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(71) Applicant: OUTDOOR WIRELESS NETWORKS LLC

[US/US]; 3642 E. US Highway 70, Claremont, North Carolina 28610 (US).

(72) Inventors: RAI, Dipen; 125 Ashridge Way, Sunbury On

Thames TW16 7SE (GB). CLARK, Steven M.; 8 Lums-

daine Drive, Dalgety Bay Fife KY11 9YU (GB). SUNDAR,

Lokeshwaran Maruthanayagam; 24A Wheathouse Rd.,

Huddersfield HD2 2UW (IN). LOCK, Steven; 5 George

Crescent, York Yorkshire YO30 2DS (GB).

(74) Agent: DEROSA, Anthony P.; Myers Bigel, P.A., 4130

Parklake Avenue, Ste. 250, Raleigh, North Carolina 27612 (US).

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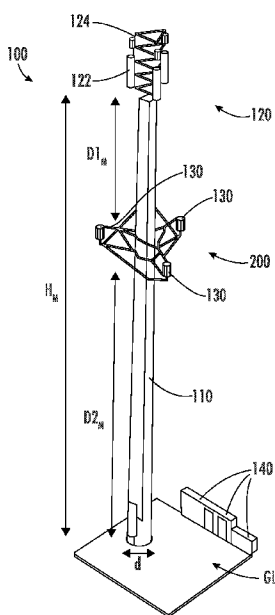


FIG. 1

(57) Abstract: The present application is directed to an antenna assembly. The antenna assembly includes a telecommunications structure; a plurality of antennas mounted to the telecommunications structure; and a plurality of wind turbines mounted to the telecommunications structure by a mounting kit, the plurality of wind turbines positioned a distance below the plurality of antennas. Mounting kits for mounting wind turbines to a telecommunications structure are also described herein.

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WIND TURBINE MOUNTING KITS FOR TELECOMMUNICATION STRUCTURES AND RELATED ASSEMBLIES

Related Application(s)

[0001] The present application claims priority from and the benefit of U.S. Provisional Patent Application Serial No. 63/483,335, filed February 6, 2023, and U.S. Provisional Patent Application Serial No. 63,490,271, filed March 15, 2023, the disclosures of which are hereby incorporated herein in their entireties.

Field

[0002] The present invention is directed generally to telecommunications assemblies, and in particular, to kits for mounting one or more wind turbines to a telecommunications structure and related assemblies.

Background

[0003] Wind energy is one of the popular renewable and sustainable energy sources, which generates power using mostly the wind turbines. Wind power is more eco-friendly, has less impact on the environment compared to fossil fuels and helps in saving energy for the future generations. Utilizing wind energy in different environments could significantly reduce energy costs, reduce environmental impacts and improve planning applications.

Summary

[0004] A first aspect of the present invention is directed to an antenna assembly. The antenna assembly includes a telecommunications structure; a plurality of antennas mounted to the telecommunications structure; and a plurality of wind turbines mounted to the telecommunications structure by a mounting kit, the plurality of wind turbines positioned a distance below the plurality of antennas.

[0005] Another aspect of the present invention is directed to an antenna assembly. The antenna assembly includes a telecommunications structure; one or more equipment cabinets; a plurality of antennas mounted to the telecommunications structure, the plurality of antennas including one or more passive antennas and one or more active antennas; and three wind turbines mounted to the telecommunications structure 120 degrees apart from each other by a

mounting kit, the three wind turbines positioned on the telecommunications structure a distance below the plurality of antennas.

[0006] Another aspect of the present invention is directed to an antenna assembly. The antenna assembly includes a monopole; a plurality of antennas mounted to the monopole; and three wind turbines mounted to the monopole a distance below the plurality of antennas by a mounting kit. The mounting kit includes a bracket system having a pair of ring mounts and a pair of offset members for each of the wind turbines, each pair of offset members extending outwardly from the ring mounts and configured to have a respective wind turbine secured thereto.

[0007] Another aspect of the present invention is directed to an antenna assembly. The antenna assembly includes a lattice antenna tower, a plurality of antennas mounted to the lattice antenna tower, and one or more wind turbines mounted to the lattice antenna tower a distance below the plurality of antennas by a mounting kit. The mounting kit includes one or more bracket systems. Each bracket system includes an upper clamping assembly, a lower clamping assembly, an offset member coupled to and extending outwardly from the upper clamping assembly, a brace member coupled to and extending outwardly from the lower clamping assembly, and a mount plate coupled to the offset member and configured to have a respective wind turbine mounted and secured thereto.

[0008] 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 combination. 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 Figures

[0009] **FIG. 1** is a perspective view of an antenna assembly having wind turbines mounted thereon according to embodiments of the present invention.

[0010] **FIG. 2A** is a perspective view of the antenna assembly of **FIG. 1**.

[0011] **FIG. 2B** is an enlarged bottom perspective view of an exemplary mounting kit for one or more wind turbines that may be used with the antenna assembly of **FIG. 1** according to embodiments of the present invention.

[0012] **FIG. 3** is a side view of an exemplary wind turbine that may be used with the antenna assembly of **FIG. 1** according to embodiments of the present invention.

[0013] **FIG. 4** is a schematic diagram of an exemplary power connection system for the wind turbines used with the antenna assembly according to embodiments of the present invention.

[0014] **FIG. 5** is a perspective environmental view of the antenna assembly of **FIG. 1** according to embodiments of the present invention.

[0015] **FIG. 6A** is a view of another antenna assembly having wind turbines mounted thereon according to embodiments of the present invention.

[0016] **FIG. 6B** is a bottom perspective view of the antenna assembly of **FIG. 6A**.

[0017] **FIG. 7A** is a side view of another antenna assembly having wind turbines mounted thereon according to embodiments of the present invention.

[0018] **FIG. 7B** is a top sectional view of the antenna assembly of **FIG. 7A** taken along section line A-A.

[0019] **FIG. 7C** is an enlarged top perspective view of the wind turbine mounting kit used with the antenna assembly of **FIG. 7C**.

[0020] **FIG. 8A** is a side view of another antenna assembly having wind turbines mounted thereon according to embodiments of the present invention.

[0021] **FIG. 8B** is a top sectional view of the antenna tower assembly of **FIG. 8A** taken along section line A-A.

[0022] **FIG. 8C** is an enlarged top perspective view of the wind turbine mounting kit used with the antenna assembly of **FIG. 8C**.

[0023] **FIG. 9A** is a side view of another antenna assembly including a platform assembly and having wind turbines mounted thereon according to embodiments of the present invention.

[0024] **FIG. 9B** is a top sectional view of the antenna assembly of **FIG. 9A** taken along section line A-A.

[0025] **FIG. 9C** is an enlarged top perspective view of the platform assembly and wind turbine mounting kit used with the antenna assembly of **FIG. 9A**.

Detailed Description

[0026] The present invention is described more fully hereinafter with reference to the accompanying drawings, in which 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 set forth 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.

[0027] In the figures, certain layers, components, or features may be exaggerated for clarity, and broken lines illustrate optional features or operations unless specified otherwise. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth 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.

[0028] It will be understood that, although the terms first, second, etc. may be used herein to describe various elements, components, regions, layers and/or sections, these elements, components, regions, layers and/or sections should not be limited by these terms. These terms are only used to distinguish one element, component, region, layer or section from another region, layer, or section. Thus, a first element, component, region, layer, or section discussed below could be termed a second element, component, region, layer or section without departing from the teachings of the present invention. The sequence of operations (or steps) is not limited to the order presented in the claims or figures unless specifically indicated otherwise.

[0029] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the specification and relevant art and should not be interpreted in an idealized or overly formal sense unless expressly so defined herein. Well-known functions or constructions may not be described in detail for brevity and/or clarity.

[0030] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising", when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition

of one or more other features, integers, steps, operations, elements, components, and/or groups thereof. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

[0031] As used herein, phrases such as "between X and Y" and "between about X and Y" should be interpreted to include X and Y. As used herein, phrases such as "between about X and Y" mean "between about X and about Y." As used herein, phrases such as "from about X to Y" mean "from about X to about Y."

[0032] It will be understood that when an element is referred to as being "on", "attached" to, "connected" to, "coupled" with, "contacting", etc., another element, it can be directly on, attached to, connected to, coupled with or contacting the other element or intervening elements may also be present. In contrast, when an element is referred to as being, for example, "directly on", "directly attached" to, "directly connected" to, "directly coupled" with or "directly contacting" another element, there are no intervening elements present. It will also be appreciated by those of skill in the art that references to a structure or feature that is disposed "adjacent" another feature may have portions that overlap or underlie the adjacent feature.

[0033] Spatially relative terms, such as "under", "below", "lower", "over", "upper", "lateral", "left", "right" and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is inverted, elements described as "under" or "beneath" other elements or features would then be oriented "over" the other elements or features. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the descriptors of relative spatial relationships used herein interpreted accordingly.

[0034] Embodiments of the present invention are directed to a mounting kit for wind turbines for telecommunication structures such as monopoles and lattice antenna towers, including kits that may be retrofitted on an existing telecommunications structure. In some embodiments, the mounting kit utilizes multiple smaller wind turbines (which may be off the shelf product) on sites with a telecommunications structure in groups of three to generate significant electrical power (*e.g.*, one-third to full power requirements of the monopole, depending on the antenna site design). In some embodiments, the mounting kit is installed at a height below the antenna and away from the antenna line of sight and radio frequency (RF) zones. The present invention may provide multiple advantages such as easy maintenance of the antennas and wind turbines, having less effect of loadings on the telecommunications structure (*e.g.*, less stress and fatigue),

and the turbines being rated for a low noise rating. In some embodiments, the three wind turbines have 120 degrees of separation, such that at any given wind direction, two turbines may always be exposed to head wind, while the third turbine would still be able to produce energy. The present invention provides a solution that balances wind speed with other telecommunications requirements which are normally not found within the wind turbine sector. Embodiments of the present invention will now be described in further detail below with reference to **FIGS. 1-9C**.

[0035] Referring to **FIG. 1**, an antenna assembly **100** according to embodiments of the present invention is illustrated. As shown in **FIG. 1**, the antenna assembly **100** includes a telecommunications structure **110**, a plurality of antennas **120**, a plurality of wind turbines **130**, and one or more equipment cabinets **140**. In some embodiments, the telecommunications structure **110** may be a monopole (*see, e.g.*, **FIG. 1**, **FIGS. 2A-2B**, **FIG. 5**, and **FIGS. 6A-6B**). In other embodiments, the telecommunications structure **110** may be a lattice antenna tower (*see, e.g.*, **FIGS. 7A-9C**). In some embodiments, the plurality of antennas **120** may include one or more passive antennas **122** and/or one or more active antennas **124**. In some embodiments, the one or more equipment cabinets **140** may include a cabinet for radios, a cabinet for electrical grid equipment, and a cabinet for wind turbine unit equipment.

[0036] The telecommunications structure **110** (*e.g.*, monopole as shown in **FIG. 1** and **FIGS. 2A-2B**) has a height (H_M) and a diameter (d). In some embodiments, the telecommunications structure **110** has a height (H_M) in a range of between about 15 meters to about 35 meters. In some embodiments, for example, when the telecommunications structure **110** is a monopole, the telecommunications structure **110** may have a mast height of about 30 meters and a headframe height of about 3.3 meters, for a total height (H_M) of about 33.3 meters. In some embodiments, the monopole **110** has a cylindrical (smooth) profile. In other embodiments, the monopole **110** has a "faceted" (*i.e.*, not smooth) cylindrical profile, for example, a 12-sided cylindrical profile.

[0037] In some embodiments, the plurality of antennas **120** are mounted above the mast at a height of about 31 meters to about 33 meters above a ground level **GL**. For example, in some embodiments, the one or more passive antennas **122** may be mounted at a height of 32 meters above ground level **GL** and the one or more active antennas **124** may be mounted at a height of about 33 meters above ground level **GL**.

[0038] In some embodiments, the plurality of wind turbines **130** are mounted on the telecommunications structure **110** a sufficient distance (D_{1M}) below the plurality of antennas **120** to avoid interference with the radio frequency zones and the line of sight of the antennas

120. In addition, mounting the wind turbines **130** a distance (**D1_M**) below the antennas **120** also provides the advantage of allowing maintenance of the antennas **120** and wind turbines **130** to be independent from each other (*i.e.*, no shutdown is required of one when the other is being serviced). For example, in some embodiments, the plurality of wind turbines **130** may be mounted a distance (**D1_M**) in a range of between about 1 meter and about 2 meters below the plurality of antennas **120**.

