



(51) International Patent Classification:

E02D 27/42 (2006.01) E04H 12/34 (2006.01)

E02D 27/02 (2006.01)

(21) International Application Number:

PCT/CA2017/050433

(22) International Filing Date:

10 April 2017 (10.04.2017)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

62/328,864 28 April 2016 (28.04.2016) US

(71) Applicant: VOYAGEUR INTERNET INC. [CA/CA];
323 Edwin Street, Winnipeg, Manitoba R3B 0Y7 (CA).

(72) Inventor: KLAUSE, Jeffrey J.; 180 George Marshall
Way, Winnipeg, Manitoba R3C 5C9 (CA).

(74) Agent: ADE & COMPANY INC.; 2157 Henderson High-
way, Winnipeg, Manitoba R2G 1P9 (CA).

(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ,
CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO,
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN,
HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KH, KN, KP, KR,

KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG,
MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM,
PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC,
SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR,
TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: TOWER ASSEMBLY WITH BALLAST RECEIVING BASE

(57) Abstract: A support tower, for example for supporting telecommunications equipment thereon, is mounted on a tower base having radially projecting frame members and ballast receptacles at the outer ends of each frame member to receive ballast material to support the tower in a foundationless manner on a ground surface. A coupler is provided for supporting the support tower relative to the radial frame members of the base such that the support tower is pivotal about a horizontal axis between an assembly position along the ground and a raised position. Lifting equipment can thus be connected directly between the support tower and the tower base without the need for auxiliary lifting equipment such as a crane or boom truck, for raising of the tower on site in a low cost manner.

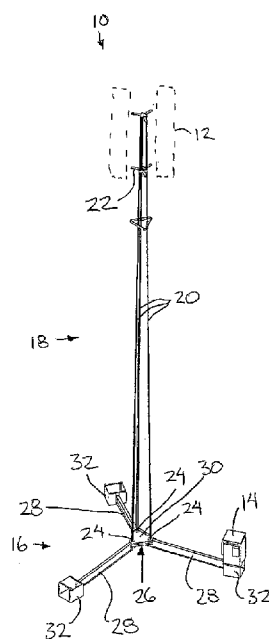


FIG. 1



TOWER ASSEMBLY WITH BALLAST RECEIVING BASE

This application claims priority benefit to U.S. provisional application Serial No. 62/328,864, filed April 28, 2016.

FIELD OF THE INVENTION

5 The present invention relates to a tower assembly, for example a communications tower supporting an antenna thereon, in which a base of the tower is self-supported on a ground surface using ballast material supported on the base, and more particularly the present invention relates to a tower assembly having a base supporting a plurality of ballast receptacles thereon spaced radially outward from a
10 central tower coupler that pivotally supports the bottom end of the tower frame thereon such that the tower frame can be erected using lifting equipment operatively connected between the tower base and the tower frame.

BACKGROUND

 Towers structures are commonly used for supporting a variety equipment
15 thereon including communications antennas, lighting, signage, wind turbines, solar panels, and various transmission devices for example. To maintain the tower supported in a stable upright configuration, it is common to employ a foundation penetrated into the ground to resist overturning forces. The foundation typically includes one or more types of piles penetrated into the ground including concrete piles, screw piles and the
20 like for example. Because of the various conditions of the ground into which a foundation must be penetrating, the design requirements of the foundation may vary considerably between different installation sites which can involve costly and time consuming design requirements for each installation site. Even when a standard foundation design is employed for use in different site conditions, the installation of piles
25 including pouring of concrete can be costly and time consuming, particularly in remote

sites.

US patent applications 2014/0059957 by Stark and US 2015/0197957 by Anderson, each disclose an example of a tower foundation structure which does not require penetration into the ground so as to be more suited to a variety of different installation conditions. In each instance a large platform is required to support ballast material thereon onto which the tower must be subsequently erected. The location of the ballast receiving platform directly adjacent to the base of the tower requires a very large amount of ballast to be supported thereon to resist overturning forces. Furthermore, the raising of the tower onto the platform typically requires use of costly lifting equipment such as a crane or boom truck which is costly and may trouble accessing to the tower site in some remote locations.

SUMMARY OF THE INVENTION

According to one aspect of the invention there is provided a tower assembly comprising:

15 a support tower; and

a tower base for being supported on a ground surface, the tower base comprising:

i) a tower coupler for supporting a bottom end of the support tower thereon such that the support tower extends longitudinally upward from the tower base;

20 ii) a plurality of frame members extending radially outward from the tower coupler; and

iii) a ballast receptacle supported on each frame member at a location spaced radially outward from the tower coupler for receiving ballast material therein.

25 The arrangement of radially oriented frame members extending between

a central tower coupler and respective ballast receptacles allows for a more efficient use of ballast material to support the tower in a foundationless manner on a ground surface. The arrangement of the frame members also provides a frame assembly which can be readily assembled from modular units for low cost and efficient transport
5 and subsequent assembly of the tower on site.

When the support tower comprises three columns arranged in a triangular configuration relative to one another, preferably the plurality of frame members of the tower base comprise three frame member extending radially outward from the three columns of the support tower respectively.

10 Preferably the tower base is a modular assembly in which each frame member is connected between the tower coupler and the respective ballast receptacle using threaded fasteners such that each frame member is readily separable from the tower coupler and the respective ballast receptacle.

When the tower assembly further comprises a control box housing
15 telecommunications equipment therein connected to an antenna on the support tower, the control box is preferably supported at a distal end of one of the frame members opposite from the tower coupler.

Preferably the tower base is adapted to be supported on the ground surface in a non-penetrating manner. Accordingly, when using a plurality of guy-wires
20 connected between the support tower and the tower base, preferably these guy-wires are the only guy-wires connected to the support tower.

The tower coupler is preferably pivotally mounted on the frame assembly such that the support tower is pivotal about a generally horizontal axis between an assembly position in which the support tower extends longitudinally outward from the
25 tower base along the ground surface and a raised position in which the support tower

extends longitudinally upward from the tower base.

According to a second aspect of the present invention there is provided a tower assembly comprising:

a support tower; and

5 a tower base comprising:

i) a plurality of frame members defining a frame assembly for being supported on a ground surface;

ii) at least one ballast receptacle supported on the frame assembly for receiving ballast material therein; and

10 iii) a tower coupler supported on the frame assembly for supporting a bottom end of the support tower thereon, the tower coupler being pivotally mounted on the frame assembly such that the support tower is pivotal about a generally horizontal pivot axis between an assembly position in which the support tower extends longitudinally outward from the tower base along the ground surface and a raised
15 position in which the support tower extends longitudinally upward from the tower base.

According to a further aspect of the present invention there is provided a method of erecting a tower assembly comprising:

providing a support tower;

20 providing a tower base including i) a frame assembly, ii) at least one ballast receptacle supported on the frame assembly, and iii) a tower coupler supported on the frame assembly;

supporting the frame assembly on a ground surface;

filling said at least one ballast receptacle with ballast material;

25 coupling a bottom end of the support tower to the tower coupler of the tower base such that the support tower is pivotal about a generally horizontal pivot axis

between an assembly position in which the support tower extends longitudinally outward from the tower base along the ground surface and a raised position in which the support tower extends longitudinally upward from the tower base;

5 pivotally raising the support tower from the assembly position to the raised position; and
fixing the support tower to the tower base in the raised position.

