

Nov. 21, 1961

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3,010,106

MOBILE ANTENNA STRUCTURE AND METHOD OF ERECTING SAME

Filed Jan. 9, 1959

6 Sheets-Sheet 1

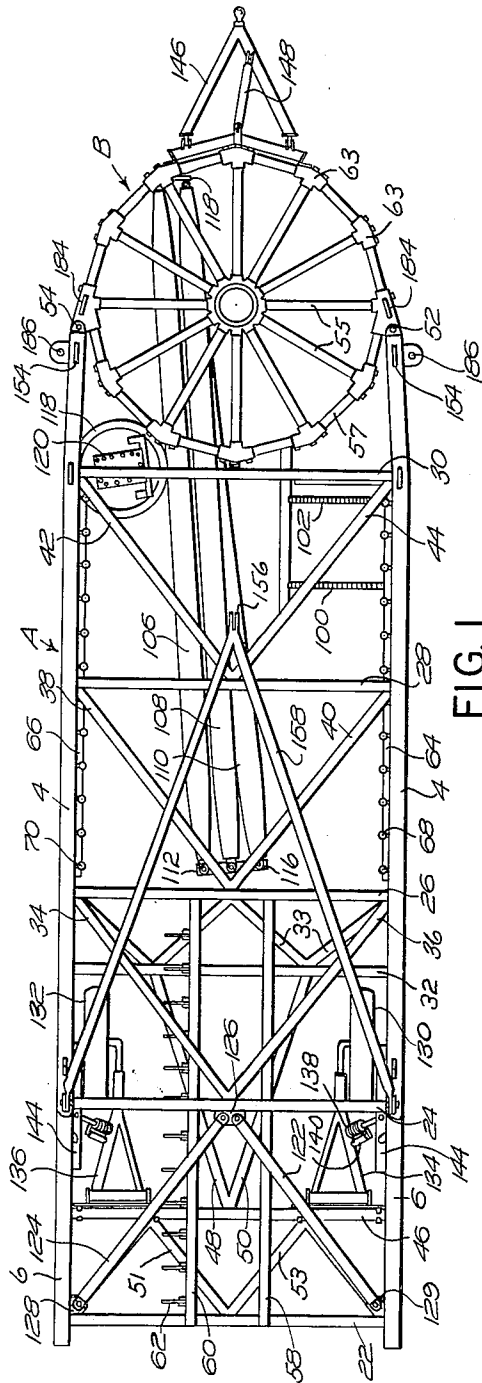


FIG. 1

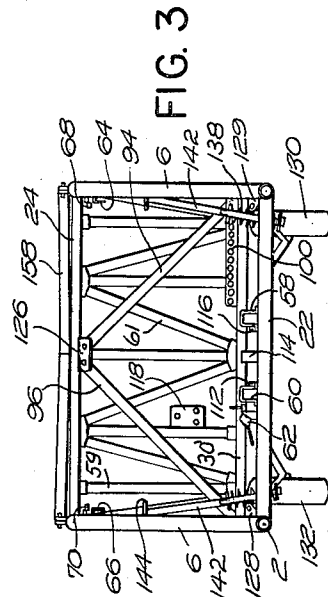


FIG. 3

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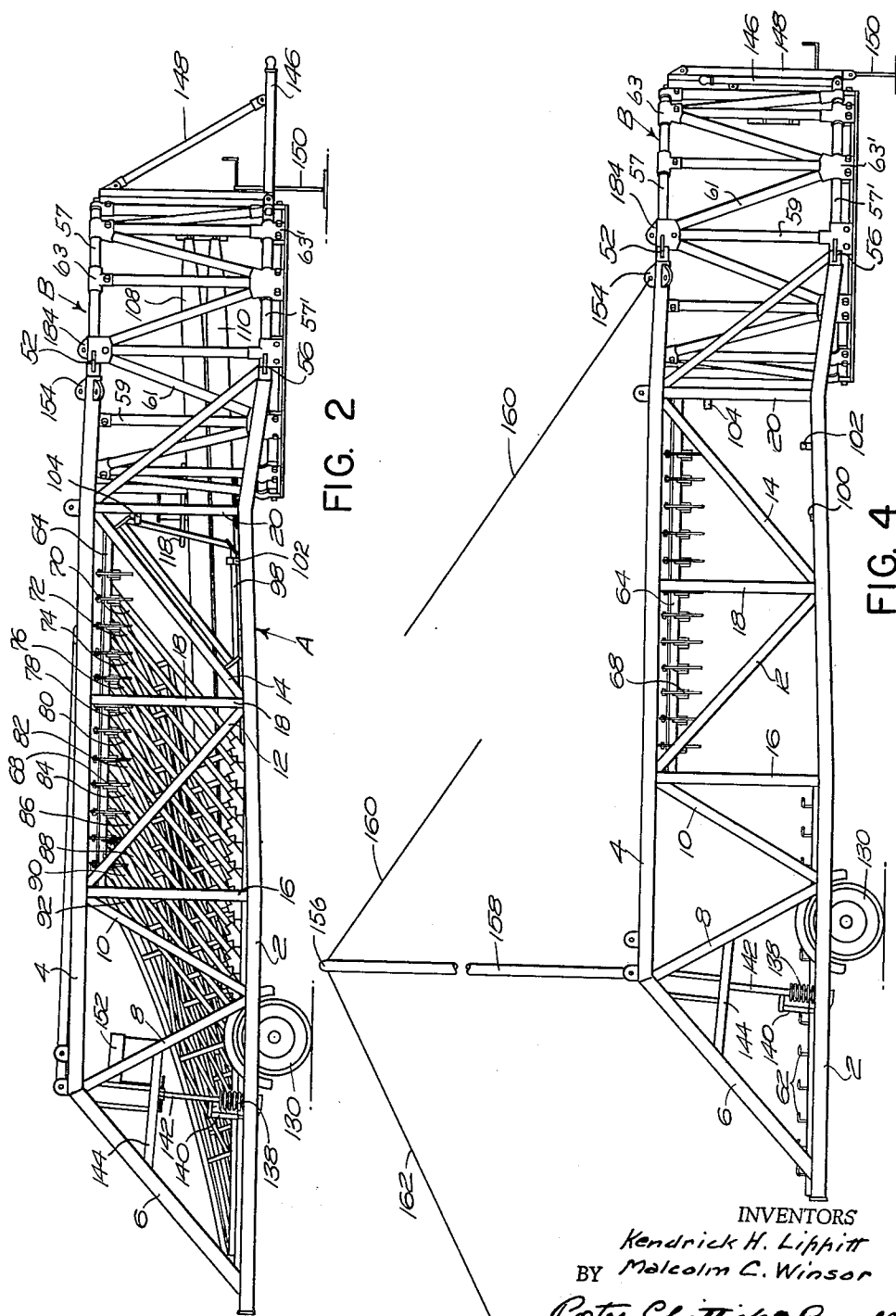
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6 Sheets-Sheet 2



