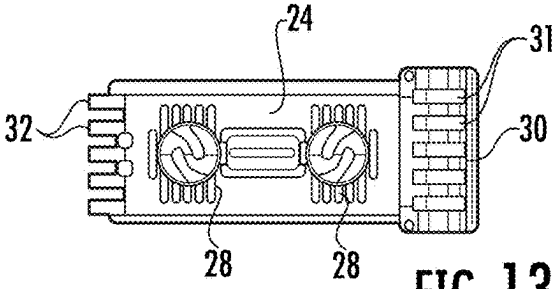


FIG. 13B

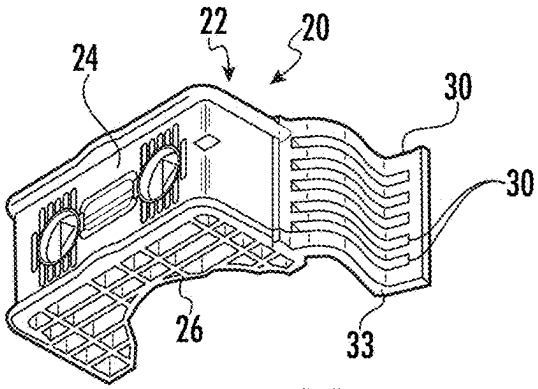


FIG. 13C

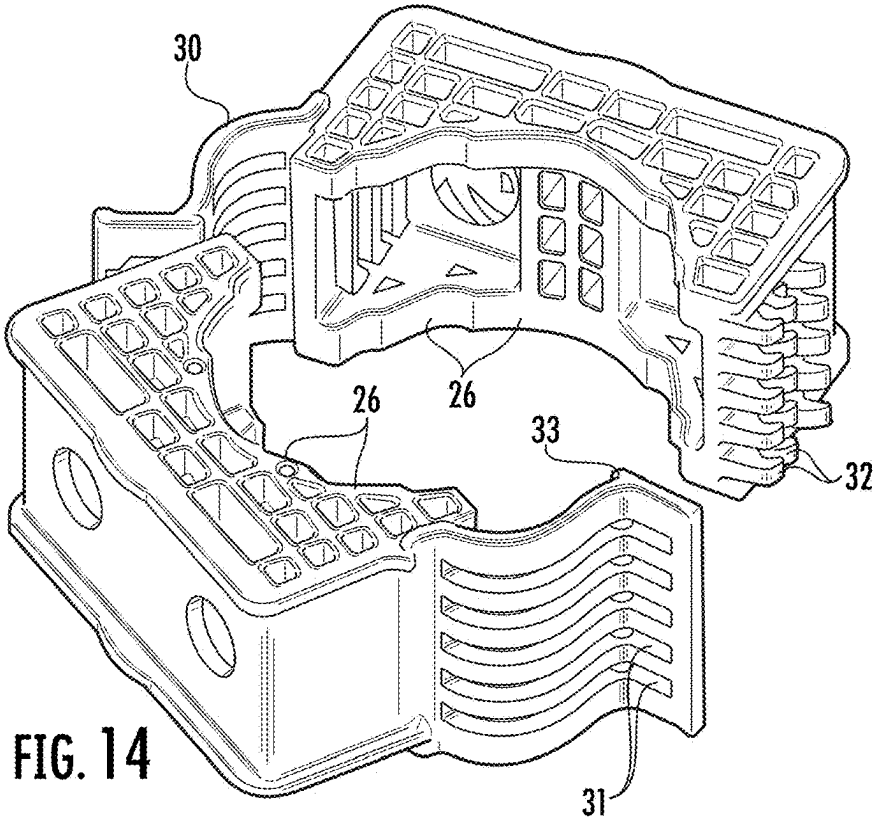
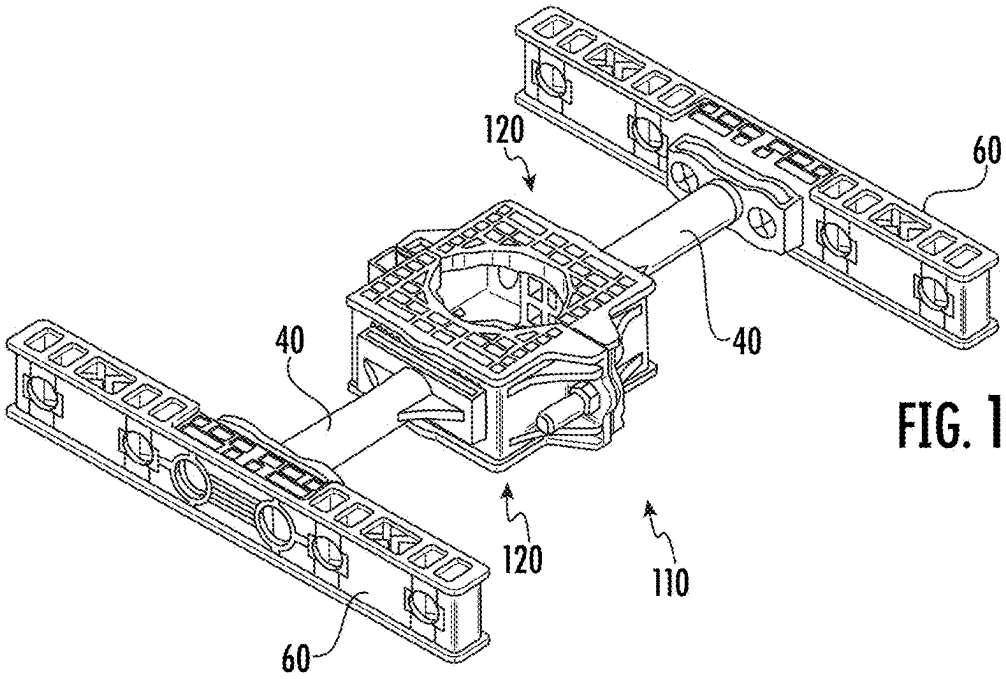


FIG. 14



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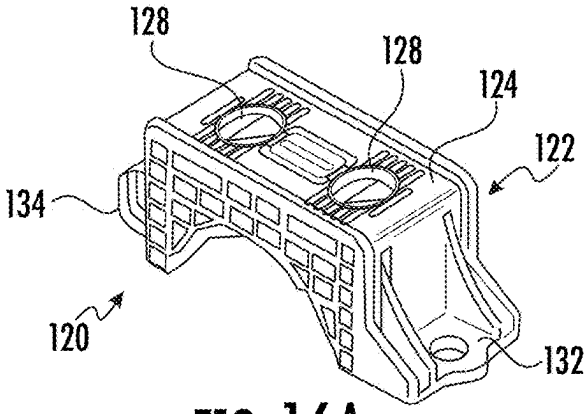


FIG. 16A

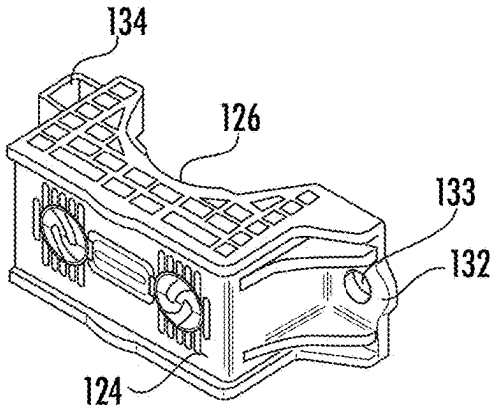


FIG. 16B

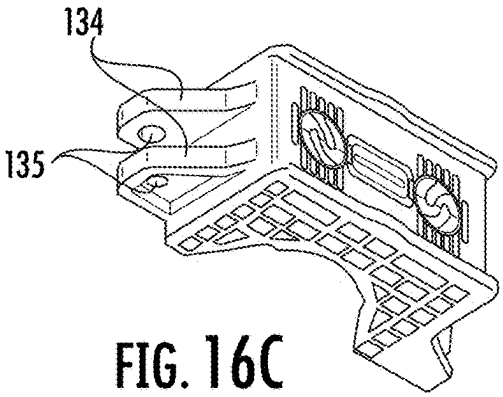


FIG. 16C

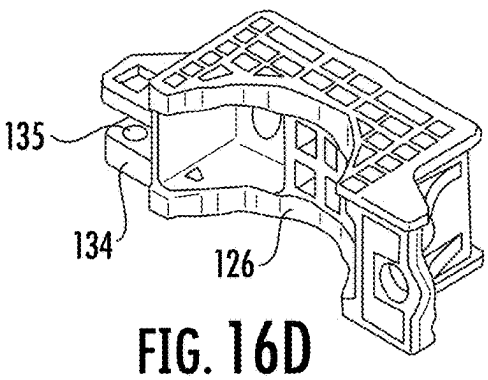
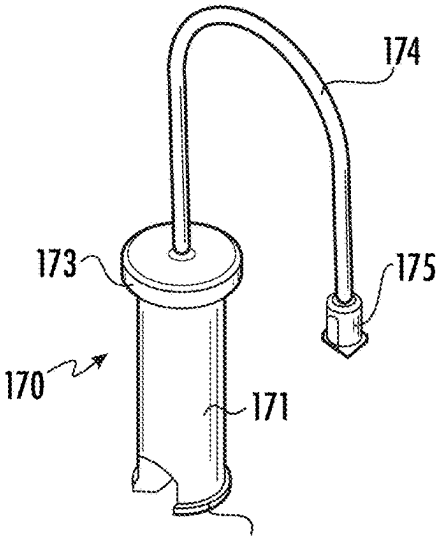


FIG. 16D



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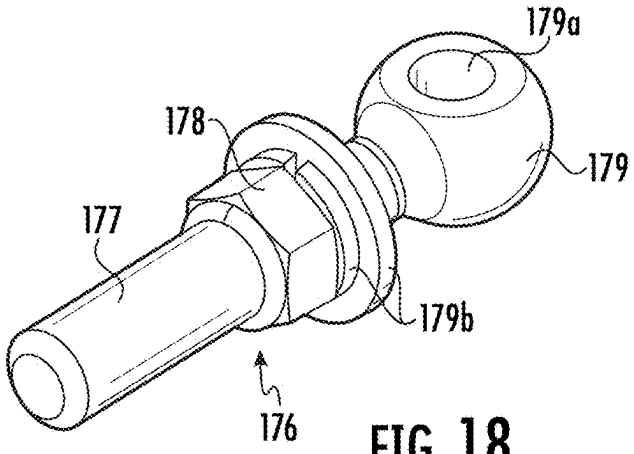

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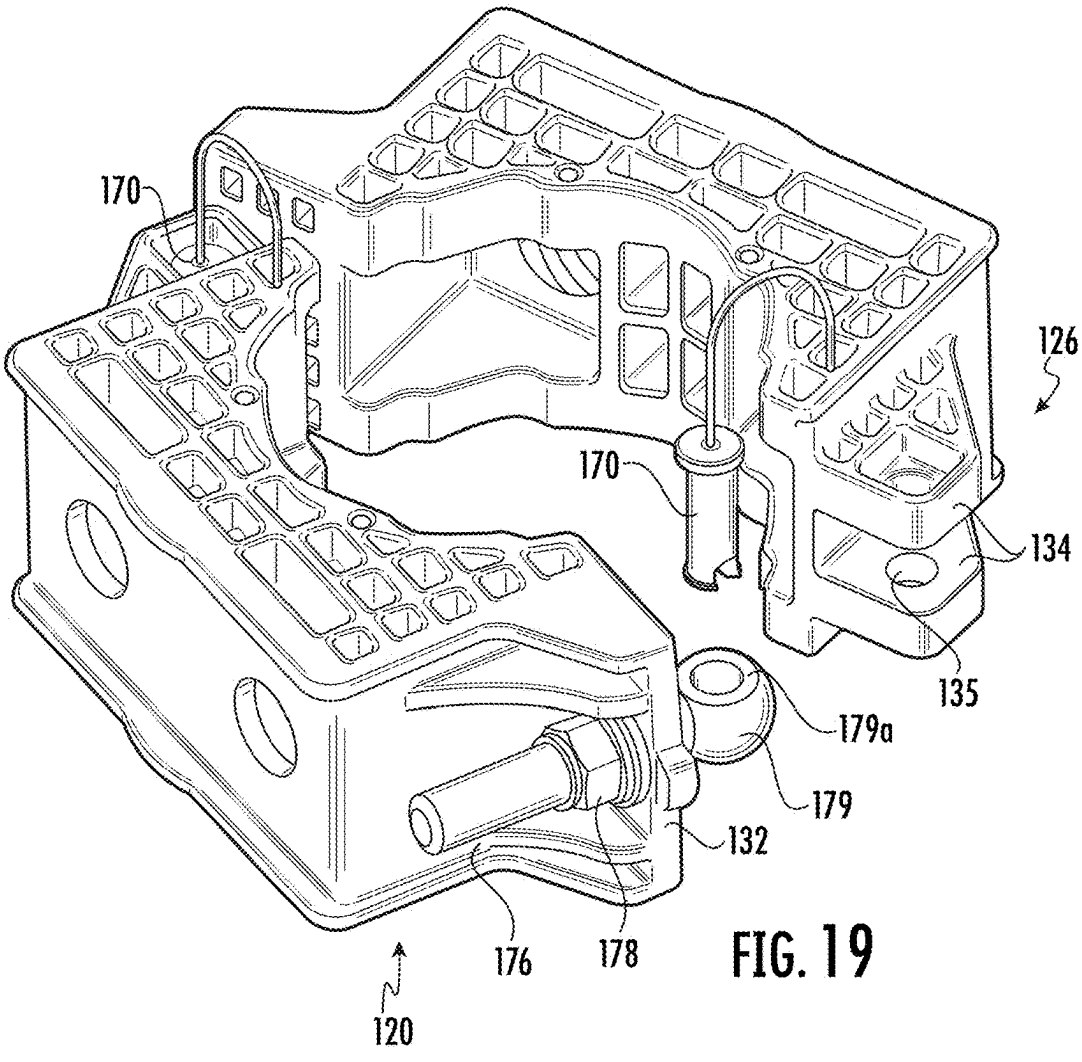

