

[54] LIMITED TRACKING REPOSITIONABLE
AZ/EL TURRET TYPE ANTENNA

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 789,786, Jan. 8, 1969, abandoned.

[52] **U.S. Cl.**..... **343/765, 343/912**

[51] **Int. Cl.** **H01q 3/00**

[58] **Field of Search** 343/763, 765, 766, 912

[56] **References Cited**

UNITED STATES PATENTS

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[57] **ABSTRACT**

For tracking missiles, such as communication and navigation missiles, which orbit synchronously with the earth and therefore remain relatively fixed as to azimuth and elevation with respect to a selected point on the earth's surface, adjustments of only a few degrees in azimuth and elevation are usually sufficient to keep an antenna focused on the satellite once the latter has attained a satisfactory orbit. The present invention is directed to a limited tracking antenna for such

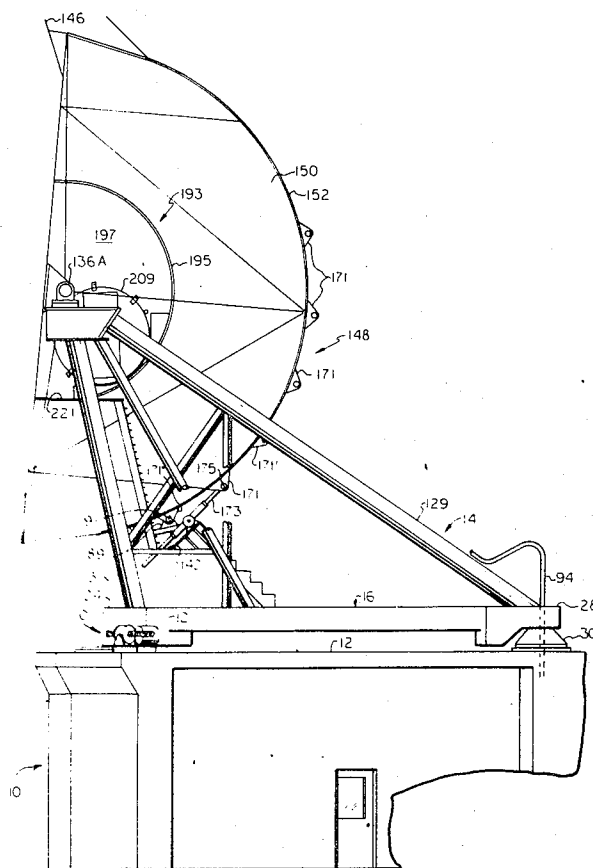
satellites, and the present disclosure is of a preferred embodiment of the invention. A triangular turret base is pivoted at one apex thereof to swing about an azimuth axis on a flat, horizontal support, structure, and is supported at each of the other apexes for limited slidable movement along a pair of slide plates removably mounted at angularly selected locations on the base. Azimuth control power drive means acts between the turret base and the support structure to control azimuth adjustment of the turret within the limits of movement permitted by the length of the slide plates.

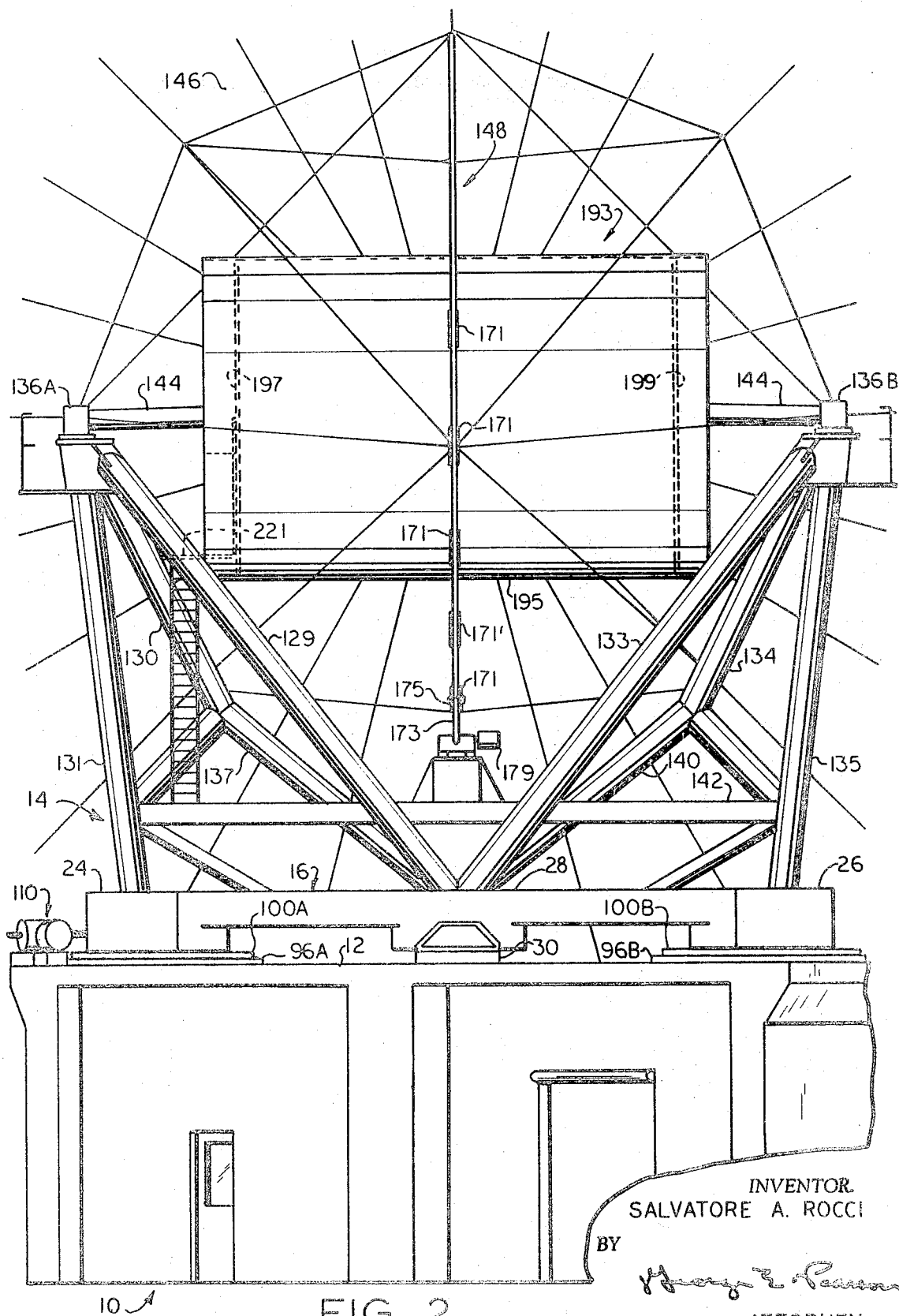
A usual antenna reflector bowl is pivoted on the turret to swing about an elevation axis, and a plurality of attachment means are provided at angularly spaced intervals along a circular mount on the antenna co-axial with the elevation axis.