The pivotal connection of the support tower to the tower base allows lifting equipment to be connected directly between the support tower and the tower base without the need for auxiliary lifting equipment such as a crane or boom truck being
10 required. The assembly and raising of the tower on site can thus be accomplished efficiently and at low cost.

When the plurality of frame members comprise three frame members extending radially outwardly from the tower coupler to respective ballast receptacles spaced radially outward from the tower coupler at evenly spaced positions in a
15 circumferential direction about the tower coupler, preferably the tower coupler supports the support tower to extend from the tower coupler diametrically opposite from one of the three frame members in the assembly position.

The support tower may be raised using an additional lifting kit which is temporarily attached to the tower assembly during lifting. The lifting kit typically includes
20 a lifting strut supported relative to the support tower to extend radially outward from a longitudinal axis of the support tower, and a winch for lifting the support tower from the assembly position to the raised position. Preferably a winch cable of the winch is operatively connected between the lifting strut and the support tower.

Preferably the lifting strut is supported to extend radially outward from the
25 pivot axis of the tower coupler.

Typically, a tension member, such as an additional cable, is supported under tension between the lifting strut (at a location where the winch cable is connected) and the support tower at a central location along a length of the support tower.

Once the support tower is erected into the raised position, the method preferably includes coupling threaded fasteners between the support tower and the tower base to fix the support tower to the tower base in the raised position.

Preferably the support tower is assembled from a plurality of modular tower sections in the assembly position of the support tower relative to the tower base prior to pivotally raising the support tower from the assembly position to the raised position.

One embodiment of the invention will now be described in conjunction with the accompanying drawings in which:

BRIEF DESCRIPTION OF THE DRAWINGS

- Figure 1 is a perspective view of the tower assembly;
- Figure 2 is a top plan view of the tower assembly;
- Figure 3 is a side elevational view along the line 3-3 of Figure 2;
- Figure 4 is a rear elevational view along the line 4-4 of Figure 2;
- Figure 5 is a perspective view of the tower base with the tower coupler shown in the assembly position of the tower, but with the tower shown removed;
- Figure 6 is a top plan view of the tower base in the assembly position;
- Figure 7 is a side elevational view of the tower base in the assembly position along the line 7-7 of Figure 6;
- Figure 8 is a rear elevational view of the tower base in the assembly position along the line 8-8 of Figure 6;
- Figure 9 is a perspective view of the tower base with the tower coupler

shown in the raised position of the tower, but with the tower shown removed;

Figure 10 is a side elevational view of the tower base in the raised position;

Figure 11 is a perspective view of a bottom side of the central frame portion of the tower base in the raised position of the tower, but with the tower shown removed;

Figure 12 is a bottom plan view of the central frame portion of the tower base in the raised position;

Figure 13 is a side elevational view of the central frame portion of the tower base in the raised position;

Figure 14 is a perspective view of the tower in the assembly position with the lifting kit supported thereon;

Figure 15 is a side elevational view of the tower in the assembly position with the lifting kit supported thereon; and

Figure 16 is a side elevational view of the tower with the lifting kit supported thereon in an intermediate position of the tower between the assembly position and the raised position.

In the drawings like characters of reference indicate corresponding parts in the different figures.

DETAILED DESCRIPTION

Referring to the accompanying figures there is illustrated a tower assembly generally indicated by reference numeral 10. The tower assembly is particularly suited for supporting various types of equipment in an elevated manner above a ground surface. In the illustrated embodiment, the tower is adapted for supporting a communication antenna 12 thereon and further includes a control box 14

housing electronic communications equipment therein which is connected to the antenna so as to enable communication among a plurality of towers to function as a wireless communications network.

5 The tower assembly 10 generally includes i) a tower base 16 for being supported on the ground surface, and ii) a support tower 18 including a tower frame which is elongate in a longitudinal direction between a bottom end for being supported on the tower base 16 and an opposing top end supporting a communication antenna 12 thereon.

10 The tower frame of the support tower comprises three columns 20 spanning the full height of the support tower in a triangular configuration relative to one another. The horizontal spacing between the columns is gradually reduced from the bottom end to the top end. A plurality of supporting struts (not shown) are interconnected between the columns 20 to create a trust structure of the tower frame. Suitable brackets 22 protrude radially outward from the support frame at vertically
15 spaced positions in proximity to the top end of the tower for supporting the communication antennas 12 thereon.

Each column 20 includes a foot plate 24 mounted at the bottom end thereof. The three foot plates 24 lie in a common plane perpendicular to the longitudinal axis of the support tower 18 and include fastener apertures therein for securement to
20 the tower base as described in further detail below.

The tower base 16 generally includes i) a frame assembly having a central frame portion 26 and three frame members 28 mounted two extend radially outward from the central frame portion at evenly spaced positions in the circumferential direction, ii) a tower coupler 30 supported on the central frame portion 26 to couple the
25 support tower to the frame assembly of the tower base, and iii) three ballast receptacles

32 supported at the outer ends of the three frame members 28 respectively for receiving ballast material therein.

The central frame portion 26 includes an upper support plate 34 which is generally triangular in shape so as to be similarly shaped and sized to the triangular pattern formed by the three foot plates 24 of the tower frame. Three mounting plates 36 extend vertically downwardly from each of the three corners of the triangular upper support plate 34 such that each mounting plate 36 is tangentially oriented relative to a central vertical axis of the upper support plate. More particularly each of the mounting plates 36 is perpendicular to the upper supporting plate and perpendicular to a radial axis extending from the central axis of the upper support plate.

A side wall 38 depends vertically downward from each of the three side edges of the upper support plate 34 such that each side wall 38 is connected between the respective adjacent pair of the mounting plates 36 at the corners of the triangular upper support plate 34. The side walls 38 extend downwardly by approximately half of the overall height of the mounting plates 36 at the corners of the upper support plate.

Additional structural support is provided by three brace plates 40 mounted below the upper support plate 34 in perpendicular relation to the upper support plate. Each brace plate 40 is joined to the other brace plates along an inner edge at the central axis of the upper support plate and extends radially outward towards an outer edge joined in perpendicular relation to the inner surface of a respective one of the mounting plates 36.

A lower plate 42 extends horizontally inward from a bottom end of each mounting plate 36 to be joined to the bottom edge of the corresponding brace plate 40 in proximity to the outer ends thereof for added structural support.

The three frame members 28 of the frame assembly of the tower base

each comprise an I-beam extending along the full length thereof between an inner end 44 and an outer end 46 of the beam. Each frame member thus comprises a top flange, a bottom flange, and a web connected between the top and bottom flanges in the usual manner of an I-beam. Each frame member further includes an end plate 48 connected
5 between the top and bottom flanges of the beam at each of the opposing inner and outer ends. The end plates 48 of each frame member are oriented transversely to the longitudinal direction of the respective frame member and are parallel to one another.

The end plates 48 at the inner end of each frame member are sized and shaped for mating abutment with a respective one of the mounting plates 36 of the
10 central frame portion. Fastener apertures are provided in the inner end plate in alignment with corresponding fastener apertures in the respective mounting plate 36 of the central frame portion to permit threaded fasteners to secure the frame members to the central frame portion in a modular manner which permits subsequent disassembly as may be desired.