[0039] In addition, the plurality of wind turbines **130** are mounted a sufficient distance (**D2_M**) above ground level **GL** to maximize the wind exposure for the wind turbines **130** while minimizing the effect of stress and fatigue on the telecommunications structure **110**. For example, in some embodiments, the plurality of wind turbines **130** may be mounted a distance (**D2_M**) in a range of between about 10 meters and about 30 meters above ground level **GL**. This also provides the advantage of easier installation and serviceability of the wind turbines **130** on the telecommunications structure **110** (*e.g.*, compared to installing the wind turbines **130** above the antennas **120**), which would require shorter power cables, *i.e.*, routed from the wind turbines **130** to the respective cabinet(s) **140**.

[0040] As further shown in **FIG. 1**, and described in further detail below, according to embodiments of the present invention, the plurality of wind turbines **130** may be secured to the telecommunications structure **110** via a mounting kit **200** (*see also, e.g.*, **FIGS. 2A-2B**). In some embodiments, the mounting kit **200** may be used to retrofit an existing antenna site such that one or more wind turbines **130** may be mounted/secured to the existing telecommunications structure **110**.

[0041] Referring to **FIGS. 2A-2B**, an exemplary mounting kit **200** according to embodiments of the present invention is illustrated. As shown in **FIGS. 2A-2B**, the mounting kit **200** may be used when the telecommunications structure **110** is a monopole (*see also, e.g.*, **FIGS. 9A-9C**). In other embodiments, as described in further detail below, a different mounting kit **700** may be used to accommodate different telecommunications structures **110** such as a triangular lattice antenna tower (*see, e.g.*, **FIGS. 7A-7C**) or a square lattice antenna tower (*see, e.g.*, **FIGS. 8A-8C**). In some embodiments, the mounting kit **200** includes a bracket system **205** that is configured to accommodate and secure three (3) wind turbines **130** to the monopole **110** (*i.e.*, 3 x turbine configuration). In other embodiments, a mounting kit may include a bracket system that is configured to accommodate and secure two (2) wind turbines **130** to the monopole **110** (*i.e.*, 2 x turbine configuration) (*see, e.g.*, mounting kit **500** and bracket system **505** for monopole assembly **400** illustrated in **FIGS. 6A-6B**).

[0042] As shown in **FIGS. 2A-2B**, the wind turbines **130** are orientated or have separation of 120 degrees. Thus, at any given wind direction, two of the wind turbines **130** may be exposed to a head wind with the third wind turbine **130** still being able to produce energy, while at a comparatively lower speed. In some embodiments, the three wind turbines **130** are capable of producing enough power to run the monopole/antenna site, thereby providing a significant savings in operation costs. For example, in some embodiments, an estimated annual energy production may be in a range of about 10,000 kWh and about 30,000 kWh.

[0043] In some embodiments, the bracket system **205** may comprise a bespoke bracket design. For example, as shown in **FIG. 2B**, in some embodiments, the bracket system **205** may comprise a pair of ring mounts **210** that are configured to secure the bracket system **205** to the monopole **110**. The ring mounts **210** may be configured to secure the bracket system **205** to monopoles having different cross-sectional shapes. In some embodiments, for each wind turbine **130**, the bracket system **205** may comprise a pair of offset members **214** that extend outwardly from the ring mounts **210**. In some embodiments, one or more cross-support members **216** may be coupled to and extend between the respective pairs of offset members **214** to provide additional structural support to bracket system **205** and mounting kit **200**. In some embodiments, the bracket system **205** may further comprise one or more additional support members **218a**, **218b**, **218c** as needed. For example, as shown in **FIG. 2B**, these additional support members **218a**, **218b**, **218c** may be coupled to and extend between the monopole **110** and a respective offset member **214** and/or a base mount **131** of the wind turbine **130**, thereby providing further structural support to the bracket system **205** and mounting kit **200**. In some embodiments, the mounting kit **200** may further comprise one or more platforms or foot-rests **220**, as well as fall-arrest securing brackets **222**, thereby allowing tasks such as inspection, lubrication, and cleaning to be easier and safer to be completed by a technician (*see also, e.g.*, platform assembly **1100** illustrated in **FIGS. 9A-9C**).

[0044] It is noted that the bracket system **205** shown in **FIG. 2B** illustrates an example bracket system **205** that may be used with the mounting kit **200** of the present invention and that other bracket system designs (for example, antenna mounting brackets) may be used with the mounting kit **200** and antenna assembly **100** of the present invention.

[0045] An exemplary wind turbine **130** that may be used in the antenna assembly **100** of the present invention is illustrated in **FIG. 3** (and alternative antenna assemblies **400**, **600**, **800**, **900** described herein). In some embodiments, the wind turbines **130** may be smaller output turbines which produce low vibration and noise (*e.g.*, less than 30 dB). The weight and size of the smaller output turbines provides the advantage of allowing easier installation of the wind

turbines **130** onto an existing telecommunications structure **110**. In some embodiments, the wind turbines **130** may be able to offset around 1.5 kWh at average wind speeds (*e.g.*, 5 meters/second). An exemplary type of wind turbine **130** that may be used with the antenna assembly **100** (as well as other antenna assemblies **400**, **600**, **800**, **900** described herein) is the TESUP Atlas X Wind Turbine (TESUP Electronics Limited, London, United Kingdom).

[0046] Referring to **FIG. 4**, a schematic diagram for an exemplary power connection system **300** for the antenna assembly **100** (and alternative antenna assemblies **400**, **600**, **800**, **900** described herein) according to embodiments of the present invention is illustrated. As shown in **FIG. 4**, in some embodiments, the electrical current (*i.e.*, AC) generated from the wind turbine **130** flows to a turbine controller **132**. The turbine controller **132** is configured to send the alternating current (AC) to an AC/DC rectification unit **330** which converts the alternating current (AC) from the wind turbine **130** to direct current (DC) that can be sent to a battery **340** and/or a radio **350** that is connected with one or more of the antennas **120** mounted at the top of the telecommunications structure **110**. In addition, current being supplied by a corresponding power grid **310** (*e.g.*, supplying power to the monopole/antenna site) may also be sent to the AC/DC rectification unit **330** via the electrical grid equipment contained within one of the cabinets **140**.

[0047] As shown in **FIG. 4**, in some embodiments, the connection system **300** of the antenna assembly **100** may also comprise an optional battery **135**. The optional battery **135** may include a smart switch **134**, a separate AC/DC rectification and/or DC/AC inversion unit **136**, and a battery system **138**. In some embodiments, the turbine controller **132** may also be configured to transmit the alternating current (AC) of the wind turbine **130** to the optional battery **135**. In some embodiments, the smart switch **134** of the optional battery **135** may be configured to redirect the alternating current (AC) received from the wind turbine **130** to the AC/DC rectification unit **330**. The same or similar connection system **300** may be used with the alternative antenna assemblies **400**, **600**, **800**, **900** described herein.

[0048] **FIG. 5** is an environmental view the antenna assembly **100** of the present invention being used at an exemplary rural site.

[0049] Referring to **FIGS. 6A-6B**, another antenna assembly **400** according to embodiments of the present invention is illustrated. Properties and/or features of the antenna assembly **400** may be as described above in reference to the antenna assembly **100** shown in **FIGS. 1-5** and duplicate discussion thereof may be omitted herein for the purposes of discussing **FIGS. 6A-6B**. The antenna assembly **400** differs from the antenna assembly **100** described herein in that the mounting kit **500** includes a bracket system **505** configured to accommodate and secure

two (2) wind turbines **130** (*i.e.*, 2 x turbine configuration) to the telecommunications structure **110** (*i.e.*, monopole as illustrated in **FIGS. 6A-6B**).

[0050] As shown in **FIGS. 6A-6B**, the wind turbines **130** are orientated or have separation of 180 degrees. In some embodiments, the bracket system **505** comprises a pair of offset members **514** that extend outwardly from the monopole **110**. In some embodiments, one or more support members **518** may be coupled to and extend between the monopole **110** and the offset members **514** to provide structural support to bracket system **505** and mounting kit **500**. In some embodiments, the bracket system **505** may further comprise base supports **516** at the free ends of the offset members **514**. The base supports **516** may be configured to have a respective wind turbine **130** mounted and secured thereto. Similar to the mounting kit **200** described herein, in some embodiments, the mounting kit **500** may further comprise one or more platforms or foot-rests, as well as fall-arrest securing brackets, thereby allowing tasks such as inspection, lubrication, and cleaning to be easier and safer to be completed by a technician (*see also, e.g.*, platform assembly **1100** illustrated in **FIGS. 9A-9C**).

[0051] It is noted that the bracket system **505** shown in **FIGS. 6A-6B** illustrates an example bracket system **505** that may be used with the mounting kit **500** of the present invention and that other bracket system designs (for example, antenna mounting brackets) may be used with the mounting kit **500** and antenna assembly **400** of the present invention.

[0052] Referring to **FIGS. 7A-7C** and **FIGS. 8A-8C**, additional antenna assemblies **600**, **800** according to embodiments of the present invention are illustrated. Properties and/or features of the antenna assemblies **600**, **800** may be as described above in reference to the antenna assemblies **100**, **400** shown in **FIGS. 1-6B** and duplicate discussion thereof may be omitted herein for the purposes of discussing **FIGS. 7A-7C** and **FIGS. 8A-8C**. The antenna assemblies **600**, **800** differ from the antenna assemblies **100**, **400** described herein in that the telecommunications structure **110** is a lattice antenna tower (*e.g.*, having a triangular or square profile) and utilizes a different mounting kit **700** to secure one or more wind turbines **130** to the lattice antenna tower **110**. For example, as shown in **FIGS. 7A-7C**, in some embodiments, the mounting kit **700** may be used to secure three (3) wind turbines **130** to a triangular lattice antenna tower **110** (*i.e.*, 3 x turbine configuration). As shown in **FIGS. 8A-8C**, in some embodiments, the mounting kit **700** may be used to secure four (4) wind turbines **130** to a square lattice antenna tower **110** (*i.e.*, 4 x turbine configuration).

[0053] As shown in **FIGS. 7A-7C** and **FIGS. 8A-8C**, similar to the antenna assemblies **100**, **400** described herein, the antenna assemblies **600**, **800** each further includes a plurality of antennas **120**, a plurality of wind turbines **130**, and one or more equipment cabinets **140**. In

some embodiments, the plurality of antennas **120** may include one or more passive antennas **122** and/or one or more active antennas **124**. In some embodiments, the one or more equipment cabinets **140** may include a cabinet for radios, a cabinet for electrical grid equipment, and a cabinet for wind turbine unit equipment.

[0054] The lattice antenna tower **110** has a height (**H_L**). In some embodiments, the lattice antenna tower **110** has a height (**H_L**) up to 200 meters or more, but typically in a range of between about 15 meters to about 60 meters. In some embodiments, the plurality of wind turbines **130** are mounted on the lattice antenna tower **110** a sufficient distance (**D_{1L}**) below the plurality of antennas **120** to avoid interference with the radio frequency zones and the line of sight of the antennas **120**. In addition, mounting the wind turbines **130** a distance (**D_{1L}**) below the antennas **120** also provides the advantage of allowing maintenance of the antennas **120** and wind turbines **130** to be independent from each other (*i.e.*, no shutdown is required of one when the other is being serviced). For example, in some embodiments, the plurality of wind turbines **130** may be mounted a distance (**D_{1L}**) in a range of between about 1 meter and about 2 meters below the plurality of antennas **120**. In some embodiments, the antenna assemblies **600**, **800** have a structural width (**D_{3L}**) in the range of between about 3 meters and about 8 meters.

[0055] In addition, the plurality of wind turbines **130** are mounted a sufficient distance (**D_{2L}**) above ground level **GL** to maximize the wind exposure for the wind turbines **130** while minimizing the effect of stress and fatigue on the lattice antenna tower **110**. This also provides the advantage of easier installation and serviceability of the wind turbines **130** on the lattice antenna tower **110** (*e.g.*, compared to installing the wind turbines **130** above the antennas **120**), which would require shorter power cables, *i.e.*, routed from the wind turbines **130** to the respective cabinet(s) **140**. For example, in some embodiments, the plurality of wind turbines **130** may be mounted a distance (**D_{2L}**) in a range of between about 10 meters or more above ground level **GL**, and typically between about 10 meters and about 30 meters above ground level **GL**. The distance (**D_{2L}**) the plurality of wind turbines **130** is mounted above ground level **GL** is dictated by the availability of wind at higher heights along the lattice antenna tower **110**. In some embodiments, the plurality of wind turbines **130** may be mounted a greater distance (**D_{2L}**) above ground level **GL** based on the height available for a particular lattice antenna tower **110** and if there are no other equipment constraints. In some embodiments, the wind turbines **130** may be positioned a distance (**D_{3L}**) apart from each other in a range of between about 3 meters and about 5 meters.