Elevation control means acts between a fixed portion of the turret and a selected one of these attachment means, and controls adjustment of the elevation angle of the antenna within the limits of movement of the elevation control means.

A hemi-cylindrical walkway or work chamber is mounted on the back of the antenna bowl with its axis substantially coincident with the elevation axis. A door is mounted in a circular plate mounted for rotative adjustment over a hole in an end of the walkway to allow positioning the door upright, and a curved step plate is provided to bridge the gap between the door and a platform for safe ingress and exit of workers entering and leaving the chamber regardless of the elevation angle of the antenna bowl.

11 Claims, 11 Drawing Figures



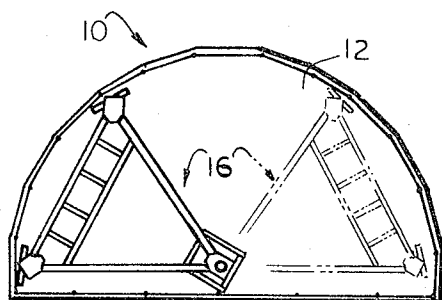
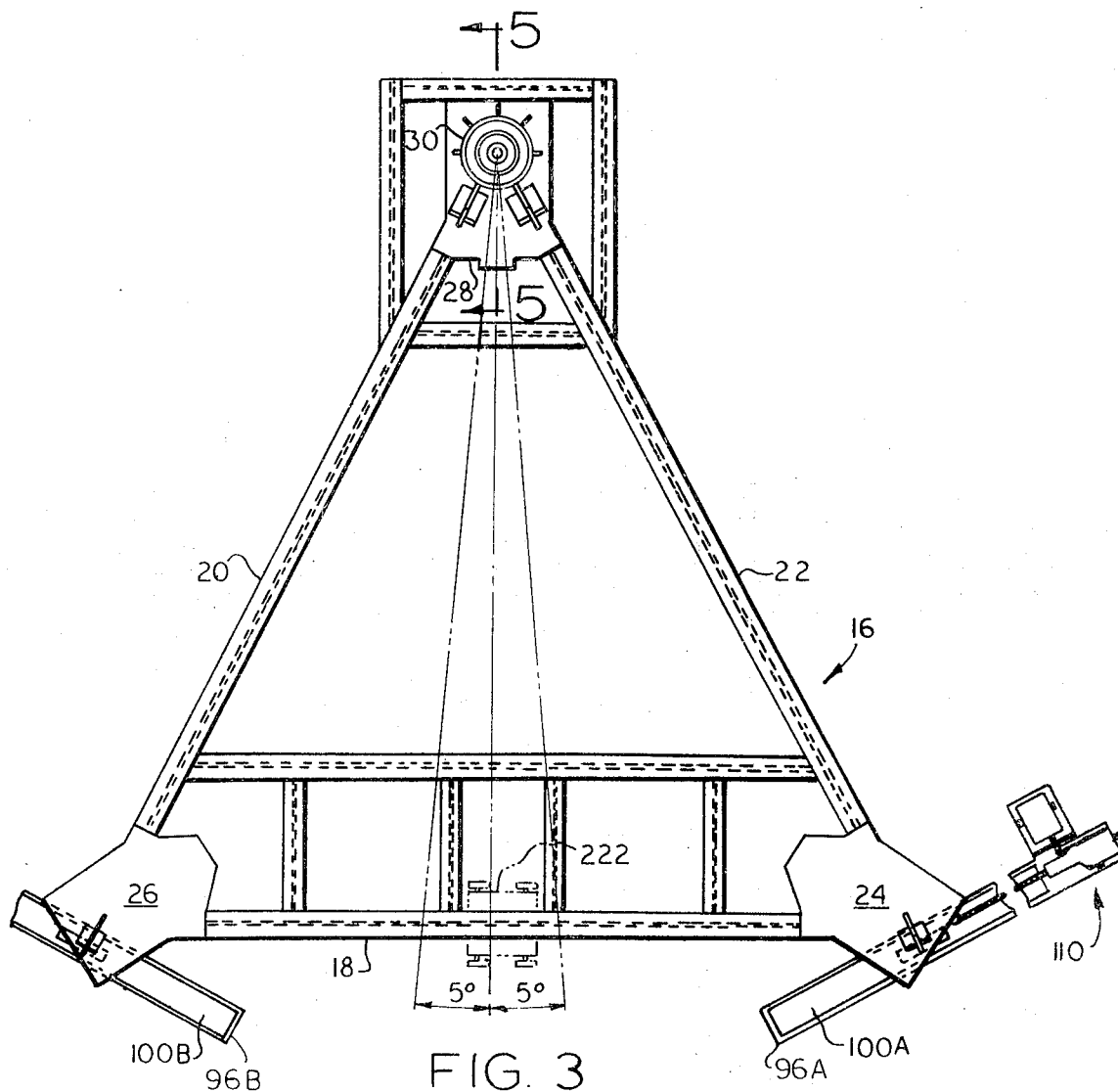