15 The end plates are oriented non-perpendicularly to the longitudinal direction of the respective frame member such that bolting the inner end plate flat against the respective mounting plate of the central frame portion results in the longitudinal axis of the frame member extending radially outward at a downward slope from the inner end to the outer end of the frame member in the assembled configuration.

20 When all three frame members are assembled, the three ballast receptacles function as footings of the overall tower base for engaging the ground and the central frame portion is supported to be spaced above the ground relative to the elevation of the three ballast receptacles.

Each ballast receptacle 32 includes a rectangular floor 50 defining the
25 bottom of the receptacles which is suitable for abutment flat against an upper surface

of the ground. An inner end wall 52 extends perpendicularly upward from an inner edge of the rectangular floor which includes a pattern a bolt apertures therein for alignment with corresponding bolt apertures within the corresponding end plate 48 at the outer end of a respective one of the frame members of the tower base. The bolt apertures permit threaded fasteners to secure the frame members to the ballast receptacles respectively in a modular manner which permits subsequent disassembly as may be desired.

Each ballast receptacle 32 further includes two side walls 54 extending perpendicularly upward from opposing side edges of the rectangular floor 50 so as to be parallel and spaced apart from one another with the inner end wall being connected between inner edges of the two side walls respectively. A brace arm 56 is also connected between the two side walls 54 at an opposing outer end of the ballast receptacle at a location spaced above the floor 50 at the top edges of the two side walls. The top side of the ballast receptacle remains open to readily permit ballast material, for example rocks or concrete blocks and like to be inserted into the receptacle through the open top end. Similarly, the outer end of the receptacle, opposite the inner end wall fastened to the respective frame member, also remains open for ease of loading ballast material into the receptacle.

The tower coupler 30 comprises a pivot plate 58 which is generally triangular in shape and sized similarly to the upper support plate 34 of the central frame portion such that the pivot plate is suitably arranged for alignment with and flat engagement upon an upper surface of the upper supporting plate in a finished assembled configuration of the tower. The pivot plate 58 is coupled along one of the three edges of the triangular shape of the plate to a corresponding edge of the triangular upper support plate 34 by a hinge pin 60 which is horizontally oriented and parallel to

the corresponding side edges of the plates.

The pivot plate 58 further includes an upright flange 62 protruding perpendicularly upward from the plate when the plate is horizontally oriented along the edge of the pivot plate corresponding to the hinge coupling. The other two edges of the triangular pivot plate 58 include a depending flange 64 formed thereon which depends downwardly when the pivot plate 58 is horizontally oriented against the upper surface of the support plate 34. The pivot plate 58 of the tower coupler is slightly larger in dimension than the triangular support plate 34 to allow the depending flanges to extend downwardly alongside the outer sides of the side walls 38 of the central frame portion of the base.

The hinge pin 60 is coupled to the pivot plate 58 by three hinge plates which are axially spaced apart at fixed positions along the outer side of the upright flange 62 and three corresponding hinge plates which are axially spaced apart along the corresponding edge of the upper support plate 34 in fixed relation thereto. The hinge pin 60 which defines the pivot axis of the pivot plate relative to the upper support plate extends through corresponding pivot apertures in each of the hinge plates.

Each foot plate 24 at the bottom of the tower frame includes three fastener apertures therein which are suitably aligned with corresponding fastener apertures in the pivot plate 58. Suitable threaded fasteners can thus be used to bolt each foot plate to the pivot plate 58 of the tower coupler such that the tower is pivotal together with the pivot plate 58 about the pivot axis of the hinge pin 60 between an assembly position in which the pivot plate extends upward from the pivot axis so that the tower coupled thereto extends generally horizontally along the ground surface, and a raised position in which the pivot plate 58 is generally horizontally oriented against the upper surface of the upper support plate 34 so that the tower extends longitudinally upward in

alignment with the central vertical axis of the central frame portion of the tower base.

The upper support plate 34 includes one fastener aperture 66 in alignment with the outermost one of the three fastener apertures for each foot plate 24 of the tower frame. A common threaded fastener is thus adapted to be received through each
5 fastener aperture 66 for collectively fastening together the upper support plate 34, the pivot plate 58, and a respective one of the foot plates 24.

The upper support plate 34 also includes two access holes 68 associated with each foot plate 24 such that the two access holes are aligned with the two other fastener apertures of the respective foot plate 24 which do not align with a
10 corresponding fastener aperture 66 in the upper plate. The access holes 68 are larger in dimension than the heads of the fasteners used at the other fastener locations of the foot plate. In this manner suitable threaded fasteners can be used to secure the foot plates 24 to the pivot plate 58 while the pivot plate remains in the assembly position of the tower. As the tower is subsequently raised, the threaded fasteners which are
15 already used to secure the foot plates 24 to the pivot plate 58 are not in interference with the upper plate by being axially aligned with and received through the corresponding access holes 68.

The assembly of the tower described herein typically involves transporting the central frame portion 26 of the tower base, the frame members 28 of the tower base,
20 the ballast receptacles 32, and various modular sections of the support tower frame as separate modular components to the site of the tower. The tower base is initially assembled using threaded fasteners to connect the frame members 28 between the central frame portion 26 and respective ones of the ballast receptacles 32. The pivot plate of the tower coupler 30 on the tower base can then be pivoted into an upright
25 orientation corresponding to the assembly position of the tower so that the modular

tower sections can be assembled to one another to form the tower frame together with the bottom end of the tower frame being fastened to the pivot plate of the tower coupler.

Prior to pivotally raising the support tower, ballast material is placed in each of the ballast receptacles. Suitable lifting equipment can then be used to raise the tower into the raised position. Once in the raised position, the third threaded fastener associated with each foot plate 24 is used to fasten the foot plates through the pivot plate 58 to the corresponding aperture 66 of the underlying upper support plate 34 of the central frame portion of the tower base to fix the tower frame relative to the tower base in the raised position.

In the preferred embodiment, the lifting equipment used to raise the tower comprises a lifting kit which is temporarily attached to the tower assembly only during lifting of the tower from the assembly position to the raised position. The lifting kit generally includes a lifting strut 70 comprised of two arms 72 which are pivotally connected at respective inner ends of the arms to axially opposed ends of the hinge pin 60 such that the lifting strut is pivotal about the hinge pin together with the tower frame. Opposing outer ends of the two arms 72 are coupled to one another. A tension member 74, for example a cable, is connected under tension between the outer ends of the two arms 72 of the lifting strut 70 and the tower frame at a central location along the length of the tower frame between the top and bottom ends thereof.

A winch 76 is operatively connected between the tower base and the support tower through the lifting strut 70. More particularly the winch 76 includes a winch cable 78 having a first end secured to a drum onto which the cable is arranged to be wound and which is supported on the frame member 28 of the tower base that is diametrically opposite from the tower frame in the assembly position relative to a central axis of the central frame portion. An opposing second end of the winch cable is secured

to the outer end of the lifting strut. The lifting strut is thus supported to extend generally radially outward from the longitudinal axis of the tower frame, and more particularly to extend radially outward from the pivot axis of the hinge pin.