FIG. 19

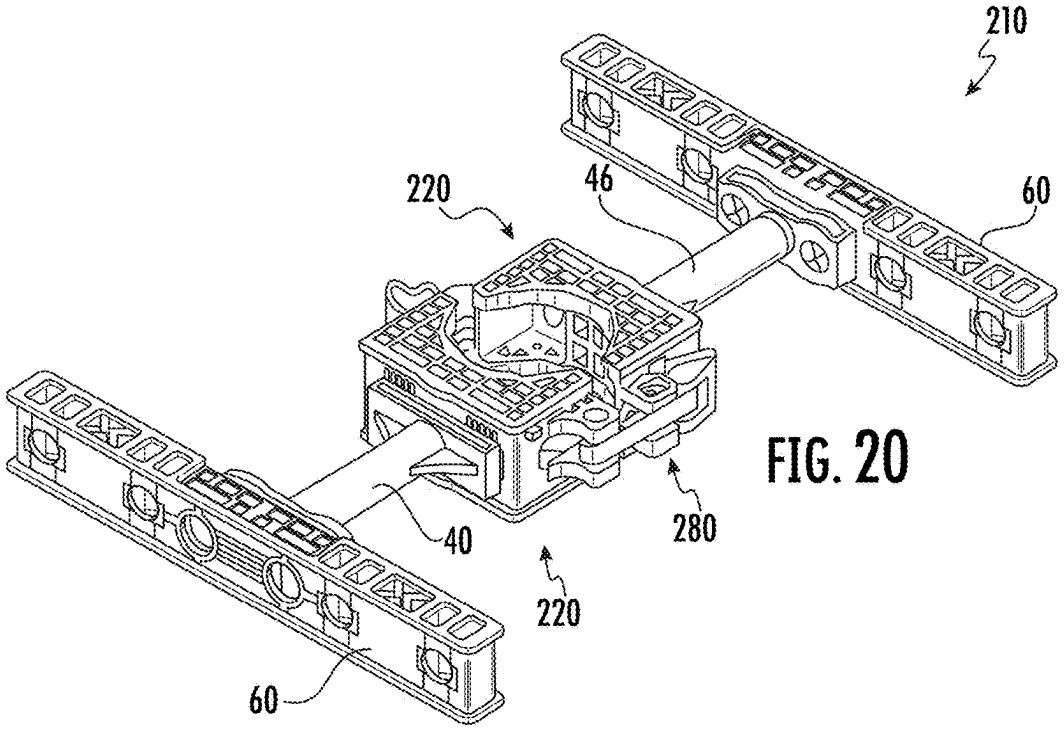

FIG. 20

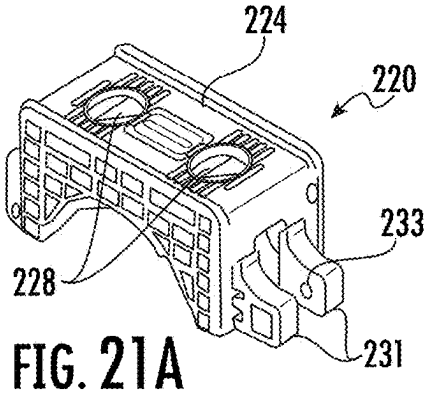

FIG. 21A

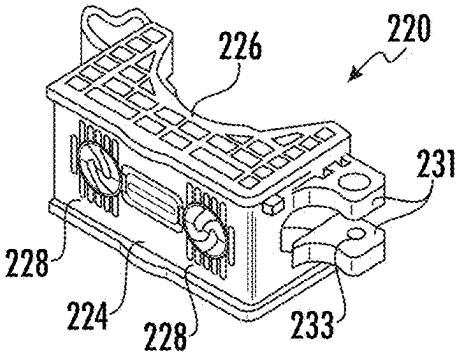

FIG. 21B

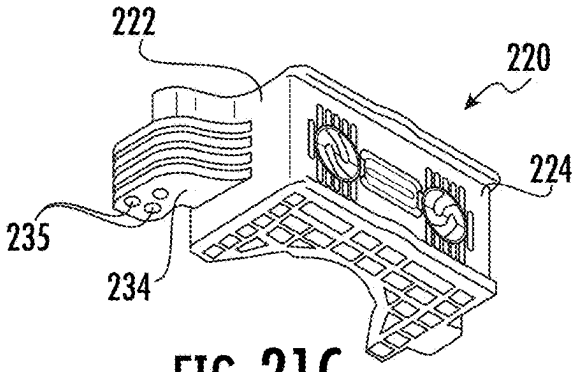

FIG. 21C

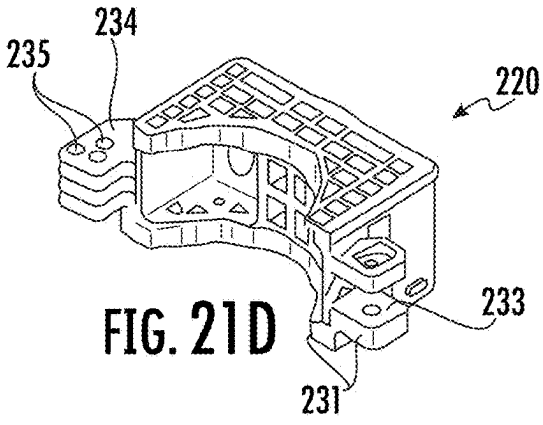

FIG. 21D

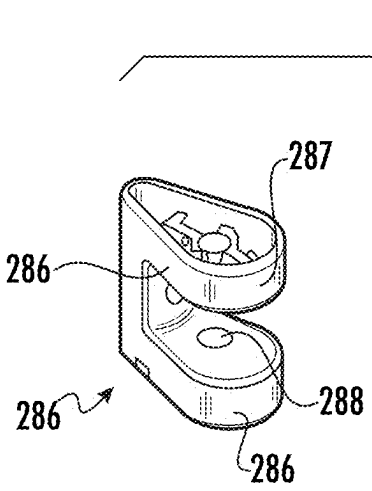

FIG. 22A

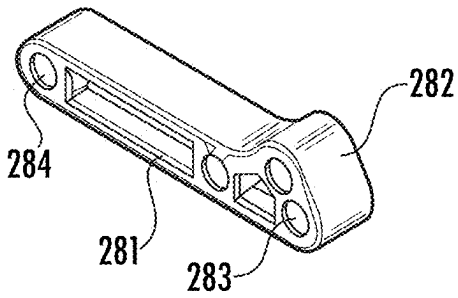

FIG. 22B

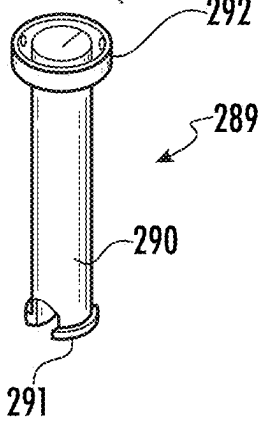

FIG. 22C

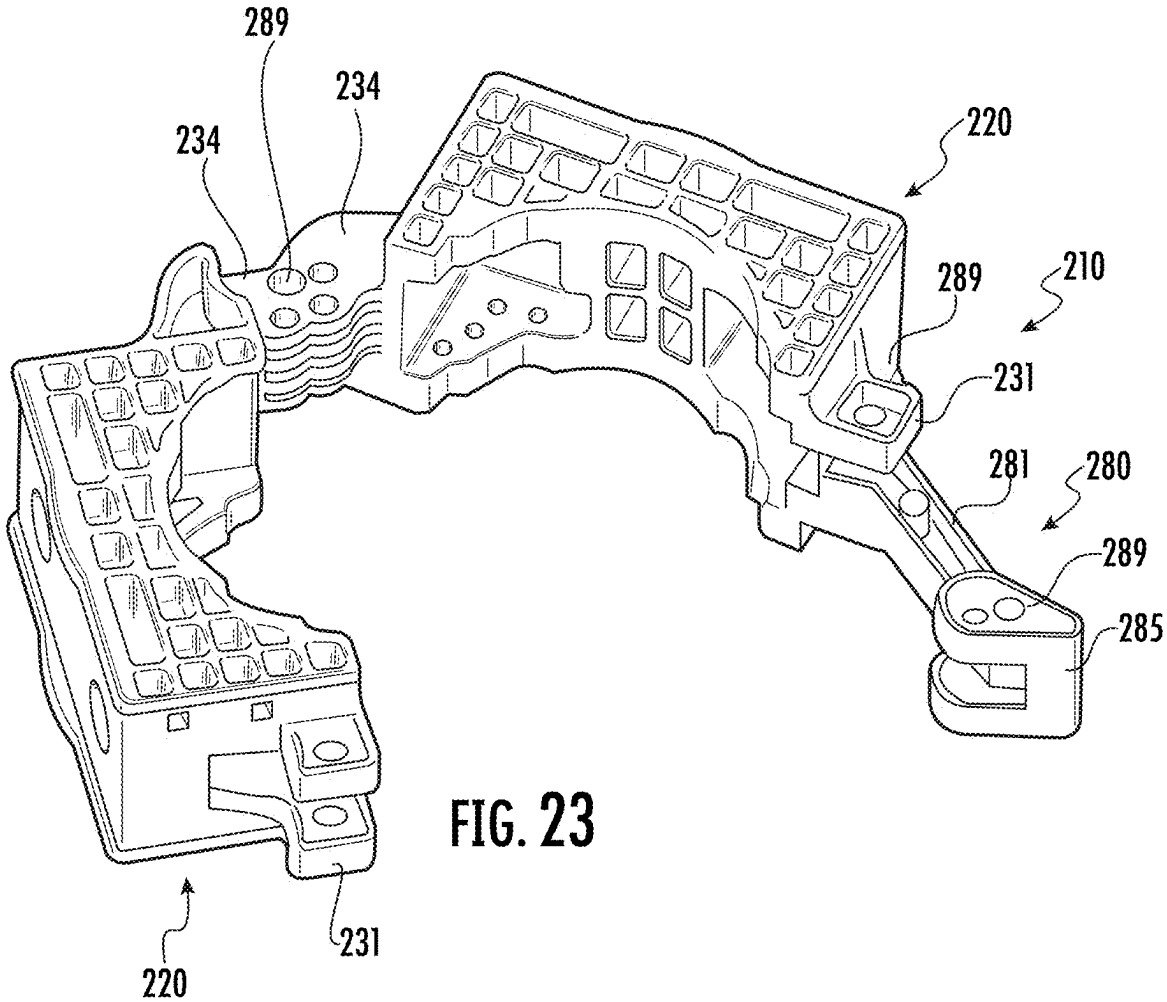

FIG. 23

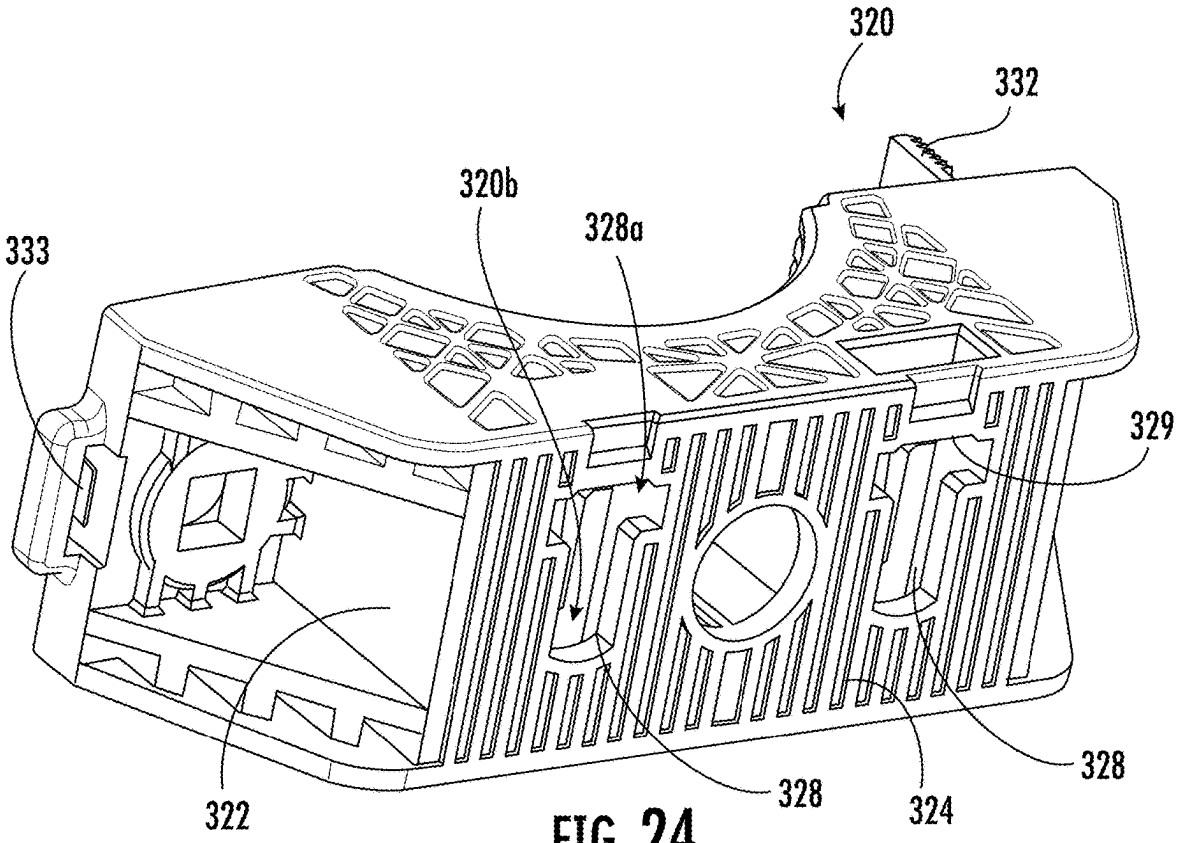

FIG. 24

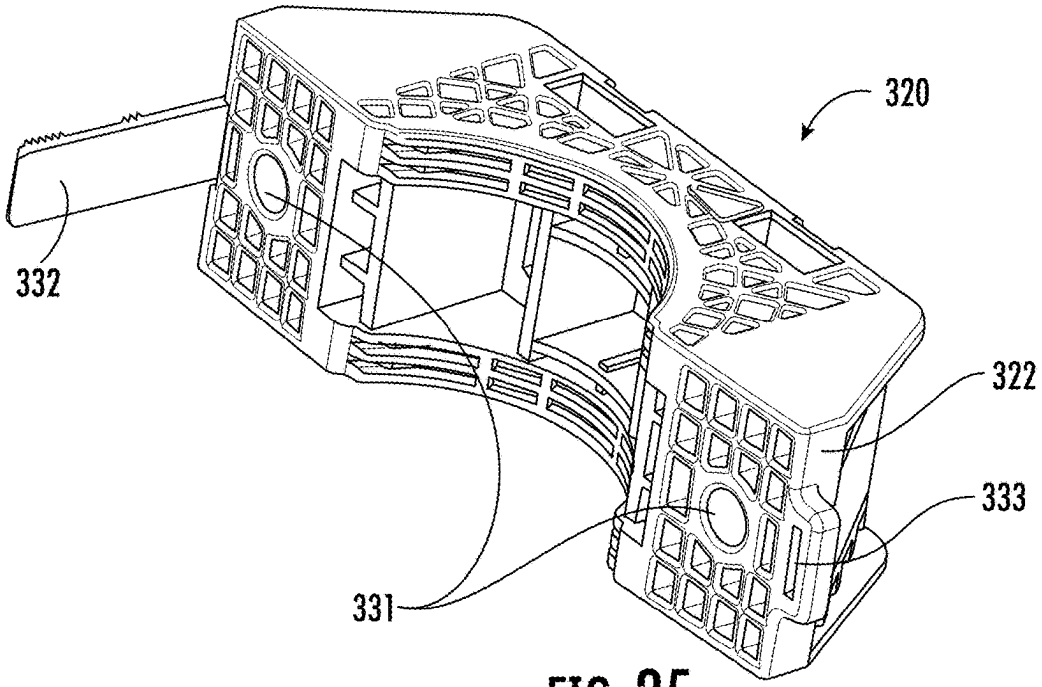

FIG. 25

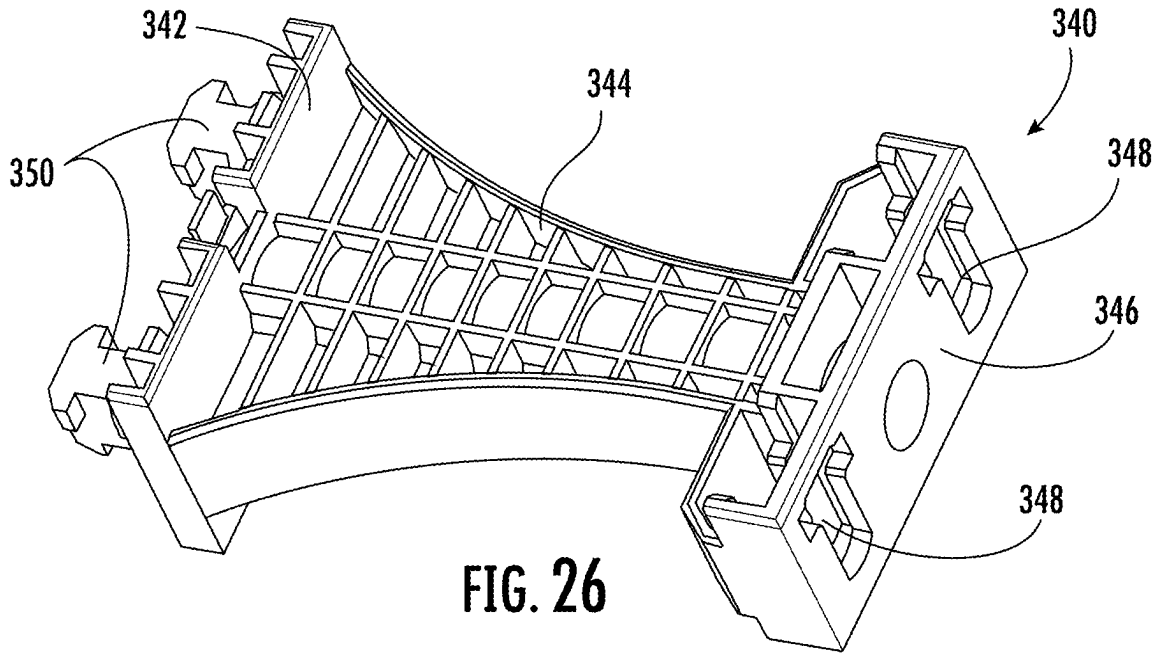
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FIG. 26

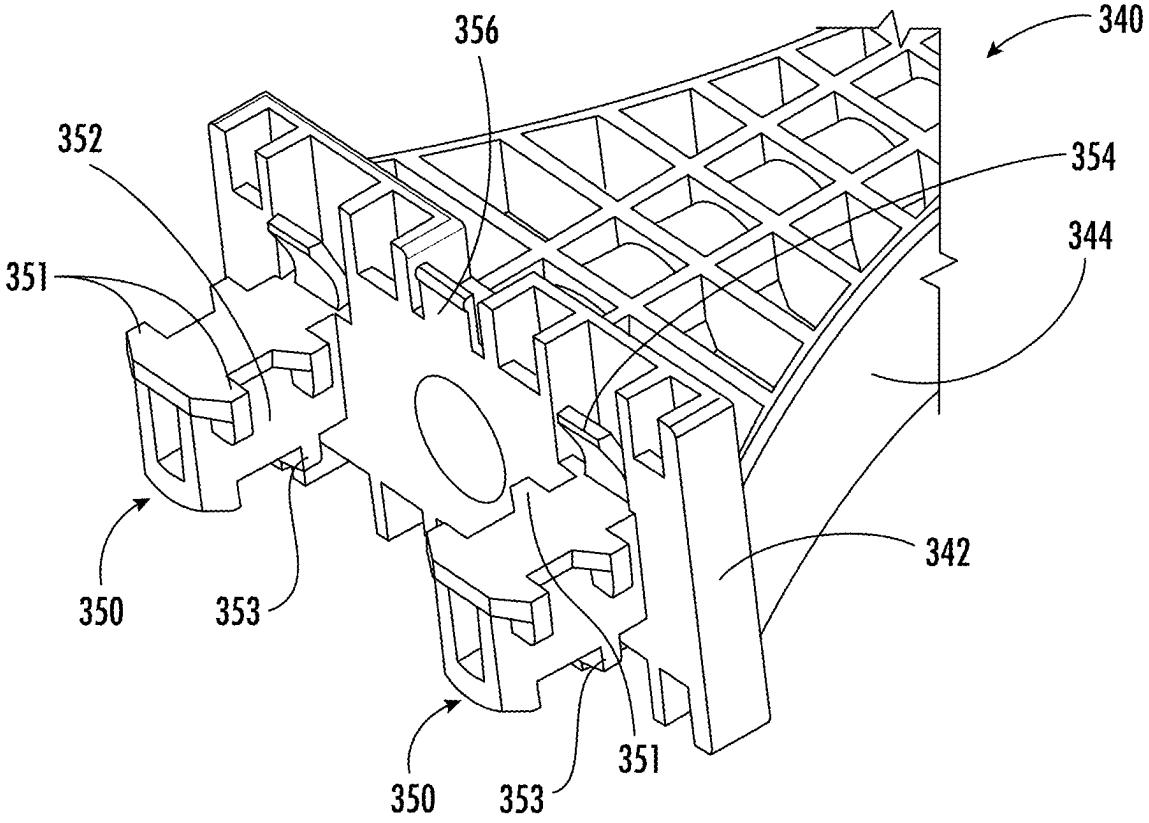
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FIG. 27