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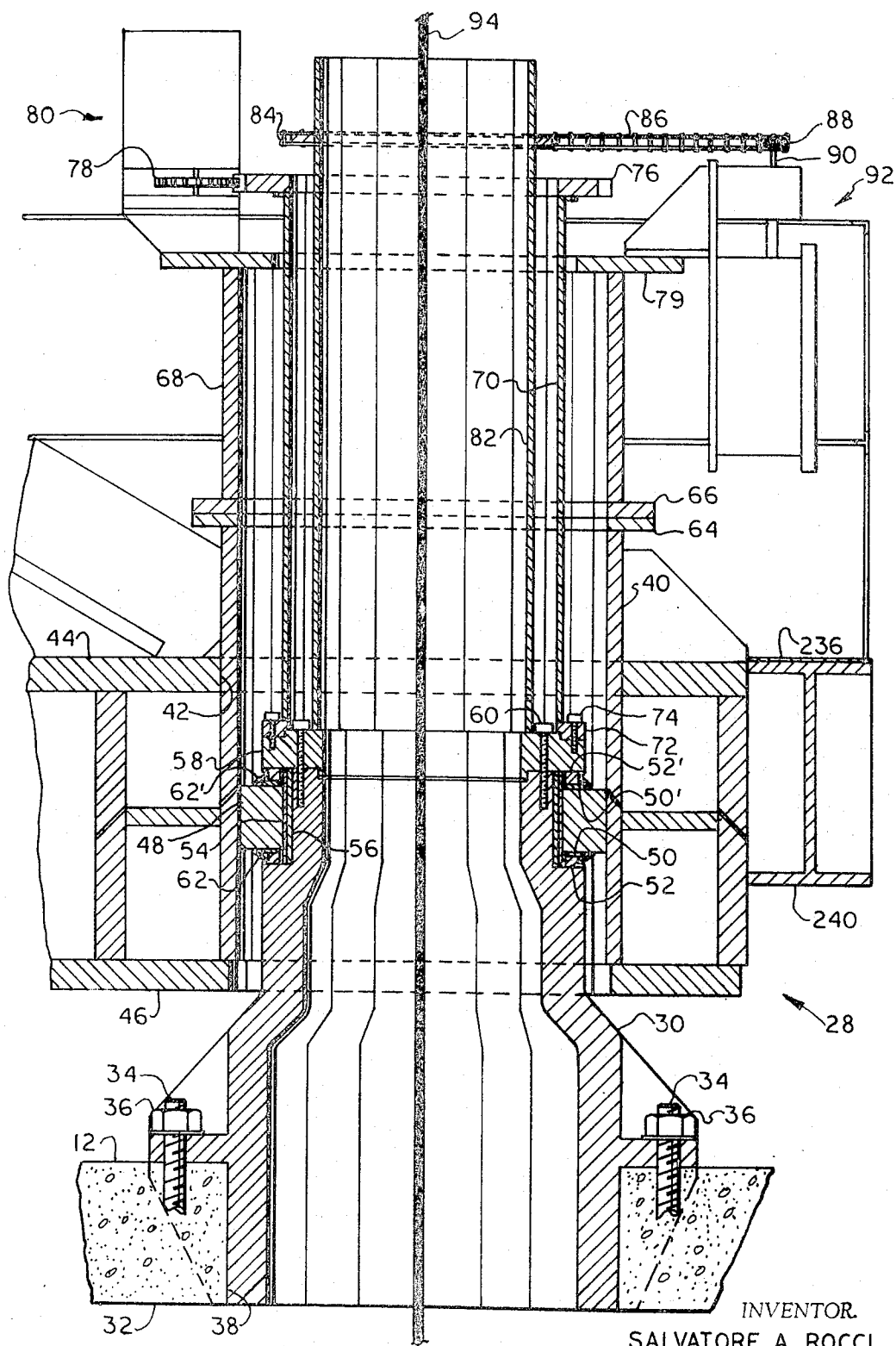
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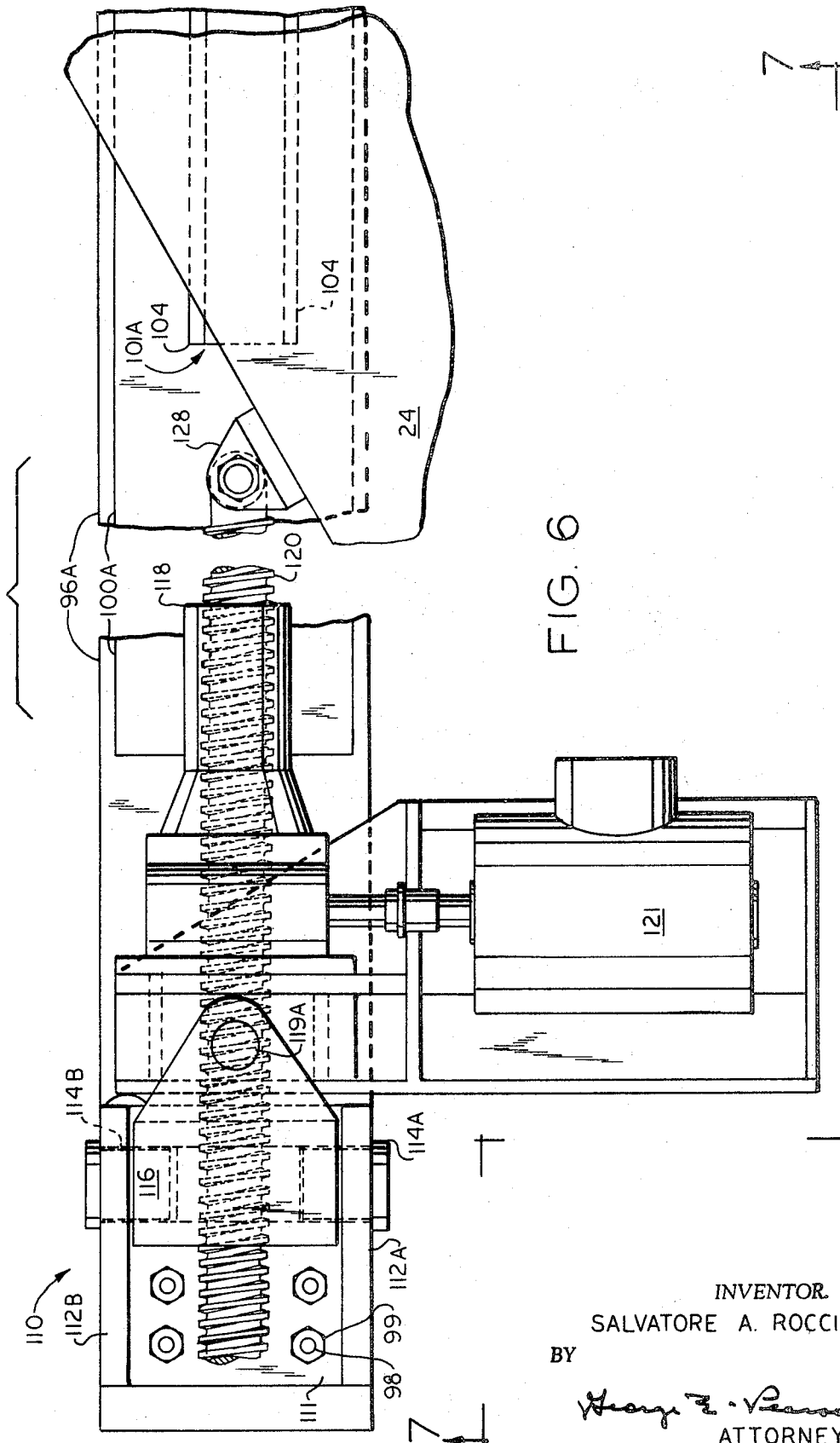