Nov. 21, 1961

K. H. LIPPITT ET AL

3,010,106

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6 Sheets-Sheet 3

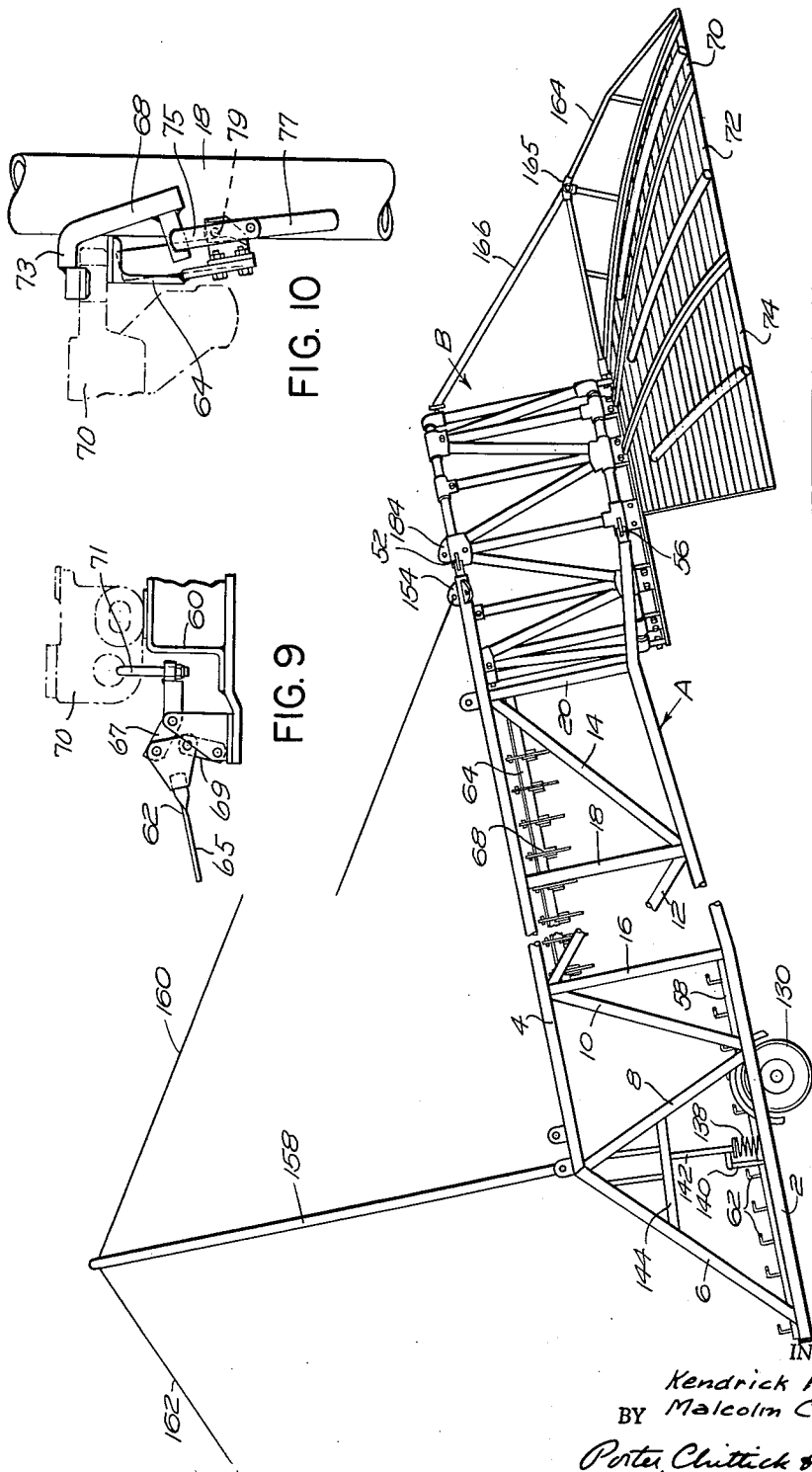


FIG. 10

FIG. 9

FIG. 5

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