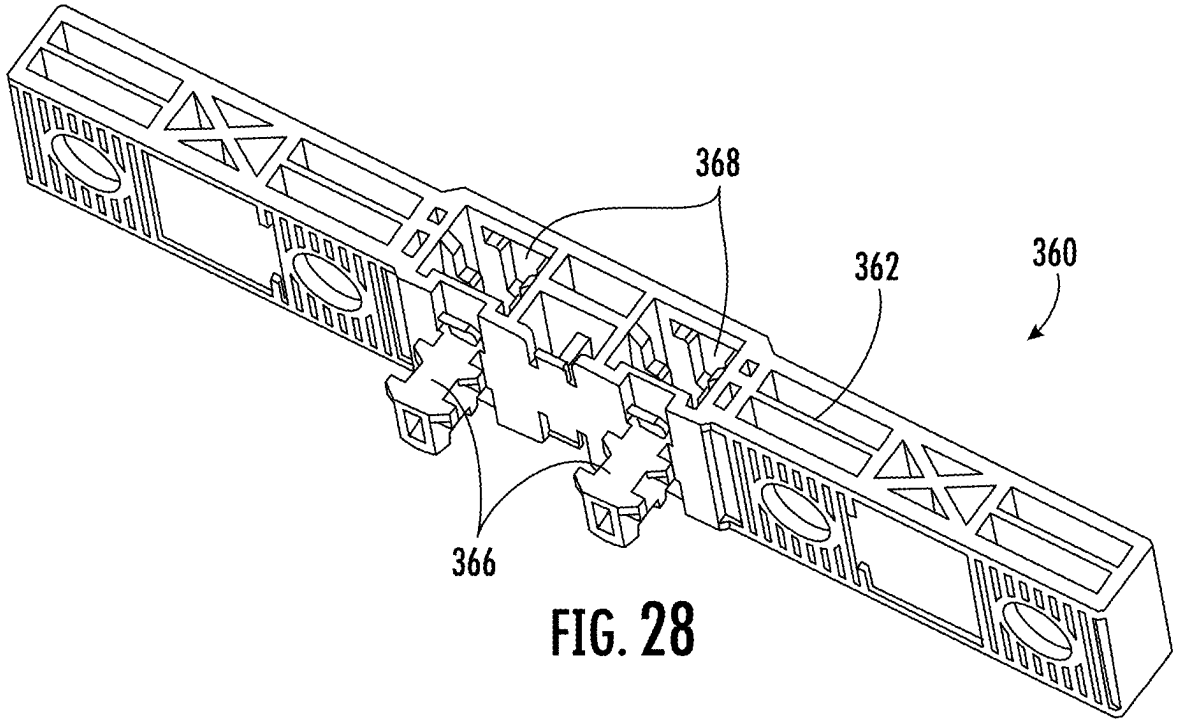

FIG. 28

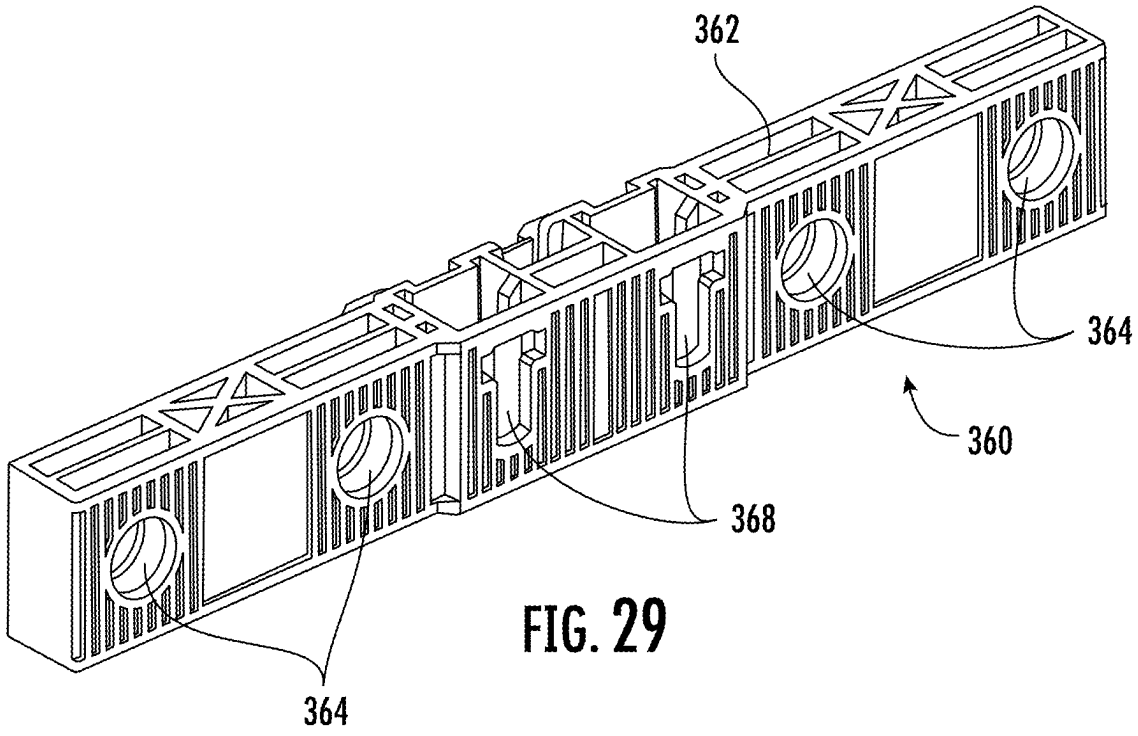

FIG. 29

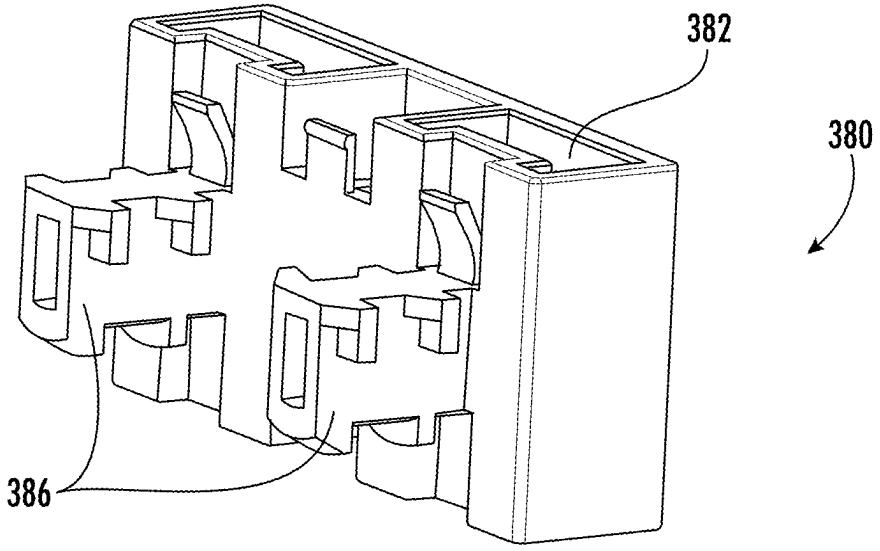

FIG. 30

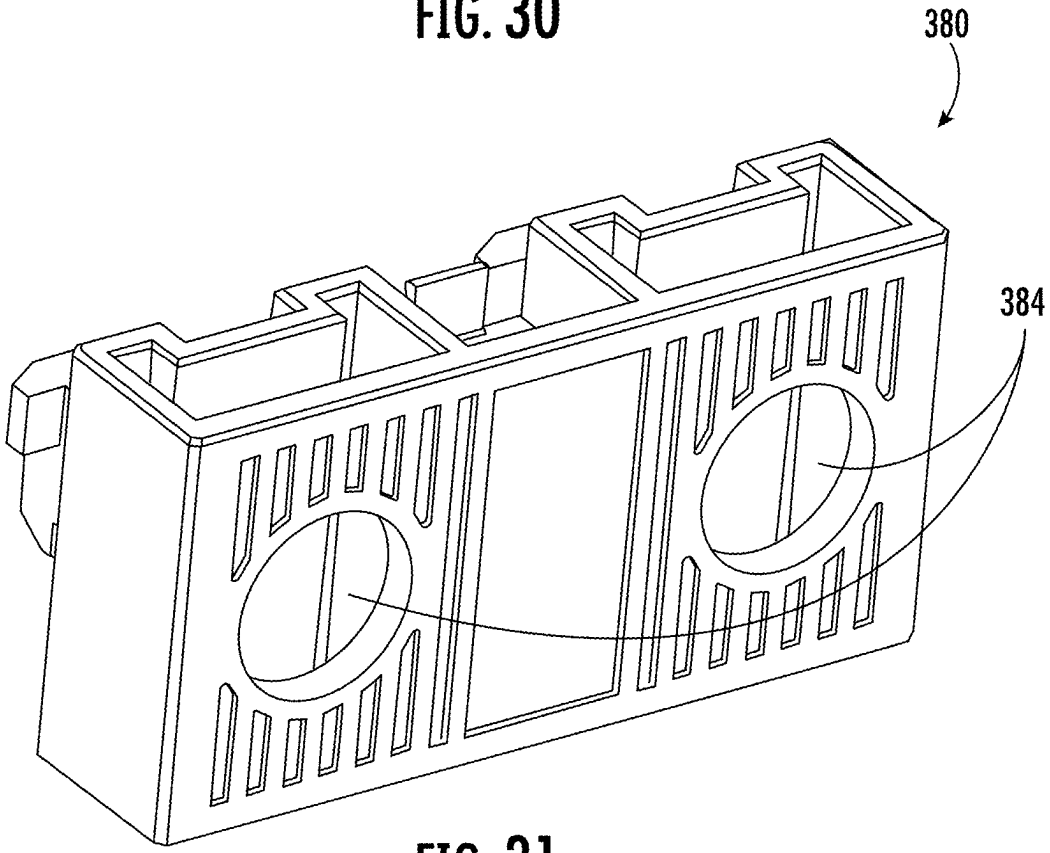

FIG. 31

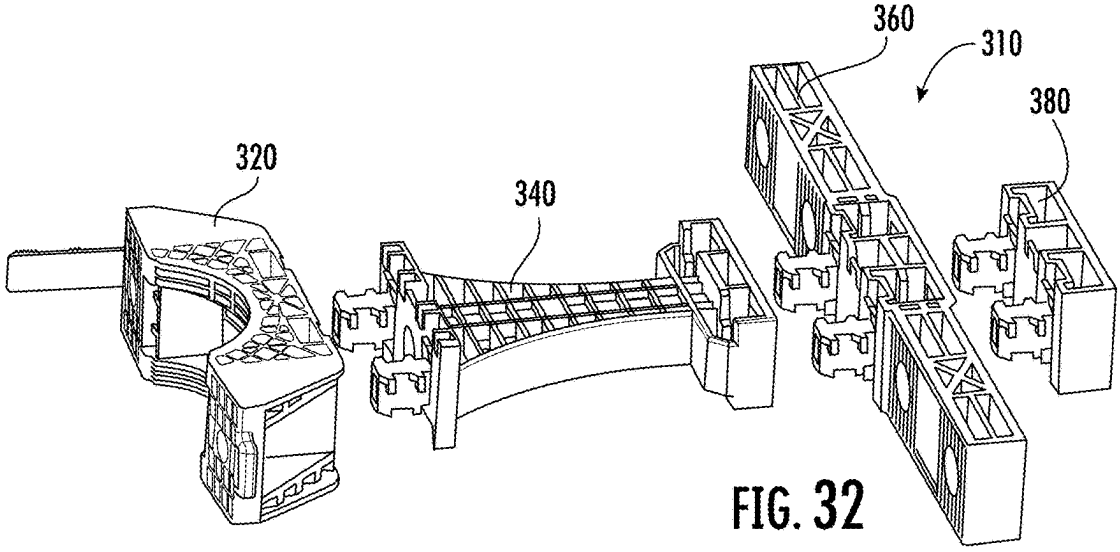

FIG. 32

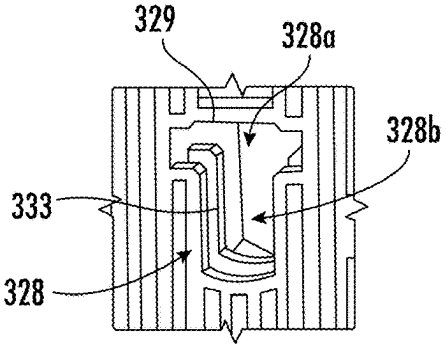

FIG. 33A

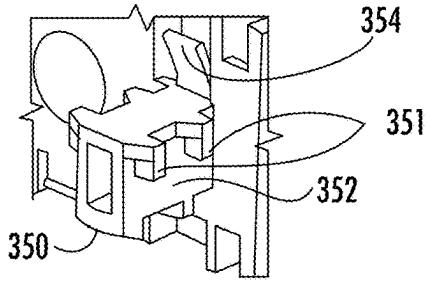

FIG. 33B

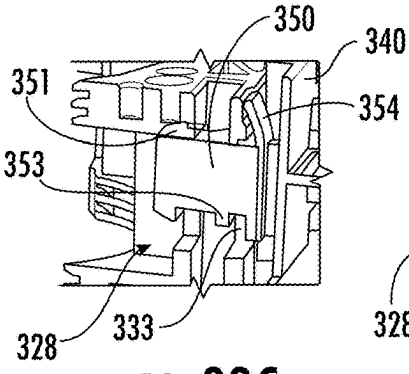

FIG. 33C

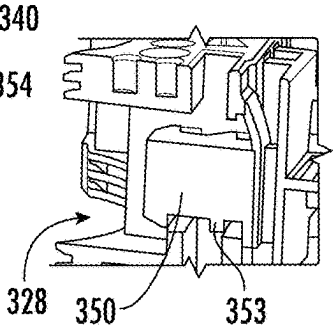

FIG. 33D

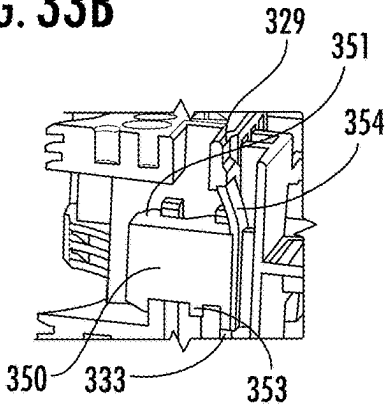

FIG. 33E

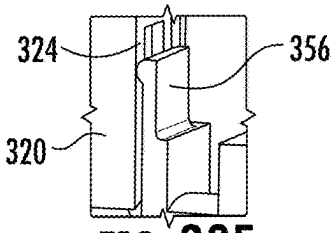

FIG. 33F

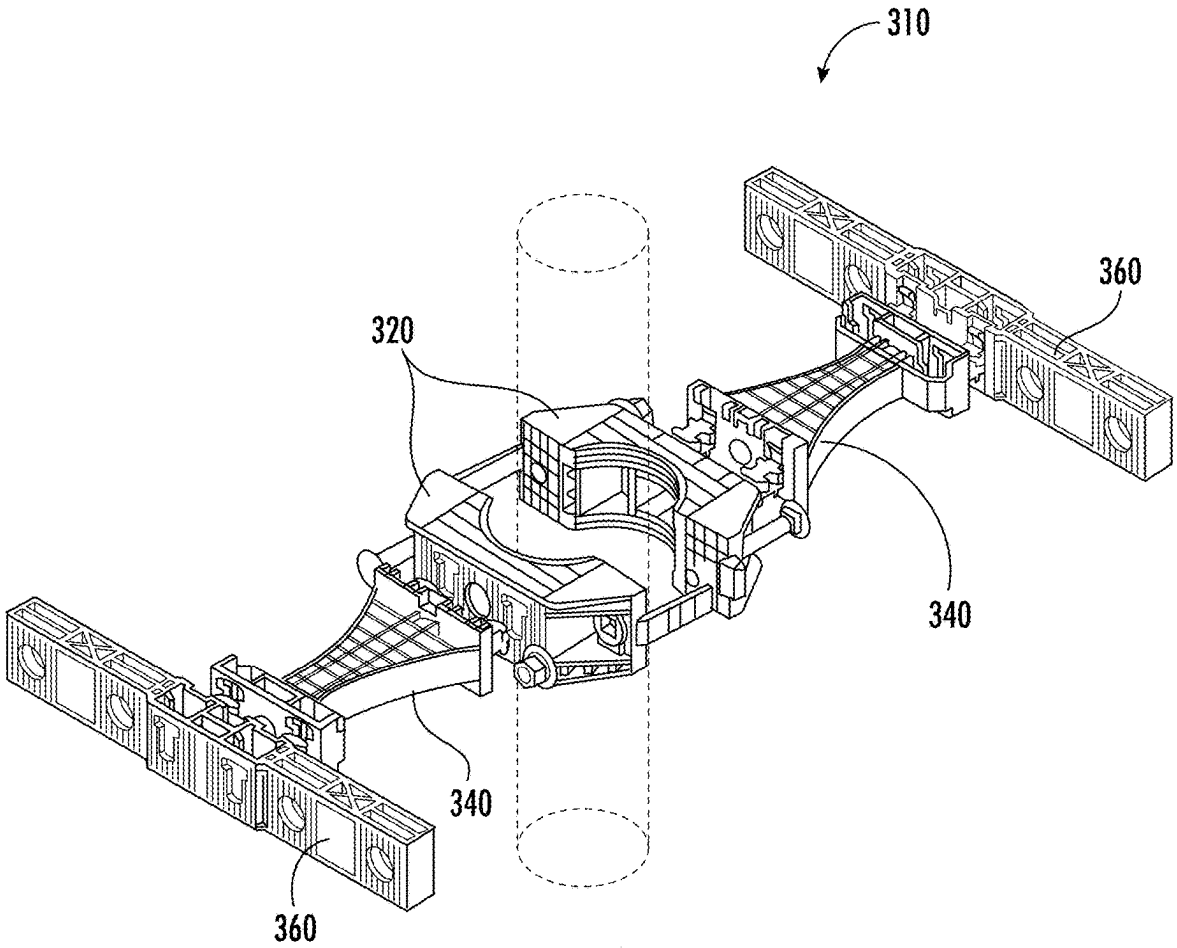

FIG. 34

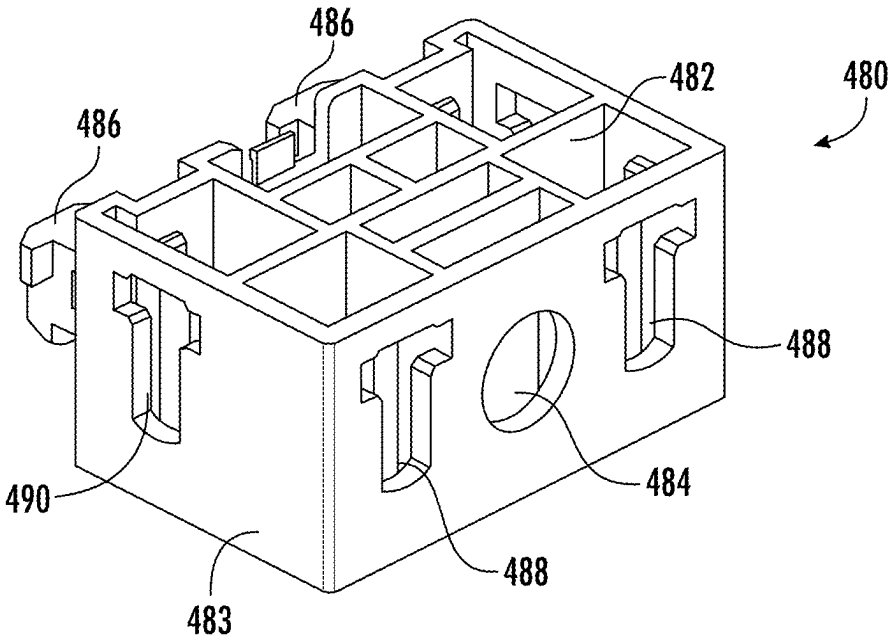

FIG. 35

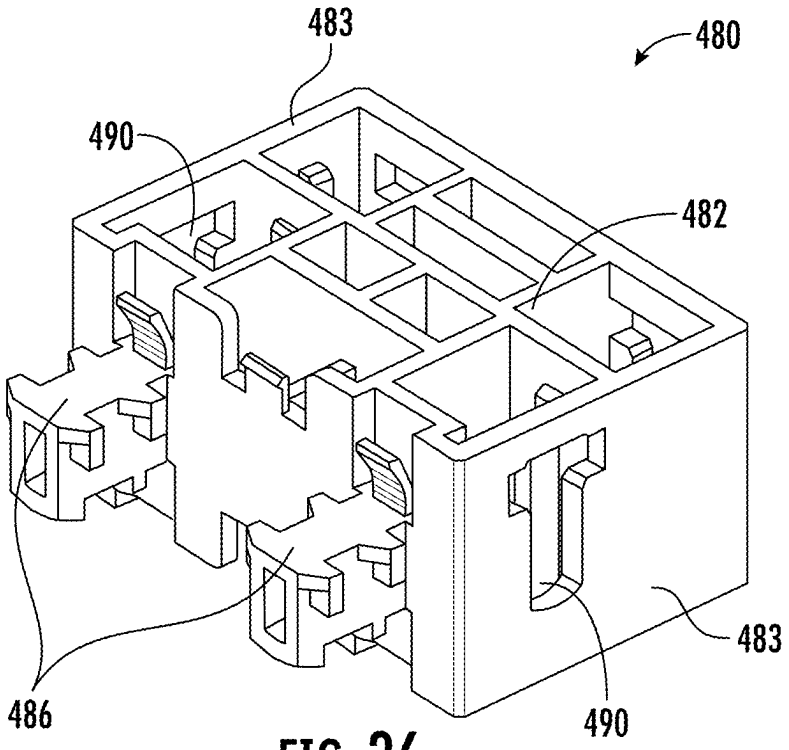

FIG. 36

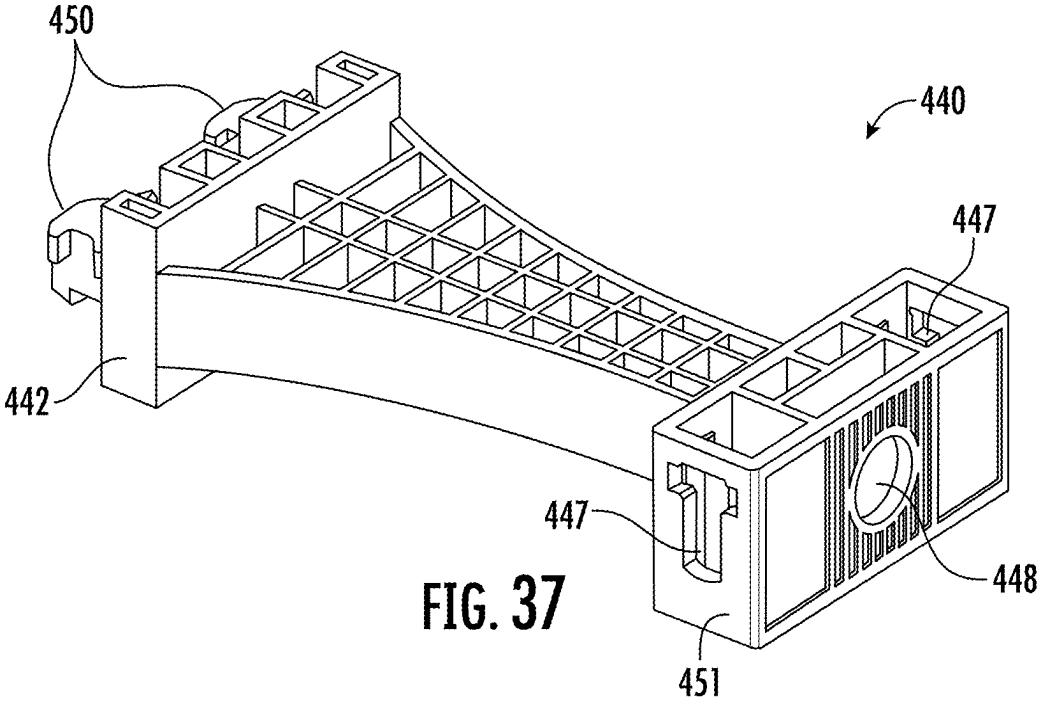

FIG. 37

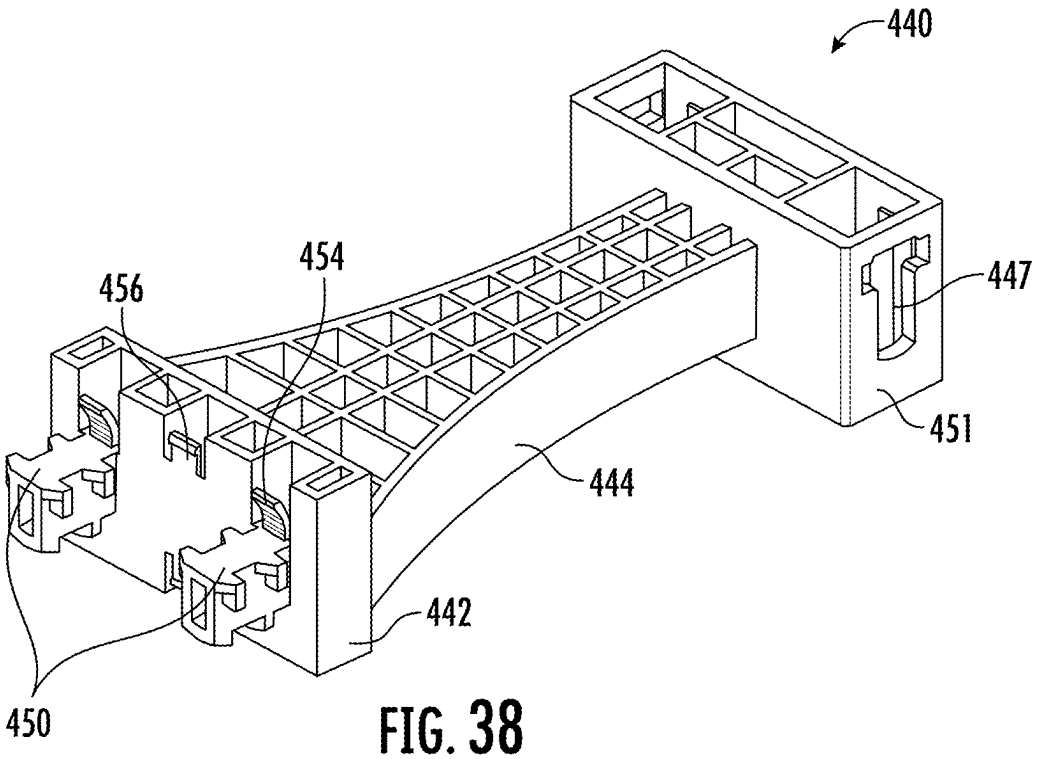

FIG. 38

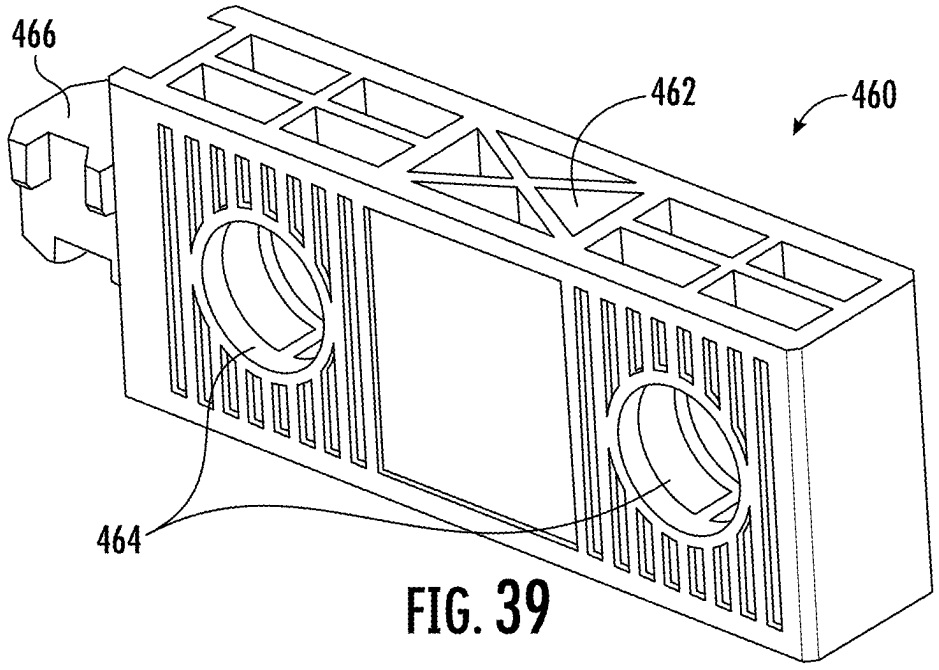

FIG. 39

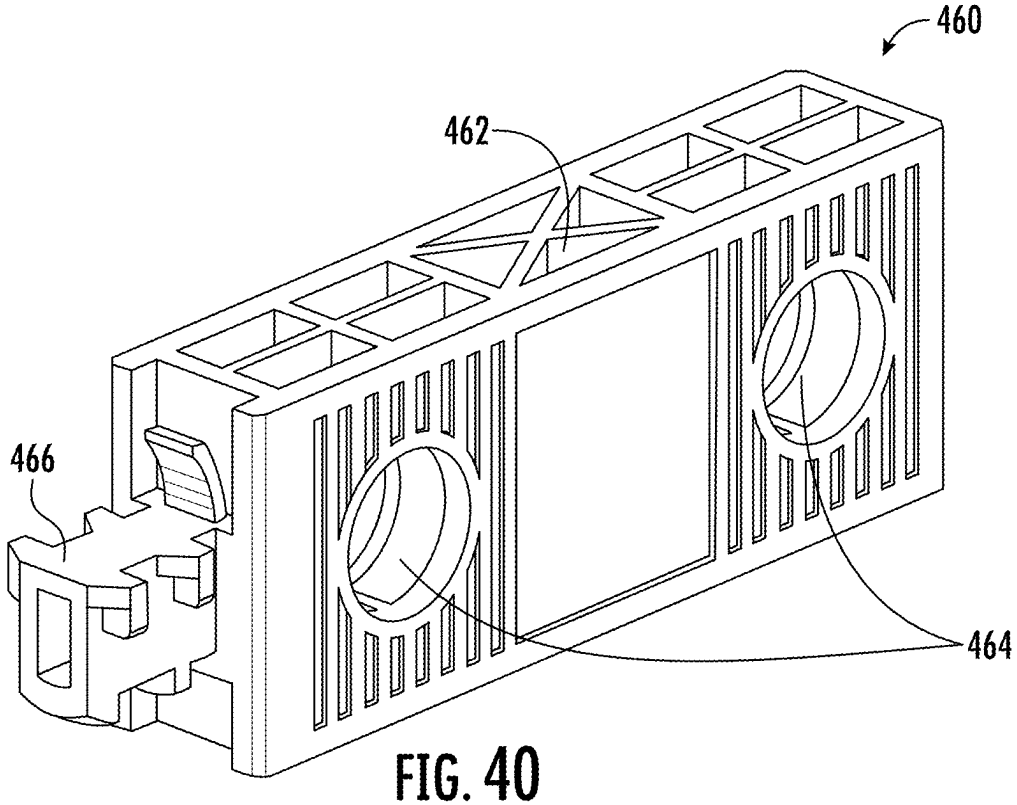

FIG. 40

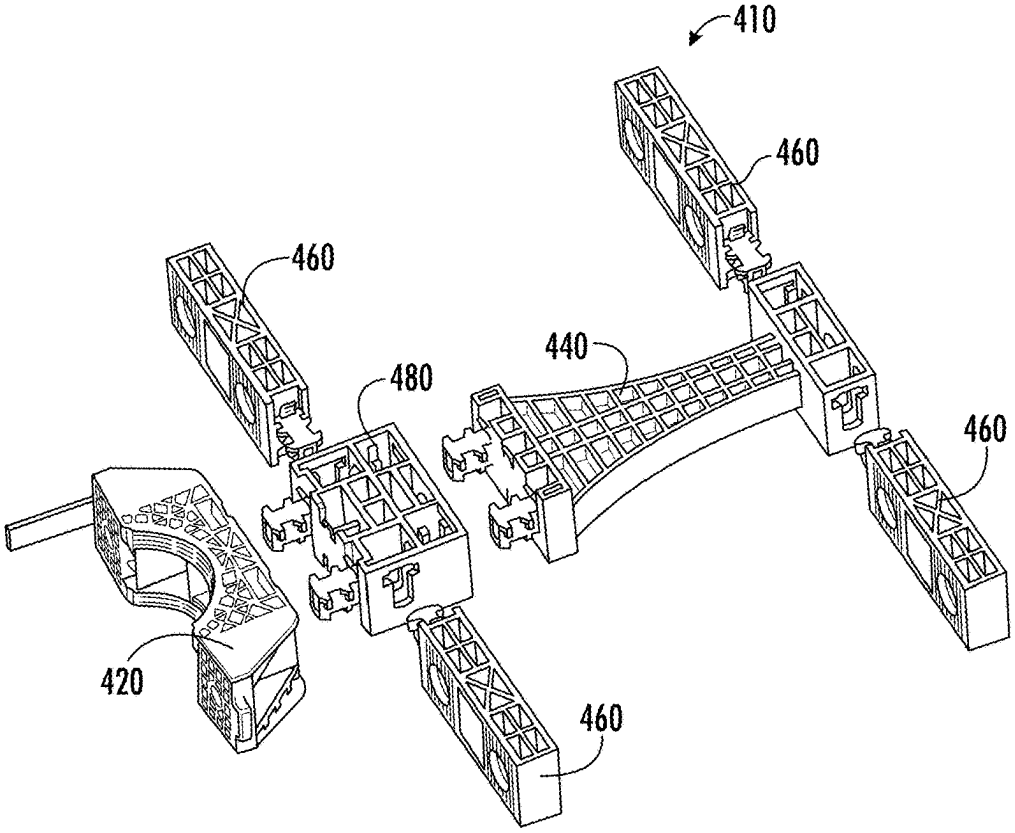

FIG. 41

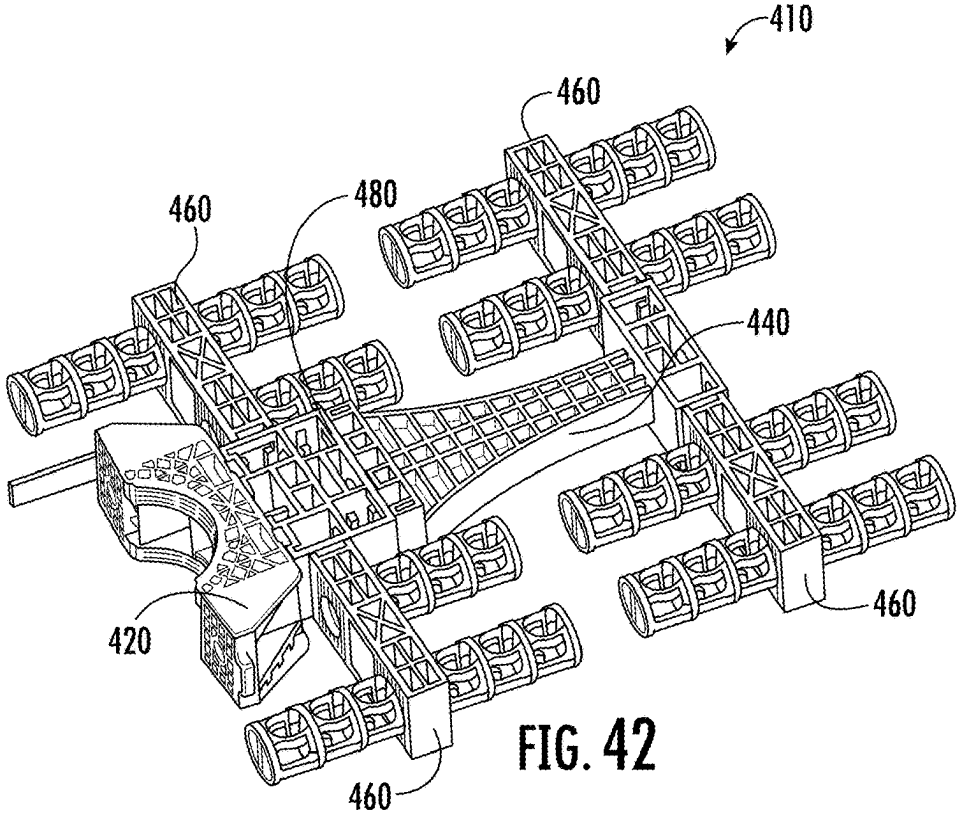

FIG. 42

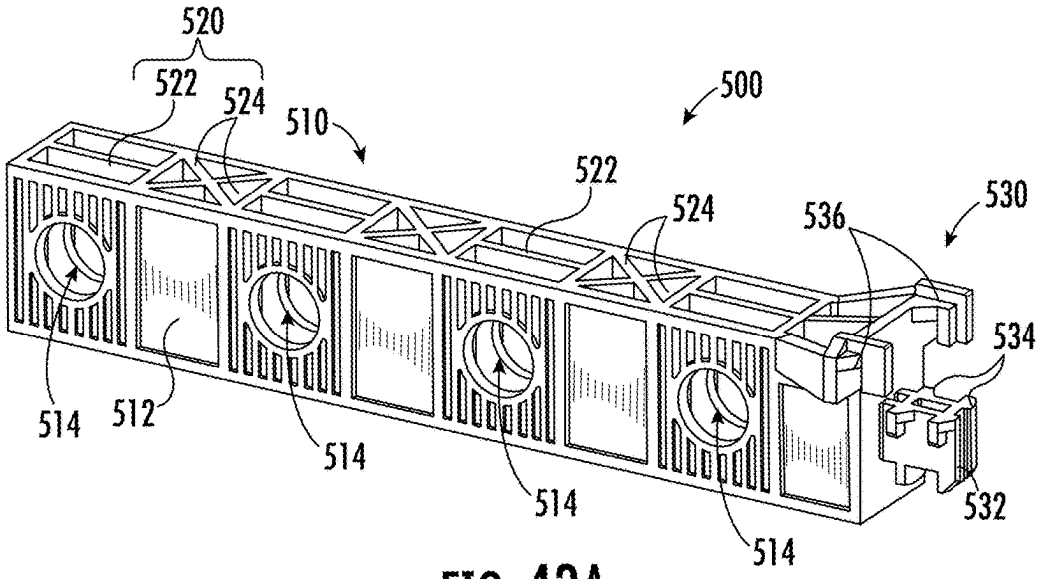

FIG. 43A

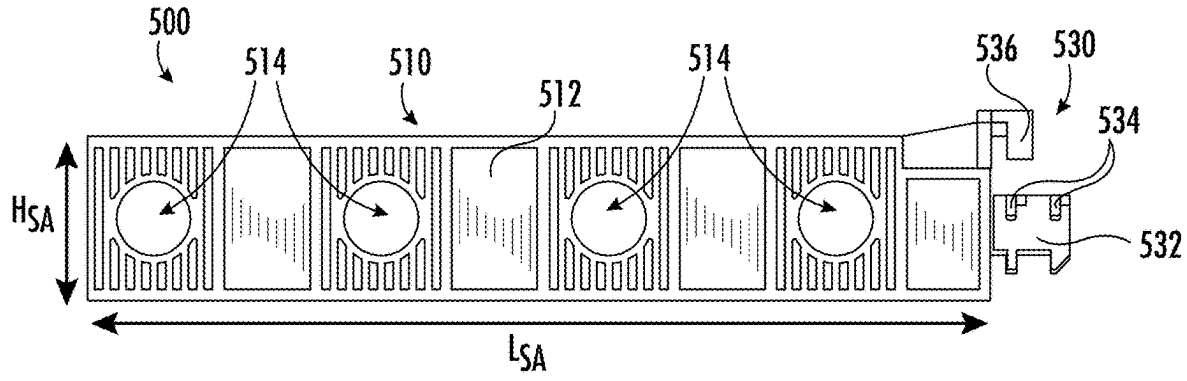

FIG. 43B

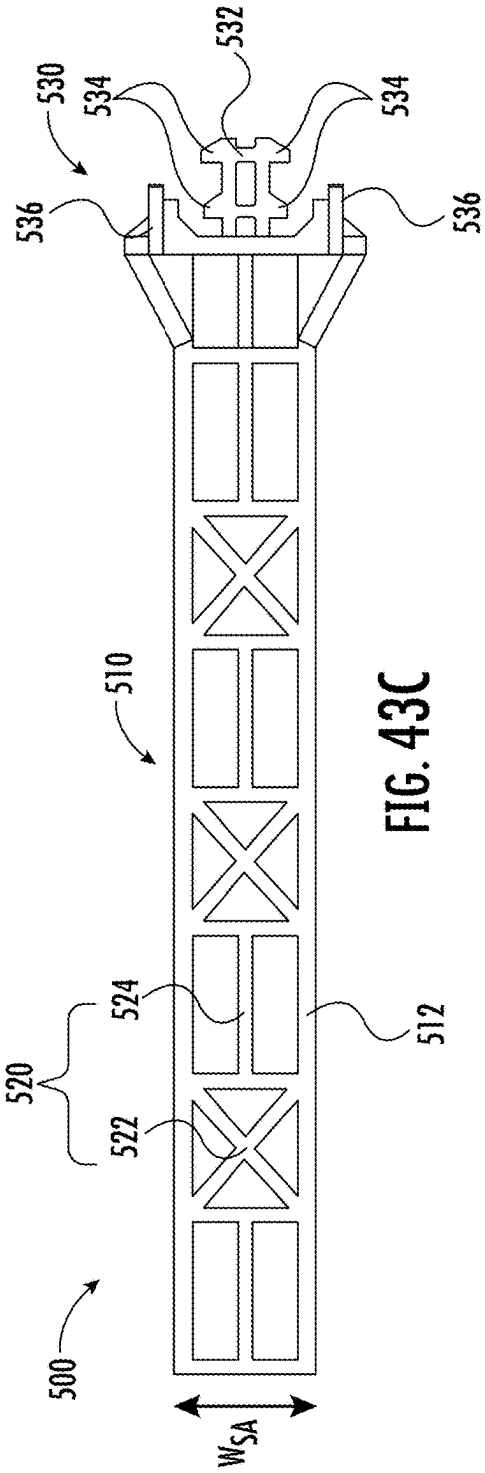

FIG. 43C

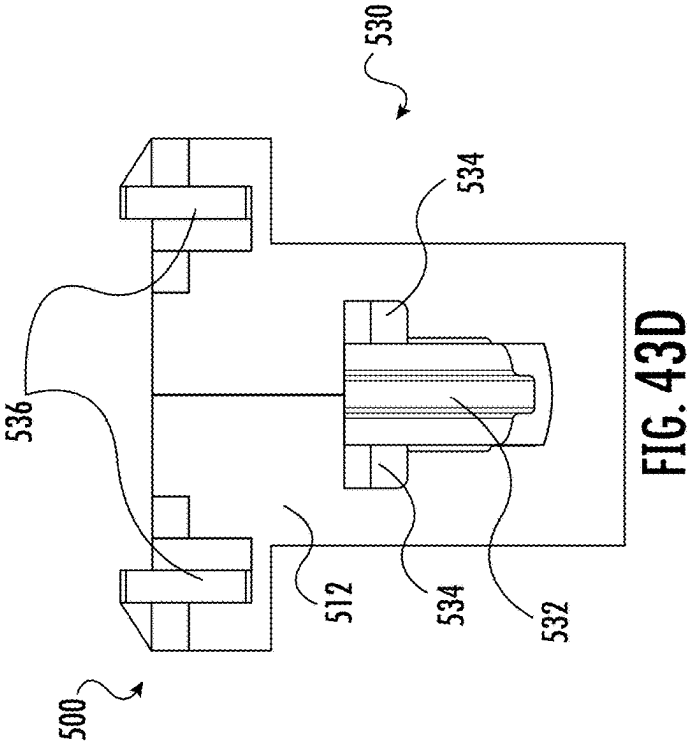

FIG. 43D

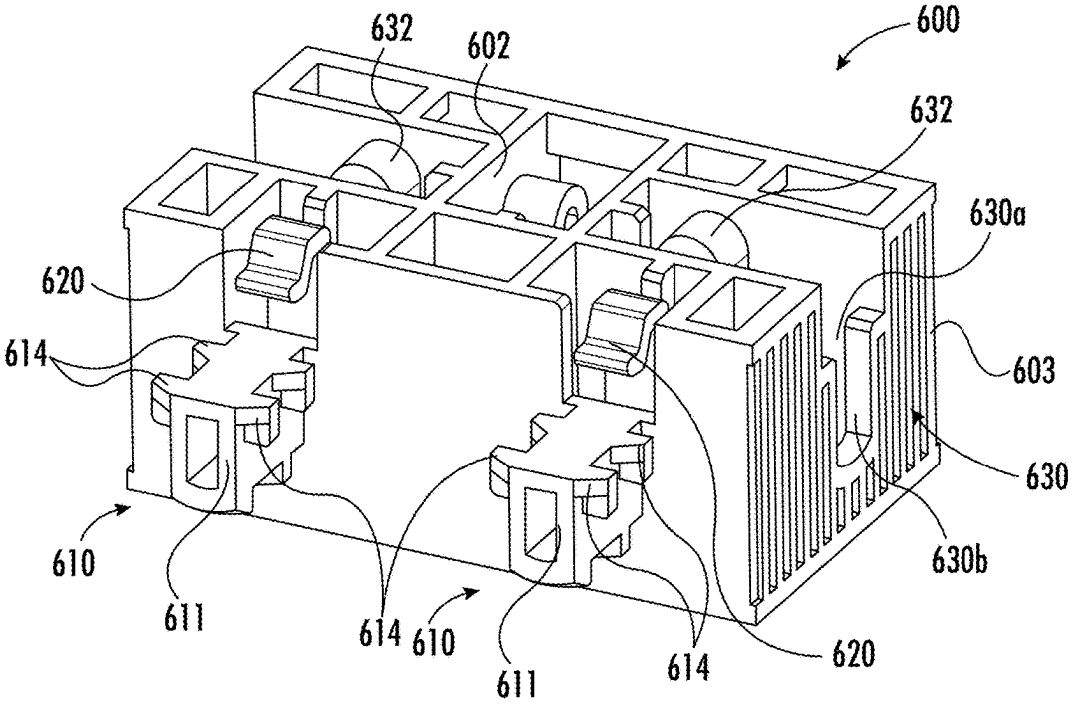

FIG. 44A

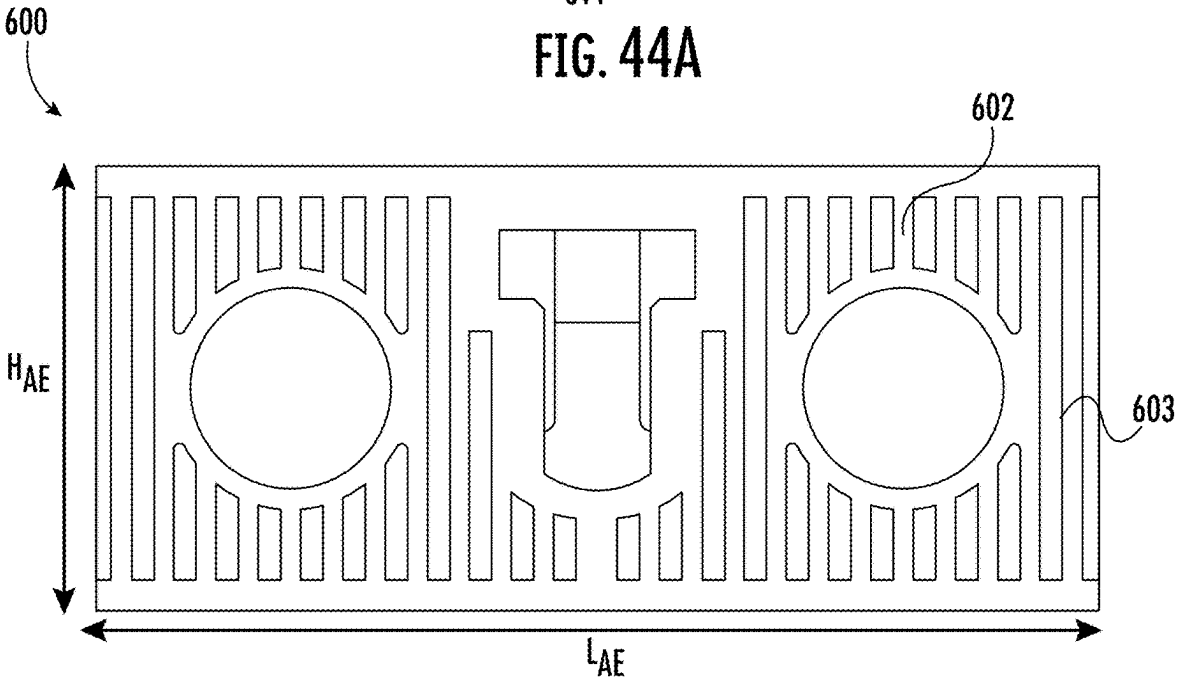

FIG. 44B

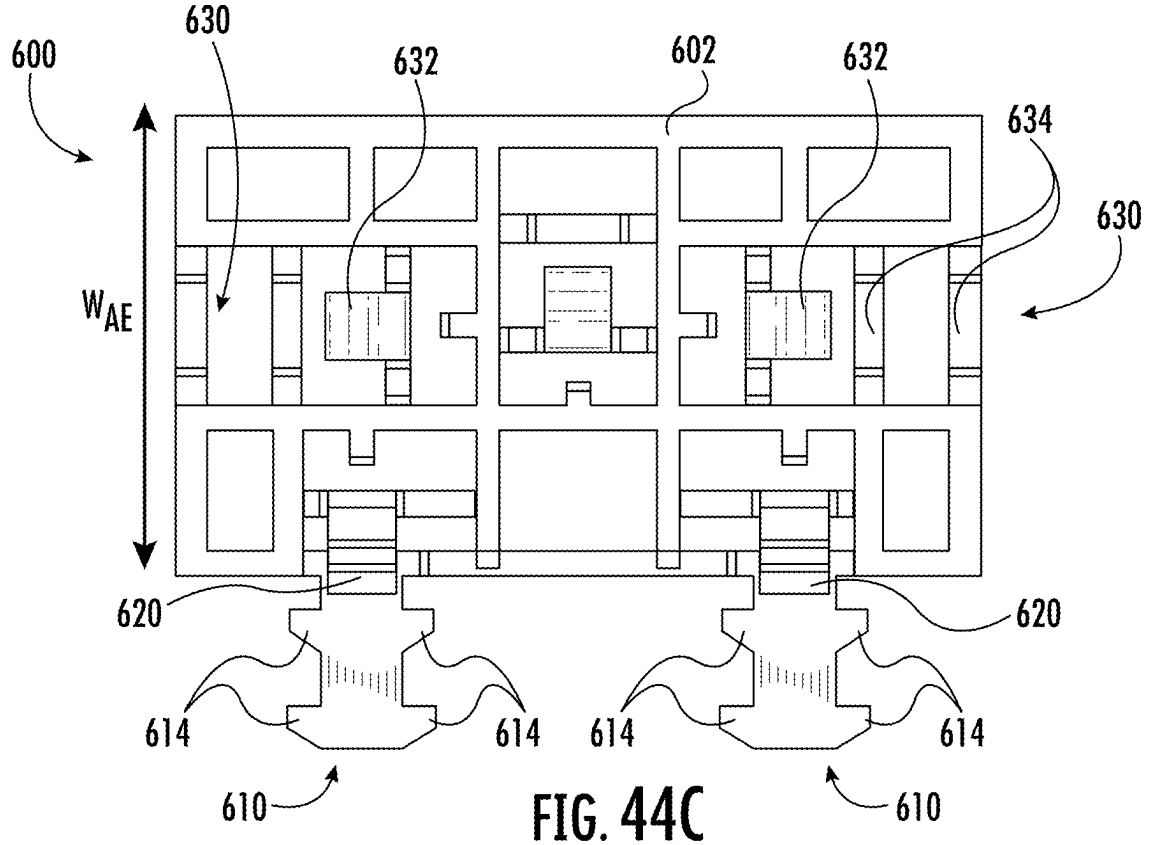

FIG. 44C

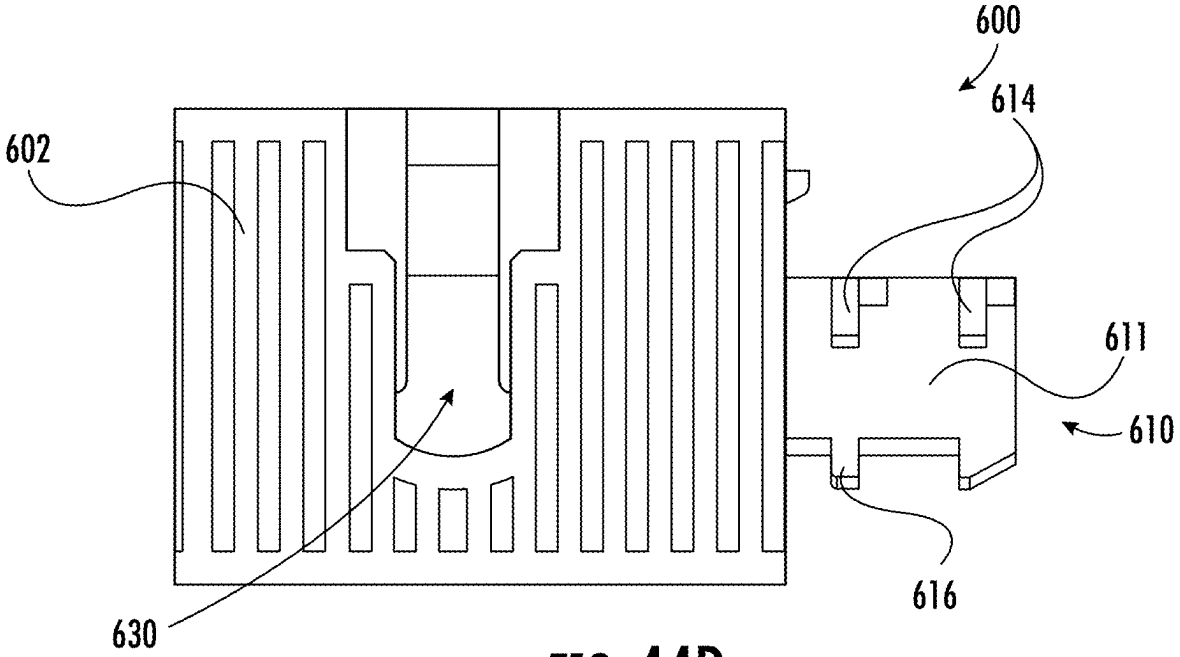

FIG. 44D

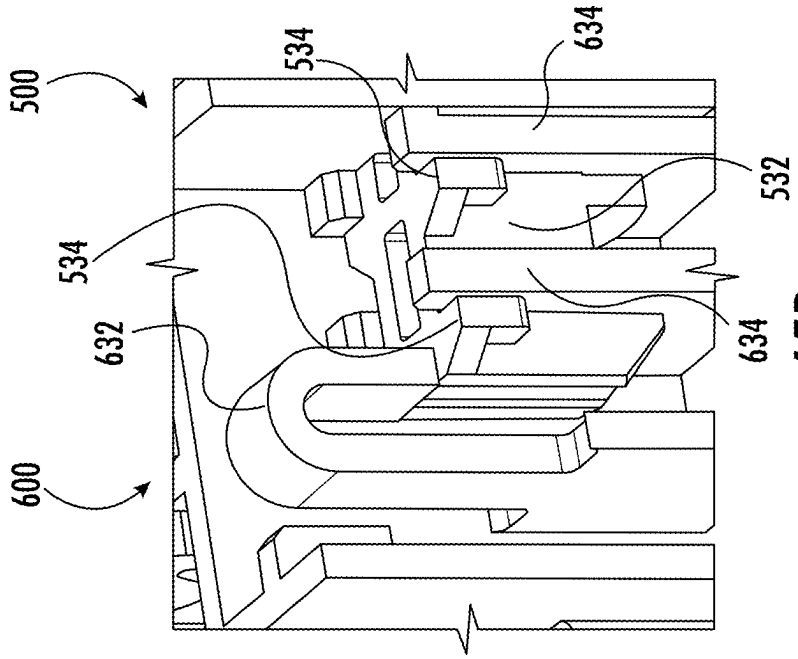

FIG. 45B

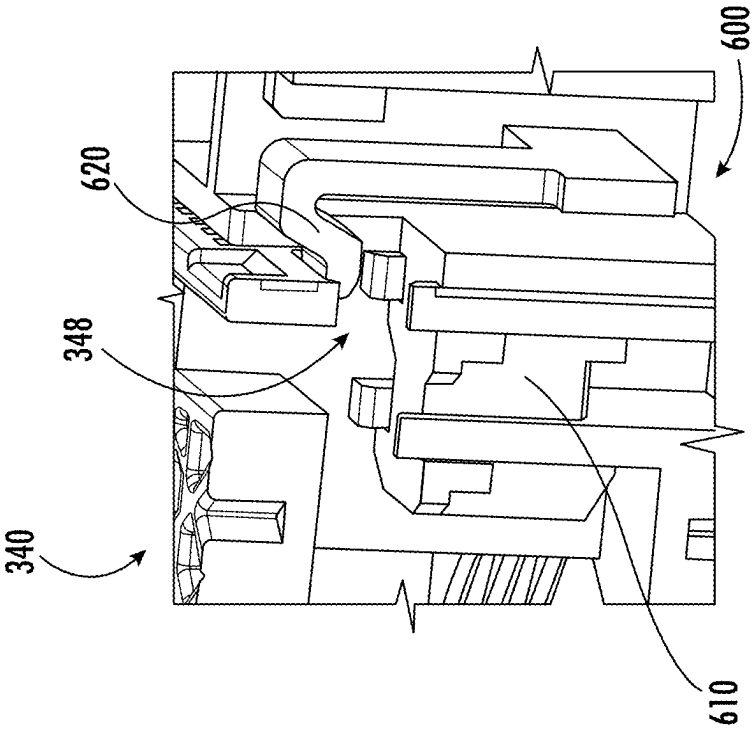

FIG. 45A

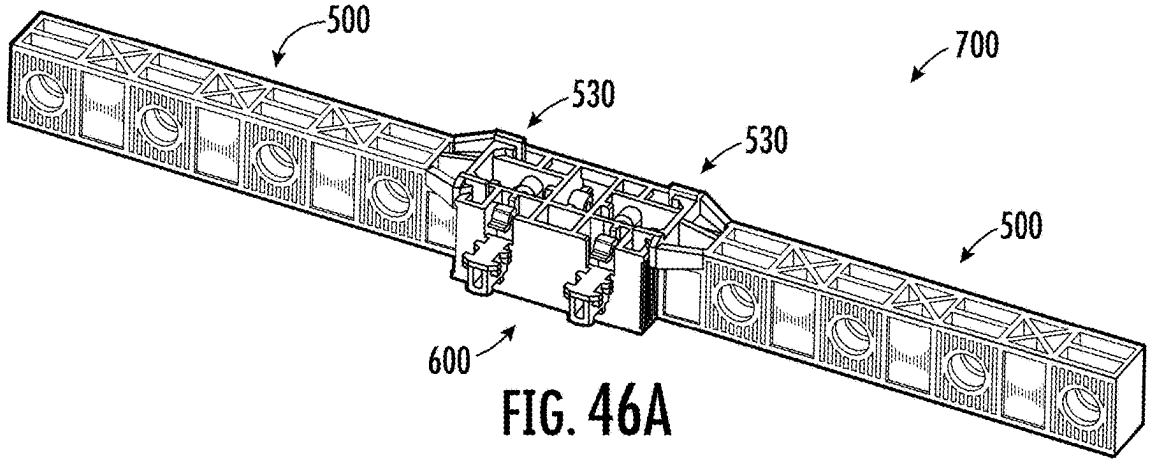

FIG. 46A

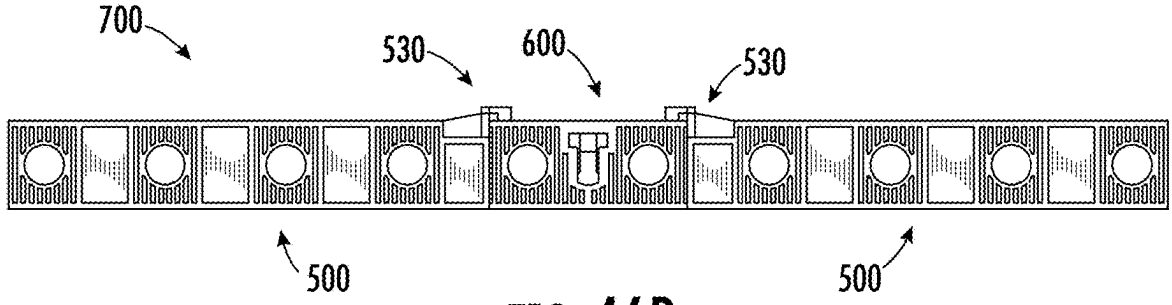

FIG. 46B

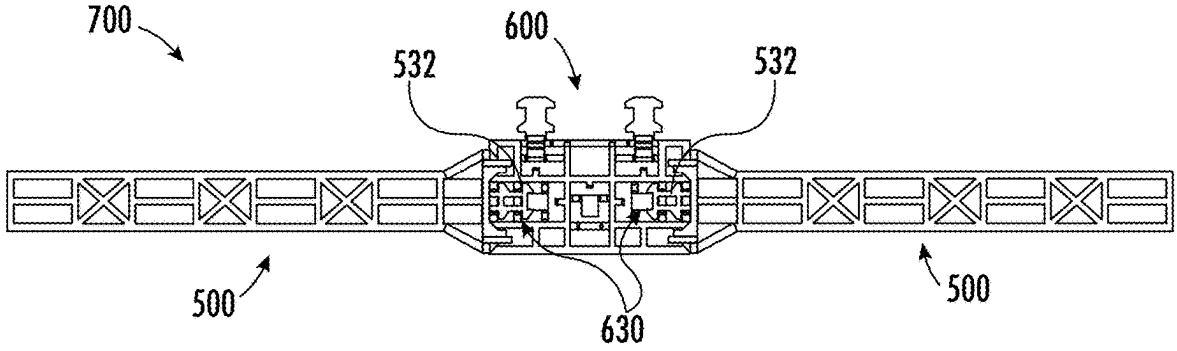

FIG. 46C

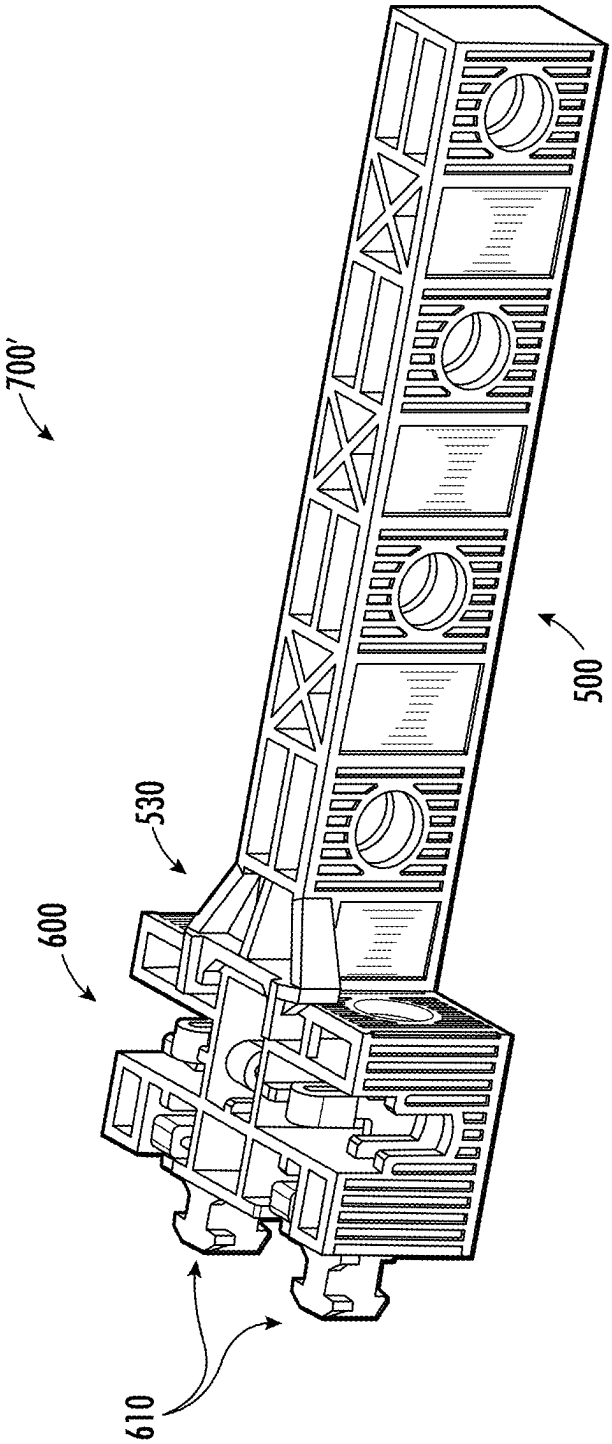

FIG. 47

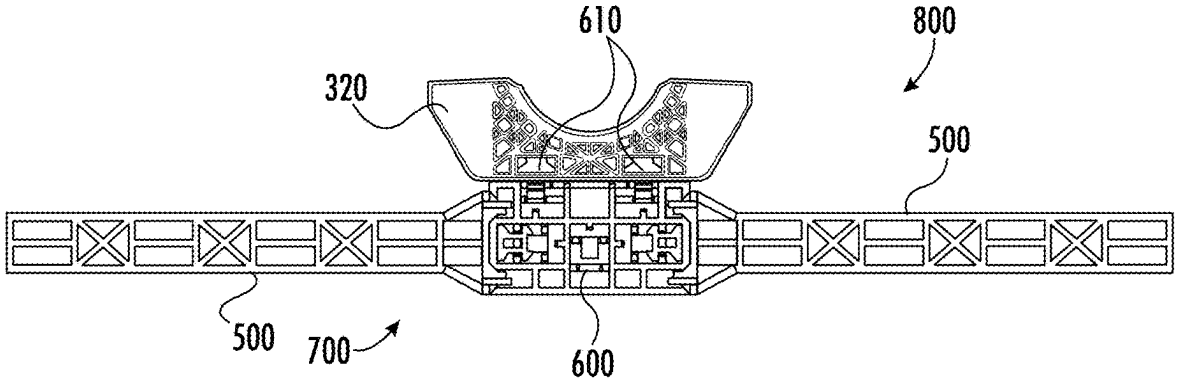

FIG. 48A

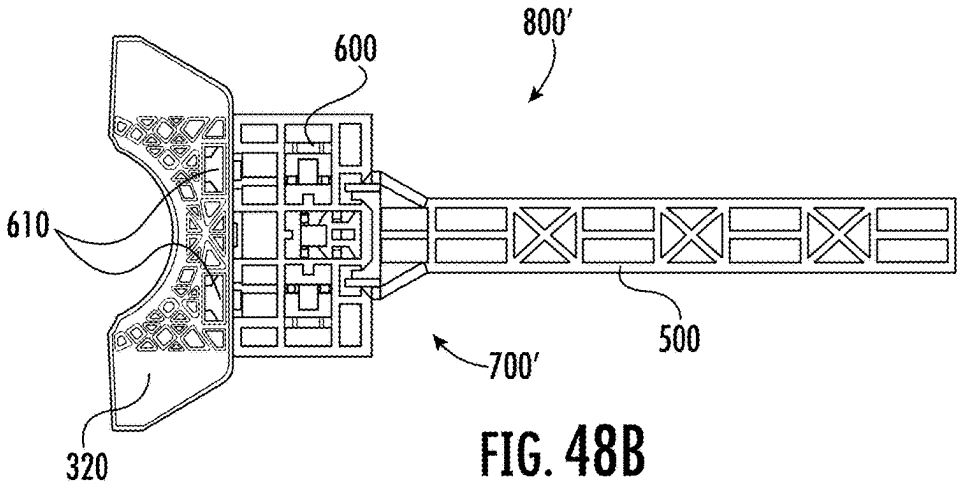

FIG. 48B

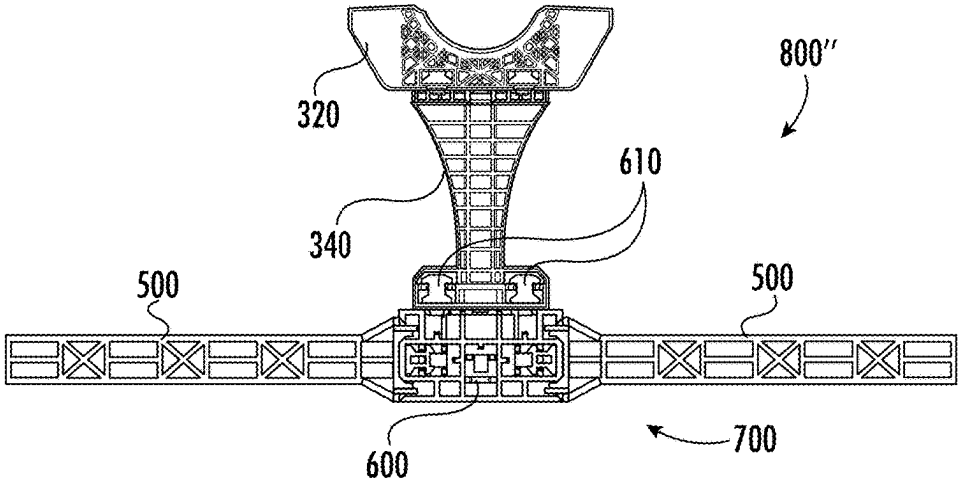

FIG. 48C

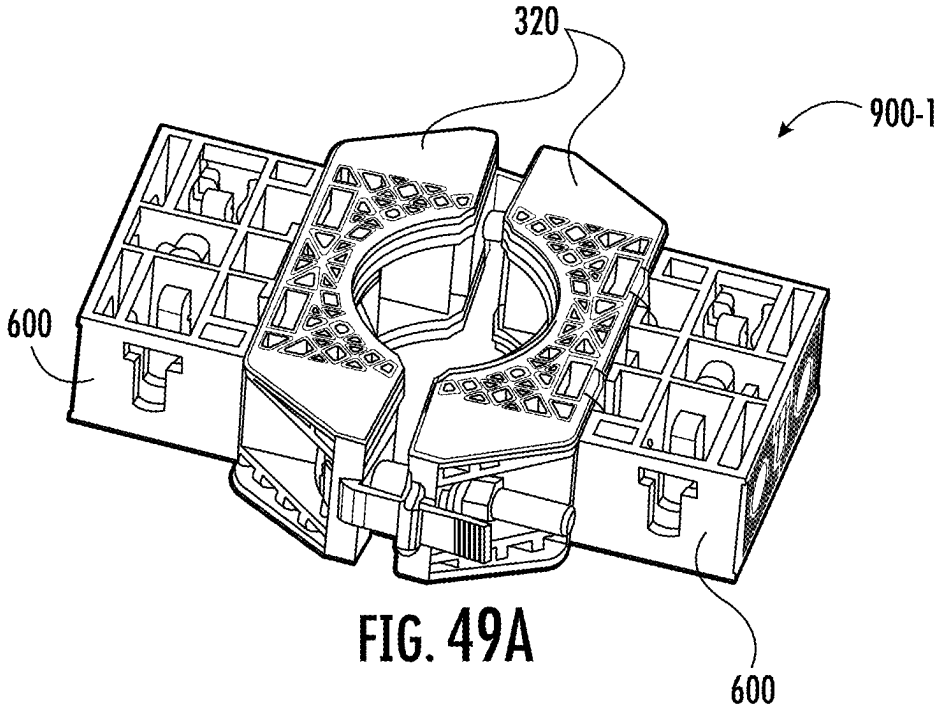

FIG. 49A

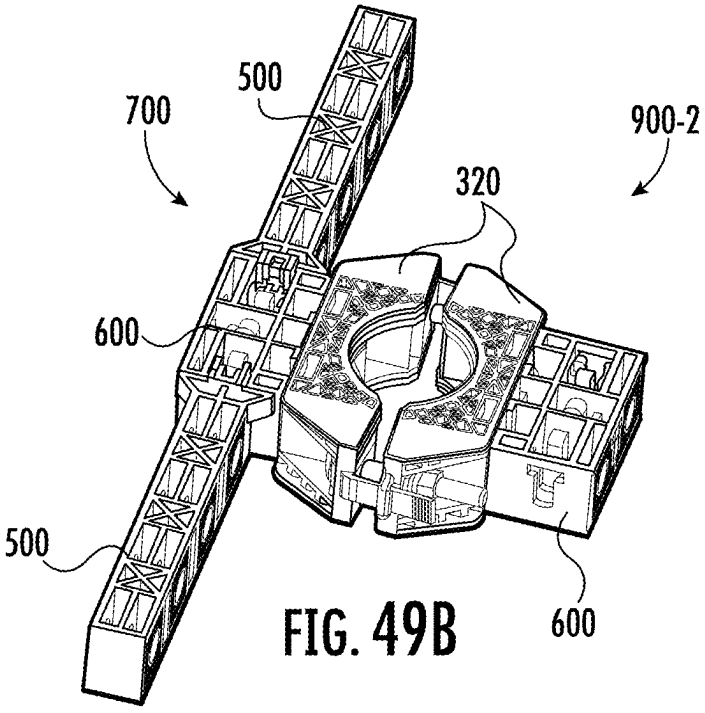