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FIG. 5.

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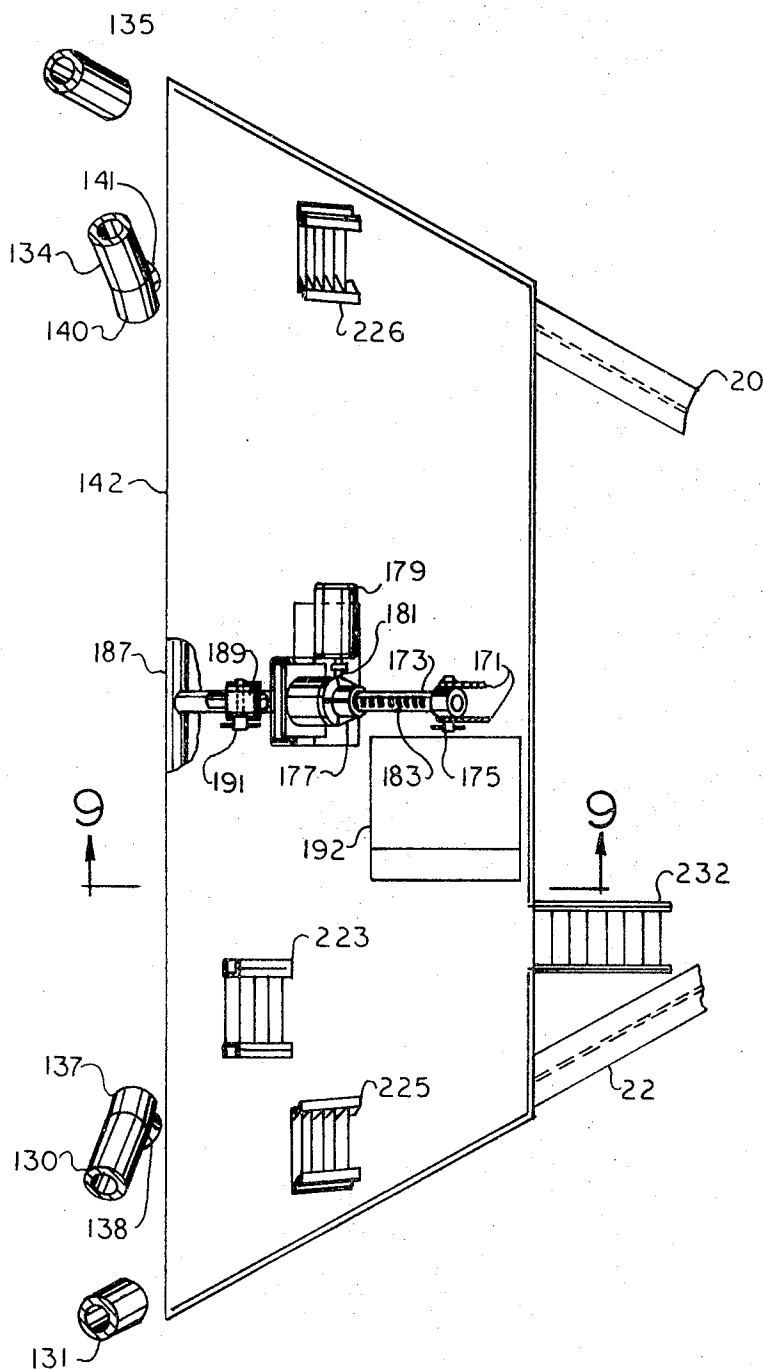