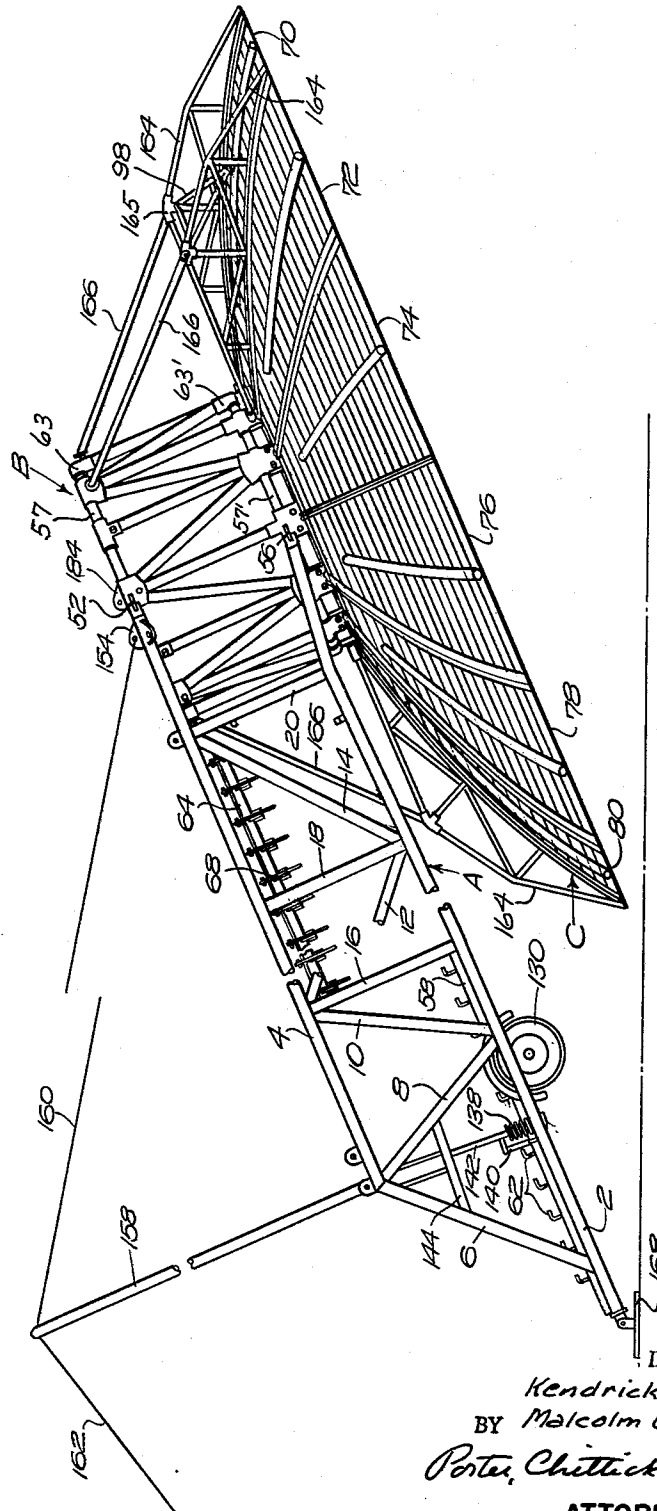
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6 Sheets-Sheet 4



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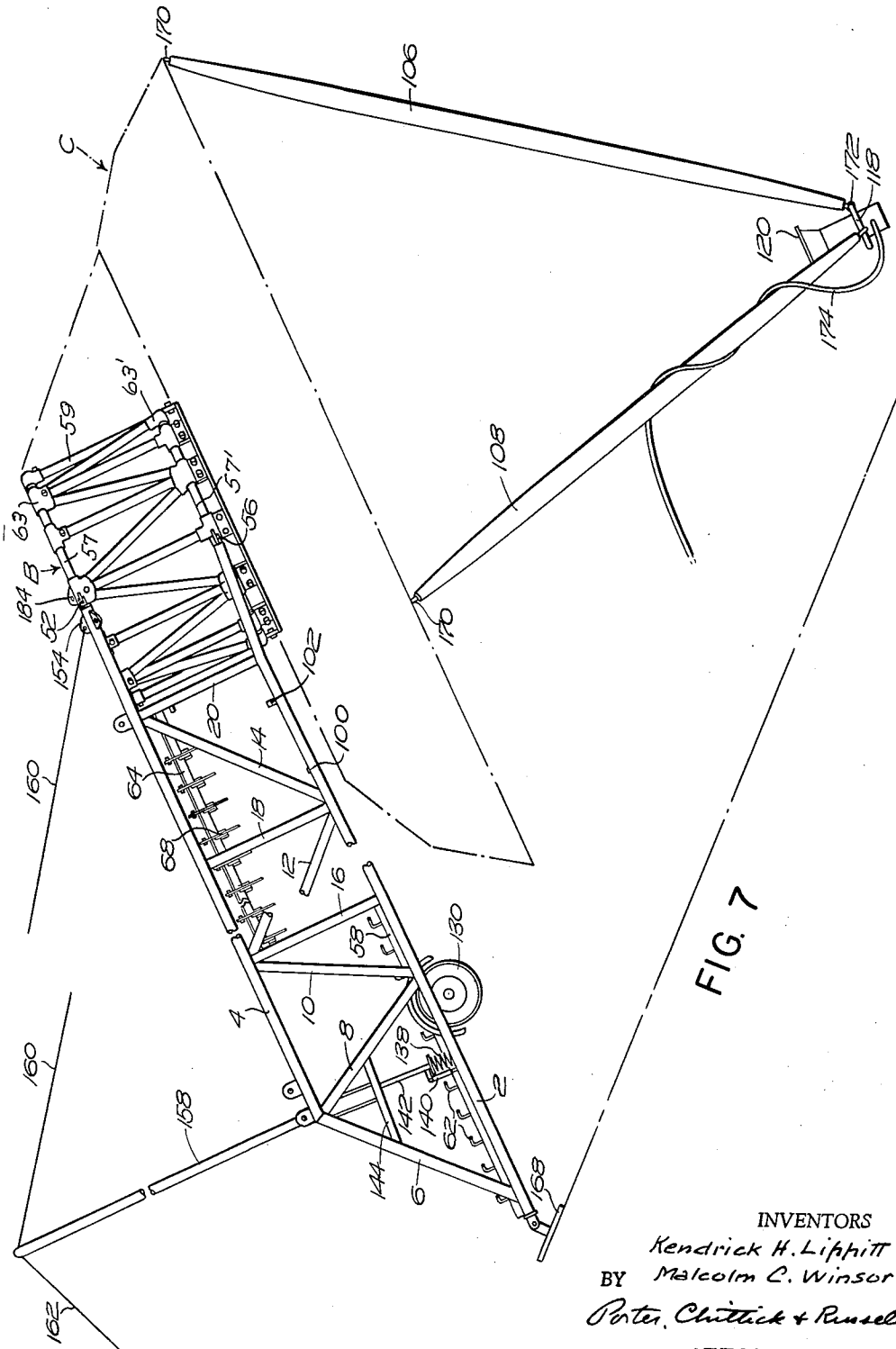
K. H. LIPPITT ET AL