FIG. 49B

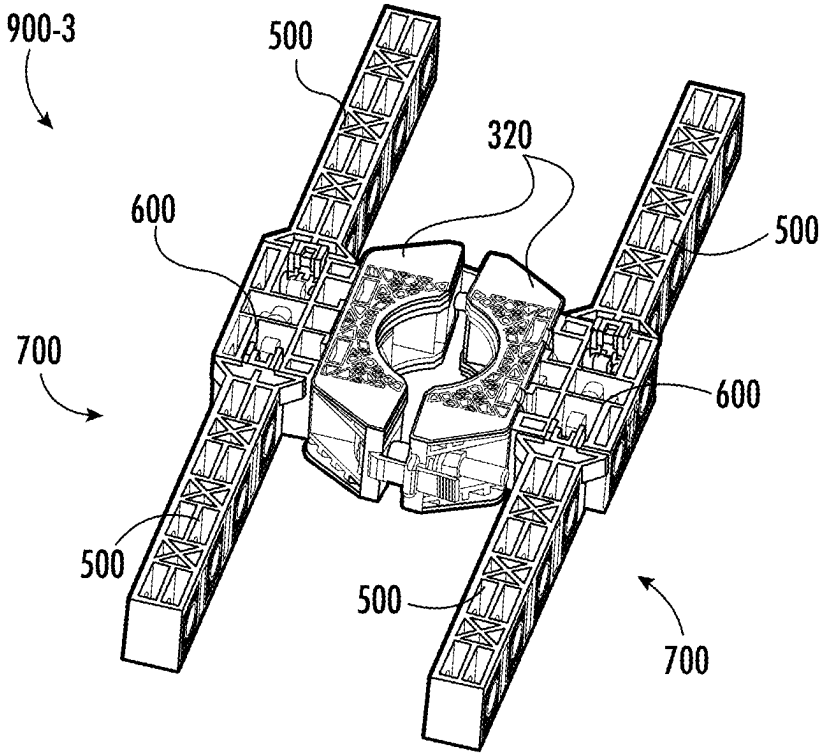

FIG. 49C

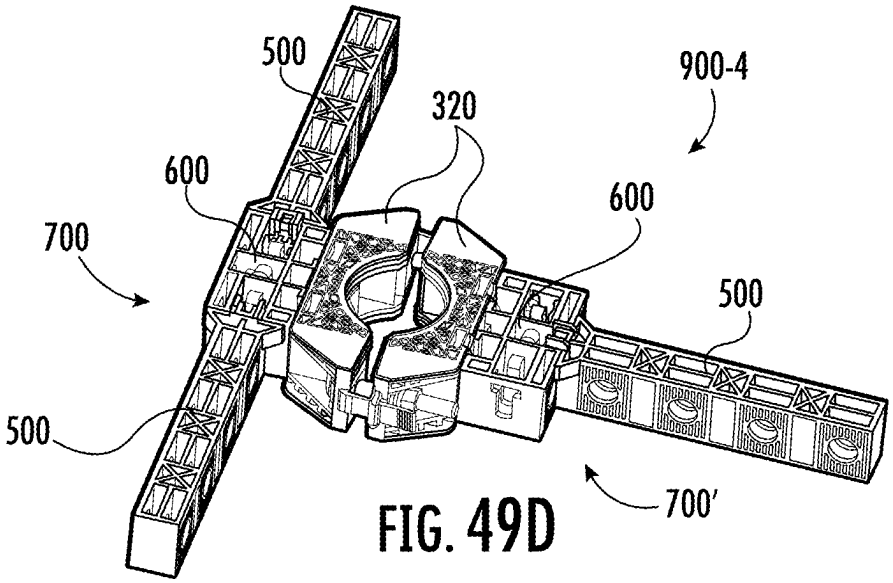

FIG. 49D

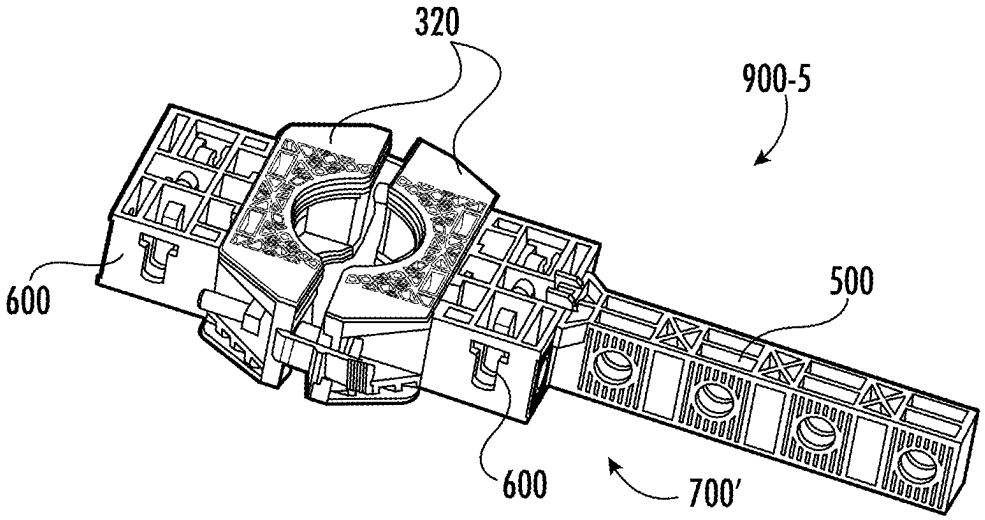

FIG. 49E

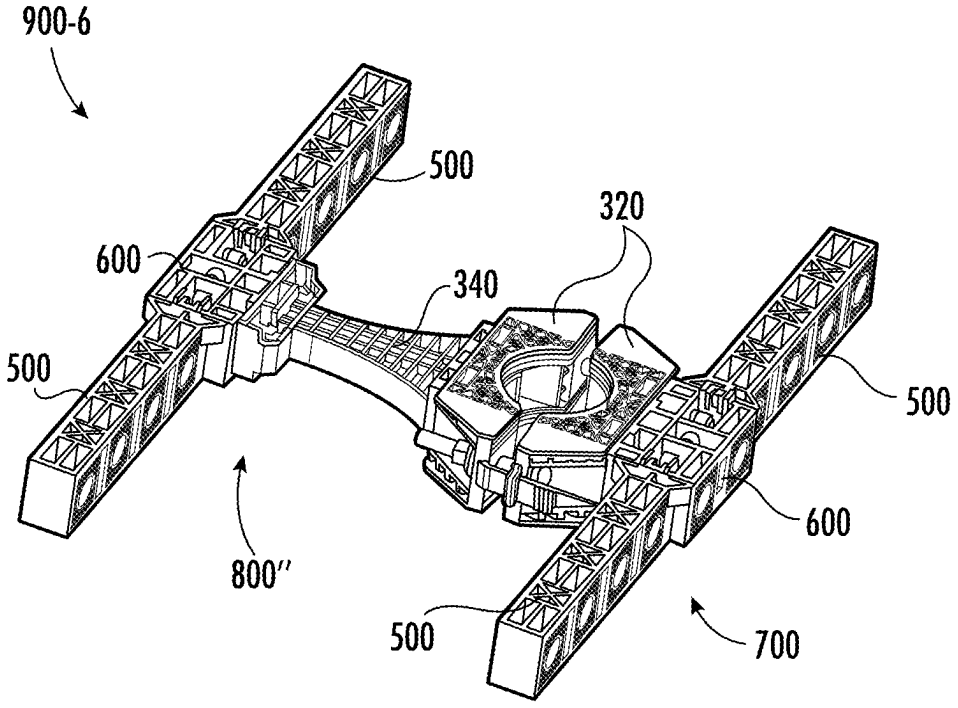

FIG. 49F

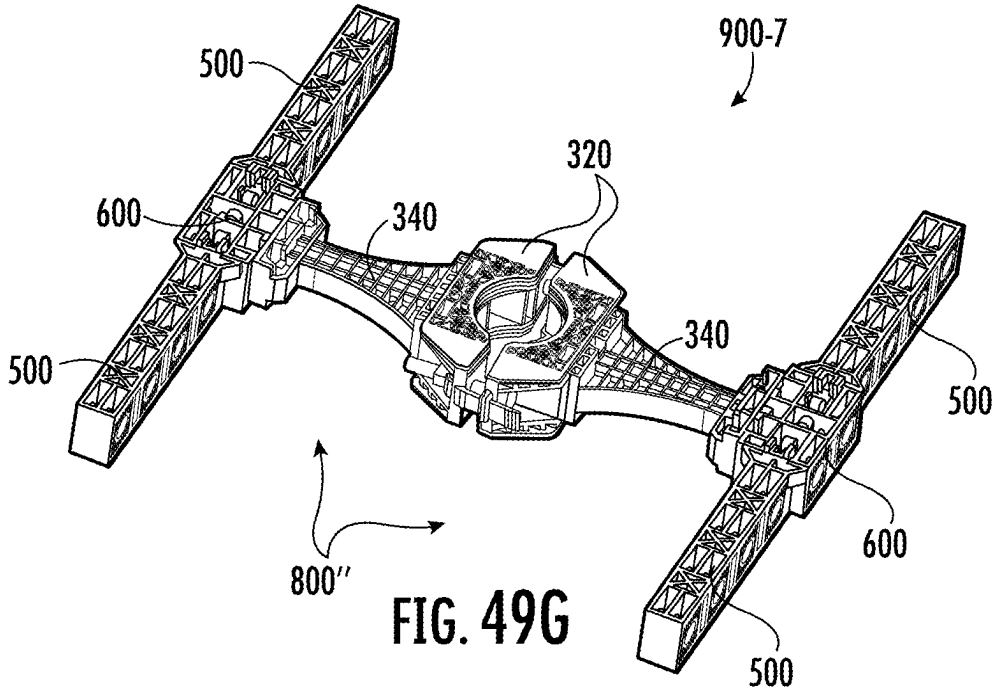

FIG. 49G

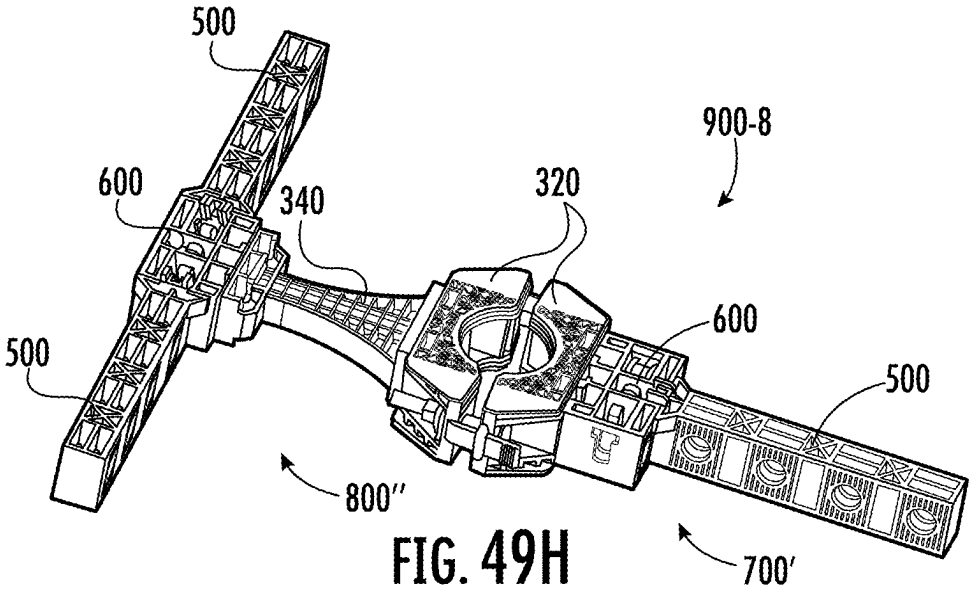

FIG. 49H

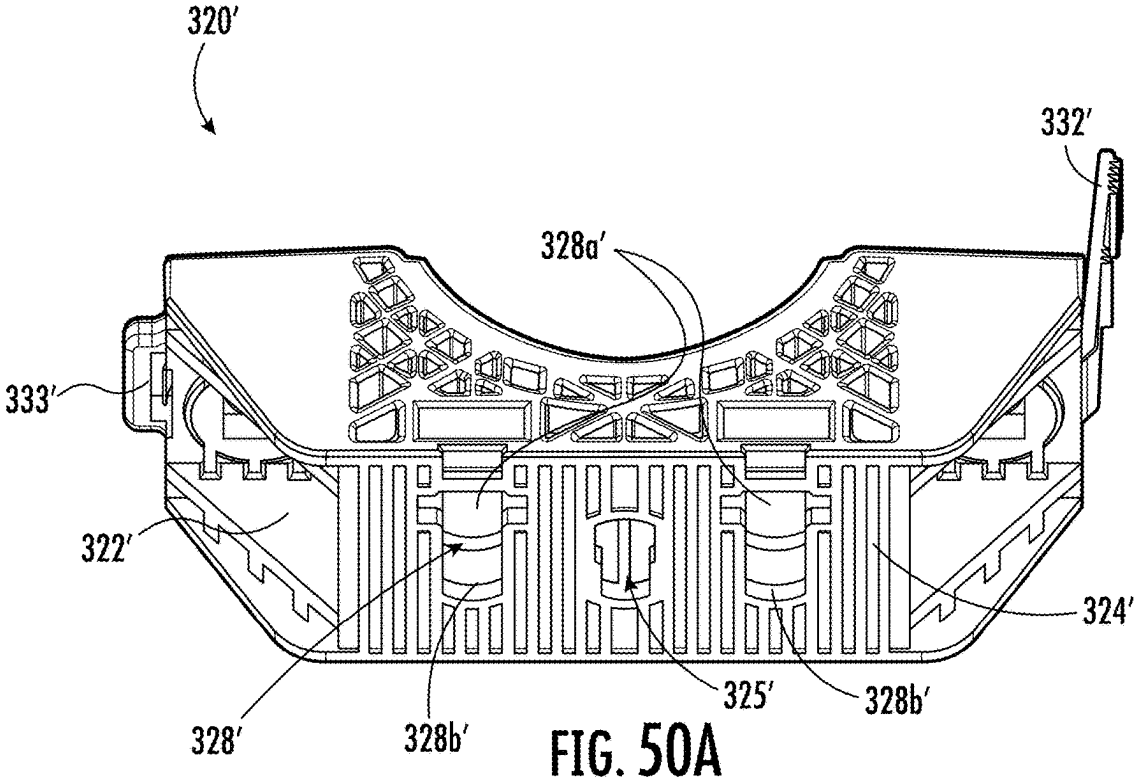

FIG. 50A

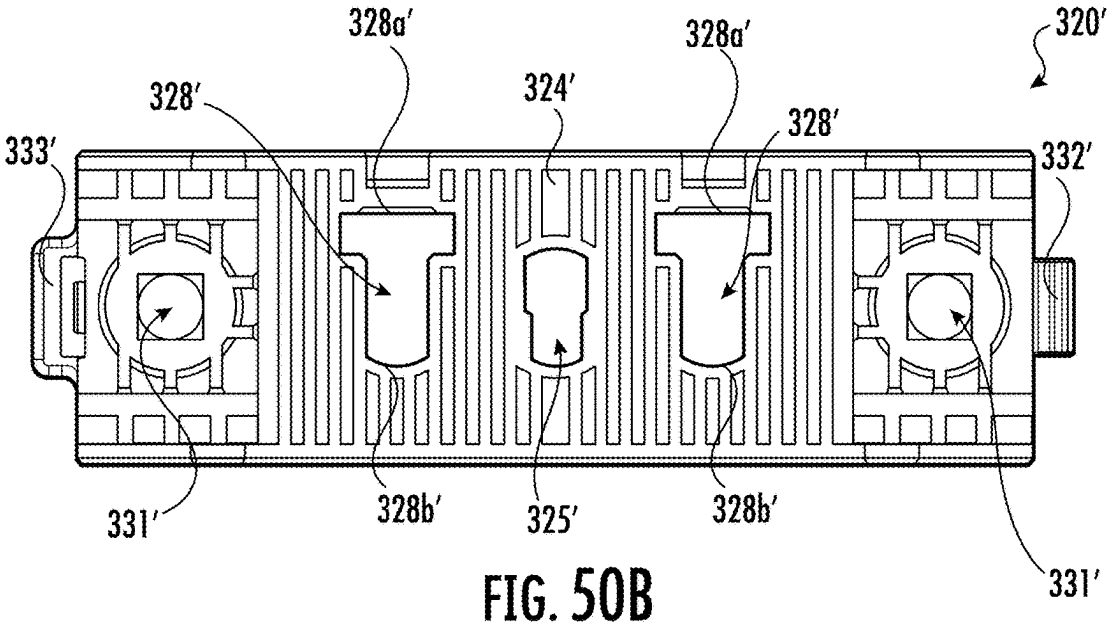

FIG. 50B

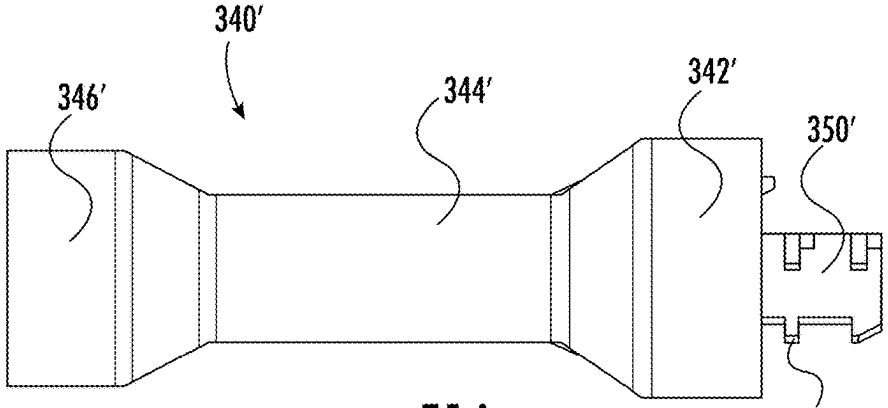

FIG. 51A

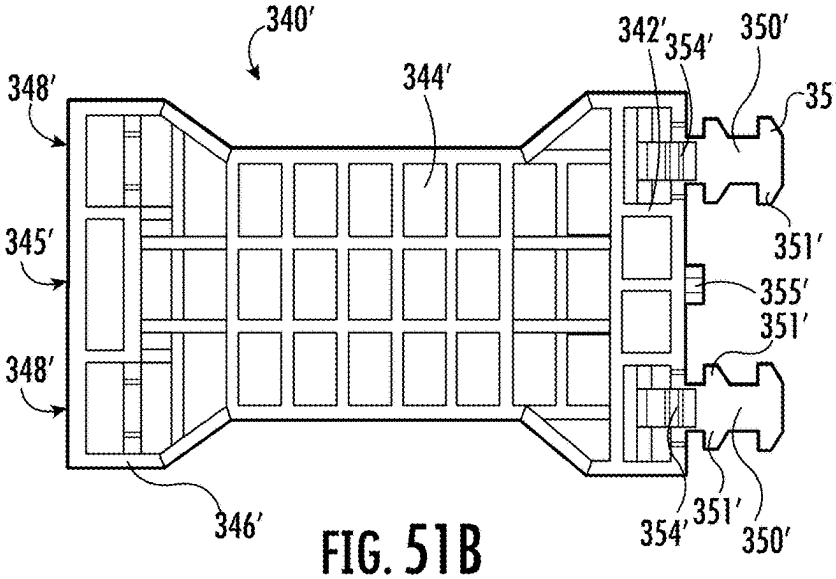

FIG. 51B

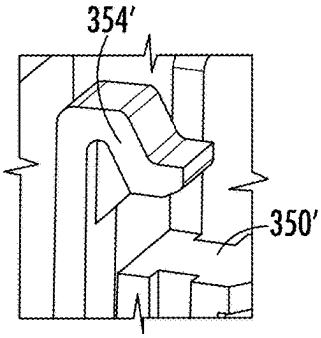

FIG. 51C

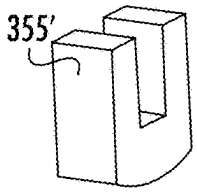

FIG. 51D

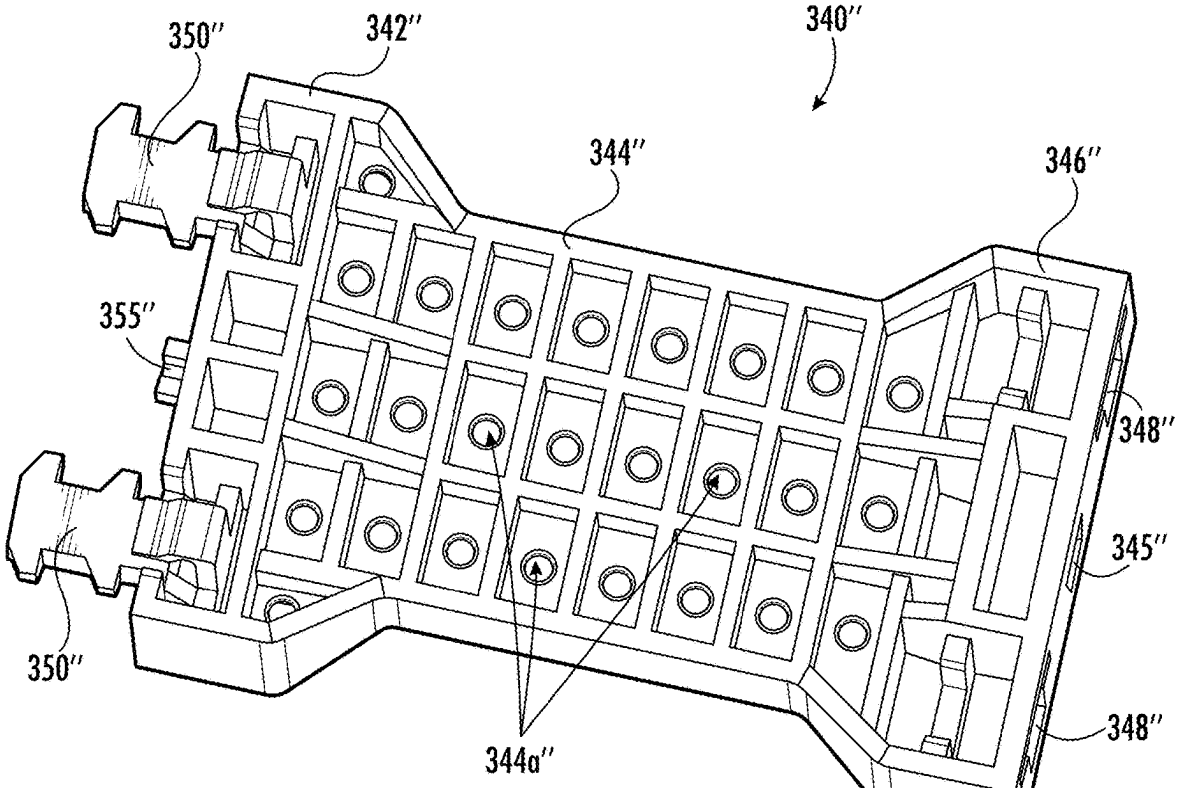

FIG. 52

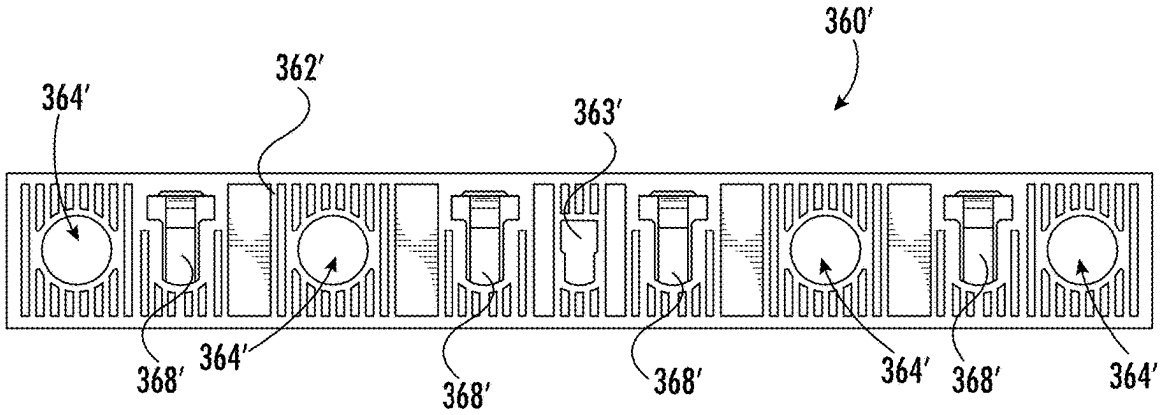

FIG. 53A

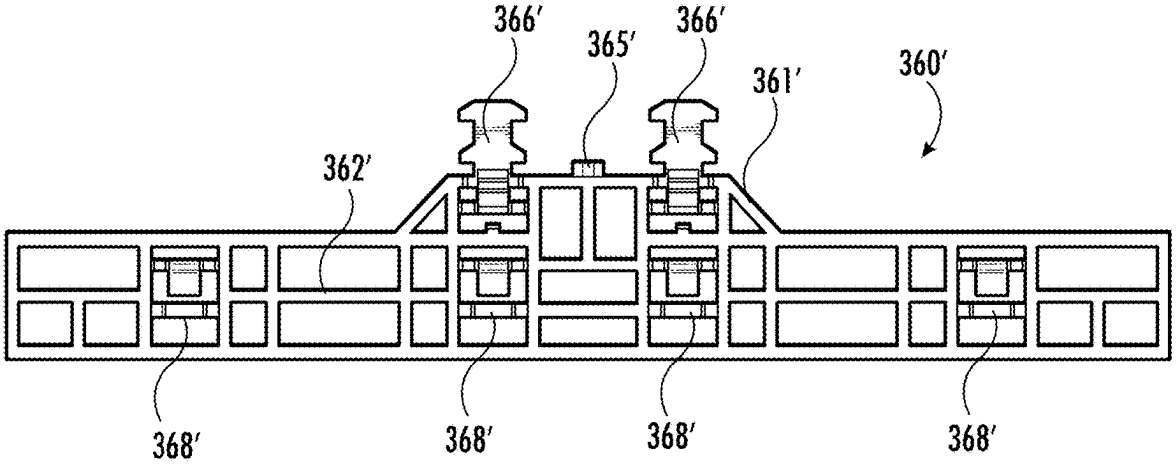

FIG. 53B

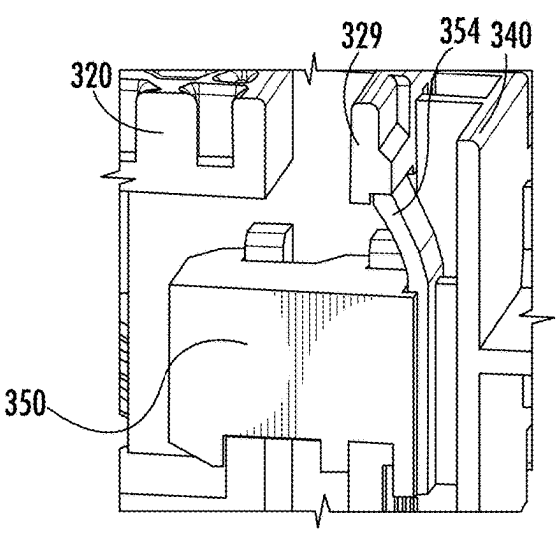

FIG. 54A

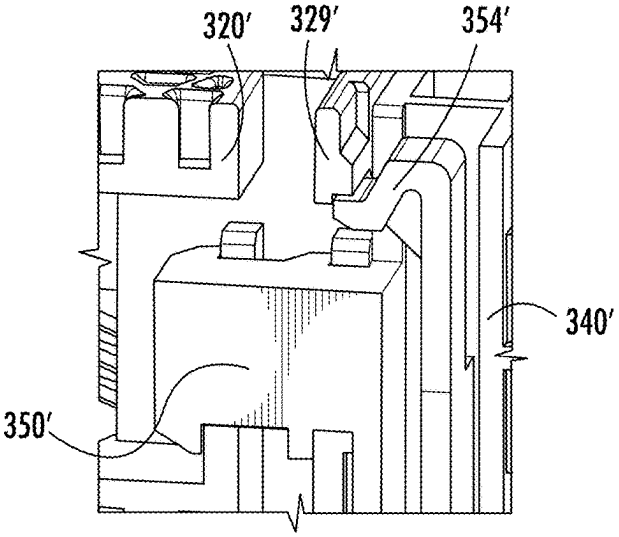

FIG. 54B

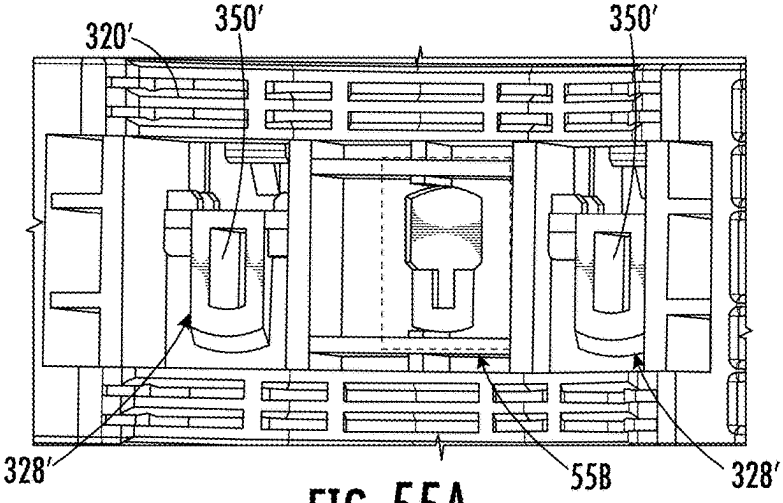

FIG. 55A

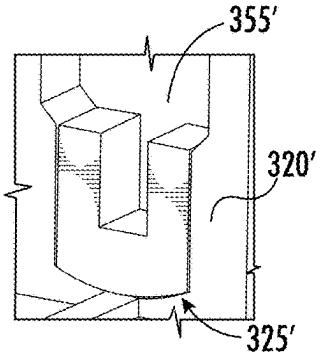

FIG. 55B

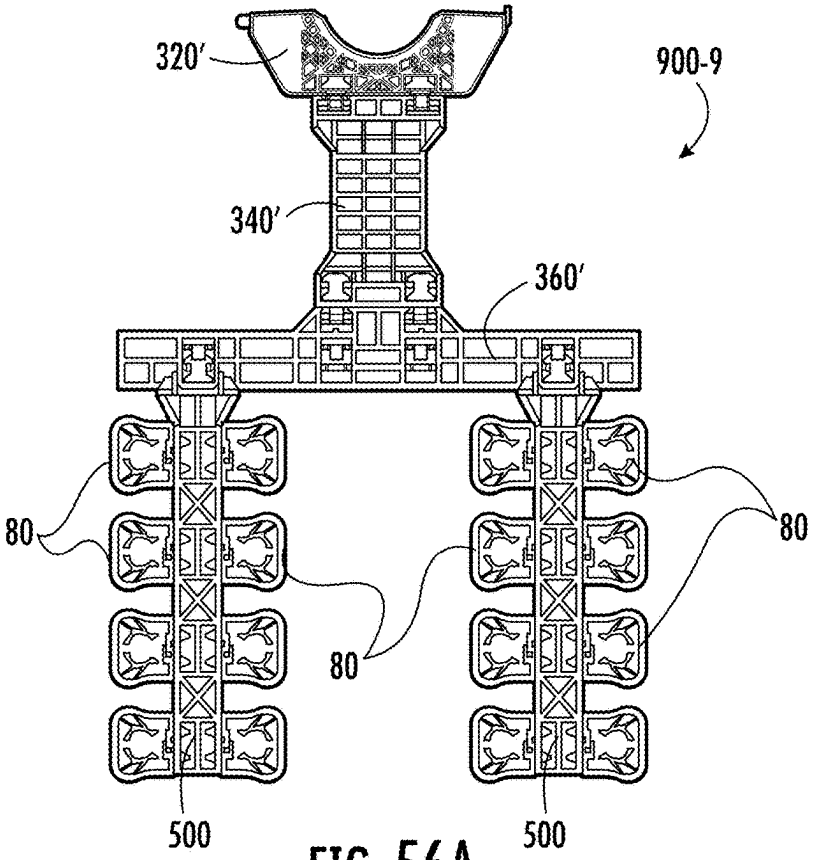

FIG. 56A

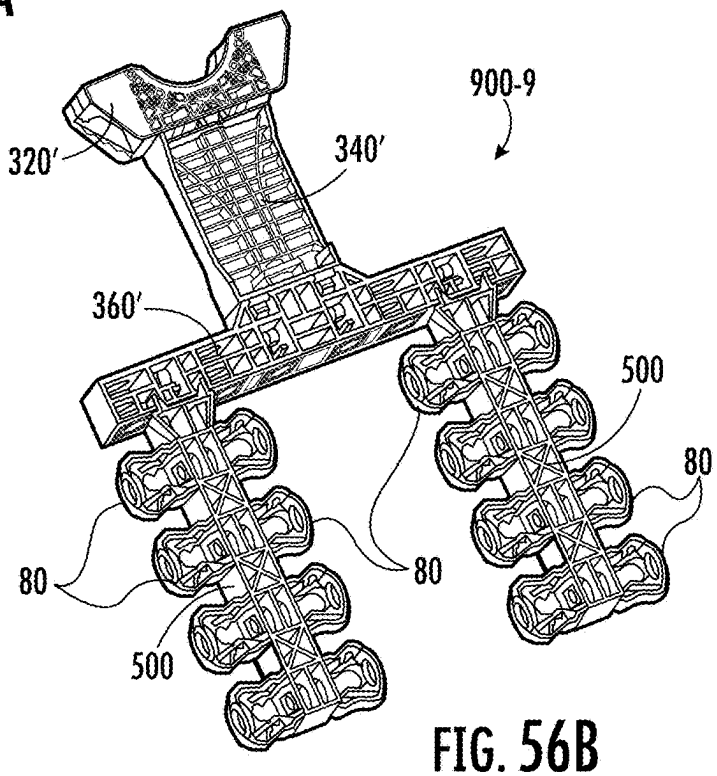

FIG. 56B

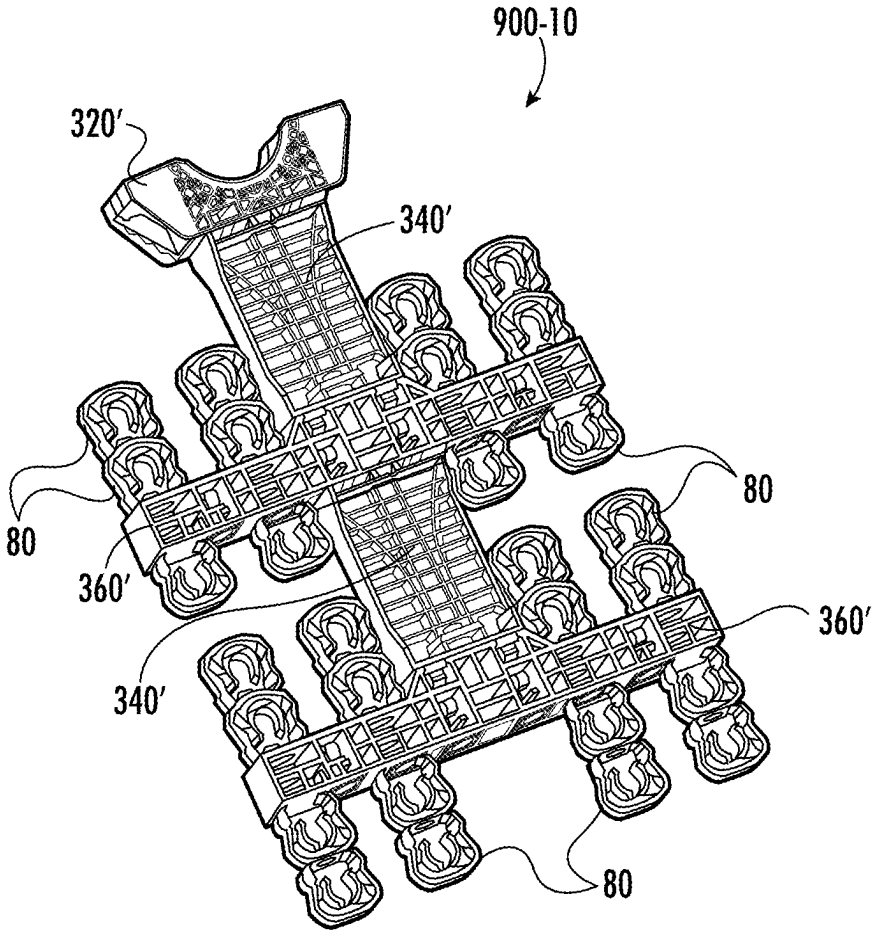

FIG. 57

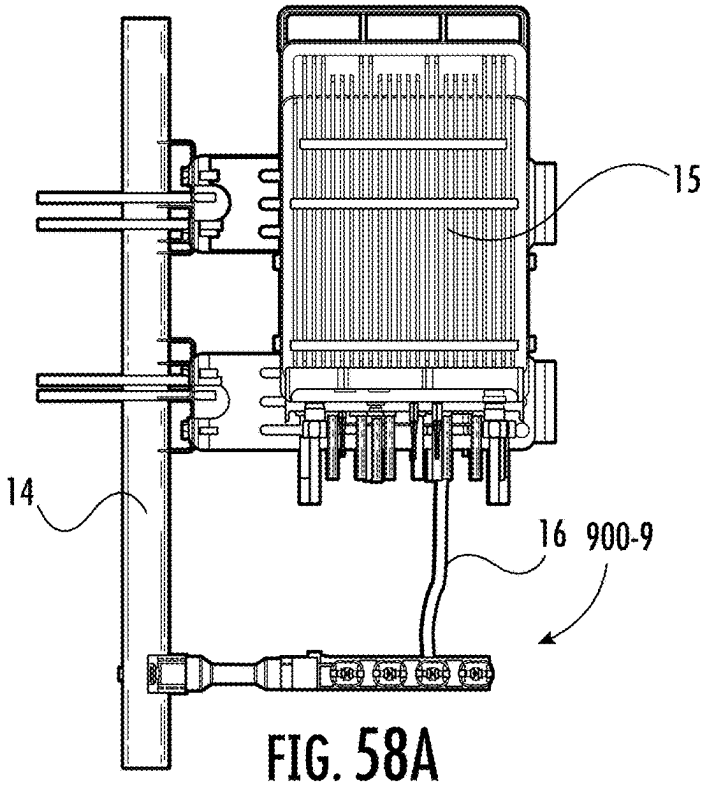

FIG. 58A

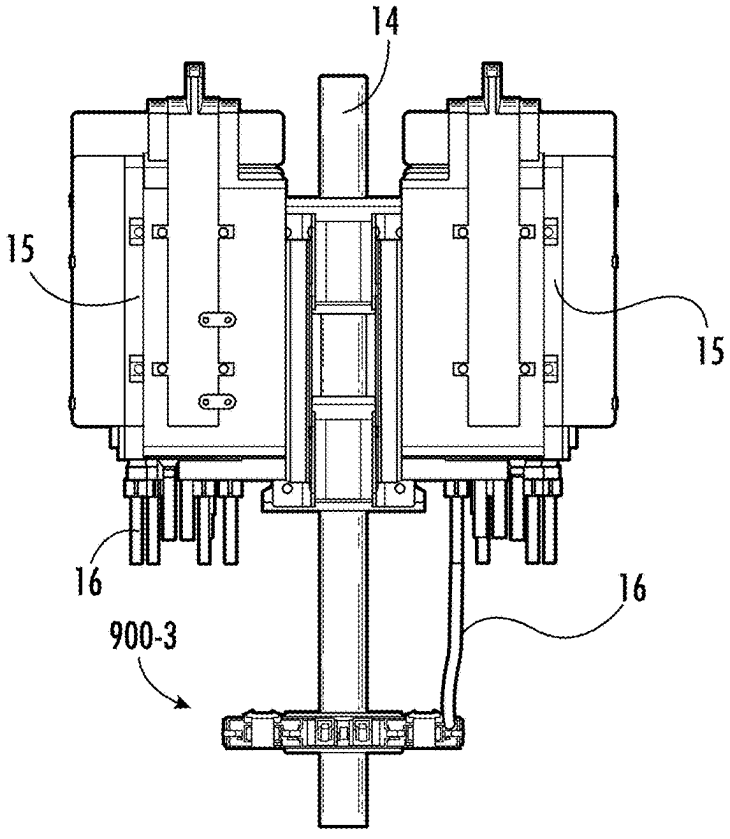

FIG. 58B

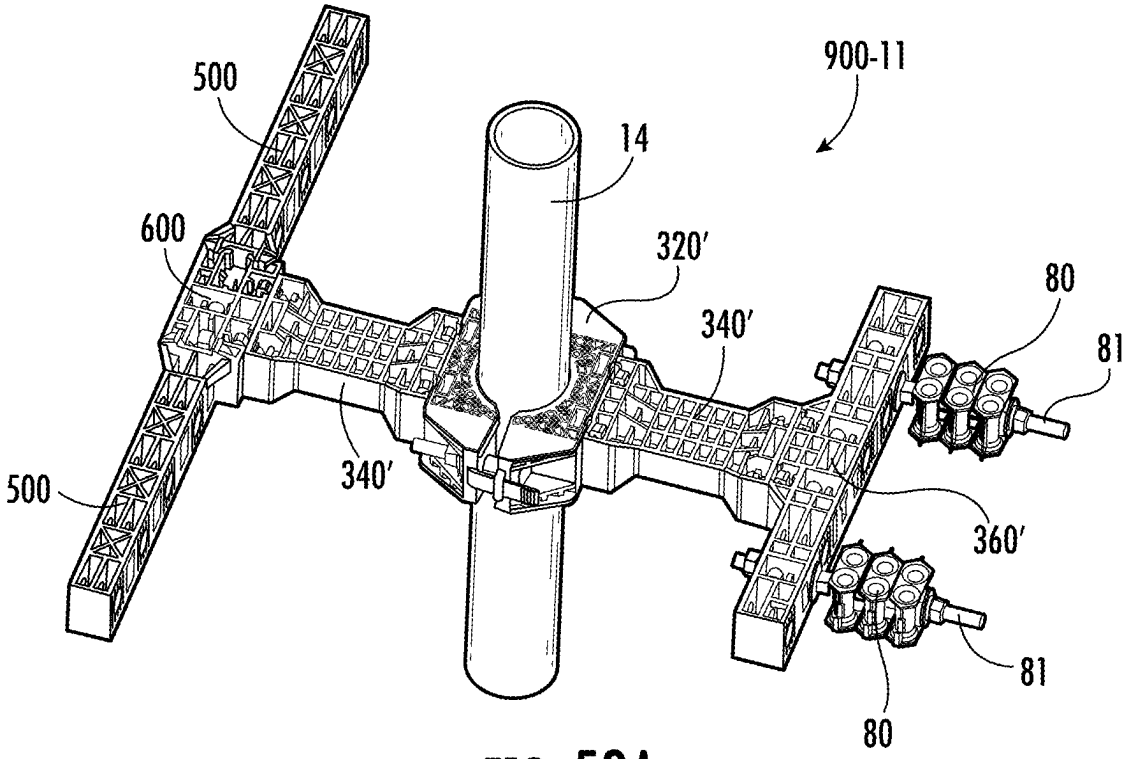

FIG. 59A

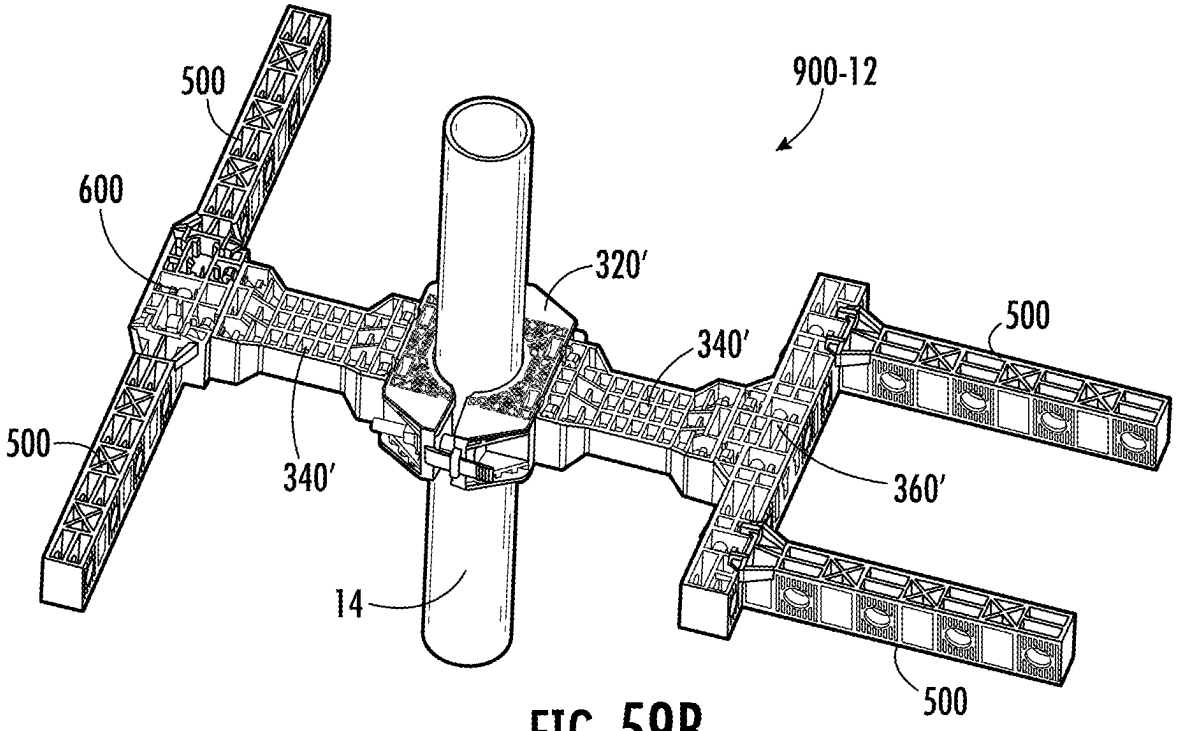

FIG. 59B

ASSEMBLIES FOR MOUNTING ANTENNA CABLES

RELATED APPLICATIONS

[0001] The present application claims priority to and the benefit of U.S. Provisional Patent Application No. 63/553,767, filed Feb. 15, 2024, and U.S. Provisional Patent Application No. 63/644,679, filed May 9, 2024, the contents of which are hereby incorporated by reference in full.

FIELD

[0002] The present invention relates generally to mounts for antennas, radios and cables, and more particularly to mounts for antennas, radios and cables on an antenna tower or monopole.

BACKGROUND