[0056] As further shown in **FIGS. 7A-7C** and **FIGS. 8A-8C**, and described in further detail below, according to embodiments of the present invention, the plurality of wind turbines **130** may be secured to the lattice antenna tower **110** via a mounting kit **700**. In some embodiments, the mounting kit **700** may be used to retrofit an existing antenna site such that one or more wind turbines **130** may be mounted/secured to the existing lattice antenna tower **110**. In some embodiments, the mounting kit **700** is configured to secure one, two, three or four wind turbines to the lattice antenna tower **110**. For example, as shown in **FIG. 7B-7C**, the mounting kit **700** may be configured to accommodate and secure three (3) wind turbines **130** to the lattice antenna tower **110** (*e.g.*, having a triangular profile) (*i.e.*, 3 x turbine configuration). As shown in **FIGS. 8B-8C**, the mounting kit **700** may be configured to accommodate and secure four (4) wind turbines **130** to the lattice antenna tower **110** (*e.g.*, having a square profile) (*i.e.*, 4 x turbine configuration).

[0057] As shown in **FIG. 7B**, the wind turbines **130** are orientated or have a separation of 120 degrees (α). Thus, at any given wind direction, two of the wind turbines **130** may be exposed to a head wind with the third wind turbine **130** still being able to produce energy, while at a comparatively lower speed. In some embodiments, the three wind turbines **130** are capable of producing enough power to run the antenna site, thereby providing a significant savings in operation costs. For example, in some embodiments, an estimated annual energy production may be in a range of about 10,000 kWh and about 30,000 kWh. As shown in **FIG. 8B**, the wind turbines **130** are oriented or have a separation of 90 degrees (β). In some embodiments, the energy production for the wind turbines **130** having a separation of 90 degrees (β) (*i.e.*, 4 x turbine configuration) may be higher than the energy production for the wind turbines **130** having a separation of 120 degrees (α) (*i.e.*, 3 x turbine configuration) due to additional turbulence from the lattice antenna tower **110**.

[0058] The mounting kit **700** of the present invention includes a plurality of bracket systems **705** configured to secure the respective wind turbines **130** to the telecommunications structure **110** (*i.e.*, lattice antenna tower). The number of bracket systems **705** on the mounting kit **700** is equal to the number of wind turbines **130** to be mounted to the lattice antenna tower **110**. As shown in **FIGS. 7B-7C** and **FIGS. 8B-8C**, in some embodiments, each bracket system **705** may comprise a pair of clamp mount assemblies **710a**, **710b** (*i.e.*, an upper clamp assembly **710a** and a lower clamp assembly **710b**) that are configured to secure the bracket system **705** for each wind turbine **130** to a respective leg **110a** of the lattice antenna tower **110**. In some embodiments, the clamp mount assemblies **710a**, **710b** may be configured to secure the bracket system **705** to legs **110a** of lattice antenna towers **110** having different cross-sectional shapes.

In some embodiments, the clamp mounts **710a**, **710b** may be standard clamping assemblies that have front and rear clamping members which are held together by threaded bolts or rods and secured with nuts. Tightening of the bolts enables the front and rear clamping members to clamp onto the leg **110a** of the lattice antenna tower **110**, with the leg **110a** being held between the clamping members of the respective clamp mount assemblies **710a**, **710b** (*see, e.g., FIG. 7C and FIG. 8C*).

[0059] In some embodiments, each bracket system **705** may further comprise an offset member **712**, a brace member **714**, and a mount plate **716**. The offset member **712** is coupled to and extends outwardly from an upper clamp assembly **710a**. In some embodiments, the offset member **712** has a length (**L_{os}**) in a range of between about 1 meter and about 3 meters. The mount plate **716** is secured to an opposing end of the offset member **712** (*i.e.*, the end opposite to the upper clamp assembly **710a**). The mount plate **716** is sized and configured such that a wind turbine **130** can be mounted and secured thereon. The brace member **714** is coupled to and extends outwardly from the lower clamp assembly **710b** at an upward angle (θ) toward the offset member **712** (*see, e.g., FIG. 7C and FIG. 8C*). For example, in some embodiments, the brace member **714** extends outwardly at an angle (θ) in the range of between about 45 degrees and about 60 degrees. The brace member **714** is secured to the offset member **712** (*e.g.*, via welding) and provides structural support to offset member **712** (and wind turbine **130** mounted to the mount plate **716**). In some embodiments, the bracket system **705** may further comprise one or more additional brace members **714**, as needed. In some embodiments, the offset and brace members **712**, **714** are tubular having a square or rectangular cross-section. In some embodiments, the mounting kit **700** may further comprise one or more platforms or foot-rests **220**, as well as fall-arrest securing brackets **222** (*see, e.g., FIG 2B*), thereby allowing tasks such as inspection, lubrication, and cleaning to be easier and safer to be completed by a technician (*see also, e.g., FIGS. 9A-9C*).

[0060] Referring to **FIGS. 9A-9C**, another antenna assembly **900** according to embodiments of the present invention are illustrated. Properties and/or features of the antenna assembly **900** may be as described above in reference to the antenna assemblies **100**, **400**, **600**, **800** shown in **FIGS. 1-8C** and duplicate discussion thereof may be omitted herein for the purposes of discussing **FIGS. 9A-9C**. The antenna assembly **900** differs from the antenna assemblies **100**, **400**, **600**, **800** described herein in that the telecommunications structure **110** (*e.g.*, a monopole) includes a platform assembly **1100** and utilizes a different mounting kit **1000** to secure one or more wind turbines **130** to the telecommunications structure **110**.

[0061] As shown in **FIGS. 9A-9C**, similar to the antenna assemblies **100, 400, 600, 800** described herein, the antenna assembly **900** further includes a plurality of antennas **120**, a plurality of wind turbines **130**, and one or more equipment cabinets **140**. In some embodiments, the plurality of antennas **120** may include one or more passive antennas **122** and/or one or more active antennas **124**. In some embodiments, the one or more equipment cabinets **140** may include a cabinet for radios, a cabinet for electrical grid equipment, and a cabinet for wind turbine unit equipment.

[0062] The telecommunications structure **110** has a height (**H_P**) similar to other telecommunications structures **110** described herein. In some embodiments, the plurality of wind turbines **130** are mounted on the telecommunications structure **110** a sufficient distance (**D_{1P}**) below the plurality of antennas **120** to avoid interference with the radio frequency zones and the line of sight of the antennas **120**. As shown in **FIG. 9A**, in some embodiments, the wind turbines **130** are mounted above the platform assembly **1100** relative to the telecommunications structure **110**. In addition, mounting the wind turbines **130** a distance (**D_{1L}**) below the antennas **120** also provides the advantage of allowing maintenance of the antennas **120** and wind turbines **130** to be independent from each other (*i.e.*, no shutdown is required of one when the other is being serviced). For example, in some embodiments, the plurality of wind turbines **130** may be mounted a distance (**D_{1P}**) in a range of between about 1 meter and about 2 meters below the plurality of antennas **120**. In addition, the plurality of wind turbines **130** are mounted a sufficient distance (**D_{2P}**) above ground level **GL** to maximize the wind exposure for the wind turbines **130** while minimizing the effect of stress and fatigue on the telecommunications structure **110**.

[0063] As described in further detail below, according to embodiments of the present invention, the plurality of wind turbines **130** may be secured to the telecommunications structure **110** (*e.g.*, monopole) via a mounting kit **1000**. In some embodiments, the mounting kit **1000** may be used to retrofit an existing monopole/antenna site such that one or more wind turbines **130** may be mounted/secured to the existing monopole **110**.

[0064] As shown in **FIGS. 9A-9C**, a platform assembly **1100** is secured to the monopole **110** via a ring mount **210**. In some embodiments, the platform assembly **1100** is a standard platform. For example, in some embodiments, the platform assembly **1100** comprises a plurality of offset members **1108** that extend radially outwardly from the ring mount **210**. One or more lower auxiliary support members **1012b** are coupled to an opposing end of each offset member **1108**. A lower horizontal pipe member **1102** extends between each pair of lower auxiliary support members **1012b** and is secured thereto by fasteners (*e.g.*, U-bolts). An upper

horizontal pipe member **1102** extends parallel to each respective lower horizontal pipe member **1102**. The corresponding upper and lower horizontal pipe members **1102** are coupled together via a plurality of vertical pipe members **1104**. In some embodiments, the platform assembly **1100** further comprises one or more upper auxiliary support members **1012a** that are coupled to and extend between adjacent upper horizontal pipe members **1102**. The platform assembly **1100** further comprises grating walkways **1106** coupled to the offset members **1108**, support members **1012a**, **1012b**, and lower horizontal pipe members **1102**.

[0065] As further shown in **FIGS. 9B-9C**, in some embodiments, the mounting kit **1000** for the wind turbines **130** includes a bracket system **1105**. The bracket system **1105** may include a plurality of vertical support members **1014** that are coupled to and extend between respective upper and lower auxiliary support members **1012a**, **1012b**. A mounting plate **1016** is secured to corresponding upper auxiliary support members **1012a**. The mounting plates **1016** are each configured to have a wind turbine **130** mounted and secured thereto. In some embodiments, the mounting kit **1000** further comprises a brace member **1018** that is coupled to and extends between each offset member **1108** of the platform assembly **1100** and an upper auxiliary support member **1012a** (*i.e.*, at an angle), thereby providing additional structural support to the mounting plate **1016** and respective wind turbine **130** secured thereto.

[0066] For a low power consumption site which only requires 1.5 kWh or annually 13,137 kWh, the power generated from the wind turbines may be more than adequate, and thus the remaining unused energy can be the source for any additional service that can be provided along with the monopole/antenna site. For example, electric vehicle charging stations are one of the emerging facilities that is growing all around the world. An opportunity may exist to collaborate telecommunication sites with electric vehicle charging stations in low power consumption sites where the surplus energy produced from an off-grid solution can be used.

[0067] The antenna assemblies **100**, **400**, **600**, **800**, **900** of the present invention provides a number of advantages including ease of integration into an existing antenna site, the ability to maintain operation of the antenna site during installation and maintenance, the ability to supply a third or more of the power required to run the antenna site, the wind turbines are quiet in operation, as well as multiple economic benefits.

[0068] The foregoing is illustrative of the present invention and is not to be construed as limiting thereof. Although a few exemplary embodiments of this invention have been described, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included

within the scope of this invention as defined in the claims. The invention is defined by the following claims, with equivalents of the claims to be included therein.

That Which is Claimed is:

1. An antenna assembly, the antenna assembly comprising:
a telecommunications structure;
a plurality of antennas mounted to the telecommunications structure; and
a plurality of wind turbines mounted to the telecommunications structure by a mounting kit, the plurality of wind turbines positioned a distance below the plurality of antennas.
2. The antenna assembly according to Claim 1, further comprising one or more equipment cabinets.
3. The antenna assembly according to Claim 2, wherein the one or more equipment cabinets include a cabinet for radios, a cabinet for electrical grid equipment and/or a cabinet for wind turbine unit equipment.
4. The antenna assembly according to any one of the preceding claims, wherein the plurality of antennas include one or more passive antennas and/or one or more active antennas.
5. The antenna assembly according to any one of the preceding claims, wherein the distance of the plurality of wind turbines below the plurality of antennas is in a range of between about 1 meter and about 2 meters.
6. The antenna assembly according to any one of the preceding claims, wherein the plurality of wind turbines are mounted to the telecommunications structure a distance in a range of between about 10 meters and about 30 meters above a ground level.
7. The antenna assembly according to any one of the preceding claims, wherein the telecommunications structure is a monopole.
8. The antenna assembly according to Claim 7, wherein the monopole has a faceted cylindrical profile.

9. The antenna assembly according to any one of Claims 7 or 8, wherein the mounting kit comprises a bracket system configured to accommodate and secure three wind turbines to the telecommunications structure.

10. The antenna assembly according to Claim 9, wherein the three wind turbines have 120 degrees of separation between each other when mounted to the telecommunications structure.

11. The antenna assembly according to any one of Claims 9 or 10, wherein the mounting kit comprises a pair of ring mounts and a pair of offset members for each wind turbine, each pair of offset members extending outwardly from the ring mounts and configured to have a respective wind turbine secured thereto.

12. The antenna assembly according to Claim 11, wherein the mounting kit further comprises one or more cross-support members coupled to and extending between the respective pairs of offset members.

13. The antenna assembly according to any one of Claims 11 or 12, wherein the mounting kit further comprises one or more additional support members coupled to an extending between the monopole and a respective offset member and/or a base member of a respective wind turbine.

14. The antenna assembly according to any one of Claims 1-6, wherein the telecommunications structure is lattice antenna tower.