3,010,106

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Filed Jan. 9, 1959

6 Sheets-Sheet 5



Nov. 21, 1961

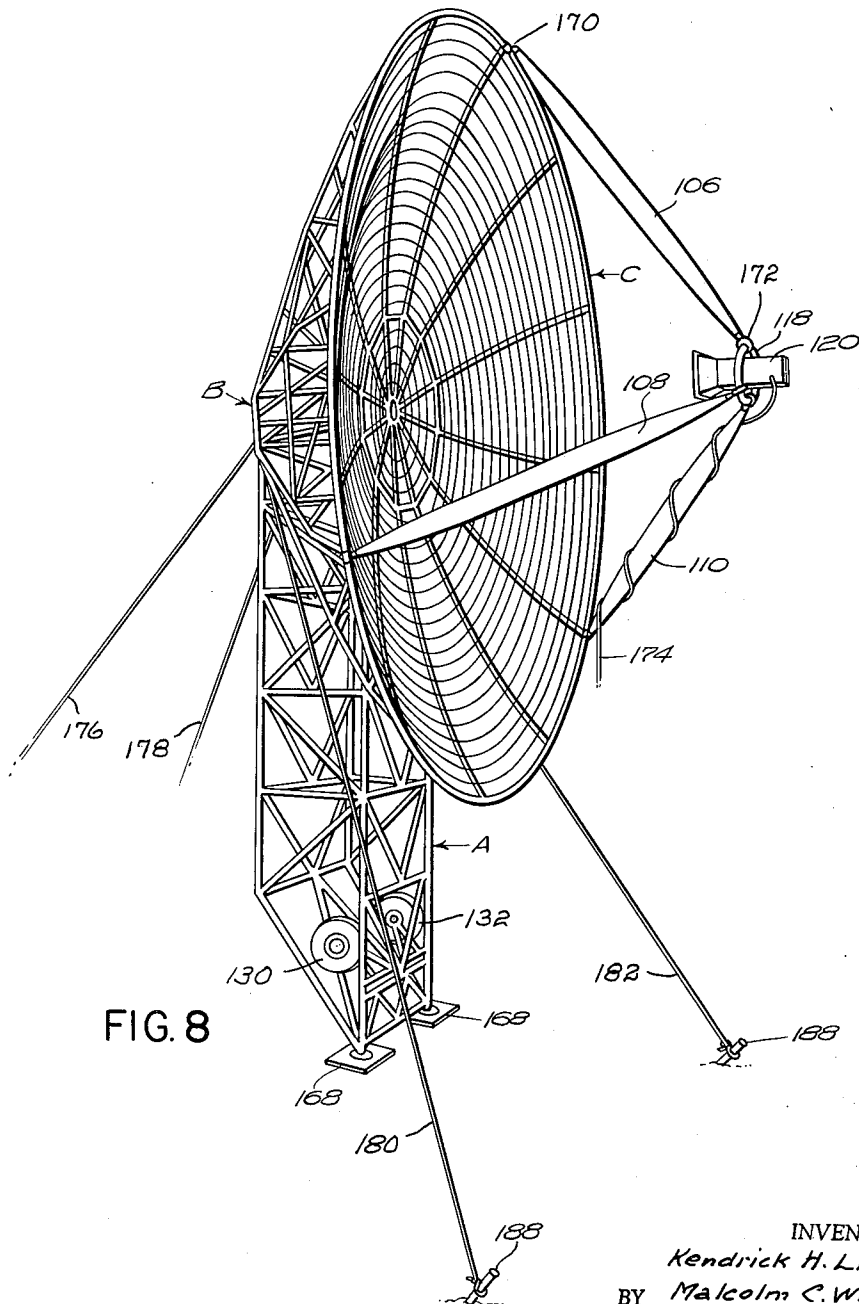
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MOBILE ANTENNA STRUCTURE AND METHOD OF ERECTING SAME

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6 Sheets-Sheet 6



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1

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MOBILE ANTENNA STRUCTURE AND METHOD OF ERECTING SAME

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7 Claims. (Cl. 343-839)

This invention is concerned with antenna equipment for use with scatter communications systems. The invention is particularly concerned with the provision of a mobile tropospheric scatter antenna structure capable of being moved from site to site for testing purposes until the proper site has been found. At this location the permanent antenna structure will then be erected after the mobile testing unit has been removed. When reference hereinafter is made to an antenna structure, it will be understood that a tropospheric scatter antenna is of primary concern but other demountable antennas may be considered as within the scope of the claims.