The winch is secured to the corresponding frame member 28 at the
5 location of the connection to the ballast receptacle towards the outer end of the frame member. A radial length of the strut is near to the length of the frame member such that the outer end of the strut substantially aligns with the outer end of the frame member locating the winch thereon. Winding the cable 78 onto the drum of the winch causes the outer end of the lifting strut to be drawn towards the outer end of the corresponding
10 frame member supporting the winch thereon while the tower frame pivots together with the strut by the tension through the tension member 74 until the tower is erected. Once erected, the final fasteners are inserted through the corresponding fastener apertures 66 in the upper support plate 34 to fix the tower frame in the raised position as described above. The lifting strut and winch can be removed once the tower is fixed in the raised
15 position.

Since various modifications can be made in my invention as herein above described, and many apparently widely different embodiments of same made, it is intended that all matter contained in the accompanying specification shall be interpreted as illustrative only and not in a limiting sense.

CLAIMS:

1. A tower assembly comprising:
a support tower; and
a tower base for being supported on a ground surface, the tower base
5 comprising:
 - i) a tower coupler for supporting a bottom end of the support tower thereon such that the support tower extends longitudinally upward from the tower base;
 - ii) a plurality of frame members extending radially outward from the tower coupler; and
 - 10 iii) a ballast receptacle supported on each frame member at a location spaced radially outward from the tower coupler for receiving ballast material therein.
2. The tower assembly according to claim 1 wherein the support tower comprises three columns arranged in a triangular configuration relative to one
15 another and wherein the plurality of frame members of the tower base comprises three frame member extending radially outward from the three columns of the support tower respectively.
3. The tower assembly according to either one of claims 1 or 2 wherein the tower base is a modular assembly in which each frame member is
20 connected between the tower coupler and the respective ballast receptacle using threaded fasteners such that each frame member is readily separable from the tower coupler and the respective ballast receptacle.
4. The tower assembly according to any one of claims 1 through 3 further comprising a control box housing telecommunications equipment therein which
25 is connected to an antenna on the support tower, the control box being supported at a

distal end of one of the frame members opposite from the tower coupler.

5. The tower assembly according to any one of claims 1 through 4 wherein the tower base is adapted to be supported on the ground surface in a non-penetrating manner.

5 6. The tower assembly according to any one of claims 1 through 5 further comprising a plurality of guy-wires connected between the support tower and the tower base wherein the plurality of guy-wires connected between the support tower and the tower base are the only guy-wires connected to the support tower.

7. The tower assembly according to any one of claims 1 through 6
10 wherein the tower coupler is pivotally mounted on the frame assembly such that the support tower is pivotal about a generally horizontal axis between an assembly position in which the support tower extends longitudinally outward from the tower base along the ground surface and a raised position in which the support tower extends longitudinally upward from the tower base.

15 8. A tower assembly comprising:
a support tower; and
a tower base comprising:

i) a plurality of frame members defining a frame assembly for being supported on a ground surface;

20 ii) at least one ballast receptacle supported on the frame assembly for receiving ballast material therein; and

iii) a tower coupler supported on the frame assembly for supporting a bottom end of the support tower thereon, the tower coupler being pivotally mounted on the frame assembly such that the support tower is pivotal about a generally
25 horizontal pivot axis between an assembly position in which the support tower extends

longitudinally outward from the tower base along the ground surface and a raised position in which the support tower extends longitudinally upward from the tower base.

9. The tower assembly according to claim 8 wherein the plurality of frame members comprises three frame members extending radially outwardly from the tower coupler to respective ballast receptacles spaced radially outward from the tower coupler at evenly spaced positions in a circumferential direction about the tower coupler, and wherein the tower coupler supports the support tower to extend from the tower coupler diametrically opposite from one of the three frame members in the assembly position.

10. The tower assembly according to either one of claims 8 or 9 further comprising a lifting strut supported to extend radially outward from a longitudinal axis of the support tower, and a winch for lifting the support tower from the assembly position to the raised position which includes a winch cable operatively connected between the lifting strut and the tower base.

11. The tower assembly according to claim 10 wherein the lifting strut is supported to extend radially outward from the pivot axis of the tower coupler.

12. The tower assembly according to any one of claims 8 through 11 further comprising a tension member supported between the lifting strut and the support tower at a central location along a length of the support tower.

13. A method of erecting a tower assembly comprising:
providing a support tower;
providing a tower base including i) a frame assembly, ii) at least one ballast receptacle supported on the frame assembly, and iii) a tower coupler supported on the frame assembly;

supporting the frame assembly on a ground surface;

filling said at least one ballast receptacle with ballast material;

coupling a bottom end of the support tower to the tower coupler of the tower base such that the support tower is pivotal about a generally horizontal pivot axis between an assembly position in which the support tower extends longitudinally outward from the tower base along the ground surface and a raised position in which the support tower extends longitudinally upward from the tower base;

pivotally raising the support tower from the assembly position to the raised position; and

fixing the support tower to the tower base in the raised position.

10 14. The method according to claim 13 wherein the frame assembly comprises three frame members extending radially outwardly from the tower coupler to respective ballast receptacles spaced radially outward from the tower coupler at evenly spaced positions in a circumferential direction about the tower coupler, the method further comprising supporting the support tower to extend from the tower coupler diametrically opposite from one of the three frame members in the assembly position.

15 15. The method according to either one of claims 13 or 14 including using a winch operatively connected between the support tower and the tower base to pivotally raise the support tower from the assembly position to the raised position.

20 16. The method according to claim 15 including providing a lifting strut supported relative to the support tower to extend radially outward from a longitudinal axis of the support tower, and operatively connecting a winch cable of the winch between the tower base and the lifting strut.

25 17. The method according to any one of claims 13 through 16 including supporting the lifting strut to extending radially outward from the pivot axis of the tower coupler.

18. The method according to any one of claims 13 through 17 including connecting a tension member under tension between the lifting strut and the support tower at a central location along a length of the support tower.

5 19. The method according to any one of claims 13 through 18 including coupling threaded fasteners between the support tower and the tower base to fix the support tower relative to the tower base in the raised position.

20. The method according to any one of claims 13 through 19 including assembling the support tower from a plurality of modular tower sections in the assembly position of the support tower relative to the tower base prior to pivotally raising the
10 support tower from the assembly position to the raised position.