FIG. 8

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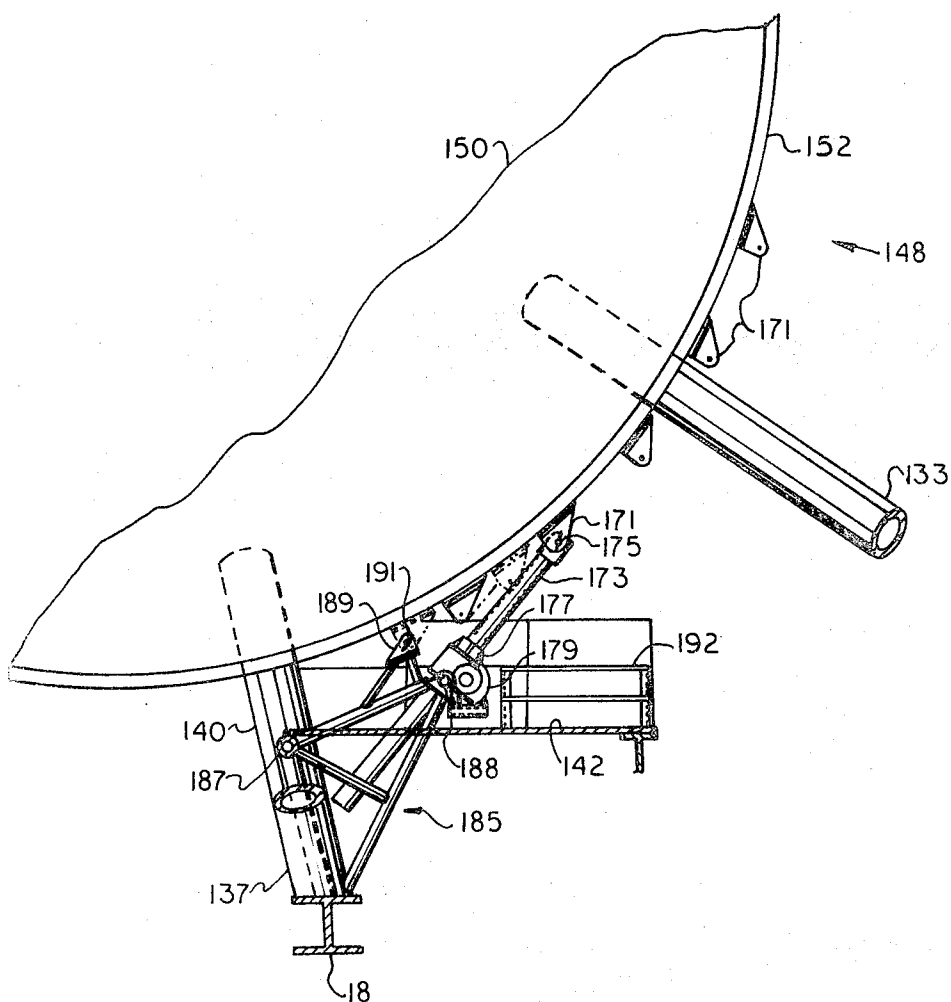


FIG. 9.