[0003] With increased demand for more wireless communication, the number of radio and antenna units that a tower traditionally supports has increased and is expected to continue to increase. New towers will need to be designed to support greater numbers of antenna and radio units, while existing towers are retrofitted to support more units, and effort is made to fully utilize space available on the towers.

[0004] Antennas typically mount to a round pipe; an exemplary mount with round vertical pipes for antenna mounting is shown in U.S. Pat. No. 9,812,762 to Skrepcinski, the disclosure of which is hereby incorporated herein in its entirety). When mounting antennas to towers or other structures, the cables attaching the radio to the antenna typically protrude from the bottom of the antenna for some unsupported length. It is typically desirable to secure these cables to maintain a sense of organization and to prevent swaying in the wind. A system of cable support brackets is commonly used to hold these cables in place. Those cable support systems usually also mount to the same pipe to which the antenna is mounted, and include two half-clamps that are joined with bolts that extend on either side of the pipe. The front plane of one of the half-clamps is parallel to the face of the antenna. Additional brackets are then bolted onto the front half-clamp. Additional support may be needed behind the antenna when the radio is not mounted in close proximity to the antenna and from the radio to an overvoltage protection unit, which is typically mounted in a central position on the mount to feed up to 6 radios.

[0005] Areas near cellular antennas (i.e., within 1λ, or one wavelength) can be (relatively) high radio frequency (RF) energy environments. Conductive items in these areas, such as hangers, brackets and other hardware, can generate undesirable passive intermodulation (PIM). Typical examples of potential PIM-generating conditions include the combination of steel-on-steel contact (between two or more components), plus low contact pressure and/or relative movement between the steel components at the joint. As such, it may be desirable to provide solutions for hanging cables with reduced (or eliminated) likelihood of PIM generation.