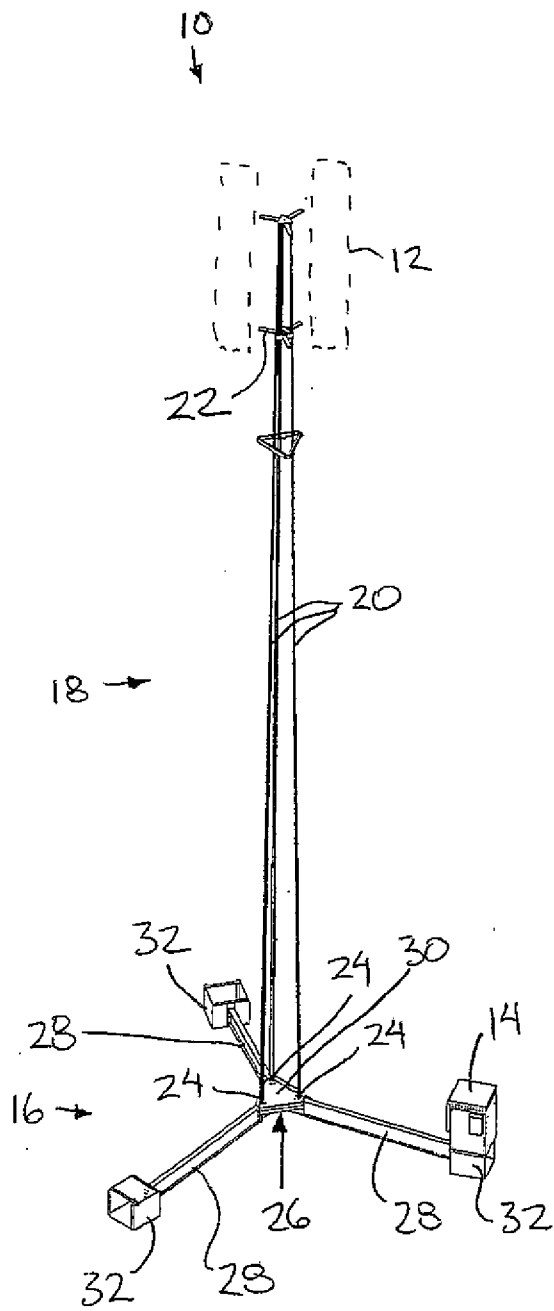


FIG. 1

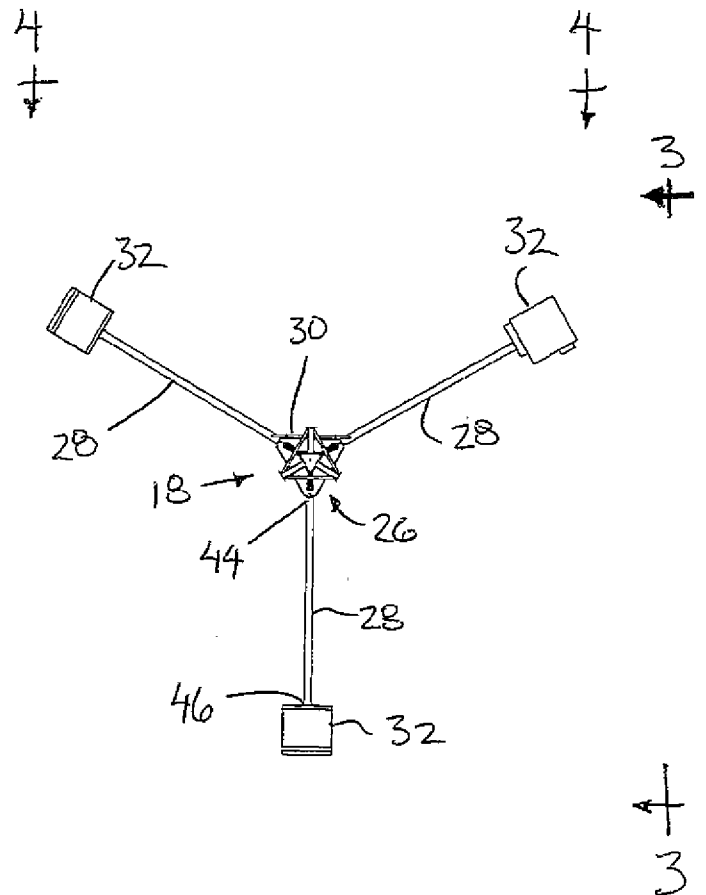


FIG. 2

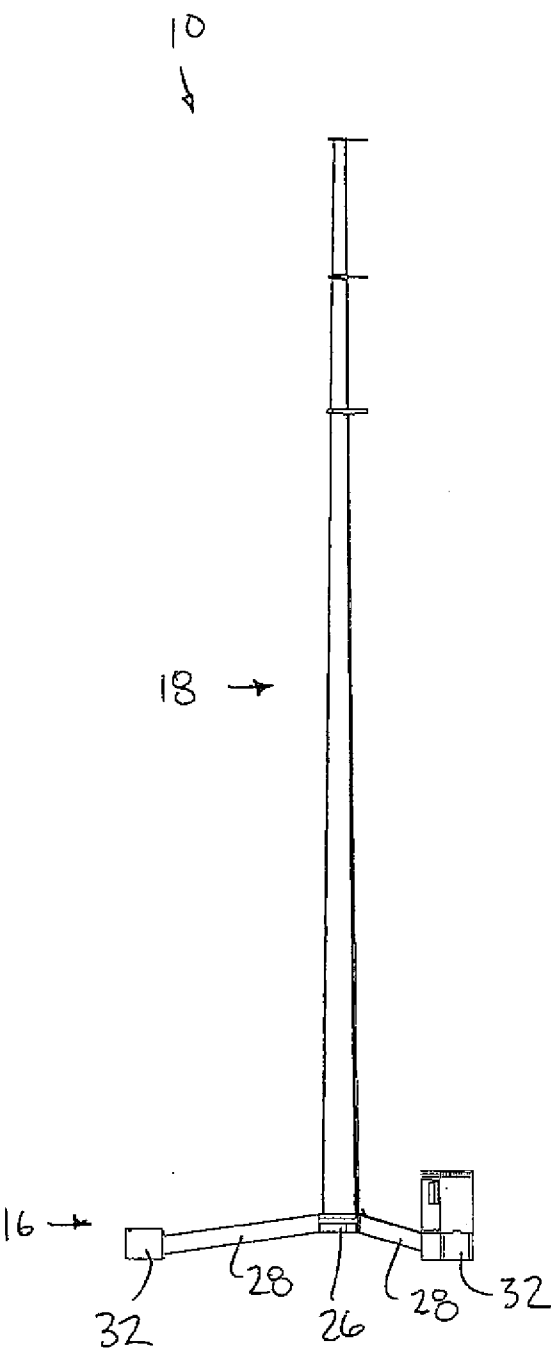


FIG. 3

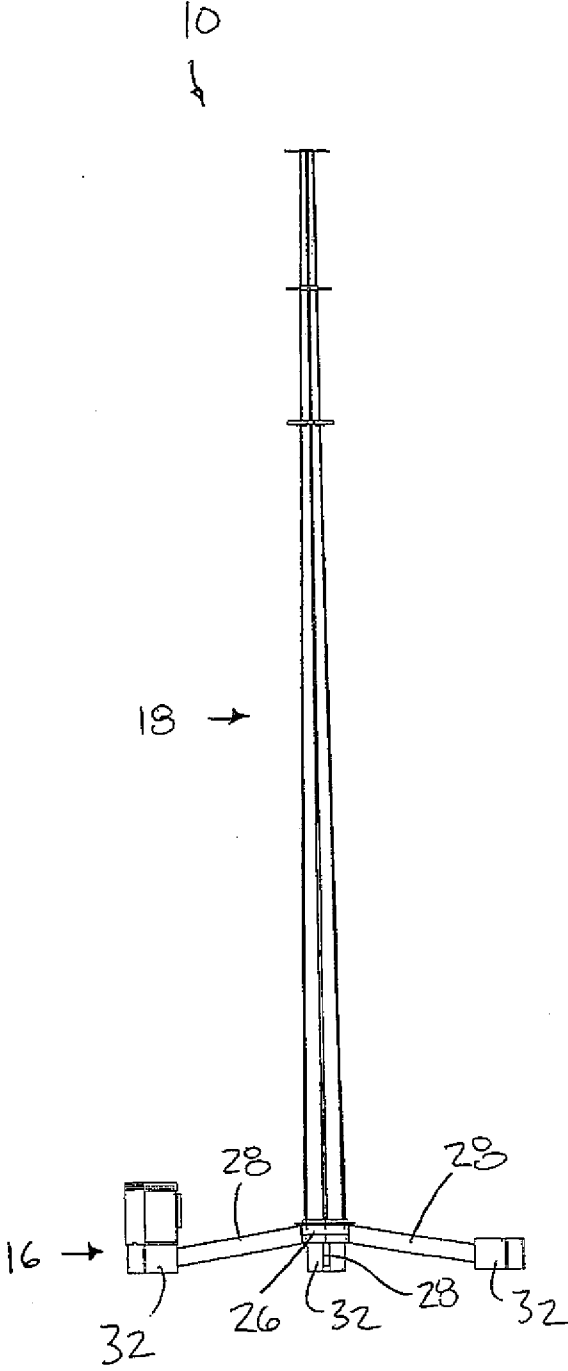