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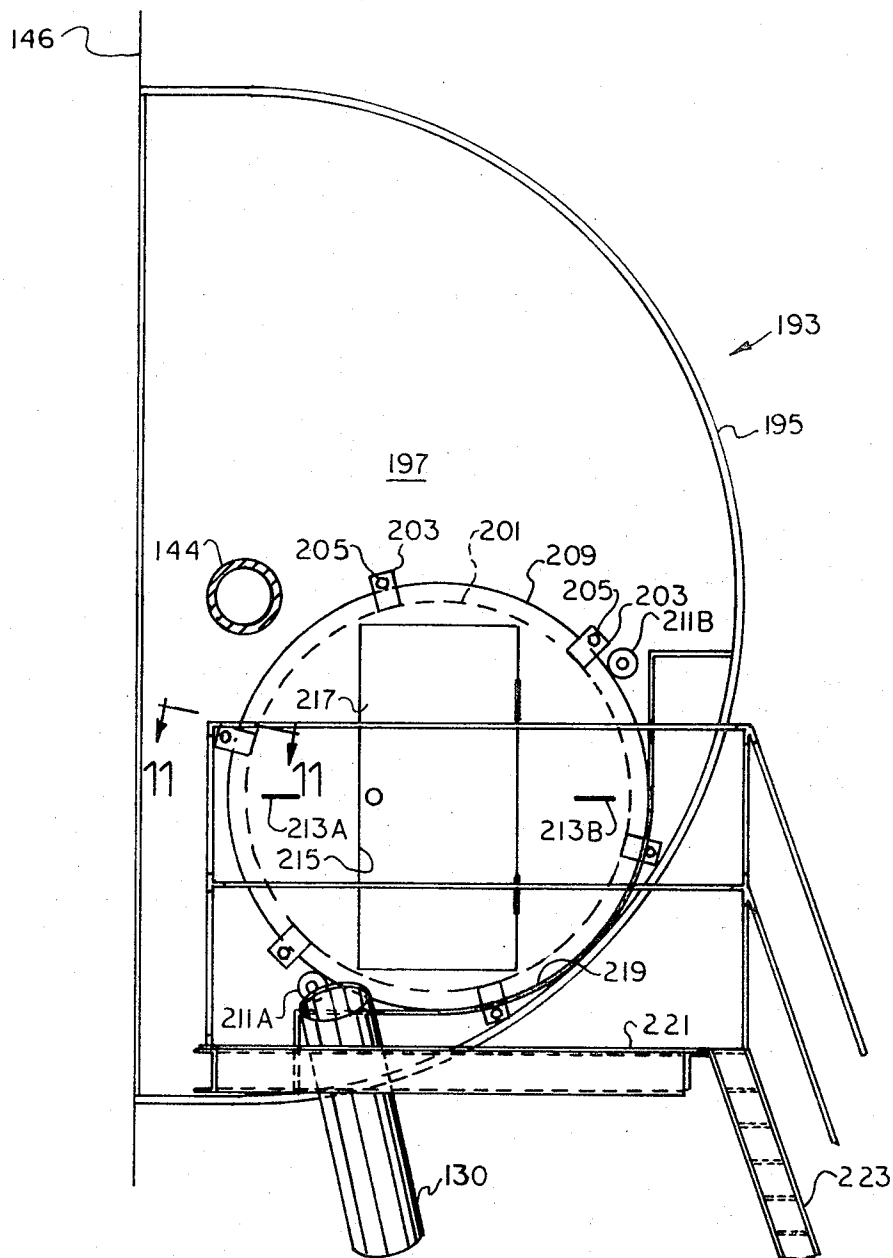


FIG. 10.

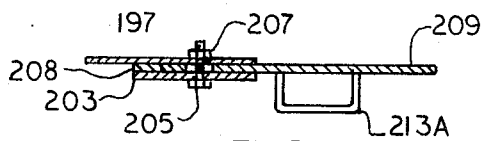


FIG. 11.

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LIMITED TRACKING REPOSITIONABLE AZ/EL TURRET TYPE ANTENNA

BACKGROUND OF THE INVENTION

This invention relates to large antennas of the type employed in tracking objects and bodies in space. This application is a continuation-in-part of "Limited Tracking Repositionable Az/El Turret Type Antenna" by Salvatore Rocci, Ser. No. 789,786, filed Jan. 8, 1969, now abandoned.

Since communication and navigation satellites are orbited at great altitudes above the earth, and at speeds which retain their substantially fixed in azimuth and elevation with respect to a station on the earth's surface, the reflectors of antennas employed in tracking the orbital paths of such satellite do not have to rotate through large azimuthal and elevational angles. However, over a long period of time the orbit of such a satellite may shift in position relative to such station on the surface of the earth, or it may be desired to focus the antenna on another satellite, so that an antenna having a reflector mounted for only limited azimuthal and elevational movement would be unable to follow the new path of such satellite. Although such loss of tracking capacity is not a problem with antennas provided with reflectors which can rotate through large azimuthal and elevational angles, the cost of such wide tracking antennas is generally considerably greater than that of an antenna with more limited tracking capability.

The driven azimuthal and elevational tracking movements of an antenna constructed in accordance with the principles of the present invention are limited in extent. However, the antenna is arranged so that the angular position at which said tracking movements occur can conveniently be varied both in azimuth and elevation. Hence, the invention provides a relatively inexpensive antenna which is well-suited for use in tracking communication and navigation satellites or other objects having similar limited orbital characteristics.

SUMMARY OF THE INVENTION

According to the present invention, the pedestal of an antenna is formed with a flat, horizontally disposed upper surface on which a turret is pivotally supported. Because the invention relates in particular to antennas of large and heavy construction, the pedestal is preferably in the form of a concrete tower having the turret mounted on the upper surface of the roof thereof. The turret is preferably formed of steel structural members and comprises a bearing portion pivoted to a pintle which is fixedly secured to the pedestal and which projects perpendicularly from the upper surface thereof.

The turret also comprises two slide blocks which depend from the lower portion thereof at points spaced from the aforesaid pintle and which slide on slide plates fixedly supported on the upper surface of the pedestal, said slide plates being equidistant from the aforesaid pintle and spaced apart circumferentially thereof. Mounted on the turret for rotation about an axis perpendicular to the longitudinal axis of the pintle is a reflector of conventional design.

An elevation wheel is fixedly attached to the back of the reflector so that its axis of rotation is coincident with the axis of rotation of the reflector, and a plurality of clevises are spaced along the periphery of this eleva-

tion wheel. An extensible member is pivotally mounted on the turret for rotation about an axis disposed parallel to the axis of rotation of the reflector, one end of said extensible member being engaged with a selected one of said clevises when the antenna is being used to track a satellite or other object and said extensible member being extended and retracted relative to its point of attachment to the turret to thereby pivot said reflector about its axis of rotation.