[0006] One approach is offered in U.S. Pat. No. 11,159,006 to Heath et al., the disclosure of which is hereby incorporated herein by reference in full. The approach discussed therein features an assembly that includes: a pair of L-shaped members, each of the L-shaped members including a main panel, a pair of jaws extending from opposite edges of the main panel, and a flange extending generally perpendicularly to the main panel. The main panel includes a plurality of first mounting apertures and the flange includes a plurality of second mounting apertures. Each of a pair of rods extends through a first mounting aperture of each of the L-shaped members; and a securing component that engages each rod to fix the members relative to each other so that the jaws are mounted to a mounting pole. Cable hangers can then be mounted in the second mounting apertures on the flange to provide organization for cables connecting an antenna mounted on the mounting pole. This is a popular solution, but it may be desirable to provide additional solutions that can increase flexibility and/or reduce PIM.

SUMMARY

[0007] As a first aspect, embodiments of the invention are directed to an assembly for providing mounting locations for cable hangers for an antenna. The assembly includes a hanger panel having a generally rectangular skeletal base. The hanger panel includes a plurality of mounting holes spaced apart on opposing side surfaces along a length of the base and at least one securing mechanism coupled to and extending outwardly from an end of the base. The assembly further includes an adapter extension having a side wall comprising a recess. The hanger panel is secured to the side wall of the adapter extension by the at least one securing mechanism received within the recess.