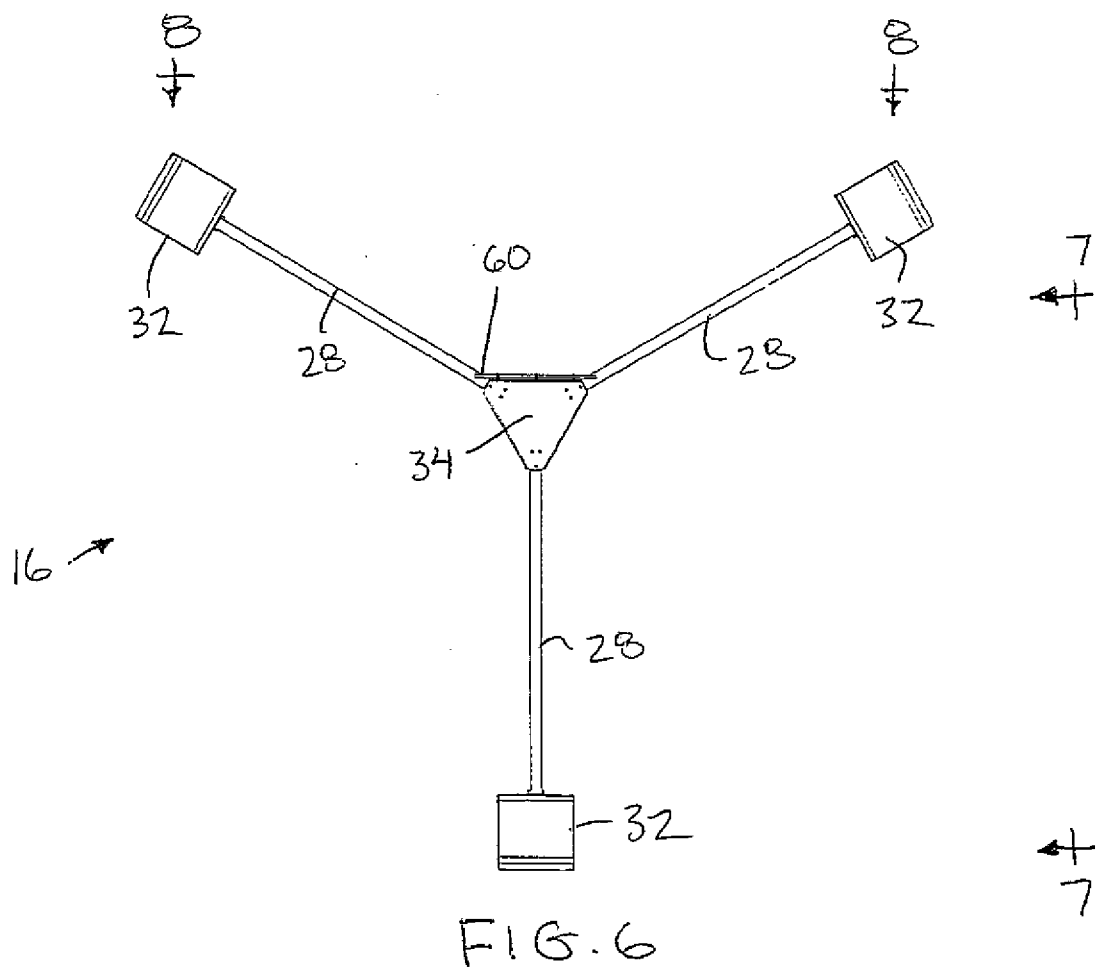
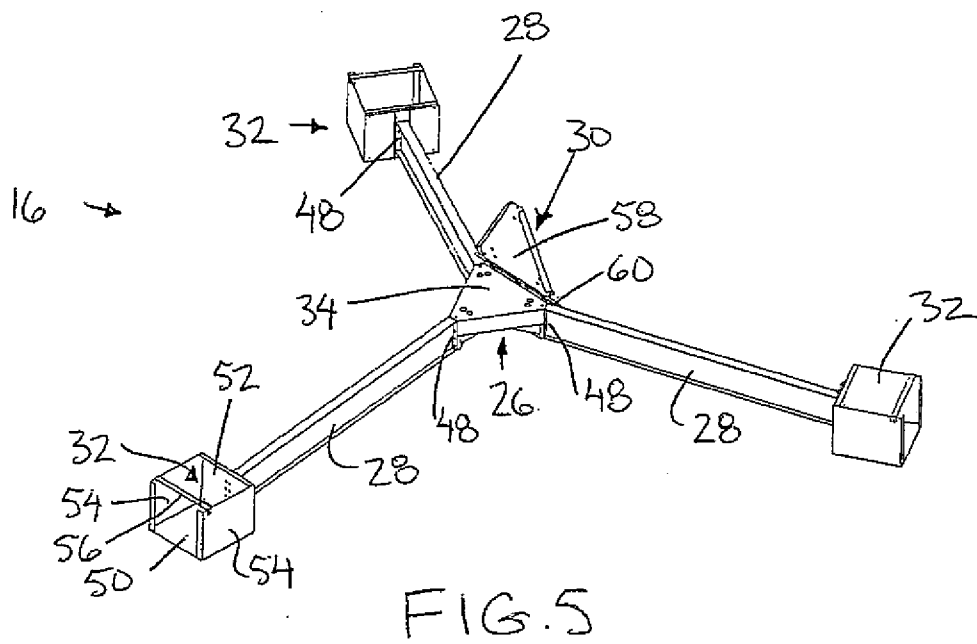
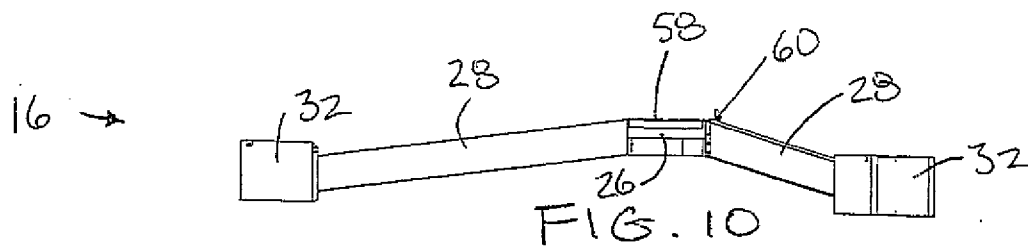
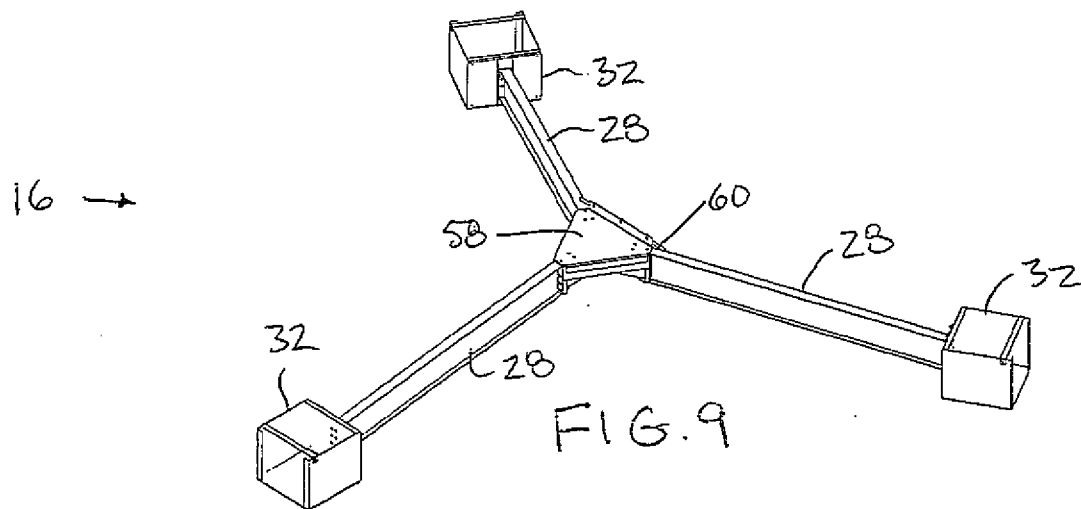
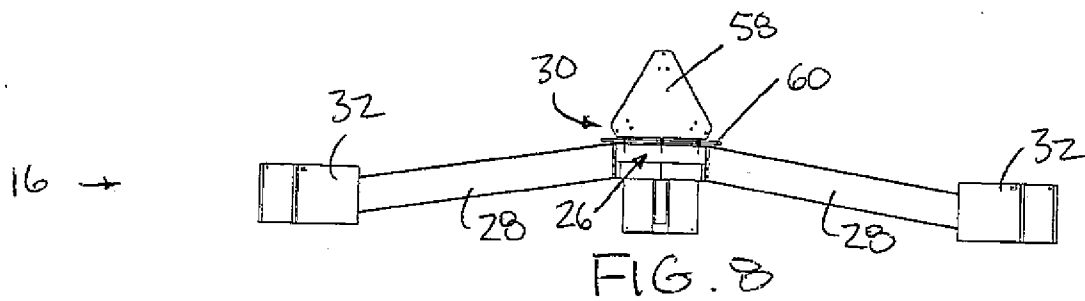