Another extensible member is mounted on the pedestal and connected at one end to the turret. Extension and retraction of this last mentioned extensible member relative to its point of attachment to the pedestal pivots the turret about the pintle to which it is attached, the slide blocks of the turret sliding on the aforesaid slide plates during this movement. A lug is attached to the turret in such manner that any one of clevises on the elevation wheel can be secured thereto by means of a locking pin, thereby permitting the reflector to be held in fixed position relative to the turret. Attached to the back of the reflector is a walkway tube the rear wall of which is hemicylindrical and which projects laterally from said elevation wheel.

As will be explained in detail hereinafter, different ranges of elevational rotation of the reflector of the aforescribed antenna can be obtained by engaging the end of the first mentioned extensible member with different ones of the clevises on the periphery of the aforesaid elevation wheel. Furthermore, through the relocation of the slide plates on the upper surface of the pedestal, different ranges of azimuthal rotation of the turret (and thus of the reflector mounted thereon) can be obtained, as will also be described in detail hereinafter.

OBJECTS OF THE INVENTION

An object of this invention is to provide a new and improved, limited tracking, turret type, elevation-over-azimuth antenna.

Another object of the invention is to provide a tracking antenna of limited azimuthal and elevational tracking movement which can conveniently be adjusted so that the reflector thereof will track selected communication and navigation satellites which change position very slightly, either in elevation or azimuth, relative to a station on the surface of the earth.

Another object of the invention is to provide inexpensive bearings for antenna rotation by placing bearing material on pads, or slide blocks, which are attached to the turret of an antenna and which slide on commercially finished surfaces of steel plates.

An additional object of the invention is to attach a walkway tube to the pivotally mounted reflector of a tracking antenna so as to provide convenient access to, and comfortable working conditions in, said walkway tube.

A further object of the invention is to provide a relatively inexpensive yet effective limited tracking antenna.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view in side elevation of a preferred turret type Az/El antenna system in accordance with the present invention, most of the reflector and a portion of the pedestal building being broken away.

FIG. 2 is a rear view of the antenna system of FIG. 1, portions being broken away.

FIG. 3 is a plan view of the turret base of the antenna system of FIGS. 1 and 2, a support carriage for use in changing the rotative position of the turret about its axis being shown in broken lines, portions being broken away.

FIG. 4 is a diagrammatic plan view of the support pedestal with the turret base shown in FIG. 3 mounted thereon, turret base being shown in solid lines in one rotatively adjusted position, and in broken lines in another adjusted position.

FIG. 5 is an enlarged, fragmentary, sectional view of the pintle which pivotally mounts the turret base on the pedestal, and is taken along line 5—5 of FIG. 3.

FIG. 6 is a fragmentary, enlarged, plan view of the azimuth tracking drive mechanism for the turret base, intermediate portions being broken away.

FIG. 7 is a sectional view taken along line 7—7 of FIG. 6.

FIG. 8 is an enlarged, fragmentary, plan view of a portion of the turret base of FIG. 3, the elevation drive mechanism and a platform with fragments of various frame tubes being shown.

FIG. 9 is a fragmentary, sectional view taken along line 9—9 of FIG. 8, a portion of the elevation wheel being shown.

FIG. 10 is an enlarged, fragmentary, elevational view showing the same end of the walkway tube as that shown in FIG. 1.

FIG. 11 is a fragmentary, further enlarged, sectional view taken along line 11—11 of FIG. 10.

Throughout the drawings and the following specification, like reference numbers designate like parts.

DETAILED DESCRIPTION

As illustrated in FIGS. 1 and 2, a preferred embodiment of the present invention comprises a support pedestal, generally designated by the number 10, which is formed of concrete and which has a flat, horizontally disposed upper surface 12. Supported on said upper surface is a turret, generally designated by the number 14, which comprises a triangular base frame 16 of I-beams 18, 20 and 22, see FIG. 3, adjacent ends of which are secured, as by welding, to apex weldments 24, 26 and 28.

Pivotal mounting of the turret 14 on the pedestal 10 is provided by a vertically disposed tubular pintle 30, see FIG. 5, the upper portion of which projects from the roof 32 of pedestal 10, and the lower portion of which is fixedly secured to the roof by bolts 34 and nuts 36, and disposed within a hole 38 extending through said roof. The same figure also illustrates in detail the bearing portion of weldment 28 of the turret base frame 16, which bearing portion comprises a vertically disposed tubular member 40 positioned within a hole 42 in the upper plate 44 of said weldment 28 and fixedly joined by welding to said upper plate and to the lower plate 46 of the weldment. A support ring 48, for supporting the portion of the weight of the turret imposed thereon by the weldment 28, is fitted into the tubular pintle member 40, and is fixedly secured thereto by suitable means, such as welding.

The support ring 48 is supported rotatably upon a bearing ring 50, preferably formed of a bearing material sold by Garlock-Nadella Inc., Cherry Hill, New Jersey, under the trade name "DU". Bearing ring 50 is backed by a steel washer 52, supported upon a shoulder formed near the upper end of pintle 30, and a bear-

ing sleeve 54, backed by a steel sleeve 56, is interposed between the periphery of support ring 48 and the pintle.

Another bearing ring 50' and steel washer 52' are interposed between the upper face of support ring 48 and an annular cap 58, which is attached co-axially onto the upper end of pintle 30 by bolts 60. This cap projects radially beyond the pintle and extends over washer 52'. Weldment 28 is thus rotatably supported by, and retained against movement longitudinally of, the pintle. Seal rings 62 and 62' are provided to seal the bearing components.