[0008] As a second aspect, embodiments of the invention are directed to a cable hanger assembly. The assembly includes a generally rectangular skeletal base having a length and a width, a plurality of mounting holes spaced apart on opposing side surfaces along the length of the base, a latch coupled to and extending outwardly from an end of the base, and a pair of hooks extending outwardly from the end of the base above the latch. The cable hanger assembly is formed of a polymeric material.

[0009] As a third aspect, embodiments of the invention are directed to a cable mounting kit. The kit includes first and second clamps. The first clamp including a first securing feature configured to engage a second securing feature on the second clamp to enable the first and second clamps to enclose and mount on a mounting structure, each of the first and second clamps including a clamping surface configured to engage the mounting structure and an opposed outer surface with a pair of first mounting openings. The kit further includes a cable hanger mounting assembly. The cable hanger mounting assembly includes a hanger panel having a generally rectangular skeletal base, the hanger panel having a plurality of mounting holes spaced apart on opposing side surfaces along a length of the base and at least one securing mechanism coupled to and extending outwardly from an end of the base. The cable hanger mounting assembly further includes an adapter extension having a first side wall having a recess and a second side wall having a pair of latches. The at least one securing mechanism of the hanger panel is configured to be received within the recess of the adapter extension, and the pair of latches of the adapter extension is configured to be received by the pair of first mounting openings of the first and second clamps.

[0010] It is noted that aspects of the invention described with respect to one embodiment, may be incorporated in a different embodiment although not specifically described relative thereto. That is, all embodiments and/or features of any embodiment can be combined in any way and/or com-

bination. Applicant reserves the right to change any originally filed claim and/or file any new claim, accordingly, including the right to be able to amend any originally filed claim to depend from and/or incorporate any feature of any other claim or claims although not originally claimed in that manner. These and other objects and/or aspects of the present invention are explained in detail in the specification set forth below. Further features, advantages and details of the present invention will be appreciated by those of ordinary skill in the art from a reading of the figures and the detailed description of the preferred embodiments that follow, such description being merely illustrative of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. **1** is a perspective view of an assembly according to embodiments of the invention mounted on a mounting pole.

[0012] FIG. **2** is a perspective view of one of the clamps of the assembly of FIG. **1**.

[0013] FIG. **3** is a perspective view of one of the adapter extensions of the assembly of FIG. **1**.

[0014] FIG. **4** is a perspective view of one of the hanger panels of the assembly of FIG. **1**.

[0015] FIG. **5** is a perspective view of the clamps of the assembly of FIG. **1** mounted on the mounting pole.

[0016] FIGS. **6-9** are perspective views of different configurations the components of the assembly of FIG. **1** may take. FIG. **6** shows one hanger panel of FIG. **4** mounted directly to one of the clamps, FIG. **7** shows one hanger panel of FIG. **4** mounted to a clamp via an adapter extension of FIG. **3**, FIG. **8** shows two hanger panels of FIG. **4** mounted directly to the clamps, and FIG. **9** shows two hanger panels of FIG. **4** mounted to the clamps via adapter extensions of FIG. **3**.

[0017] FIGS. **10-12** are perspective views of the assemblies of FIGS. **5**, **7** and **9** with cable hangers mounted thereon.

[0018] FIGS. **13**A-**13**C are top, front and perspective views of the clamp of FIG. **2**.

[0019] FIG. **14** is a perspective view of two clamps of FIGS. **13**A-**13**C illustrating how the clamps are secured together.

[0020] FIG. **15** is a perspective view of an assembly according to alternative embodiments of the invention.

[0021] FIGS. **16**A-**16**D are perspective views of one of the clamps of the assembly of FIG. **15**.

[0022] FIG. **17** is a clamp pin used to secure the clamp members of the assembly of FIG. **15**.

[0023] FIG. **18** is an eye bolt used to secure the clamp members of the assembly of FIG. **15**.

[0024] FIG. **19** is a perspective view of the assembly of FIG. **15** showing how the clamp pin and eyebolt are employed to secure the clamps of FIG. **15**.

[0025] FIG. **20** is a perspective view of an assembly according to further embodiments of the invention.

[0026] FIGS. **21**A-**21**D are perspective views of one of the clamps of the assembly of FIG. **20**.

[0027] FIGS. **22**A-**22**C are perspective views of a latch lever, a latch link, and a latch pin used to secure the assembly of FIG. **20**.

[0028] FIG. **23** is a perspective view of the assembly of FIG. **20** showing how the components of FIGS. **22**A-**22**C are employed to secure the clamps of FIG. **20**.

[0029] FIG. **24** is a front perspective view of a clamp of an assembly (shown in FIG. **32**) for mounting cables according to further embodiments of the invention.

[0030] FIG. **25** is a rear perspective view of the clamp of FIG. **24**.

[0031] FIG. **26** is a front perspective view of an adapter extension of the assembly of FIG. **32**.

[0032] FIG. **27** is a rear perspective view of the adapter extension of FIG. **26**.

[0033] FIG. **28** is a rear perspective view of a hanger panel of the assembly of FIG. **32**.

[0034] FIG. **29** is a front perspective view of the hanger panel of FIG. **28**.

[0035] FIG. **30** is a rear perspective view of a mounting adapter of the assembly of FIG. **32**.

[0036] FIG. **31** is a front perspective view of the mounting adapter of FIG. **24**.

[0037] FIG. **32** is an exploded view of an assembly for mounting cables according to further embodiments of the invention.

[0038] FIG. **33**A is a front perspective view of a T-shaped opening in the clamp of FIG. **24**.

[0039] FIG. **33**B is a rear perspective view of a T-shaped latch of the adapter extension of FIG. **26**.

[0040] FIGS. **33**C-**33**E are sequential section views showing the insertion of the latch of FIG. **33**B into the opening of FIG. **33**A.

[0041] FIG. **33**F is a partial view showing the support member of the adapter extension of FIG. **26** engaging the clamp of FIG. **24**.

[0042] FIG. **34** is a partially exploded view of two assemblies of FIG. **32** (without the mounting adapters) being brought together to mount on a mounting structure (such as a mounting pole).

[0043] FIG. **35** is a front perspective view of a mounting adapter according to additional embodiments of the invention.

[0044] FIG. **36** is a rear perspective view of the mounting adapter of FIG. **35**.

[0045] FIG. **37** is a front perspective view of an adapter extension according to additional embodiments of the invention.

[0046] FIG. **38** is a rear perspective view of the adapter extension of FIG. **37**.

[0047] FIG. **39** is a front perspective view of a hanger panel according to additional embodiments of the invention.

[0048] FIG. **40** is a rear perspective view of the hanger panel of FIG. **39**.

[0049] FIG. **41** is an exploded perspective view of an assembly that includes a clamp, the mounting adapter of FIG. **35**, the adapter extension of FIG. **37**, and four of the hanger panels of FIG. **39**.

[0050] FIG. **42** is a perspective view of the assembly of FIG. **41**.

[0051] FIG. **43**A is a perspective view of a hanger panel according to embodiments of the present invention.

[0052] FIG. **43**B is a side view of the hanger panel of FIG. **43**A.

[0053] FIG. **43**C is a top view of the hanger panel of FIG. **43**A.

[0054] FIG. **43**D is an end view of the hanger panel of FIG. **43**A.

[0055] FIG. **44**A is a perspective view of another adapter extension according to embodiments of the present invention.

[0056] FIG. **44**B is a rear view of the adapter extension of FIG. **44**A.

[0057] FIG. **44**C is a top view of the adapter extension of FIG. **44**A.

[0058] FIG. **44**D is a side view of the adapter extension of FIG. **44**A.

[0059] FIG. **45**A is an enlarged view of a securing mechanism of the adapter extension of FIG. **44**A engaged with the adapter extension of FIG. **26** according to embodiments of the present invention.

[0060] FIG. **45**B is an enlarged view of another securing mechanism of the adapter extension of FIG. **44**A engaged with the hanger panel of FIG. **43**A according to embodiments of the present invention.

[0061] FIG. **46**A is a perspective view of an assembly according to embodiments of the present invention utilizing two hanger panels of FIG. **43**A secured to the adapter extension of FIG. **44**A.

[0062] FIG. **46**B is a side view of the assembly of FIG. **46**A.

[0063] FIG. **46**C is a top view of the assembly of FIG. **46**C.

[0064] FIG. **47** is a perspective view of an alternative assembly according to embodiments of the present invention utilizing one hanger panel of FIG. **43**A and one adapter extension of FIG. **44**A.

[0065] FIGS. **48**A-**48**C are top views of different configurations of the assemblies of FIG. **46**A and FIG. **47** used with the clamp of FIG. **24** (FIGS. **48**A-**48**B) or the adapter extension of FIG. **26** (FIG. **48**C).

[0066] FIGS. **49**A-**49**H are perspective views of alternative configurations that assemblies according to embodiments of the present invention may take.

[0067] FIG. **50**A is a front perspective view of an alternative clamp according to embodiments of the present invention.

[0068] FIG. **50**B is a front view of the clamp of FIG. **50**A.

[0069] FIG. **51**A is a side view of an alternative adapter extension according to embodiments of the present invention.

[0070] FIG. **51**B is a top view of the adapter extension of FIG. **51**A.

[0071] FIG. **51**C is an enlarged perspective view of a locking mechanism of the adapter extension of FIG. **51**B according to embodiments of the present invention.

[0072] FIG. **51**D is an enlarged perspective view of the anti-rotation feature of the adapter extension of FIG. **51**B according to embodiments of the present invention.

[0073] FIG. **52** is a top perspective view of an alternative adapter extension of FIGS. **51**A-**51**B according to embodiments of the present invention.

[0074] FIG. **53**A is a front view of an alternative hanger panel according to embodiments of the present invention.

[0075] FIG. **53**B is a top view of the hanger panel of FIG. **53**A.

[0076] FIGS. **54**A-**54**B illustrate different locking mechanisms for the components of the assemblies according to embodiments of the present invention.

[0077] FIG. **55**A-**55**B illustrate an anti-rotation feature for assemblies according to embodiments of the present invention.

[0078] FIG. **56**A is a top view of an assembly that may be used with a remote radio unit according to embodiments of the present invention.

[0079] FIG. **56**B is a top perspective view of the assembly of FIG. **56**A.

[0080] FIG. **57** is a perspective view of a stacked configuration of the assembly of FIG. **56**B according to embodiments of the present invention.

[0081] FIGS. **58**A-**58**B are side views of the assembly of FIG. **56**A installed under remote radio units according to embodiments of the present invention.

[0082] FIGS. **59**A-**59**B are perspective views of alternative assemblies that may be used with a remote radio unit according to embodiments of the present invention.

DETAILED DESCRIPTION

[0083] 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.

[0084] 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 "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 connected" or "directly coupled" to another element, there are no intervening elements present.

[0085] Referring now to the drawings, an assembly for mounting antenna cables is shown in FIG. **1** and designated broadly therein at **10**. The assembly **10** includes two clamps **20**, two adapter extensions **40**, and two hanger panels **60**, which are then mounted on a mounting pole **14**. These components are described in greater detail below. See also U.S. Patent Application Publication No. 2024/0039264 to Wang et al., the disclosures of which are incorporated herein by reference in their entirety.

[0086] Referring now to FIG. **2**, one of the clamps **20** is shown therein. The clamp **20** includes a skeletal body **22** with a generally flat outer surface **24** and arcuate clamping surfaces **26** opposite the outer surface **24**. Two mounting holes **28** (typically with a ¾ inch nominal diameter) are located in the outer surface **24**. A generally S-shaped latch **30** extends from one end of the body **22**. A plurality of fingers **32** extend from the opposite end of the body **22** (see FIGS. **13**A-**13**C). The latch **30** and fingers **32** are configured to secure two clamps **20** around a mounting pole **14**; details

regarding the latch **30** and fingers **32** and how they secure the clamps **20** are provided below in connection with the discussion of FIGS. **13**A-**13**C and **14**.

[0087] Referring now to FIG. **3**, one of the adapter extensions **40** is shown therein. The adapter extension **40** includes a base **42**, a shaft **44** that is fixed to the base **42** and extends generally normal thereto, and a head **46** that is fixed to the base and is generally parallel with the base **42**. Two snap-fit latches **48** are mounted to the base **42** opposite the shaft **44**, and are sized and positioned to fit within the mounting holes **28** of the clamp **20**. Two mounting holes **50** are located in the head **46** and are sized and spaced similarly to the mounting holes **28**.

[0088] Referring now to FIG. **4**, the hanger panel **60** has a generally rectangular skeletal base **62**. Four mounting holes **64** (typically having a nominal diameter of ¾ inch) are spaced across the front surface of the base **42**. Two snap-fit latches **66** extend from the rear surface of the base **62**; the latches **66** are sized and positioned to fit within the mounting holes **50** of the adapter extension **40** or the mounting holes **28** in the clamp **20**.

[0089] In some embodiments, all of the clamps **20**, adapter extensions **40** and hanger panels **60** comprise a polymeric material. When so formed, none of the joints or connections between these components includes a metal-to-metal contact surface, such that no PIM is generated at these joints/connections.

[0090] As can be seen in FIGS. **5**-**9**, these components can be employed in various combinations to provide mounting locations for cable hangers, which are in turn used to grasp and assist in organizing cables near an antenna. FIG. **5** illustrates two clamps **20** fastened together and mounted on a mounting pole **14**. In this configuration, cable hangers (shown in FIG. **10** at **80**) are mounted in the mounting holes **28** in the clamps **20**. Because the cable hangers **80** are stackable on each other, a large number of cables can be grasped and organized in a small area. Such stackable cable hangers are well-known in this field, and are described in, for example, U.S. Pat. No. 10,158,218 to Vaccaro et al.; U.S. Pat. No. 11,004,367 to Vaccaro et al.; and U.S. Pat. No. 10,801,646 to Vaccaro; and co-pending and co-assigned U.S. Patent Publication No. 2022/0316622 (U.S. patent application Ser. No. 17/577,570) to Joshi et al., each of which is incorporated herein by reference in full.

[0091] An alternative configuration is shown in FIG. **6**, wherein one hanger panel **60** is mounted directly to one of the clamps **20** via the insertion of snap-fit latches **66** of the hanger panel **60** into mounting holes **28** of the clamp **20**. FIG. **8** shows a configuration with two hanger panels **60**, with one hanger panel **60** mounted to each of the clamps **20**. FIG. **11** illustrates stacks of cable hangers **80** mounted in each of the mounting holes **64** of the hanger panels **60**.

[0092] Another alternative configuration is shown in FIG. **7**, wherein one adapter extension **40** is mounted via the snap-fit latches **48** in the mounting holes **28** of one of the clamps **20**, and one hanger panel **60** is mounted via the snap-fit latches **66** in the mounting holes **50** of the adapter extension **50**. FIG. **9** shows a configuration like that of FIG. **7**, but with two sets of adapter extensions **40** and hanger panels **60** mounted to the clamps **20** (this arrangement is also shown in FIG. **1**). FIG. **12** illustrates stacks of cable hangers **80** mounted in the mounting holes **64** of the hanger panels **60**.

[0093] The configuration if FIGS. **9** and **12** can also provide an advantage when used to mount and organize fiber optic cable. Fiber optic cable typically has a minimum bend radius, which refers to a bend radius below which the cable should not be bent in order to avoid damage to the optical fibers. The length of the adapter extensions may be selected so that the hanger panels **60** are separated by a distance that enables fiber optic cables to be mounted thereon without reaching the minimum bend radius. As an example, the hanger panels **60** may be separated by at least 10 inches, and in some instance 12 inches or even 14 inches, to avoid minimum bend radius concerns.

[0094] Thus, it can be seen that the collection of clamps **20**, adapter extensions **40** and hanger panels **60** can provide a technician with numerous ways to mount cable hangers **80**, and can do so while eliminating PIM that might be generated by metal-on-metal contact surfaces.

[0095] As described above, the clamps **20** are configured so that they can be secured to each other in order to mount on a mounting pole **14**. FIGS. **13**A-**13**C illustrate one clamp **20** in more detail. As can be seen in these figures, the aforementioned latch **30** is generally S-shaped and includes five slots **31** along its length. A rib **33** extends across the width of the latch **30** on its inboard surface. On the opposite side of the body **22** of the clamp **20**, the fingers **32** are arranged in three rows, with each row having five fingers **32**. When two clamps **20** are brought together for securing to a mounting pole **14**, the fingers **32** of one clamp **20** are received in the slots **31** in the latch **30** of the other clamp **20**. The fingers **32** are hooked, such that they engage and capture the rib **33** of the latch **31**. Because there are multiple rows of fingers **32** on each clamp **20**, a technician can select the row of fingers **32** that enables the clamps **20** be securely fastened for the mounting pole **14** within a relatively broad range of diameters.

[0096] It can also be seen in FIGS. **13**A and **14** that the clamping surfaces **26** of each clamp **20** are not smoothly continuous, but instead comprise multiple arced segments. The presence of these segments can enable the clamps **20** to be secured tightly to mounting poles **14** of different diameters.

[0097] Referring now to FIGS. **15**-**19**, another assembly, designated broadly at **110**, is shown therein. The assembly **110** includes adapter extensions **40** and hanger panels **60** like those of the assembly **10**, but utilizes clamps **120** that are configured to be secured together differently than the clamps **20**. As shown in FIGS. **16**A-**16**D, each clamp **120** has a body **122**, an outer surface **124** with mounting holes **128**, and clamp surfaces **126** like the clamp **20**. However, on one side of the body **122** the clamp **120** has a platform **132** with a mounting hole **133**, and on the opposite side of the body **122** the clamp **120** has two gussets **134** with mounting holes **135**.

[0098] The clamps **120** are secured with a clamp pin **170** and an eye bolt **176**. As shown in FIG. **17**, a clamp pin **170** has a body **171** with hooks **172** at its lower end, a collar **173** at the upper end of the body **171**, and a tether **174** that extends from the collar **173** and has a clip **175** at its free end. The eye bolt **176** (FIG. **18**) has a threaded shaft **177**, a hex nut **178**, and a head **179** with an eye **179***a*.

[0099] To connect the clamps **120**, the shaft **177** of the eye bolt **176** is inserted into the mounting hole **133** in the platform **132** of one clamp **120**, and the nut **178** is rotated onto the shaft **177**. The head **179** is positioned between the gussets **134** of the other clamp **120**, and the body **171** of the

clamp pin **170** is inserted through both mounting holes **135** in the gussets **134** and through the eye **179***a*. The hooks **172** and the collar **173** on the clamp pin **170** maintain the clamp pin **170** in place.

[0100] When the clamps **120** are to be attached to a mounting pole **14**, the technician may begin by inserting both clamp pins **170** as described above. The clips **175** can be used to clip the clamp pins **170** to the clamps **120** to prevent them from getting lost. The assembly **110** can be brought to the mounting pole **14**, one of the clamp pins **170** can be removed from the eye bolt **176** (as in FIG. **19**), and the clamps **120** may be opened to receive the mounting pole **14**. The clamps **120** can then be clamped onto the mounting pole **14** and the clamp pin **170** can be replaced. The clamps **120** can be tightened by tightening one or both of the hex nuts **178**. As shown in FIG. **18**, one or more washers **179***b* may be included between the hex nut **178** and the platform **132**.

[0101] Referring now to FIGS. **20-23**, another assembly, designated broadly at **210**, is shown therein. The assembly **210** includes adapter extensions **40** and hanger panels **60** like those of the assemblies **10**, **110**, but utilizes clamps **220** that are configured to be secured together differently than the clamps **20**, **120**. As shown in FIGS. **21**A-**21**D, each clamp **220** has a body **222**, an outer surface **224** with mounting holes **228**, and clamp surfaces **226** like the clamp **20**. However, on one side of the body **222** the clamp **220** has two flanges **231**, each with a mounting hole **233**, and on the opposite side of the body **222** the clamp **220** has four wings **234**, each with three mounting holes **235** arranged in a triangular pattern.

[0102] FIGS. **22**A through **22**C illustrate the components of a separate latch **280** used to attach the clamps **220** together. A latch link **281** has a triangular head **282** at one end with a hole **283**, and also has a hole **284** at the opposite end. A latch lever **285** is generally U-shaped, with the arms **286** of the "U" being triangular with a rounded end **287**. Holes **288** are present in the arms **286**. A latch pin **289** has a shaft **290**, hooks **291** at one end of the shaft **290**, and a collar **292** at the opposite end.

[0103] To secure the clamps **220** together, the wings **234** of the clamps **220** are interleaved, and a latch pin **289** is inserted through one of the "columns" of mounting holes **235** in each clamp **220** (wherein the pattern of holes **235** provides some flexibility to accommodate mounting poles of different diameters). The latch link **281** is fastened to the flanges **231** of one of the clamps **220** via another latch pin **289** inserted through the holes **233** in the flanges and the hole **283** in the head of the latch link **281**. The latch lever **285** is attached to the opposite end of the latch link **281** with a third latch pin **289**, which is inserted through the holes **288** in the latch lever arms **286** and the hole **284** in the latch link **281**. When the assembly **210** is mounted to a mounting pole **14**, the latch link **281** is pivoted so that the latch lever **285** engages the flanges **231** on the other clamp **220**, and the latch lever **285** is then pivoted so that its rounded ends **287** engage rounded surfaces of the flanges **231** to lock the latch **280** in place.

[0104] Referring now to FIGS. **24-33**, another assembly, designated broadly at **310**, is illustrated therein. Like the prior discussed assemblies, the assembly **310** includes two clamps **320**, an adapter extension **340**, and hanger panels **360**, albeit of somewhat different configurations. Also, the assembly **310** may include a mounting adapter **380** to facilitate mounting of the adapter extension **340** and/or the hanger panel **360**. All of these components are discussed in greater detail below.

[0105] Referring to FIGS. **24** and **25**, the clamp **320** has a body **322**, an outer surface **324** with mounting openings **328**, and clamp surfaces **326** like the clamp **20**. However, the mounting openings **328** arc "T-shaped" openings, with an upper horizontal section **328***a* and lower vertical section **328***b* (see also FIG. **33**A). Also, a shoulder **329** is present above each mounting opening **328**, and an internal lower rim **333** is present in the vertical section **328***b*. Holes **331** extend through the body **322** on each side to receive a carriage bolt or the like (see FIG. **34**). At one end, the clamp **320** includes a strap **332** that extends away from the outer surface **326**, and at the opposite end the clamp **320** includes a loop **333** that is configured to receive the strap **332** from a second mating clamp **320**.

[0106] Referring now to FIGS. **26** and **27**, the adapter extension **340** has a base **342** and a head **346** that is generally parallel with the base **342** like the adapter **40**, but these components are connected by a tapering body **344** that extends from the base **342** to the head **346**. The head **346** includes two T-shaped openings **348** that are similar in shape to the T-shaped openings **328** of the clamp **320**. At the opposite end of the adapter extension **340**, two latches **350** extend away from the base **342**. The body **352** of each latch **350** is generally rectangular in cross-section. Wings **351** extend laterally from the body **352**. The wings **351** and body **352** are sized and configured to fit into the T-shaped openings **328** on the base **320**, with the body **352** being shorter in height than the T-shaped opening **328**. A lower lip **353** depends from the lower surface of the body **352**. In addition, a curved finger **354** extends upwardly from the body **352** and slightly rearwardly away from the tapering body **344**, and a support member **356** extends upwardly between the T-shaped latches **350**.

[0107] Referring now to FIGS. **28** and **29**, the hanger panel **360** is similar to the hanger panel **60**, with a generally rectangular skeletal base **362** and four mounting holes **364** (typically having a nominal diameter of ¾ inch) are spaced across both the front and rear surfaces of the base **362**. Two T-shaped latches **366** extend from the rear surface of the base **362**; the latches **366** are similar to the latches **348** described above and are sized and positioned to fit within the T-shaped openings **348** of the adapter extension **340** or the or the T-shaped openings **328** in the clamp **320**. On its front surface, the base **362** has two T-shaped openings **368** that are sized and configured to receive T-shaped latches from the mounting adapter **380** (described below).

[0108] Referring now to FIGS. **30** and **31**, the mounting adapter **380** is generally rectangular with a skeletal base **382** and mounting holes **384** (typically nominally ¾ inch in diameter) on the front surface of the base **382**. Two T-shaped latches **386** extend rearwardly from the base **382**.

[0109] FIG. **32** illustrates one particular configuration for the assembly **310**. In this configuration, the adapter extension **340** is mounted to the clamp **320** via the T-shaped latches **350**, which are inserted into the T-shaped openings **328** in the clamp **320** (details of the mounting of any of various T-shaped latches in any of the T-shaped openings are set forth below). The hanger panel **360** is mounted to the head **346** of the adapter extension **340** via the insertion of the T-shaped latches **366** into the T-shaped openings **348**. The mounting adapter **380** is mounted to the hanger panel **360**

via insertion of the T-shaped latches **386** into the T-shaped openings **368**. In this configuration, the hanger panel **360** and the mounting adapter **380** provide mounting locations (in the form of the mounting holes **364** and **384**) for cable hangers) similar to that shown in FIG. **12** above, but with additional mounting locations provided by the mounting holes **384** of the mounting adapter **380**. In some embodiments, the assembly **310** may omit the mounting adapter **380**, in which case the assembly **310** provides the same number of mounting locations as that shown in FIG. **12**.

[0110] Those skilled in this art will appreciate that the arrangements shown in FIGS. **10** and **11** can also be achieved with the assembly **310**. More specially, the arrangement shown in FIG. **10** can be created by mounting the mounting adapter **380** directly onto the clamp **320** (with the T-shaped latches **386** being inserted into the T-shaped openings **328**). The arrangement shown in FIG. **11** can be achieved by mounting the hanger panel **360** directly onto the clamp **320**, (with the T-shaped latches **366** being inserted into the T-shaped openings **328**). This arrangement may be augmented by the mounting of the mounting adapter **380** onto the hanger panel **360**.

[0111] Referring now to FIGS. **33**A-**33**E, the mounting of any of the T-shaped latches into any of the T-shaped openings is illustrated therein (using the T-shaped latch **350** and the T-shaped opening **328** as examples). As shown in FIG. **33**C, the T-shaped latch **350** is inserted into the T-shaped opening **328**, with the wings **351** slipping into the horizontal section **328** of the T-shaped opening **328** and the body **352** slipping into the vertical section **328***b*. Once the T-shaped latch **350** is fully inserted, it is lowered (see FIGS. **33**D and **33**E) until it "bottoms out" in the vertical section **328***b* of the T-shaped opening **328**. In the position the wings **351** and the lower lip **353** of the T-shaped latch **350** have advanced rearwardly and downwardly sufficiently to capture the rim **333** and the rearward edge of the T-shaped opening **328** (see FIG. **33**E).