15. The antenna assembly according to Claim 14, wherein the mounting kit comprises a plurality of bracket systems, each bracket system comprising an upper clamping assembly, a lower clamping assembly, an offset member coupled to and extending outwardly from the upper clamping assembly, a brace member coupled to an extending outwardly from the lower clamping assembly, and a mount plate coupled the offset member and configured to have a respective wind turbine mounted and secured thereto.

16. The antenna assembly according to any one of the preceding claims, wherein the mounting kit comprises a platform assembly or one or more foot-rests.

17. The antenna assembly according to Claim 16, wherein the platform assembly is secured to the telecommunications structure via ring mount, the platform assembly comprises:
a plurality of offset members that extend radially outwardly from the ring mount,
one or more lower auxiliary support members coupled to an opposing end of each offset member,
a lower horizontal pipe member extending between each pair of lower auxiliary support members;
an upper horizontal pipe member extending parallel to each respective lower horizontal pipe member and is coupled together via a plurality of vertical pipe members;
one or more upper auxiliary support members that are coupled to and extend between adjacent upper horizontal pipe members; and
one or more grating walkways coupled to the offset members, lower auxiliary support members, and lower horizontal pipe members.

18. The antenna assembly according to Claim 17, wherein the mounting kit includes a bracket system comprising a plurality of vertical support members that are coupled to and extend between respective upper and lower auxiliary support members, a mounting plate secured to corresponding upper auxiliary support members and configured to have a wind turbine mounted and secured thereto, and a brace member that is coupled to and extends between each offset member of the platform assembly and an upper auxiliary support member.

19. The antenna assembly according to any one of the preceding claims, wherein the mounting kit comprises one or more fall-arrest securing brackets.

20. The antenna assembly according to any one of the preceding claims, further comprising a connection system, the connection system comprising a turbine controller, an AC/DC rectification unit, and a battery or radio load.

21. The antenna assembly according to Claim 20, wherein the connection system further comprises an optional battery having a smart switch, a second AC/DC rectification unit and/or DC/AC inversion unit, and a battery system.

22. The antenna assembly according to any one of the preceding claims, wherein the plurality of wind turbines produces an annual energy production in a range of about 10,000 kWh and about 30,000 kWh.

23. An antenna assembly, the antenna assembly comprising:
a telecommunications structure;
one or more equipment cabinets;
a plurality of antennas mounted to the telecommunications structure, the plurality of antennas including one or more passive antennas and one or more active antennas; and
three wind turbines mounted to the telecommunications structure 120 degrees apart from each other by a mounting kit, the three wind turbines positioned on the telecommunications structure a distance below the plurality of antennas.

24. The antenna assembly according to Claim 23, wherein the one or more equipment cabinets include a cabinet for radios, a cabinet for electrical grid equipment and/or a cabinet for wind turbine unit equipment.

25. The antenna assembly according to any one of Claims 23 or 24, wherein the distance of the three wind turbines below the plurality of antennas is in a range of between about 1 meter and about 2 meters.

26. The antenna assembly according to any one of Claims 23-25, wherein the three wind turbines are mounted to the telecommunications structure a distance in a range of between about 10 meters and about 30 meters above a ground level.

27. The antenna assembly according to any one of Claims 23-26, wherein the telecommunications structure is a monopole.

28. The antenna assembly according to Claim 27, wherein the mounting kit includes a bracket system comprising a pair of ring mounts and a pair of offset members for each of the wind turbines, each pair of offset members extending outwardly from the ring mounts and configured to have a respective wind turbine secured thereto.

29. The antenna assembly according to Claim 28, wherein the bracket system further comprises one or more cross-support members coupled to and extending between the respective pairs of offset members.

30. The antenna assembly according to any one of Claims 28 or 29, wherein the bracket system further comprises one or more additional support members coupled to an extending between the monopole and a respective offset member and/or a base member of a respective wind turbine.

31. The antenna assembly according to any one of Claims 23-26, wherein the telecommunications structure is lattice antenna tower.

32. The antenna assembly according to Claim 31, wherein the mounting kit comprises a plurality of bracket systems, each bracket system comprising an upper clamping assembly, a lower clamping assembly, an offset member coupled to and extending outwardly from the upper clamping assembly, a brace member coupled to an extending outwardly from the lower clamping assembly, and a mount plate coupled the offset member and configured to have a respective wind turbine mounted and secured thereto.

33. The antenna assembly according to any one of Claims 23-32, wherein the mounting kit comprises a platform assembly or one or more foot-rests.

34. The antenna assembly according to Claim 33, wherein the platform assembly is secured to the telecommunications structure via ring mount, the platform assembly comprises:

- a plurality of offset members that extend radially outwardly from the ring mount,
- one or more lower auxiliary support members coupled to an opposing end of each offset member,
- a lower horizontal pipe member extending between each pair of lower auxiliary support members;
- an upper horizontal pipe member extending parallel to each respective lower horizontal pipe member and is coupled together via a plurality of vertical pipe members;
- one or more upper auxiliary support members that are coupled to and extend between adjacent upper horizontal pipe members; and

one or more grating walkways coupled to the offset members, lower auxiliary support members, and lower horizontal pipe members.

35. The antenna assembly according to Claim 34, wherein the mounting kit includes a bracket system comprising a plurality of vertical support members that are coupled to and extend between respective upper and lower auxiliary support members, a mounting plate secured to corresponding upper auxiliary support members and configured to have a wind turbine mounted and secured thereto, and a brace member that is coupled to and extends between each offset member of the platform assembly and an upper auxiliary support member.

36. The antenna assembly according to any one of Claims 23-35, wherein the mounting kit comprises one or more fall-arrest securing brackets.

37. The antenna assembly according to any one of Claims 23-36, further comprising a connection system, the connection system comprising a turbine controller, an AC/DC rectification unit, and a battery or radio load.

38. The antenna assembly according to Claim 37, wherein the connection system further comprises an optional battery having a smart switch, a second AC/DC rectification unit and/or DC/AC inversion unit, and a battery system.

39. An antenna assembly, the antenna assembly comprising:
a monopole;
a plurality of antennas mounted to the monopole; and
three wind turbines mounted to the monopole a distance below the plurality of antennas by a mounting kit,
wherein the mounting kit includes a bracket system comprising a pair of ring mounts and a pair of offset members for each of the wind turbines, each pair of offset members extending outwardly from the ring mounts and configured to have a respective wind turbine secured thereto.

40. The antenna assembly according to Claim 39, further comprising one or more equipment cabinets, wherein the one or more equipment cabinets include a cabinet for radios, a cabinet for electrical grid equipment and/or a cabinet for wind turbine unit equipment.

41. The antenna assembly according to any one of Claims 39 or 40, wherein the plurality of antennas include one or more passive antennas and/or one or more active antennas.

42. The antenna assembly according to any one of Claims 39-41, wherein the distance of the three wind turbines below the plurality of antennas is in a range of between about 1 meter and about 2 meters.

43. The antenna assembly according to any one of Claims 39-42, wherein the three wind turbines are mounted to the monopole a distance in a range of between about 10 meters and about 30 meters above a ground level.

44. The antenna assembly according to any one of Claims 39-43, wherein the three wind turbines have 120 degrees of separation between each other when mounted to the monopole.

45. The antenna assembly according to any one of Claims 39-44, wherein the bracket system further comprises one or more cross-support members coupled to and extending between the respective pairs of offset members.

46. The antenna assembly according to Claim 45, wherein the bracket system further comprises one or more additional support members coupled to an extending between the monopole and a respective offset member and/or a base member of a respective wind turbine.

47. The antenna assembly according to any one of Claims 39-46, wherein the mounting kit comprises a platform assembly or one or more foot-rests.

48. The antenna assembly according to Claim 47, wherein the platform assembly is secured to the telecommunications structure via ring mount, the platform assembly comprises:

a plurality of offset members that extend radially outwardly from the ring mount,
one or more lower auxiliary support members coupled to an opposing end of each offset member,

a lower horizontal pipe member extending between each pair of lower auxiliary support members;

an upper horizontal pipe member extending parallel to each respective lower horizontal pipe member and is coupled together via a plurality of vertical pipe members;

one or more upper auxiliary support members that are coupled to and extend between adjacent upper horizontal pipe members; and

one or more grating walkways coupled to the offset members, lower auxiliary support members, and lower horizontal pipe members.

49. The antenna assembly according to Claim 48, wherein the mounting kit includes a bracket system comprising a plurality of vertical support members that are coupled to and extend between respective upper and lower auxiliary support members, a mounting plate secured to corresponding upper auxiliary support members and configured to have a wind turbine mounted and secured thereto, and a brace member that is coupled to and extends between each offset member of the platform assembly and an upper auxiliary support member.

50. The antenna assembly according to any one of Claims 39-49, wherein the mounting kit comprises one or more fall-arrest securing brackets.

51. The antenna assembly according to any one of Claims 39-50, further comprising a connection system, the connection system comprising a turbine controller, an AC/DC rectification unit, and a battery or radio load.

52. The antenna assembly according to Claim 51, wherein the connection system further comprises an optional battery having a smart switch, a second AC/DC rectification unit and/or DC/AC inversion unit, and a battery system.

53. An antenna assembly, the antenna assembly comprising:
a lattice antenna tower;
a plurality of antennas mounted to the lattice antenna tower; and

one or more wind turbines mounted to the lattice antenna tower a distance below the plurality of antennas by a mounting kit,

wherein the mounting kit includes one or more bracket systems, each bracket system comprising an upper clamping assembly, a lower clamping assembly, an offset member coupled to and extending outwardly from the upper clamping assembly, a brace member coupled to an extending outwardly from the lower clamping assembly, and a mount plate coupled the offset member and configured to have a respective wind turbine mounted and secured thereto.

54. The antenna assembly according to Claim 53, further comprising one or more equipment cabinets, wherein the one or more equipment cabinets include a cabinet for radios, a cabinet for electrical grid equipment and/or a cabinet for wind turbine unit equipment.

55. The antenna assembly according to any one of Claims 53 or 54, wherein the plurality of antennas include one or more passive antennas and/or one or more active antennas.

56. The antenna assembly according to any one of Claims 53-55, wherein the distance of the one or more wind turbines below the plurality of antennas is in a range of between about 1 meter and about 2 meters.

57. The antenna assembly according to any one of Claims 53-56, wherein the one or more wind turbines are mounted to the lattice antenna tower a distance in a range of between about 10 meters and about 30 meters above a ground level.

58. The antenna assembly according to any one of Claims 53-57, wherein the lattice antenna tower has a triangular profile, and wherein three wind turbines are mounted to the lattice antenna tower and have 120 degrees of separation between each other.

59. The antenna assembly according to any one of Claims 53-57, wherein the lattice antenna tower has a square profile, and wherein four wind turbines are mounted to the lattice antenna tower and have 90 degrees of separation between each other.

60. The antenna assembly according to any one of Claims 53-59, wherein the mounting kit further comprises a platform assembly or one or more foot-rests.

61. The antenna assembly according to Claim 60, wherein the platform assembly is secured to the telecommunications structure via ring mount, the platform assembly comprises:

- a plurality of offset members that extend radially outwardly from the ring mount,
- one or more lower auxiliary support members coupled to an opposing end of each offset member,
- a lower horizontal pipe member extending between each pair of lower auxiliary support members;
- an upper horizontal pipe member extending parallel to each respective lower horizontal pipe member and is coupled together via a plurality of vertical pipe members;
- one or more upper auxiliary support members that are coupled to and extend between adjacent upper horizontal pipe members; and
- one or more grating walkways coupled to the offset members, lower auxiliary support members, and lower horizontal pipe members.

62. The antenna assembly according to Claim 61, wherein the mounting kit includes a bracket system comprising a plurality of vertical support members that are coupled to and extend between respective upper and lower auxiliary support members, a mounting plate secured to corresponding upper auxiliary support members and configured to have a wind turbine mounted and secured thereto, and a brace member that is coupled to and extends between each offset member of the platform assembly and an upper auxiliary support member.