The invention is also concerned with the provision of a rigid framework which serves a dual purpose. The framework, which may also be called a transit case, will hereafter be referred to as the frame and is such that all of the sections of a demountable antenna may be stored therein with the frame capable of acting as a trailer to permit the moving of the unit from site to site. Thereafter when a site has been reached which it is thought may prove desirable, the sections of the antenna reflector may be removed from the frame, or transit case, and mounted thereon. When the mounting of the reflector sections has been completed, the frame may then be shifted to vertical position, at which time it acts as a rigid support for the reflector and the related horn and transmission lines. Testing at this location may then be undertaken to determine whether or not the site is desirable for a permanent installation. When such determination has been made, the frame is lowered to permit the disassembly of the reflector sections after which they may be stowed and secured within the frame which then again forms a two-wheel trailer unit which may be conveyed to another site for further test work.

The frame which alternatively acts as the trailer or tower is in a preferred form constructed of welded aluminum tubing in a trusswork frame design. The particular form of trusswork may be varied as seems expedient so long as it provides the required rigidity to insure that the reflector sections, when mounted thereon, will be rigid enough to meet all testing requirements. When the frame is in towing position, it acts as an efficient two-wheel trailer inside of which are stored the reflector sections, the feed supports and the feed components. When the site has been reached and the reflector sections, feed components and feed supports removed and mounted on the frame and the frame hoisted to vertical position, the trailer wheels may be retracted into the frame to be out of the way. In one preferred form of the invention, it has been found that the combined weight of the frame, the reflector sections, and all other components is about 3300 pounds, with the frame having a length of about 30 feet and carrying a reflector 28 feet in diameter.

When acting as a trailer, the width and height are such that the unit may be towed over normal highways by a commercial motorcar. In addition, the clearance of the frame over the ground is such that the unit may be towed across rough terrain by a suitable truck or tractor.

By providing a frame construction of sufficient size which is open or may be opened at one end, all of the reflector elements may be introduced and compactly stowed therein. Thus there are no additional components that

2

need to be shipped separately and consequently no crating problems are involved.

Additionally, the entire loaded unit is small enough and light enough to be shipped by military air freight. This is obviously an important feature where quick testing of proposed antenna sites is deemed necessary by the Armed Services.

The present invention contemplates a frame having as an integral part thereof a center section and twelve removable reflector sections of known construction. The design of these elements does not constitute any part of the invention except insofar as the frame formation makes it possible for reflector or tip sections of this general type to be nested and stowed within the confines of the frame for towing and to be attached to the center section when erected for testing.

Because of the nesting characteristics of the tip sections which is necessary to get them within the confines of the frame, it is customary to provide additional removable triangular bracing for the rear of each tip section. Accordingly space is also provided within the frame for stowing a suitable number of such triangular braces which are placed in bracing position on the tip sections as the reflector sections are being assembled on the center section.

The invention also includes the novel method of effecting assembly of the reflector sections on the center section. The method is such that assembly may be accomplished by workmen standing on the ground. The use of ladders and the like is unnecessary.

These and other features of the invention will appear more clearly as the description proceeds with the aid of the accompanying drawings in which:

FIG. 1 is a plan view of the frame in horizontal position with the reflector sections and triangular braces removed therefrom. The spars, horn ring and feed horn are still in secured position.

FIG. 2 is a side elevation of the frame acting as a trailer in complete loaded position showing the reflector sections in nested position, the spars, the triangular braces and other equipment.

FIG. 3 is a view looking from the rear forward of the frame in empty condition with the rear diagonal braces removed.

FIG. 4 is a side elevation of the frame with all equipment removed and with the gin pole in erected position prior to upward tilting of the frame.

FIG. 5 shows the frame in its initial upward tilted position at which the upper six reflector sections may be attached to the center section.

FIG. 6 is generally similar to FIG. 5 but with the frame raised to a higher position so that the lower six reflector sections may be attached to the center section along with all of the other required bracing.

FIG. 7 shows the frame and reflector now raised to a still higher angle sufficient to permit the attachment to the reflector of the three spars, horn ring and horn and the disposition of the transmission line about one of the spars.

FIG. 8 shows the frame and completely assembled reflector drawn to fully erect position where it is rigidly held by a plurality of guys.

FIG. 9 shows a detail of one of the lower clamps.

FIG. 10 shows a detail of one of the upper clamps.

Referring first to FIGS. 1, 2, 3 and 4, it will be seen that there has been provided a frame unobstructed through its interior which is indicated as the part A. This part has on its forward end a generally polygonal attachment which is called the center section and indicated generally as the part B. Part A constitutes the carrying portion of the frame when it is in horizontal

3

position as shown in FIG. 2 and acting as a trailer, while the center section B, which is rigid and integral with the part A, acts as the supports for a plurality of reflector sections which are subsequently mounted thereon and then carried to vertical position as shown in FIG. 8.