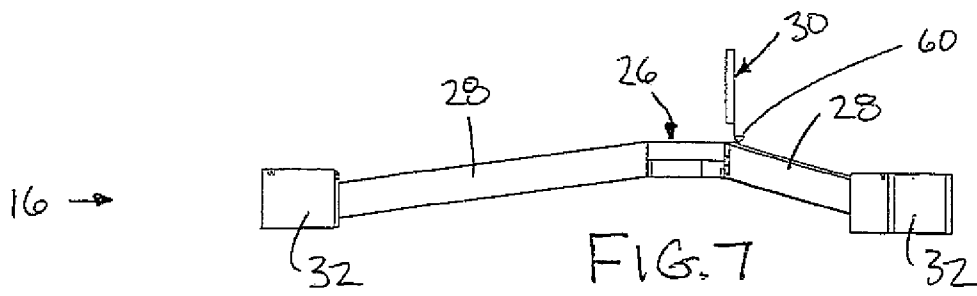
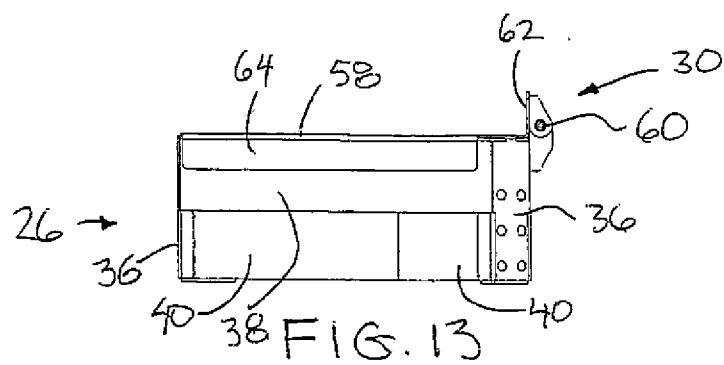
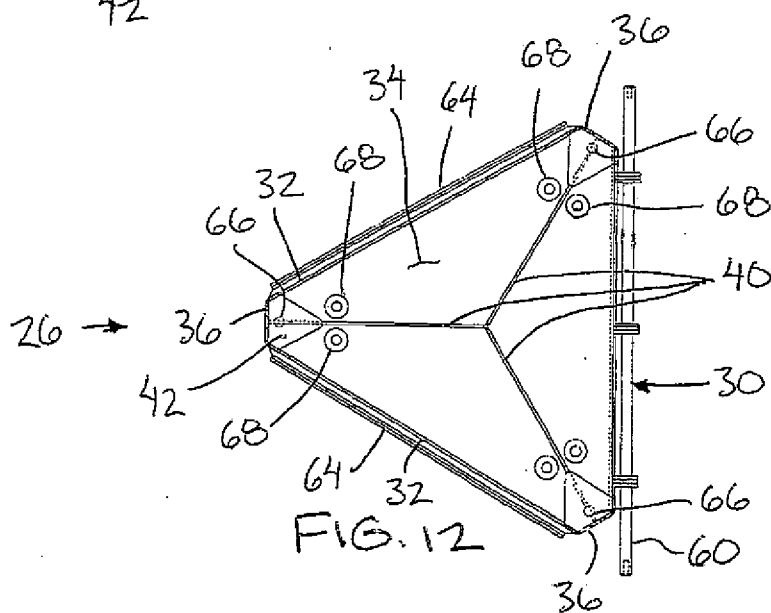
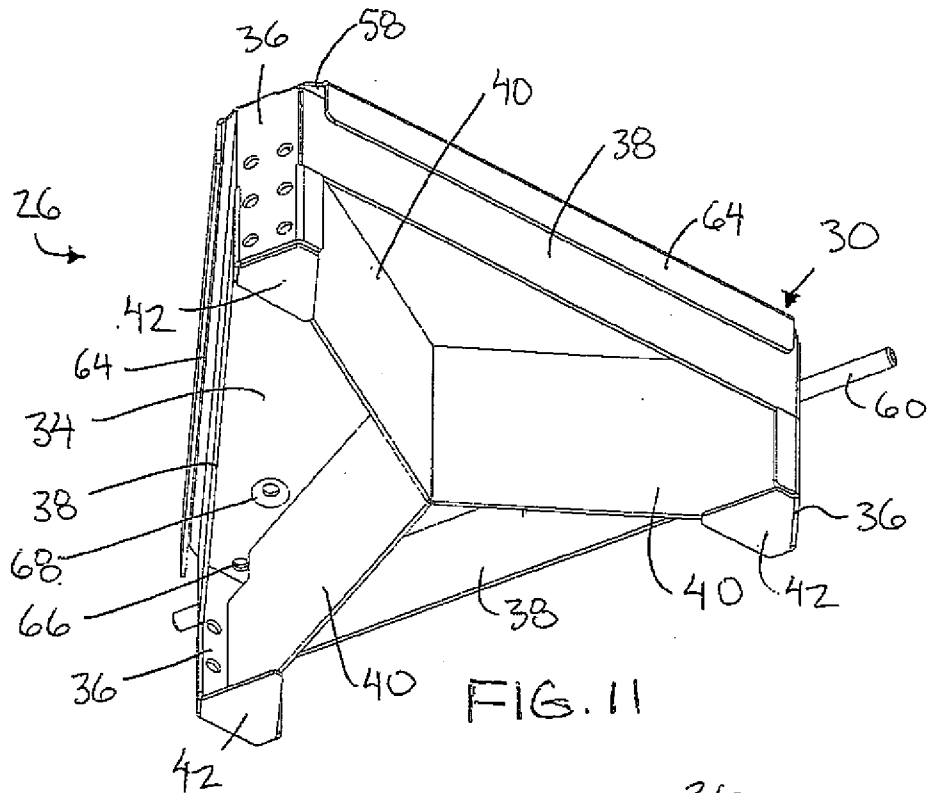
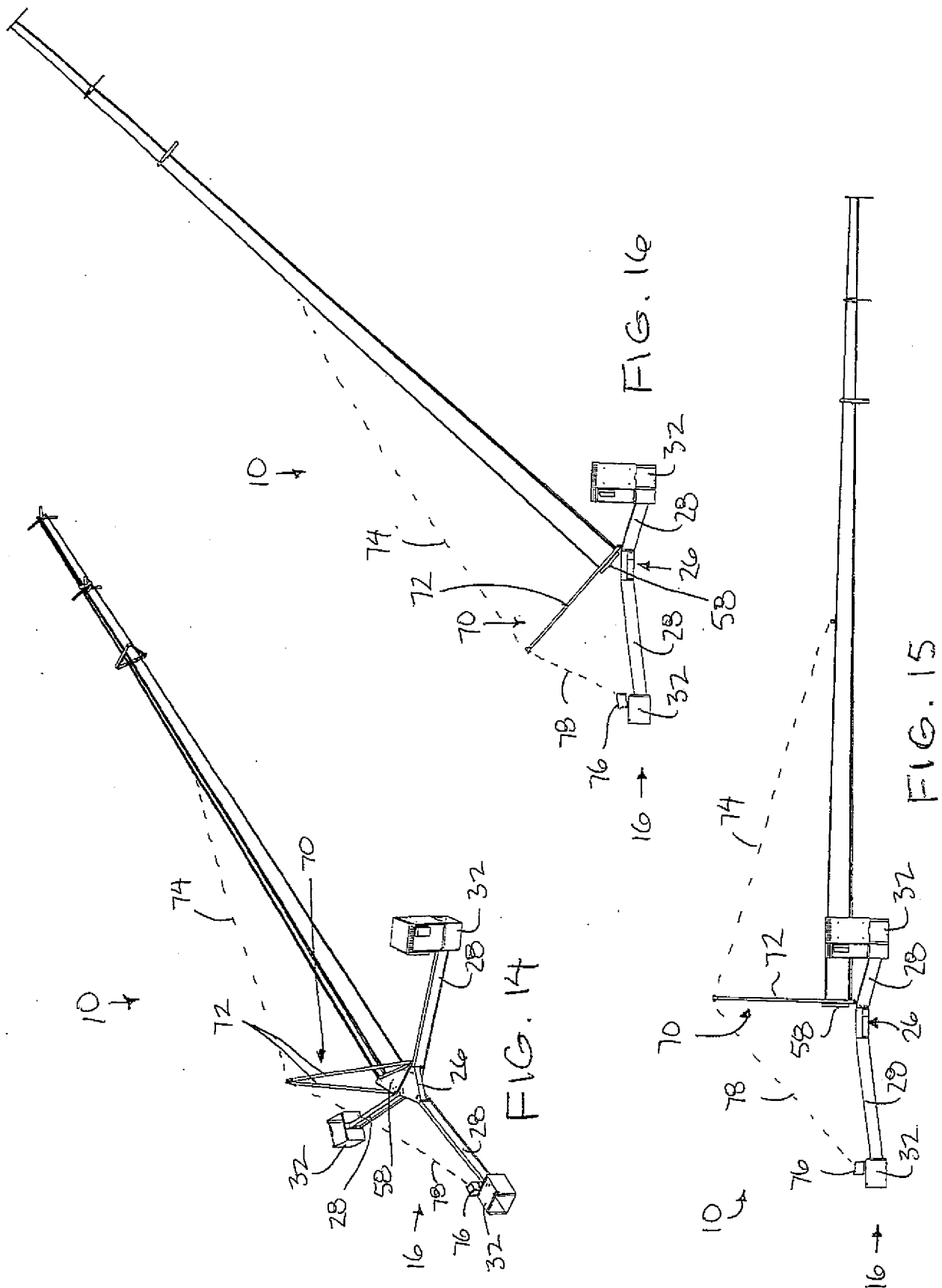