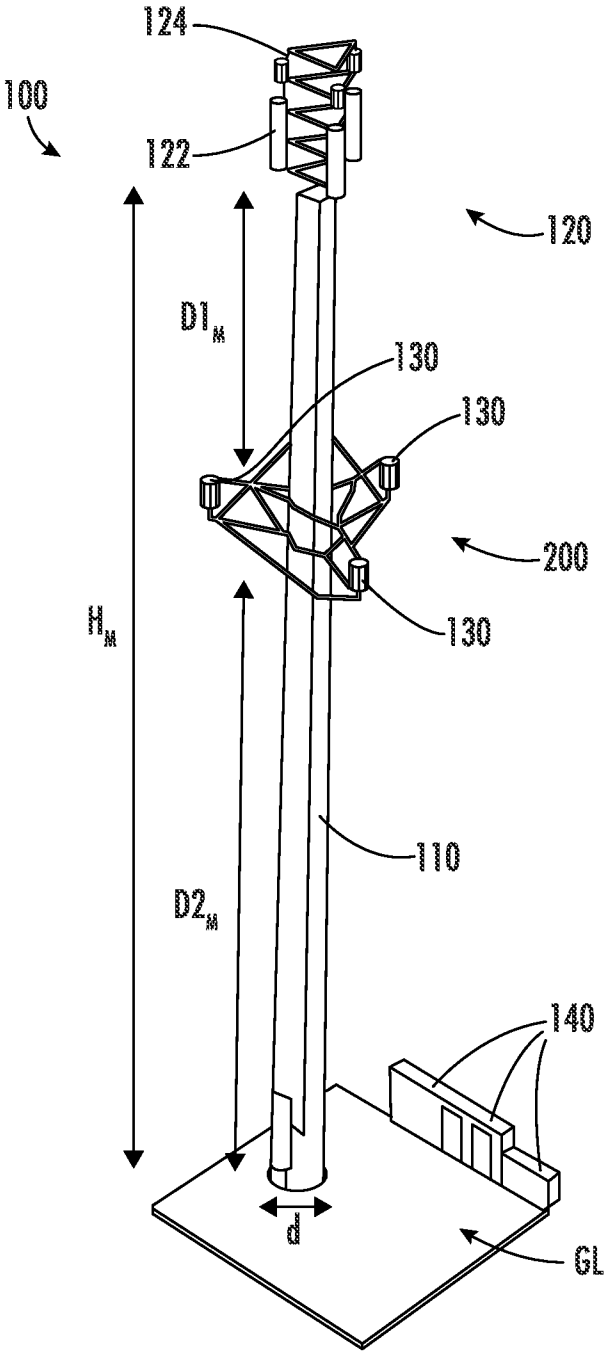


FIG. 1

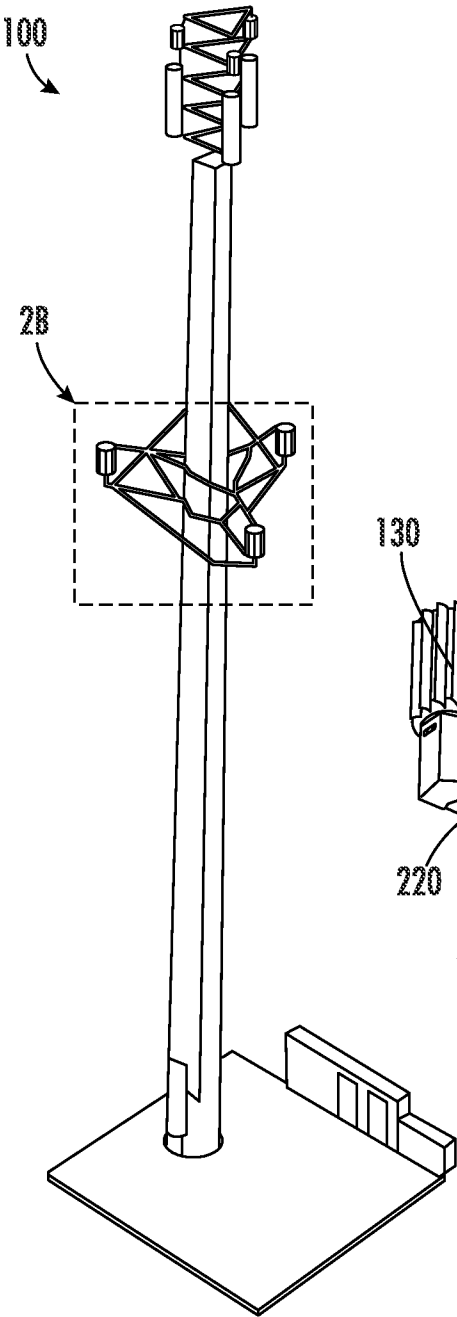


FIG. 2A

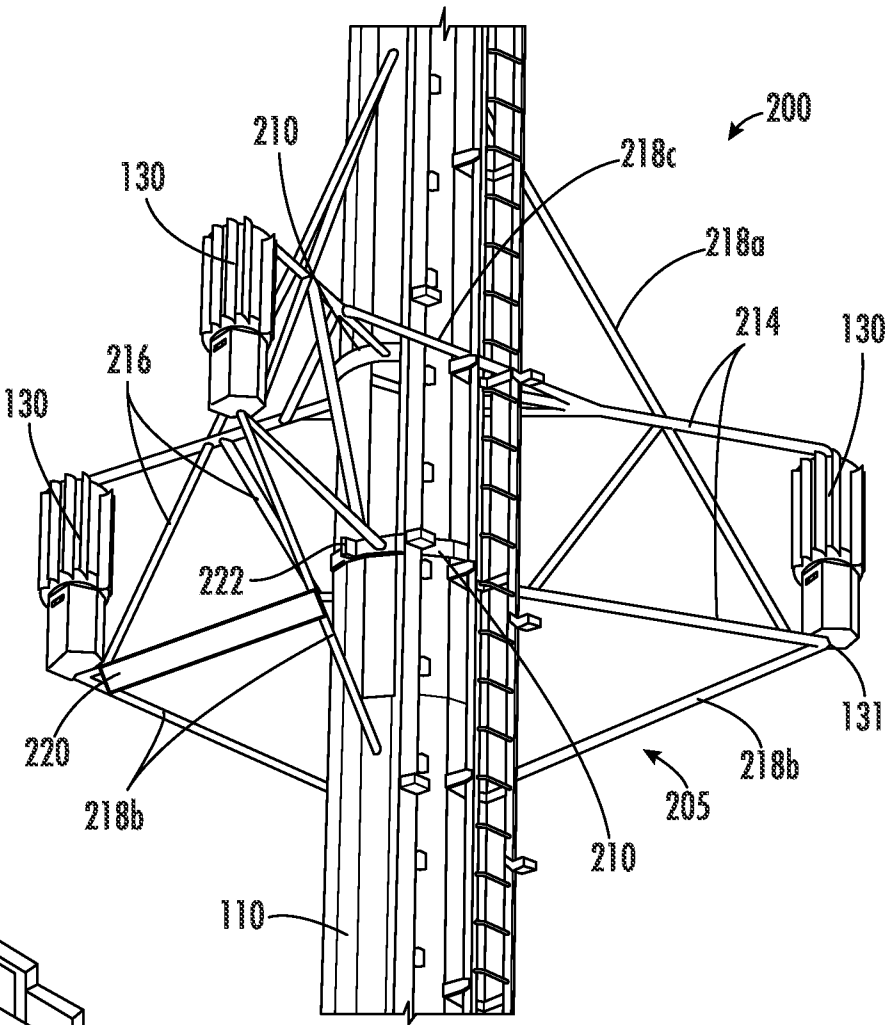
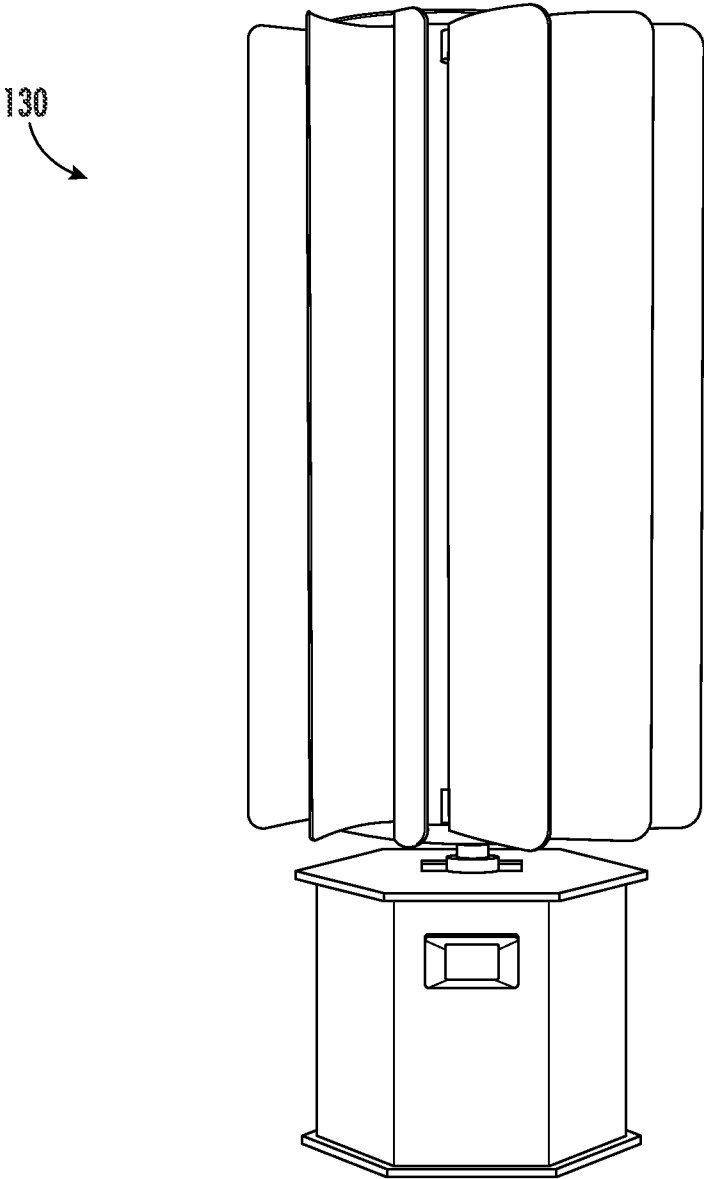


FIG. 2B



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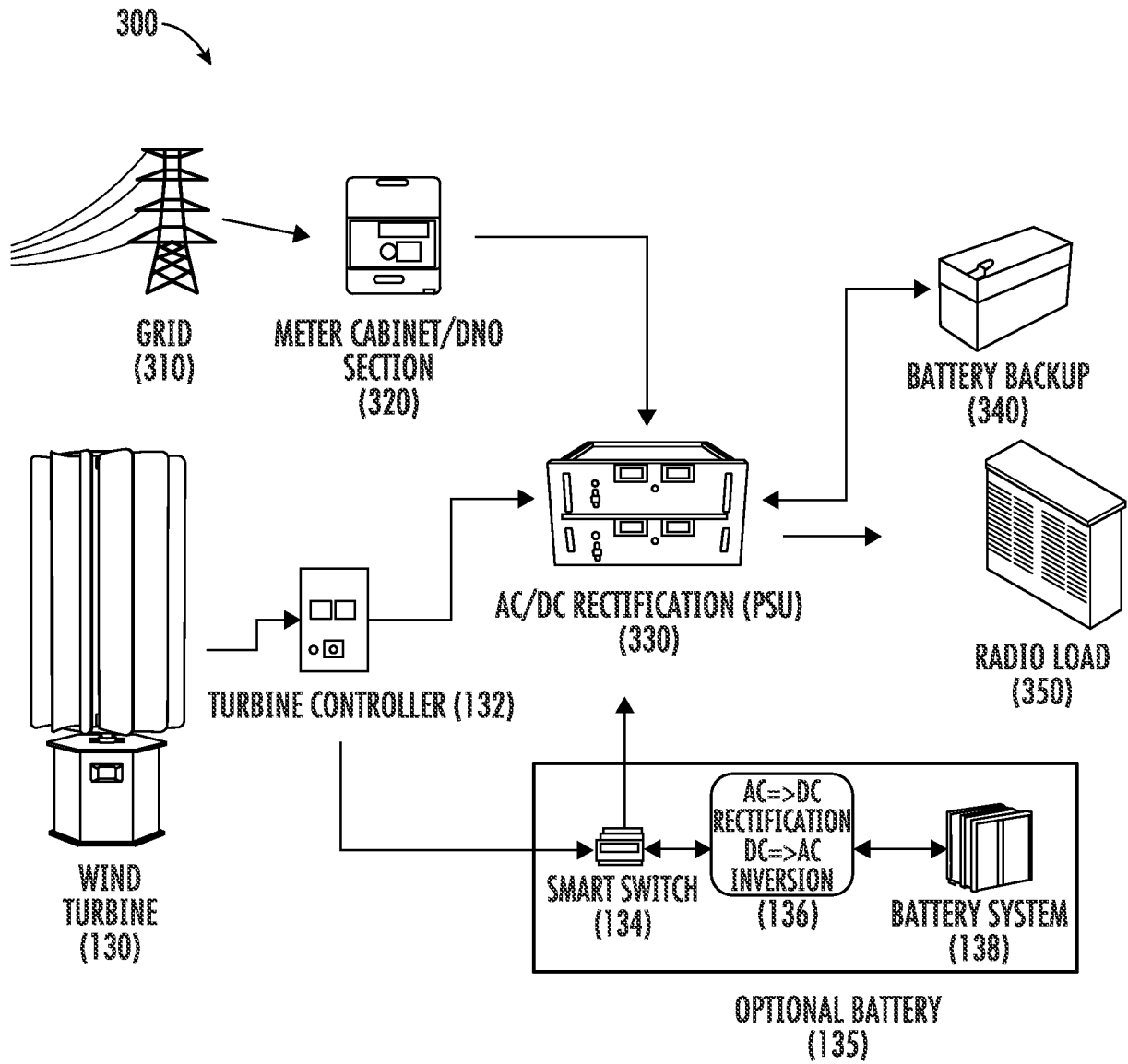