The carrying portion of the frame A may be made according to any suitable structural design of sufficient strength to carry the loads imposed thereupon when acting as a trailer and also as a vertical support when stood on end. In the construction shown, there are two generally parallel longitudinal lower members 2 and two generally parallel upper members 4 which are connected along each side by a succession of diagonal and vertical members as shown. All of these members are of tubing, preferably aluminum, and welded together to form a framework of sufficient strength for the purpose intended. The rear diagonal members are numbered 6, and the other pairs of side diagonal members are numbered respectively 8, 10, 12 and 14, while the vertical side members are numbered 16, 18 and 20.

Referring now to FIGS. 1 and 3, it can be seen that the side frames are connected by horizontally extending cross members as follows: The rear ends of members 2 and 6 are connected by a member 22. The upper members 4 are connected by upper cross members 24, 26, 28 and 30. There are corresponding lower cross members (one of which is shown at 30' in FIG. 3) connecting the lower side members 2 and located immediately below members 26, 28 and 30 as viewed in FIG. 1, and additionally there is another lower cross member 32 which is connected by diagonal bracing 33 to the lower cross member immediately forward thereof.

In addition there is diagonal bracing in the plane of the longitudinal members 2 and the longitudinal members 4. Those diagonal braces between members 4 are indicated at 34 and 36, 38 and 40, 42 and 44. It will be understood that there are similar diagonal braces (not shown) in the plane of members 2 immediately below the diagonal braces 38 and 40 and 42 and 44.

A horizontal cross brace 46 (see FIG. 1) in the plane of members 22 and 32 is also provided, and between members 22, 46 and 32 in the plane of the lower members 2 are the diagonal braces 48 and 50, 51 and 53.

The forward ends of members 2 and 4 are connected to the lower and upper rims of the center section B. In FIG. 1, the points of connection are indicated at 52 and 54, and one of the lower points of connection is shown in FIG. 2 at 56.

The center section B, as can be seen from the several illustrations, is a structural drumlike element composed of a plurality of upper and lower radial members 55, upper and lower circumferential members 57 and 57' and vertical and diagonal members 59 and 61 which produce a unit of great rigidity. All of the members are of aluminum tubing welded to fittings 63 and 63' at both ends. Further description of center section B is believed unnecessary except to say that at the upper and lower fittings 63 and 63' means are provided for facilitating connection thereto of the reflector sections and the diagonal braces.

Carried by the lower crossbars 22, 46 and 32 and the crossbar that is located directly under upper crossbar 26 as viewed in FIG. 1 are two longitudinally extending rails 58 and 60. Along the side of rail 60 are mounted a plurality of hold-downs or clamps 62, twelve in number, one for each of the twelve reflector sections which will be mounted in the frame. One of the hold-downs 62 is illustrated in FIG. 9. It consists of a handle 65 pivoted to lever 67 and swinging link 69. On the end of lever 67 is a hook 71 which engages the end of a reflector section, 70 for example. Downward movement of handle 65 pulls hook 71 downward to hold section 70 against rails 58 and 60. Locking of the clamp is caused by the toggle action of link 69.

Welded to the interior sides of the vertical members

4

16, 18 and 20 are longitudinally extending angles 64 and 66, one on either side. These angles 64 and 66 have mounted thereon at equally spaced distances a group of twelve clamping devices or hold-downs 68 and 70. One such hold-down 68 is shown in FIG. 10. It consists of a bent arm 73 having a rigid extension 75 pivoted to lever 77. Lever 77 is pivoted at its upper end at 79 to a bracket fixed to angle 64. As lever 77 is swung down from horizontal, arm 73 is drawn down on the laterally extending ear 81 of the appropriate section, 70 for example, to hold the section tightly against angle 64. Arm 77 is locked in clamping position by the over center action of the pivoted parts. The angles 64 and 66 support the laterally extending eyes on the outer ends of the individual reflector sections and the clamps 68 and 70 hold these eyes firmly in place on members 64 and 66. Thus between the hold-down 62 and the hold-downs 68 and 70 each of the twelve individual reflector sections is capable of being rigidly secured within the frame A.

The individual reflector sections are of a tapered character as can be seen in FIGS. 5, 6 and 8, having along each of their radial edges bracing members. This bracing is illustrated with respect to section 70 shown in FIG. 6. The bracing on the other sections 72, 74, 76 and 78 has been omitted for clarity. The configuration of the sections is such that they may be readily nested together as is indicated in FIG. 2 with the frame A. In this way the entire group of twelve reflector sections can be stored within the confines of a relatively small space. The sections are positioned within the frame by inserting them one at a time from the rear. Thus as we see the sections in FIG. 2, the section numbered 70 was inserted first, followed by sections 72, 74, 76, 78, 80, 82, 84, 86, 88, 90 and 92.

The forward end of the interior opening of frame A in which the sections are stored is limited by two diagonal braces 94 and 96 (FIG. 3) which extend in a vertical plane under the horizontal cross member 30. In the space immediately to the rear of these diagonal braces is room for storage of twelve auxiliary triangular braces 98 which are set side by side and shown in side elevation in FIG. 2. Suitable securing means indicated in FIGS. 2, 3 and 4 at 100, 102 and 104 serve as means for maintaining these twelve auxiliary braces securely affixed in this available space forward of the forwardmost reflector section 70.

Also stored within the confines of sections A and B together are the three spars numbered 106, 108 and 110. The rear ends of these spars have eyes which permit them to be affixed to studs 112, 114 and 116 secured to the lower crosswise extending braces and the forward ends of the spars are correspondingly affixed to studs in a plate 118 mounted near the front end of center piece B. Thus during transit the three spars will be mounted rigidly and separate from each other.