FIG. 4









INTERNATIONAL SEARCH REPORT

International application No.

PCT/CA2017/050433

A. CLASSIFICATION OF SUBJECT MATTER

IPC: *E02D 27/42* (2006.01), *E02D 27/02* (2006.01), *E04H 12/34* (2006.01)

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)

IPC: *E02D 27/42* (2006.01), *E02D 27/02* (2006.01), *E04H 12/34* (2006.01)CPC: *E02D 27/42*, *E02D 27/02*, *E04H 12/34*, *E02D-27/425*, *E04H-12/345*

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

Canadian Patent Database

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

Questel-Orbit, keywords: tower, base, ballast

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ---- A	US 2015/0240442 A1 (IVARS SALOM, J, ET AL.) 27 August 2015 (27-08-2015)	1-5 ---- 6-20

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

* Special categories of cited documents:	"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
"A" document defining the general state of the art which is not considered to be of particular relevance	"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
"E" earlier application or patent but published on or after the international filing date	"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
"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)	"&" document member of the same patent family
"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	

Date of the actual completion of the international search
16 July 2017 (16-07-2017)Date of mailing of the international search report
03 August 2017 (03-08-2017)Name and mailing address of the ISA/CA
Canadian Intellectual Property Office
Place du Portage I, C114 - 1st Floor, Box PCT
50 Victoria Street
Gatineau, Quebec K1A 0C9
Facsimile No.: 819-953-2476

Authorized officer

Robert Gruber (819) 639-7852

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CA2017/050433

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
US2015240442A1	27 August 2015 (27-08-2015)	US2015240442A1	27 August 2015 (27-08-2015)
		US9605401B2	28 March 2017 (28-03-2017)
		CN104812963A	29 July 2015 (29-07-2015)
		EP2933381A1	21 October 2015 (21-10-2015)
		ES2452933A1	03 April 2014 (03-04-2014)
		ES2452933B1	09 March 2015 (09-03-2015)
		WO2014053680A1	10 April 2014 (10-04-2014)