FIG. 4

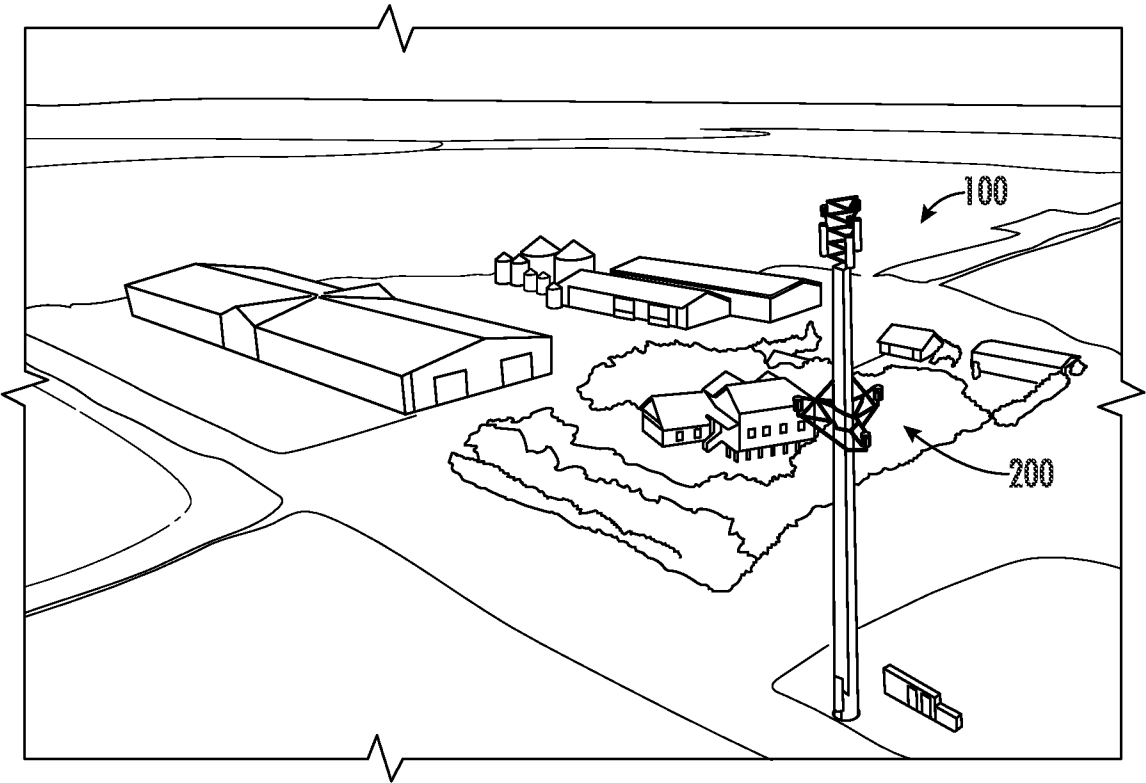
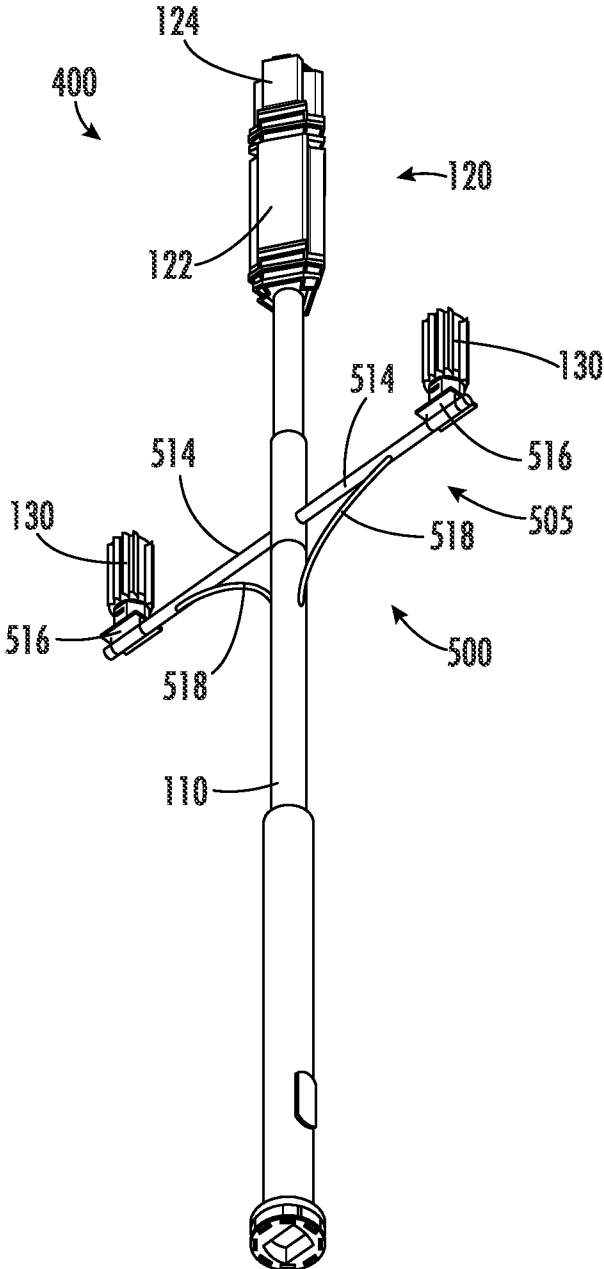
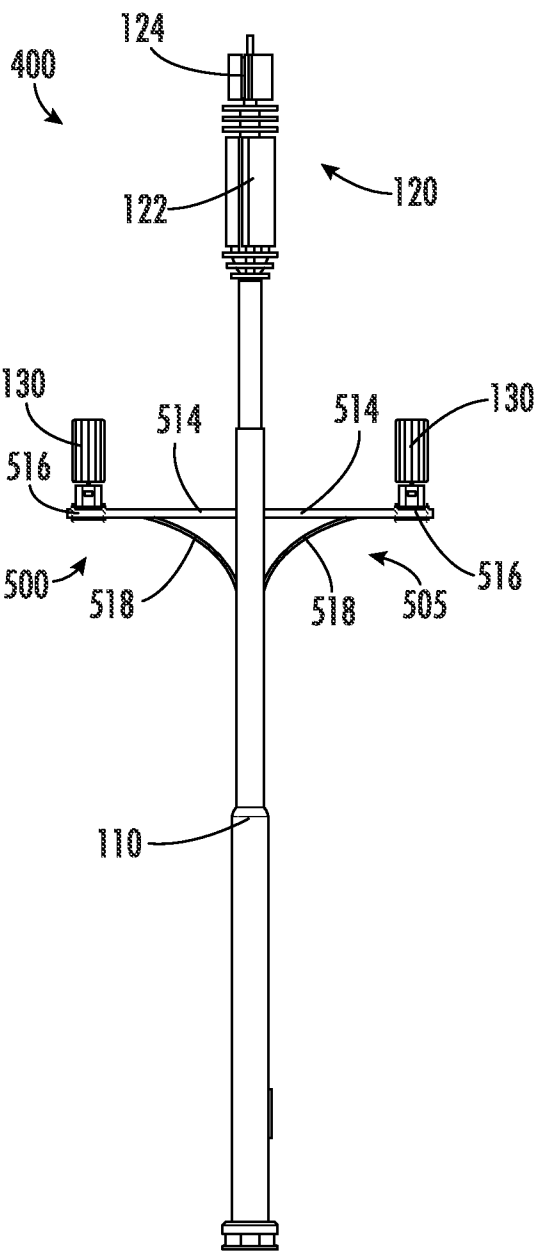
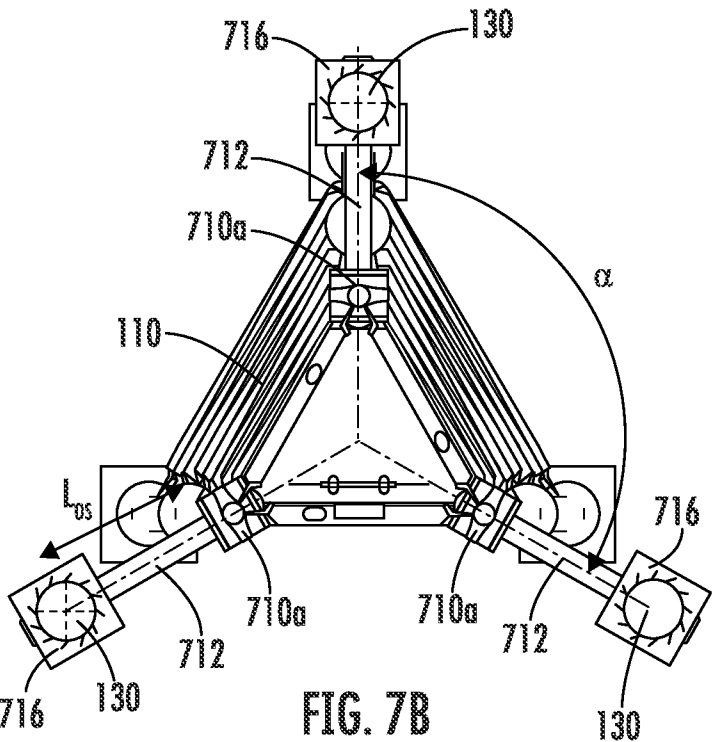
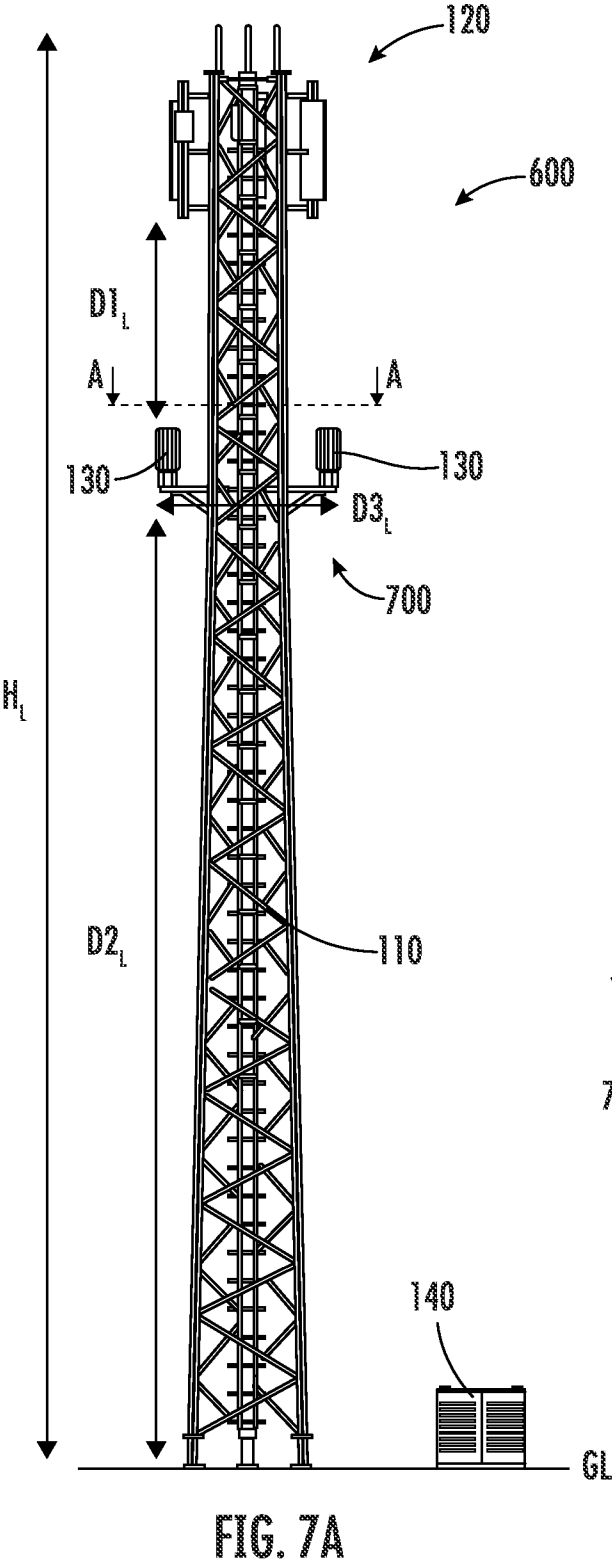