Provision is also made for mounting within the frame A the horn ring 118. It is secured as in the position shown in FIGS. 1 and 2. For clarity, the horn ring has been omitted from the other figures. Attached to the horn ring and supported thereby is the feed horn 120. When removed from the frame and assembled, the horn ring is affixed to the outer ends of the three spars as will be shown hereinafter.

When all of the equipment is placed within frame A and properly secured, the rear end is closed by a pair of diagonal braces 122 and 124 shown only in FIG. 1. These braces are secured at their upper ends to plate 126 and two lower corner plates 128 and 130 shown in FIGS. 1 and 3.

In order that the unit may be moved about as a trailer, the rear end thereof is mounted on a pair of wheels 130 and 132. The wheels have their axles connected to suitable wishbones 134 and 136 which are pivoted to cross member 46. The wheels are sprung by appropriate springs 138 and the ride is improved by the use of shock absorbers 140. While not essential, it is considered preferable

that the wheels be swung to the interior of the frame when the frame is in vertical position. This is accomplished by freeing the spring supports 142 from the short longitudinal members 144. When this is done, the wishbones may swing inwardly to position the wheels within the frame as shown in FIG. 8.

The short generally horizontal bars 144, of which there is one on either side, have an inwardly extending flange which is capable of supporting thereon the ends of a transversely extending box 152 (see FIG. 2) which is designed to carry the reflector section rear braces 166 and all the tools and other equipment needed in assembling and erecting the tower and reflector. This box is removable and will be the first item removed from the frame A after the unit has reached the assembly site.

The unit during travel is connected to the motor vehicle by means of the V-shaped coupling 146 which is maintained in horizontal position by the diagonal brace 148. Prior to freeing the trailer from the motor vehicle a jack 150 is screwed downwardly to engage the ground, thus to support the forward end of the unit. After the coupling 146 has been freed, the brace 148 is disconnected at its lower end permitting coupling 146 to swing to vertical position while the brace 148 hangs down over it as shown in FIG. 4.

At this point, with the trailer now located at a selected site, assembly of the antenna can begin. The braces 122 and 124 are removed from the rear end. Box 152 is removed. Clamps 62, 68 and 70 are released, and the reflector sections removed. Then the triangular braces 98 are removed as well as the three spars 106, 108 and 112 along with the horn ring 118 and the feed horn 120.

The next stage in the erection of the unit is as follows: A line is attached to the two eyes 154 and from this line a single line is run through the fork 156 of the V-shaped gin pole 158 which has been swung from the horizontal position of FIGS. 1, 2 and 3 to vertical position as shown in FIG. 4. The line is indicated generally at 160, and the rear end thereof 162 leads to the ground where it may be pulled on mechanically or manually. Blocks will be put under the wheels 130 and 132 to prevent rearward movement of the unit, and then when sufficient force is exerted on line 162 the frame will initially tilt upwardly at its front end as shown in FIG. 5. In this limited raised position it becomes possible for the workmen to attach the upper six reflector sections to the lower periphery of the center section in a manner well understood in the art. As this operation goes forward, the triangular braces 98, one of which is shown in position in section 70 in FIG. 6, are interposed between the radial bracing frames 164 of each of the several sections. It will be understood that each of the twelve sections has two radially extending braces similar to the braces 164 shown on section 70 in FIG. 6. Adjacent braces 164 of adjacent sections are connected to each other, and from the point of such connection as at 165 in FIG. 6 diagonally extending rear braces 166 (removed from box 152) are connected to the fittings 63 of the upper periphery of center section B. Thus in a construction in which there are twelve sections forming the reflector there will be twelve braces 166, each brace being radially aligned with the line of meeting of adjacent sections.

After the upper six sections have been secured as indicated in FIG. 5, the line 162 is pulled further to the rear so that the rear ends of the members 2, now supported by foot plates 168, pivot upwardly on such foot plates causing the wheels 130 and 132 to leave the ground as shown in FIG. 6. The altitude of center section B is now sufficient to permit the other six sections to be applied to the center section along with the appropriate braces 166 and the triangular braces 98. It will be understood that after all of the sections are assembled in the manner shown in FIG. 6, the reflector will constitute a rigidly braced unit rendering it capable of withstanding deflection against the

worst combination of wind, rain, snow, ice and temperature.

Further pull is then exerted on line 162 so that the unit is raised to a higher position as shown in FIG. 7, at which point the three spars 106, 108 and 110, previously connected to the outer periphery of the reflector as at 170 at points 120 degrees apart, may now be connected to the horn ring 118 as at 172 at a point clear of the ground. Thus the horn ring and the feed horn 120 are supported by a rigid tripod arrangement that is mounted on the periphery of the reflector sections, which assembled reflector will now be generally designated C. The transmission line 174 is wound in conventional fashion about one of the lower spars such as 108 in FIG. 7 or 110 as shown in FIG. 8 to be led to the appropriate electrical equipment.

The assembly is now complete so that the frame A may be drawn by further tension on line 162 to vertical position as shown in FIG. 8 where it will be secured by four additional guys 176, 178, 180 and 182 fastened to the eyes 184 and 186, of which there are two on each side of the rear of the center member B. The guys are appropriately secured to guy anchors 188.

When in erected position as shown in FIG. 8, the tower, consisting of the frame A and the associated center section B and the reflector C, will be rigid within the requirements of proper antenna operation. Sending and receiving tests may then commence to determine the desirability of the site selected.