[0112] In addition, the finger **354** descends with the T-shaped latch **350** (flexing as it descends) until it reaches the shoulder **329**, at which point it recovers partially from its deflection to fit within the shoulder **329** (see FIG. **33**E). In this position, the finger **354** can provide rearward pressure to the clamp **320** to help "lock" the adapter extension **340** in place, and also provides a stop against upward movement of the adapter extension **340** relative to the clamp **320**. The support member **356** also applies further rearwardly-directed pressure against the outer surface of the clamp **320** (see FIG. **33**F).

[0113] As shown in FIG. **34**, two clamps **320** can be attached to a mounting pole (shown in broken line in FIG. **34**) via carriage bolts **390** or other fasteners that are inserted into holes **331**. Straps **332** are inserted into loops **333** on each side of the clamps **320** to assist with alignment during mounting and/or to provide additional stability.

[0114] Referring now to FIGS. **35**-**42**, another assembly, designated broadly at **410**, is illustrated therein. Like the prior discussed assembly, the assembly **410** includes two clamps **420** (only one of which is shown in FIGS. **41** and **42**), an adapter extension **440**, hanger panels **460**, and a mounting adapter **480**, albeit of somewhat different configurations (with the exception of the clamps **420**, which are the same as the clamps **320**). The other components are discussed in greater detail below.

[0115] Referring to FIGS. **35** and **36**, the mounting adapter **480** is generally rectangular with a skeletal base **482** and one mounting hole **484** (typically nominally ¾ inch in diameter) on the front surface of the base **482**. Two T-shaped latches **486** similar to those described above extend rearwardly from the base **482**. The mounting adapter **480** includes T-shaped openings **488** on its front surface on either side of the mounting hole **484**. The mounting adapter **480** further includes a T-shaped opening **490** on each side wall **483**.

[0116] Referring now to FIGS. **37** and **38**, the adapter extension **440** has a base **442** and a head **446** that is generally parallel with the base **442**, and a tapering body **444** that extends from the base **442** to the head **446**. The head **446** includes a mounting hole **448** on its front surface and two T-shaped openings **447** (one on each side wall **451**). At the opposite end of the adapter extension **440**, two T-shaped latches **450** similar to those described above extend away from the base **442**. The adapter extension **440** also includes a curved finger **454** and a support member **456** similar to those described above.

[0117] Referring now to FIGS. **39** and **40**, the hanger panel **460** has a generally rectangular skeletal base **462** and two mounting holes **464** (typically having a nominal diameter of ¾ inch) on each of the front and rear surfaces of the base **462**. A T-shaped latch **466** similar to those described above extends from the side surface **463** of the base **462**.

[0118] One arrangement of the assembly **410** is shown in FIGS. **41** and **42**. In this arrangement, the mounting adapter **480** is mounted onto the clamp **420** via the T-shaped latches **486** being inserted into the T-shaped openings in the clamp **420**. The adapter extension **440** is mounted to the mounting adapter **480** via the T-shaped latches **450** being inserted into the T-shaped openings **488**. One or more hanger panels **460** can then be mounted onto the side surfaces of either (or both) of the mounting adapter **480** and the head **446** of the adapter extension **440**; the T-shaped latches **466** are inserted into the T-shaped openings **447**, **488**; as shown in FIGS. **41** and **42**, the hanger panels **460** can be mounted on both sides of the adapter extension **440** and/or the mounting adapter **480**. Cable hangers can then be mounted on the mounting holes **464** on the front and rear surface of the hanger panels **460** as well as in the mounting hole **484** in the adapter extension **440**.

[0119] Those of skill in this art will appreciate that the assembly **410** may omit the adapter extension **440**, in which case the hanger panels **460** can be mounted on the mounting adapter **480** only. In another embodiment, the mounting adapter **480** may be omitted, such that hanger panels **460** are mounted only on the adapter extension **440**.

[0120] In a further embodiment, it can be conceived that the clamp **420** and the mounting adapter **480** may be formed as an integral unit.

[0121] Notably, all of the clamps **20**, **120**, **220**, **320**, **420** are configured so that they can be used with an identical mating clamp **20**, **120**, **220**, **320**. This can reduce tooling costs and labor in manufacturing as well as simplifying assembly.

[0122] Referring to FIGS. **43**A-**43**D, an alternative hanger panel (or straight arm adapter) **500** according to embodiments of the present invention is illustrated. As shown in FIGS. **43**A-**43**D, in some embodiments, the hanger panel **500** has a generally rectangular skeletal base **510** having a length LSA, a width WSA and a height HsA. In some embodiments, the base **510** has a length LSA of about 230

mm, a width WsA of about 29 mm, and a height HsA of about 42 mm. One or more securing mechanisms **530** are coupled to or integral with an end of the base **510** (extending axially outwardly thereform). In some embodiments, the base **510** may comprise a plurality of support beams **520**. In some embodiments, the plurality of support beams **520** may include axial beams **522** and/or cross beams **524**. A plurality of mounting holes **514** (typically having a nominal diameter of ¾ inch) are spaced apart on opposing side surfaces **512** along the length L_{SA} of the base **510**. In some embodiments, the mounting holes **514** may be spaced apart from each other a distance of about 58 mm. In some embodiments, the hanger panel **500** is formed from a polymeric material.

[0123] In some embodiments, one of the securing mechanisms **530** of the hanger panel **500** includes a latch **532** extending from the end of the base **510**. The latch **532** may include a plurality of wings **534** extending radially outwardly therefrom and a lower lip **536** extending downwardly therefrom. In some embodiments, the latch **532** is sized and configured to fit within a corresponding recess **630** of an alternative adapter extension **600**, as described in further detail below. In some embodiments, one of the securing mechanisms **530** of the hanger panel **500** may include a pair of hooks **536** extending from the end of the base **510**. In some embodiments, the pair of hooks **536** reside above the latch **532**. As described in further detail below, in some embodiments, the hooks **536** are configured to engage a top edge of the adapter extension **600**.

[0124] Referring to FIGS. **44**A-**44**D, the adapter extension **600** according to embodiments of the present invention is illustrated. As shown in FIGS. **44**A-**44**C, in some embodiments, the adapter extension **600** has a generally rectangular skeletal base **602** having four side walls **603**. In some embodiments, the adapter extension **600** has a length L_{AE} of about 95 mm, a width W_{AE} of about 54 mm, and a height H_{AE} of about 42 mm. The base **602** comprises a recess **630** in one or more of the side walls **603**. In some embodiments, the adapter extension **600** is formed from a polymeric material.

[0125] As described in further detail below, in some embodiments, each recess **630** of the adapter extension **600** is configured to receive the latch **532** of the hanger panel **500**. For example, in some embodiments, the latch **532** is received by an open end **630***a* of the recess **630** and configured to slide down a vertical section **630***b* of the recess **630** until the latch **532** "bottoms out" in the vertical section **630***b* of the recess **630**. As the latch **532** is received in the recess **630**, the wings **534** of the latch **532** engage support members **634** of the adapter extension **600** residing within the recess **630**. In some embodiments, when in position, the latch **532** has advanced rearwardly and downwardly sufficiently until a securing mechanism **632** of the adapter extension **600** is deflected and engages the latch **532**, thereby securing the hanger panel **500** to the adapter extension **600**. In some embodiments, the pair of hooks **536** engage a top edge of the adapter extension **600**, thereby further securing the hanger panel **500** to the adapter extension **600**.

[0126] In some embodiments, the adapter extension **600** further comprises a pair of latches **610** extending outwardly from one of the side walls **603**. In some embodiments, similar to the latch **532** of the hanger panel **500**, each latch **610** of the adapter extension **600** may comprise wings **614** and a lower lip **616** extending outwardly therefrom. In some embodiments, the latches **610** of the adapter extension **600** are configured to be received by the T-shaped opening **328** of the clamp **320** or T-shaped opening **348** of the adapter extension **340** described herein (see, e.g., FIGS. **48**A-**48**C).

[0127] For example, in some embodiments, the wings **614** of the latch **610** are configured to slide into the horizontal section **328***a* of the T-shaped opening **328** of the clamp **320** and the body **611** of the latch **610** is configured to slide into the vertical section **328***b* of the T-shaped opening **328** of the clamp **320**. Once the respective latches **610** are fully inserted, they are lowered until each "bottoms out" in the vertical section **328***b* of the T-shaped opening **328**. In some embodiments, when in position, the wings **614** and the lower lip **616** of each latch **610** have advanced rearwardly and downwardly sufficiently to capture the rim **333** and the rearward edge of the T-shaped opening **328** (see, e.g., FIGS. **48**A-**48**B). In some embodiments, the latches **610** of the adapter extension **600** are configured to be received in the T-shaped openings **348** of the adapter extension **340** in a similar manner (see, e.g., FIG. **48**C).

[0128] In some embodiments, the adapter extension **600** may further include one or more securing mechanisms **620**, **632**. In some embodiments, the one or more securing mechanisms **620**, **632** may be snap-fit securing mechanisms. In some embodiments, a first securing mechanism **620** may reside above a respective latch **610** and is configured to secure the latch **610** within the T-shaped opening **328** of the clamp **320** or the T-shaped opening **348** of the adapter extension **340** (when inserted therein) (see, e.g., FIG. **45**A). In some embodiments, a second securing mechanism **632** may reside within a respective recess **630** and is configured to secure the latch **532** of the hanger panel **500** (when inserted therein) (see, e.g., FIG. **45**B).

[0129] FIGS. **46**A-**46**C and FIG. **47** illustrate assemblies **700**, **700'** according to embodiments of the present invention which have different configurations that the hanger panel **500** and adapter extension **600** may be utilized. As shown in FIGS. **46**A-**46**C, the assembly **700** includes two hanger panels **500** secured to opposing side walls **603** of the adapter extension **600** (via securing mechanisms **530**). For example, as shown in FIG. **46**C, the latch **532** of each hanger panel **500** is received within respective recesses **630** of the adapter extension **600**. As shown in FIG. **47**, the assembly **700'** includes one hanger panel **500** secured to a side wall **603** opposing the latches **610** (via securing mechanism **530**).

[0130] FIGS. **48**A-**48**C illustrate assemblies **800**, **800'**, **800"** which show different configurations that may be formed utilizing the components of the present invention described herein. As shown in FIG. **48**A, in some embodiments, the assembly **700** (i.e., two hanger panels **500** and adapter extension **600**) may be secured to clamp **320** (via latches **610** of the adapter extension **600**). As shown in FIG. **48**B, in some embodiments, the assembly **700'** (i.e., one hanger panel **500** and adapter extension **600**) may be secured to the clamp **320** (via latches **610** of the adapter extension **600**). As shown in FIG. **48**C, in some embodiments, the assembly **700** may be secured to adapter extension **340** via latches **610** of the adapter extension **600** (the adapter extension **340** being further secured to clamp **320**).

[0131] FIGS. **49**A-**49**H illustrate assemblies **900-1** to **900-8** which show further exemplary configurations that may be formed utilizing the hanger panel **500**, adapter extension **600**, adapter extension **340** and clamps **320** described herein. It will be understood by those of skill in this art that the assemblies **110**, **210**, **310**, **410**, **700**, **700'**,

800, **800'**, **800"**, and **900-1** to **900-8** can be used to create any of the configurations of adapter extensions and hanger panels shown in FIGS. **6-12**, FIGS. **48**A-**48**C, and FIGS. **49**A-**49**H. It will also be understood by those of skill in the art that the configurations are not limited to those shown in the figures.

[0132] Referring to FIGS. **50**A-**50**B, an alternative clamp **320'** according to embodiments of the present invention is illustrated. Properties and/or features of the clamp **320'** may be as described above in reference to the clamp **320** shown in FIG. **24** and FIG. **25** and duplicate discussion thereof may be omitted herein for the purposes of discussing FIGS. **50**A-**50**B.

[0133] As shown in FIGS. **50**A-**50**B, the clamp **320'** has a body **322'**, an outer surface **324'** with mounting openings **328'**, and clamp surfaces **326'** like the clamp **320**. The mounting openings **328'** are "T-shaped" openings, with an upper horizontal section **328***a'* and lower vertical section **328***b'*. Also, a shoulder **329'** is present above each mounting opening **328'** (sec, e.g., FIG. **54**B). Holes **331'** extend through the body **322'** on each side to receive a carriage bolt or the like. At one end, the clamp **320'** includes a strap **332'** that extends away from the outer surface **326'**, and at the opposite end the clamp **320'** includes a loop **333'** that is configured to receive the strap **332'** from a second mating clamp **320'**.

[0134] The clamp **320'** differs from clamp **320** described herein in that the outer surface **324'** of the clamp **320'** further includes an aperture **325'** residing between the mounting openings **328'**. The aperture **325'** is configured to receive and/or engage with a corresponding positioning feature **355'**, **365'** of an adapter extension **340'** or hanger panel **360'** (sec, e.g., FIGS. **51**B, FIG. **51**D, FIG. **52**, FIGS. **53**A-**53**B, and FIGS. **55**A-**55**B) when the adapter extension **340'** or hanger panel **360'** is secured to the clamp **320'**. As described in further detail below, the positioning features **355'**, **365'** may help to prevent rotation and shaking between the components after installation.

[0135] Referring to FIGS. **51**A-**51**B, an alternative adapter extension **340'** according to embodiments of the present invention is illustrated. Properties and/or features of the adapter extension **340'** may be as described above in reference to the adapter extension **340** shown in FIG. **26** and FIG. **27** and duplicate discussion thereof may be omitted herein for the purposes of discussing FIGS. **51**A-**51**B.

[0136] As shown in FIGS. **51**A-**51**B, similar to the adapter extension **340** described herein, the adapter extension **340'** has a base **342'** and a head **346'** that is generally parallel with the base **342'**. The head **346'** includes two T-shaped openings **348'** that are similar in shape to the T-shaped openings **328'** of the clamp **320'**. At the opposite end of the adapter extension **340'**, two latches **350'** extend away from the base **342'**. Each latch **350'** is generally rectangular in cross-section. Wings **351'** extend laterally from the latch **350'**. The wings **351'** and latch **350'** are sized and configured to fit into the T-shaped openings **328'** on the clamp **320'**, with the latch **350'** being shorter in height than the T-shaped opening **328'**. A lower lip **353'** depends from the lower surface of the latch **350'**.

[0137] The adapter extension **340'** differs from the adapter extension **340** in that the body **344'** of the adapter extension **340'** does not continuously taper as it extends from the base **342'** to the head **346'** (compare adapter extension **340'** with the adapter extension **340** shown in FIG. **26**). The adapter extension **340'** may have increased strength compared to the adapter extension **340** described herein. As shown in FIG. **51**C, in some embodiments, the curved finger **354** of the adapter extension **340** may be replaced with an alternative securing mechanism **354'** that is configured to engage with the shoulder **329'** of the clamp **320'** to help secure the components together (see also, e.g., FIG. **54**B). As discussed above, as shown in FIG. **51**B and FIG. **51**D, the adapter extension **340'** further includes a positioning feature **355'** extending outwardly from the base **342'**. The positioning feature **355'** is configured to be received by the aperture **325'** of the clamp **320'**. The position feature **355'** helps to prevent rotation and shaking between the adapter extension **340'** and the clamp **320'** and secured together.

[0138] Referring to FIG. **52**, an alternative adapter extension **340"** according to embodiment of the present invention is illustrated. Properties and/or features of the adapter extension **340"** may be as described above in reference to the adapter extension **340'** shown in FIGS. **51**A-**51**B and duplicate discussion thereof may be omitted herein for the purposes of discussing FIG. **52**. As shown in FIG. **52**, the adapter extension **340"** differs from the adapter extension **340'** described herein in that the body **344"** of the adapter extension **340"** includes a plurality of draining holes **344***a"*. The draining holes **344***a"* help to prevent water from collecting (and freezing) on the adapter extension **340"**, thereby helping to avoid mold and/or additional load weight on the adapter extension **340"**.

[0139] Referring to FIGS. **53**A-**53**B, an alternative hanger panel **360'** according to embodiments of the present invention is illustrated. Properties and/or features of the hanger panel **360'** may be as described above in reference to the hanger panel **360** shown in FIG. **28** and FIG. **29** and duplicate discussion thereof may be omitted herein for the purposes of discussing FIGS. **53**A-**53**B.

[0140] As shown in FIGS. **53**A-**53**B, the hanger panel **360'** is similar to the hanger panel **360**, with a generally rectangular skeletal base **362'** and four mounting holes **364'** (typically having a nominal diameter of ¾ inch) are spaced across both the front and rear surfaces of the base **362'**. Two T-shaped latches **366'** extend from the rear surface of the base **362'**; the latches **366'** are similar to the latches **350'** described above and are sized and positioned to fit within the T-shaped openings **348**, **348'** of the adapter extensions **340**, **340'** or the or the T-shaped openings **328**, **328'** in the clamps **320**, **320'**. On its front surface, the base **362'** has two T-shaped openings **368'** that are sized and configured to receive T-shaped latches from the mounting adapter **380** or adapter extensions **340**, **340'**, **600** described herein.

[0141] The hanger panel **360'** differs from the hanger panel **360** described herein in that, in some embodiments, the rear surface of the base **362'** of the hanger panel **360'** includes additional structural support **361'** adjacent to where the latches **366'** extend outwardly. In addition, as described above, the hanger panel **360'** includes a positioning feature **365'** residing between the latches **366'**. The positioning feature **355'** is configured to be received by the aperture **325'** of the clamp **320'** or aperture **345'** of the adapter extension **340'**. Similar to the position feature **355'** of the adapter extension **240'**, the position feature **355'** of the hanger panel **360'** helps to prevent rotation and shaking between the hanger panel **360'** and the clamp **320'** or adapter extension **340'** when secured together. In some embodiments, the

hanger panel **360'** may also include similar securing mechanisms as the adapter extension (e.g., securing mechanism **354'** shown in FIG. **54**B).

[0142] FIGS. **54**A-**54**B compare the securing mechanism of the adapter extension **340** described herein (i.e., curved finger **354**) (FIG. **54**A) with the alternative securing mechanism **354'** of the adapter extension **340'** (FIG. **54**B) and corresponding engagement of the respective securing mechanisms **354**, **354'** with the shoulder **329**, **329'** of clamp **320**, **320'** when the respective adapter extensions **340**, **340'** are engaged therewith. In some embodiments, the alternative securing mechanism **354'** may allow for easier disassembly of the engaged components (e.g., the components may be disassembled directly by hand rather than needing a tool such as a screwdriver).

[0143] FIGS. **55**A-**55**B illustrate the positioning feature **355'** of the adapter extension **340'** received within the aperture **325'** of the clamp **320'** according to embodiments of the present invention. The positioning feature **365'** of the hanger panel **360'** is configured to engage with the aperture **325'** of the clamp **320'** or aperture **345'** of the adapter extension **340'** in a similar manner.

[0144] FIGS. **56**A-**56**B illustrate an assembly **900-9** having an exemplary configuration that may be formed utilizing the clamp **320'**, adapter extension **340'**, hanger panel **360'**, and hanger panels **500** described herein. A plurality of cable hangers **80** may be secured to the hanger panels **500**. In some embodiments, the assembly **900-9** may be used to organize cables **16** connected to one or more remote radio units **15** (see, e.g., FIGS. **58**A-**58**B). FIG. **57** illustrates an assembly **900-10** having another exemplary configuration. As shown in FIG. **57**, two adapter extensions **340'** and hanger panels **360'** are configured in a stacked relationship.

[0145] As noted above, and shown in FIGS. **58**A-**58**B, in addition to antennas, in some embodiments, the components described herein may be used for organizing and/or managing cables **16** from one or more remote radio units **15**.

[0146] Referring to FIGS. **59**A-**59**B, alternative assemblies **900-11**, **900-12** according to embodiments of the present invention are illustrated. These assemblies **900-11**, **900-12** have additional exemplary configurations that may be formed utilizing components described herein and may be used for organizing and/or managing cables **16** from one or more remote radio units **15**. As shown in FIG. **59**A, in some embodiments, the assembly **900-11** may include the clamp **320'** secured to a mounting pole **14**. Two adapter extensions **340'** are engaged with the clamp **320'** and extend outwardly in opposing directions. Two hanger panels **500** are engaged with an adapter extension **600** which is engaged with one of the adapter extensions **340'**. The two hanger panels **500** extend outwardly in opposing directions from the adapter extension **600** and are positioned generally perpendicular to the adapter extension **340'**. A hanger panel **360'** is engaged with the other adapter extension **340'** and a plurality of cable hangers **80** are coupled to the hanger panel **360'** with respective fasteners **81**.

[0147] As shown in FIG. **59**B, in some embodiments, the assembly **900-12** may include the clamp **320'** to a mounting pole **14**. Two adapter extensions **340'** are engaged with the clamp **320'** and extend outwardly in opposing directions. Two hanger panels **500** are engaged with an adapter extension **600** which is engaged with one of the adapter extensions **340'**. The two hanger panels **500** extend outwardly in opposing directions from the adapter extension **600** and are positioned generally perpendicular to the adapter extension **340'**. A hanger panel **360'** is engaged with the other adapter extension **340'**. Two hanger panels **500** are engaged with the hanger panel **360'** and extend outwardly therefrom. The two hanger panels **500** are positioned generally perpendicularly to hanger panel **360'**.

[0148] It should also be apparent that any of the assemblies **110**, **210**, **310**, **410** may be provided as a kit, which may include the clamp and one or more of the mounting adapter, the hanger panel(s), and the adapter extension.

[0149] It will also be apparent to those of skill in this art that other configurations of securing features for securing the clamps to a mounting pole or other mounting structure beyond those shown herein may be employed. One clamp should have a first securing feature (exemplified, but not limited to, the latch **30**, the clamp pin **170**, the latch **280**, and the carriage bolt **390**) and the other clamp should have a second securing feature (exemplified, but not limited to, the fingers **32**, the eye bolt **176**, the flanges **231**, and a nut for the carriage bolt **390**) that engages the first securing feature to maintain the clamps in a secured condition. Other potential features include latches, flanges, fingers and the like of different configurations, tongue-in-groove configurations, sliding rails and channels, and the like. It may be desirable with any of these configurations that the securing features be configured so that the clamps may be secured on mounting poles of different diameters.

[0150] 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.

What is claimed is:

1. An assembly for providing mounting locations for cable hangers for an antenna, the assembly comprising:

a hanger panel having a generally rectangular skeletal base, the hanger panel comprising a plurality of mounting holes spaced apart on opposing side surfaces along a length of the base and at least one securing mechanism coupled to and extending outwardly from an end of the base, and

an adapter extension having a side wall comprising a recess,

wherein the hanger panel is secured to the side wall of the adapter extension by the at least one securing mechanism received within the recess.

2. The assembly according to claim **1**, wherein at least one of the hanger panel and the adapter extension are formed of a polymeric material.

3. The assembly according to claim **1**, wherein the base of the hanger panel comprises a plurality of support beams include axial beams and/or cross beams.

4. The assembly according to claim **1**, wherein each of the plurality of mounting holes have a nominal diameter of ¾ inch.

5. The assembly according to claim **1**, wherein the at least one securing mechanism includes a latch sized and configured to fit within the recess of the adapter extension.

6. The assembly according to claim 5, wherein the latch comprises a plurality of wings extending outwardly therefrom and a lower lip extending downwardly therefrom.

7. The assembly according to claim 1, wherein the at least one securing mechanism includes a pair of hooks extending from the end of the base, the pair of hooks configured to engage a top edge of the adapter extension.

8. The assembly according to claim 1, wherein the adapter extension has a generally rectangular skeletal base having four side walls, wherein at least two of the side walls comprise a recess configured to receive the at least one securing mechanism of the hanger panel.

9. The assembly according to claim 5, wherein the recess of the adapter extension comprises an open end and a vertical section, and wherein the latch of the hanger panel is configured to be received by the open end and slide down the vertical section.

10. The assembly according to claim 1, wherein the adapter extension further comprises a securing mechanism residing within the recess configured to engage the at least one securing mechanism of the hanger panel.

11. The assembly according to claim 1, wherein the adapter extension is a first adapter extension, and wherein the adapter extension further comprises a pair of latches extending outwardly from a side wall, each latch configured to be received by an opening of a clamp or an opening of a second adapter extension.

12. The assembly according to claim 11, wherein the first adapter extension comprises a second securing mechanism residing above each latch, the securing mechanisms configured to secure the latch within a respective opening of the claim or second adapter extension.

13. A cable hanger assembly, the assembly comprising:

a generally rectangular skeletal base having a length and a width,

a plurality of mounting holes spaced apart on opposing side surfaces along the length of the base;

a latch coupled to and extending outwardly from an end of the base; and

a pair of hooks extending outwardly from the end of the base above the latch,

wherein the cable hanger assembly is formed of a polymeric material.

14. The assembly according to claim 13, wherein the base comprises a plurality of support beams include axial beams and/or cross beams.

15. The assembly according to claim 13, wherein each of the plurality of mounting holes have a nominal diameter of ¾ inch.

16. The assembly according to claim 13, wherein the latch is sized and configured to fit within a recess of an adapter extension.

17. The assembly according to claim 13, wherein the latch comprises a plurality of wings extending outwardly therefrom and a lower lip extending downwardly therefrom.

18. The assembly according to claim 13, wherein the pair of hooks is configured to engage a top edge of an adapter extension.

19. A cable mounting kit, the kit comprising

first and second clamps, the first clamp including a first securing feature configured to engage a second securing feature on the second clamp to enable the first and second clamps to enclose and mount on a mounting structure, each of the first and second clamps including a clamping surface configured to engage the mounting structure and an opposed outer surface with a pair of first mounting openings; and

a cable hanger mounting assembly, the cable hanger mounting assembly comprising:

a hanger panel having a generally rectangular skeletal base, the hanger panel comprising a plurality of mounting holes spaced apart on opposing side surfaces along a length of the base and at least one securing mechanism coupled to and extending outwardly from an end of the base, and

an adapter extension having a first side wall comprising a recess and a second side wall comprising a pair of latches,

wherein the at least one securing mechanism of the hanger panel is configured to be received within the recess of the adapter extension, and

wherein the pair of latches of the adapter extension is configured to be received by the pair of first mounting openings of the first and second clamps.

20. The kit according to claim 19, wherein the adapter extension is a first adapter extension, the kit further comprising a second adapter extension, the second adapter extension comprising a base having second pair of latches being receivable within the first mounting openings of the first and second clamps, a member extending from the base, and a head with a pair of second mounting openings, the pair of latches of the first adapter extension configured to be received by the pair of second mounting openings.

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