FIG. 5





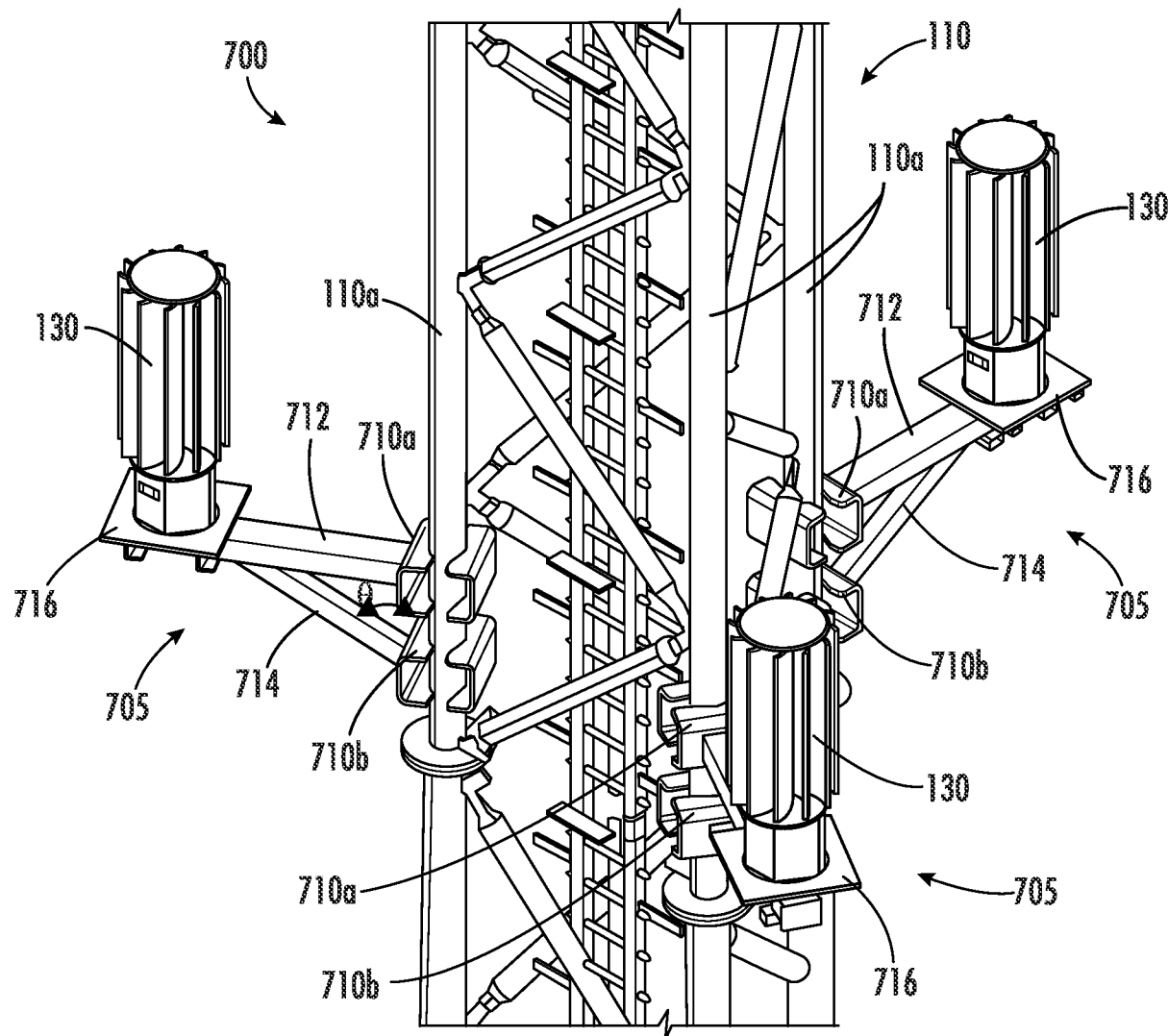


FIG. 7C

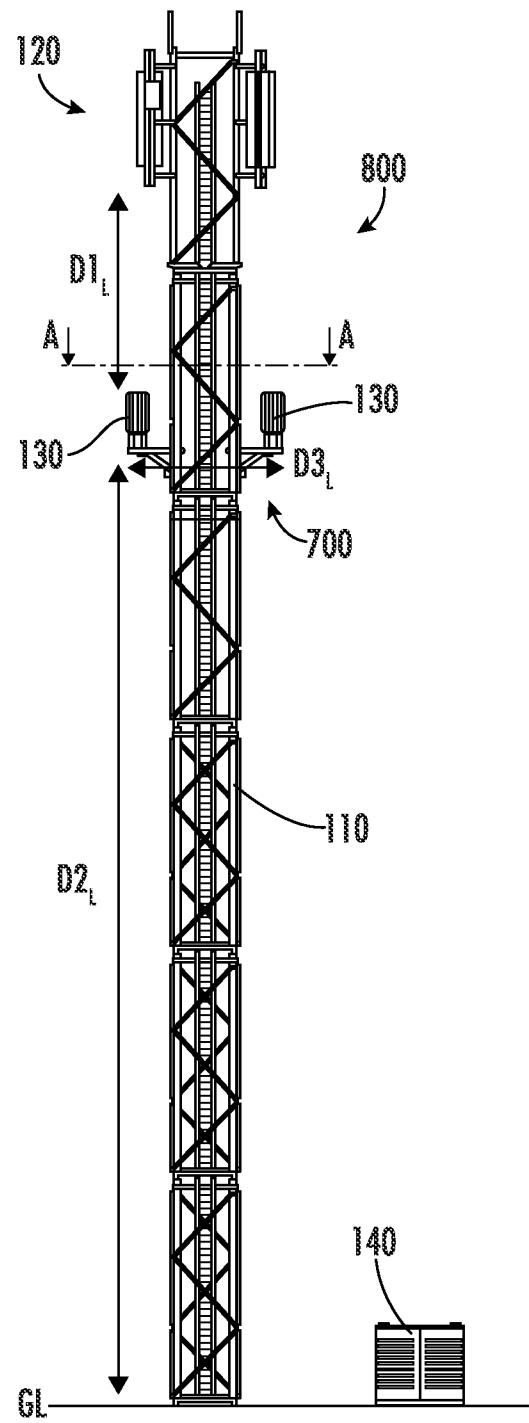


FIG. 8A

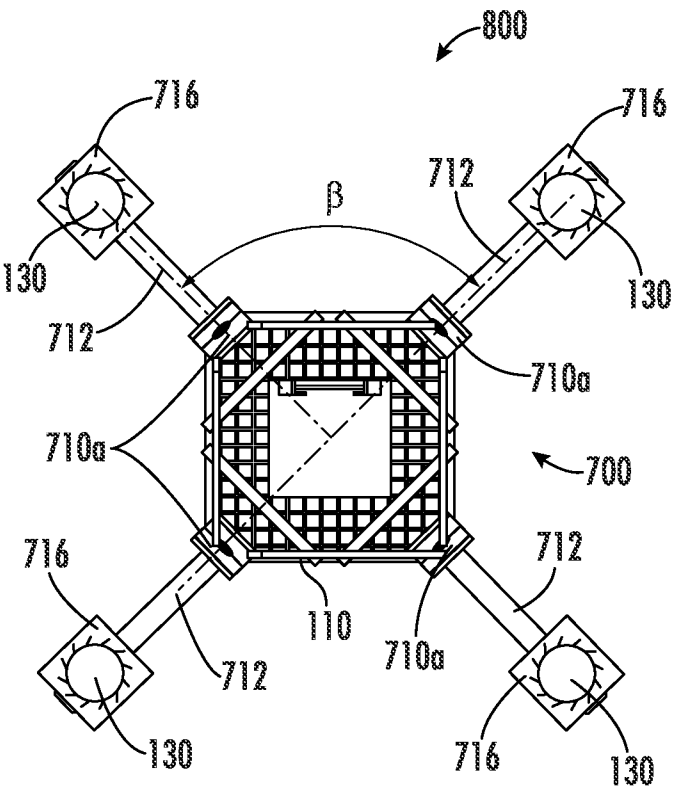


FIG. 8B

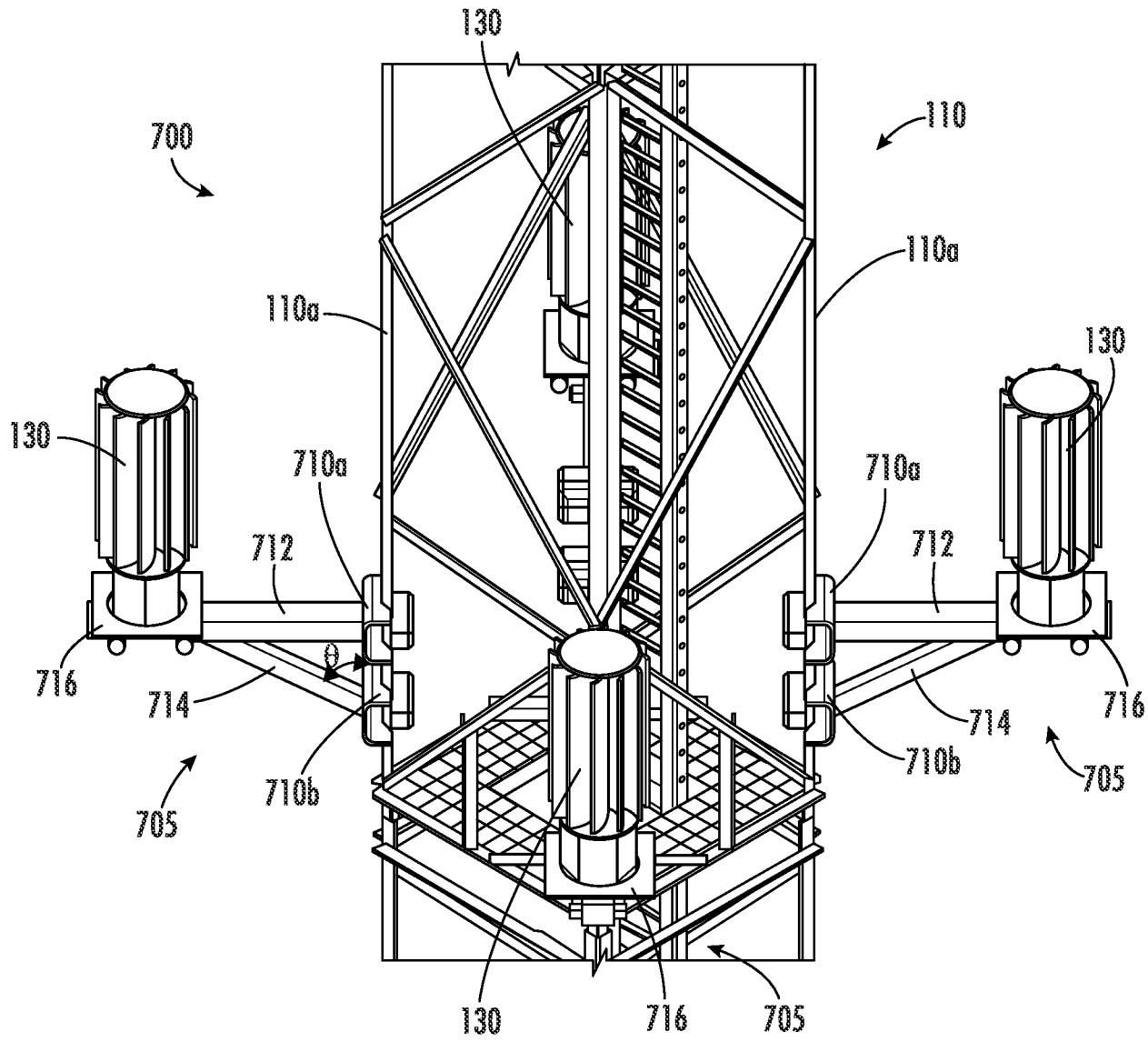


FIG. 8C

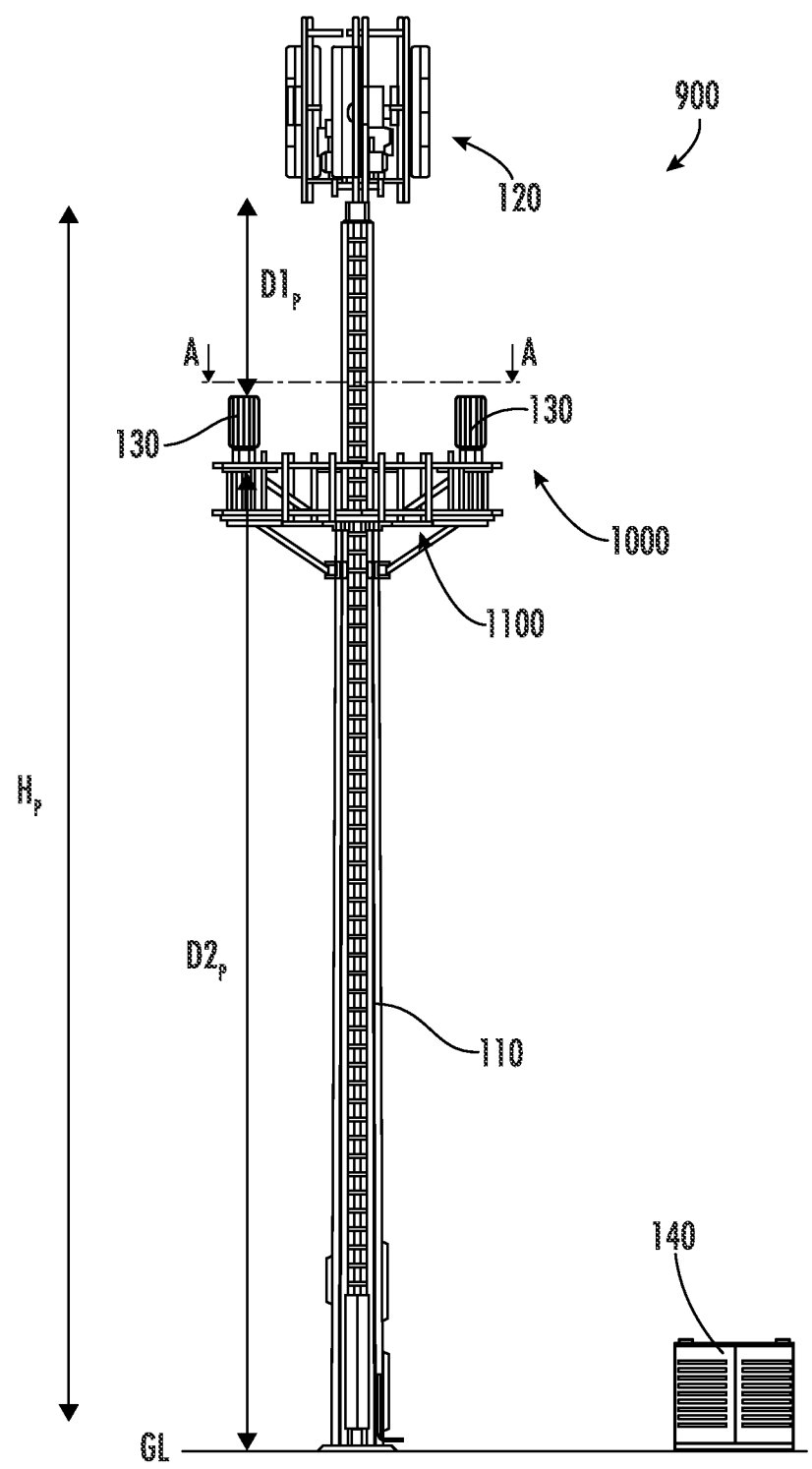


FIG. 9A

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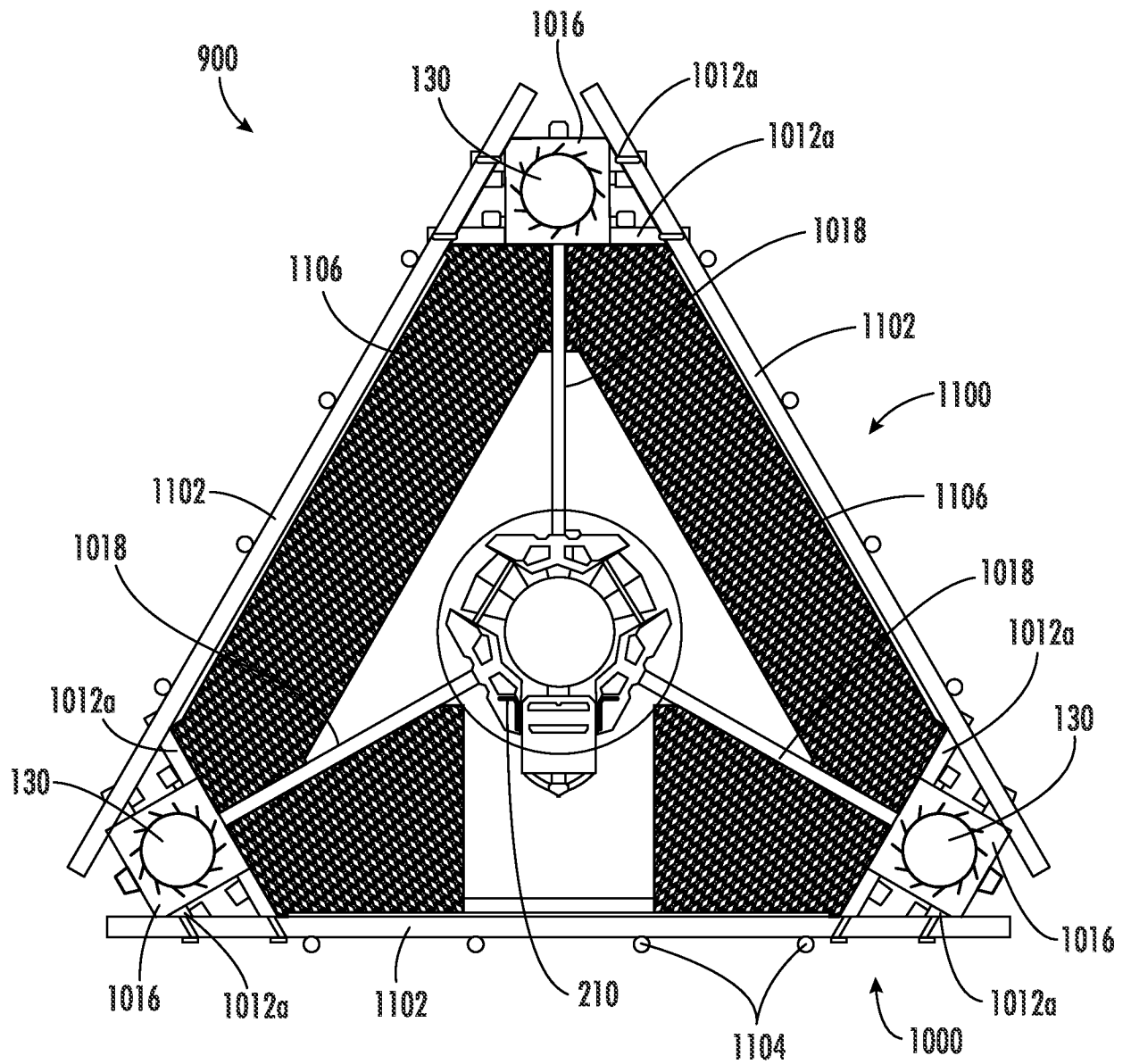
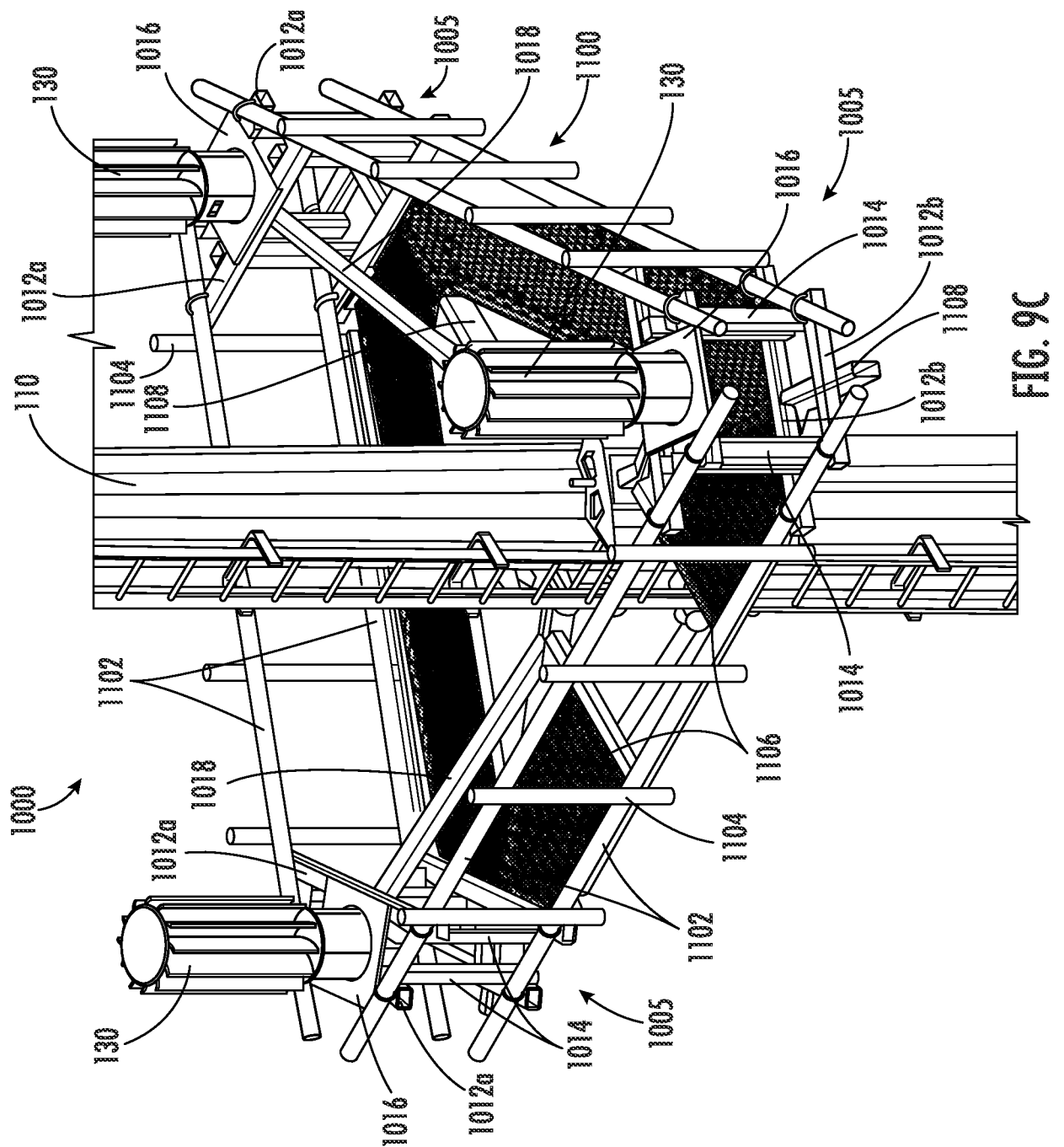


FIG. 9B



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 24/12309

A. CLASSIFICATION OF SUBJECT MATTER

IPC - INV. H01Q 1/22, F03D 9/43, F03D 13/20 (2024.01)

ADD. F03D 80/00, H01Q 1/44, E04H 12/00 (2024.01)

CPC - INV. H01Q 1/1242, F03D 9/43, H01Q 1/246, F03D 13/2005, F03D 13/201, F03D 13/203

ADD. H01Q 21/205, F03D 13/20, F03D 80/00, F05B 2240/913, F05B 2240/912, F05B 2240/9121

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

See Search History document

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

See Search History document

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

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2009/0224554 A1 (Flynn) 10 September 2009 (10.09.2009) entire document, especially: fig 3c, 3d, 4a, 4b, para [0004], [0005], [0025], [0026], [0027]	1
---		2-4
Y		

A		23-25, 39-41, 53-55
Y	US 2011/0177844 A1 (Lowas, III) 21 July 2011 (21.07.2011) entire document, especially: Abstract, fig 4, para [0056], [0058]	2-4
---		23-25
A		
A	US 2011/0148116 A1 (Halstead) 23 June 2011 (23.06.2011) entire document	1-4, 23-25, 39-41, 53-55
A	US 2004/0232703 A1 (Michael) 25 November 2004 (25.11.2004) entire document	1-4, 23-25, 39-41, 53-55
A	US 2013/0272875 A1 (Sieber et al.) 17 October 2013 (17.10.2013) entire document	1-4, 23-25, 39-41, 53-55

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

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

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search

16 April 2024 (16.04.2024)

Date of mailing of the international search report

MAY 01 2024

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents

P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-273-8300

Authorized officer

Kari Rodriguez

Telephone No. PCT Helpdesk: 571-272-4300

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 24/12309

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

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

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☒ Claims Nos.: 5-22, 26-38, 42-52, 56-62
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

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

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

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

Remark on Protest

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