At the completion of the tests, all of the procedures set forth above are repeated in reverse order, resulting in all of the parts being disassembled so that they may be restored to secured position within the then horizontal frame A. The wheels, of course, will have been restored to down position and with the hitch 146 in operative position the unit now acting as a trailer may again be connected to the motive power to be moved to another location for further testing purposes.

While one particular construction of frame A, center section B and reflector sections C has been shown and described with respect to FIGS. 1 to 7, it will be understood that alternative bracing forms might be employed and one such modification is shown in the erected structure in FIG. 8. The essential requirement that must be met in all cases, however, is that there be a center section B that is rigidly connected to the frame A and that the sections of the reflector C be demountable and of such size as to be positioned within the confines of the frame A along with the spars and other removable braces, if any. Accordingly, it will be understood that it is intended that all equivalent structures are to be encompassed within the scope of the appended claims. It is further pointed out that while the frame A is shown as an openwork braced tubular frame, the walls, top and bottom, might be covered with sheet metal to afford additional protection from the elements therewithin while the trailer is in transit as well as adding whatever additional structural rigidity may be afforded by such sheet members.

It is our intention to cover all changes and modifications of the example of the invention herein chosen for purposes of the disclosure which do not constitute departures from the spirit and scope of the invention.

We claim:

1. A mobile antenna structure having a reflecting paraboloid comprising a wheeled trailer frame having a hollow interior adapted to receive a plurality of stacked parabolic reflector sections within said compartment, a reflector supporting center section formed as the apex portion of said paraboloid and integral with said trailer, means for connecting said reflector sections to said center section to complete said paraboloid, and bracing integral with said trailer and center section sufficient to provide a rigid support for said antenna when said structure is erected in vertical position.

2. A mobile antenna as set forth in claim 1, and means affixed to said compartment interior for removably securing the ends of said reflector sections to the interior of said compartment.

3. A mobile antenna structure comprising a frame having a hollow interior adapted for receiving stacked antenna reflector sections when in horizontal position and as a tower for supporting assembled antenna reflector sections when in vertical position, a center parabolic section for supporting reflector sections rigidly attached to said frame, the face of said center section being on the underside thereof when said frame is in horizontal position, means for securing said sections when placed within said storage compartment in fixed relation thereto, wheels at the rear of said frame for supporting said frame when in horizontal position in the nature of a trailer, means for connecting said center section to a towing unit, means fixed with respect to said frame and center section on which may be mounted three spars, and means pivoted to the upper side of said frame to assist in shifting said frame from horizontal to vertical position.

4. A mobile antenna structure comprising a frame having a hollow interior adapted for receiving stacked antenna reflector sections when in horizontal position and as a tower for supporting assembled antenna reflector sections when in vertical position, a center parabolic section for supporting reflector sections rigidly attached to the end of said frame, the face of said center section being on the underside thereof when said frame is in horizontal position, means affixed to said frame for securing said sections when placed within said storage compartment in fixed relation thereto, wheels at the rear of said frame for supporting said frame in horizontal position in the nature of a trailer, means for connecting said center section to a towing unit, means fixed with respect to said frame and center section on which may be mounted three spars, and a gin pole pivotally mounted on the upper rear of said frame and acting when in erected position to cooperate with a line connecting to the forward end of the structure and passing over said gin pole to provide increased leverage so that said structure may be pulled by said line from horizontal to vertical position.

5. Means for transporting the demounted truncated sections of a tropospheric scatter antenna and for subsequently acting alternatively as a mounting for said antenna sections, said means comprising four longitudinally extending light structural members and crosswise and diagonal bracing between adjacent members to comprise a framework, said framework being rectangular in cross-section and unobstructed interiorly lengthwise for at least a distance equal to approximately twice the radial dimension of one of said sections, the unobstructed interior crosswise dimension of said framework being greater than the chord of the outer periphery of each of said sections, a center section on which said sections may be mounted, said center section integral with and connected

to one end of said framework, said center section comprised of a plurality of upper and lower radial members, upper and lower circumferential members to which said radial members are respectively secured, and vertical and diagonal members connecting said circumferential members, a longitudinally extending rail secured to the bottom of said framework and clamps for securing the inner ends of said sections to said rail, and a plurality of clamping means adjacent the upper interior longitudinally extending corners of said frame for clamping the outer corners of said sections to said framework, and a pair of wheels under said framework at the end remote from said center section.

6. A mobile antenna structure having a reflecting paraboloid comprising a frame having a hollow interior adapted for receiving stacked antenna reflector sections when in horizontal position and as a tower for supporting assembled antenna reflector sections when in vertical position, a parabolic center section rigidly attached to one end of said frame for supporting said reflector sections, the reflecting face of said center section being on the underside thereof when said frame is in horizontal position, wheels at the rear of said frame for supporting said frame when in horizontal position in the nature of a trailer, and a base at the other end of said frame for supporting said frame when in vertical position.

7. A mobile antenna structure having a reflecting paraboloid comprising a frame having a hollow interior adapted for receiving stacked antenna reflector sections when in horizontal position and as a tower for supporting assembled antenna reflector sections when in vertical position, a parabolic center section rigidly attached to one end of said frame for supporting reflector sections, the reflecting face of said center section being on the underside thereof when said frame is in a horizontal position, a plurality of truncated parabolic reflector sections adapted to be connected to said center section to form a complete parabolic reflector, the dimensions of said reflector sections being such as to permit their being positioned in stacked relation within the confines of said hollow interior in fixed relation thereto, wheels at the rear of said frame for supporting said frame when in horizontal position in the nature of a trailer, and a base at the other end of said frame for supporting said frame when in vertical position.

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