The upper end of tubular member 40 is formed with an integral flange 64, to which is bolted the mating flange 66 of a second tubular member 68, the latter being of similar tubing and coaxial with tubular member 40. A third tubular member 70 is positioned co-axially within tubular members 40 and 68 and is secured to cap 58 by an integral flange 72 on its lower end and bolts 74. Secured to the upper end of tubular member 70 by bolts (not shown) is a gear 76, in mesh with a gear 78 constituting part of an azimuth read-out device 80. The latter is mounted on a support ring 79 mounted co-axially on the upper end of tubular member 68. A fourth tubular member 82 is positioned co-axially within tubular member 70, and is welded at its lower end to the upper surface of cap 58. The upper end of tubular member 82 has a ring sprocket 84 secured co-axially thereon, and a drive chain 86 passes around sprocket 84 and also around a second sprocket 88, the latter being mounted on the shaft 90 of a limit switch 92 on support ring 79.

Extending through the pintle 30 and tubular member 82 is an electrical conductor cable 94, which supplies electrical current to various turret mounted mechanisms. As shown in FIG. 3, 6 and 7 two slide support base plates 96A and 96B are mounted on the surface 12 at any desired pair of a plurality of selected angular locations on the pedestal 10, and are secured in such position by bolts 98 and nuts 99, see FIGS. 6 and 7. The base plates 96A and 96B are spaced apart circumferentially of a circle swung from said pintle and are so spaced radially therefrom that they will be positioned under the turret base weldments 24 and 26, respectively, with the turret in a selected, rotatively adjusted position. The base plates 96A and 96B have slide plates 100A and 100B, respectively, fixedly attached to their upper surfaces by suitable means, such as welding. A pair of slide blocks 101A and 101B are mounted beneath the turret base weldments 24 and 26, respectively, for slidable movement along these slide plates, see particularly FIGS. 3, 6 and 7, upon azimuth tracking movement of the turret about the pintle 30 as an axis.

The lower surface of each slide block preferably has a layer of suitable bearing material 102 bonded thereto, such as the "DU" mentioned previously herein.

Each of the slide blocks 101A and 101B comprises two relatively interfitted portions, as best shown in FIG. 7, said portions comprising an upper portion 106, attached one to each weldment 24 and 26, and a self-adjusting lower portion 107. Each slide block upper portion 106 has a cylindrical section, concavely curved lower face 108, shown in broken lines in FIG. 7, while its associated lower portion 107 has a corresponding convexly curved upper face which fits thereto. Thus, the assembled slide blocks 101A and 101B support the

substantial weight imposed thereon by the weldments 24 and 26, while the lower portions 107 are free to adjust to conform to longitudinal variations from the horizontal in the slide plates 100A and 100B upon which they are supported. Flanges 104 are provided one along each side of the convex upper surface of each slide block lower member 107 to prevent lateral displacement of the lower member.

At one end of the base plate 96A, beyond the slide plate 100A thereon, is mounted an azimuth tracking drive mechanism which is best shown in FIGS. 6 and 7. This drive mechanism comprises a support member 100 having a base 111 and a pair of upright trunnion arms 112A and 112B. Bolts 98 which anchor base plate 96A to the pedestal 10 also pass through holes in the base 111 and anchor support member 110 to the base plate and to the pedestal. Trunnioned between the arms 112A and 112B by trunnion pins 114A and 114B is a trunnion block 116, which in turn pivotally supports a jack screw bearing 118 by trunnion pins 119A and 119B. Bearing 118 has mounted therein a conventional jack screw 120 driven by a reversible electric motor 121. As illustrated, this mechanism is of a well known type known as a 50 ton ball screw jack. One end of the jack screw 120 is pivotally connected to a fitting 128 secured to weldment 24 as by welding.

For supporting a usual reflector mechanism for tracking in elevation, two associated groups of support tubes 129, 130 and 131, and 133, 134 and 135 are mounted on the turret base frame 16. Each of these groups forms a tripod having reflector bearings 136A and 136B, respectively, fixedly mounted at the apexes thereof.

The construction and arrangement of the support tubes, bearings and base frame are similar to corresponding members disclosed in U.S. Pat. Application Ser. No. 750,444, filed by Robert D. Hall on Aug. 5, 1968, now Pat. No. 3,604,011 and assigned to Rohr Corporation, the assignee of the present invention.

As illustrated in FIG. 2, the ends of a reflector support shaft 144 are respectively journaled in reflector bearing structures 136A and 136B, and a conventional dish type reflector 146, only a small central portion of which is shown, is fixedly mounted on said shaft.

In order to provide a plurality of circumferentially spaced attachment points for an elevation tracking drive mechanism, an elevation half wheel 148 is secured to the back of the reflector with the axis of rotation of the wheel coincident with the axis of shaft 144. Such axis is herein referred to as the elevation axis of the antenna. The wheel 148 comprises a substantially semi-circular plate 150 disposed perpendicular to shaft 144, and mounted on and secured to the reflector assembly in a manner which will be obvious to any ordinarily skilled antenna designer. Since the structure and mounting details of this wheel are not per se features of the invention, and will be designed for each type of antenna in which the invention is mounted, they are omitted herein. Fixedly mounted at selected, spaced intervals along the rim 152 of the wheel 148 are a plurality of suitable attachment elements, such as clevises 171, which are spaced circumferentially of the rim. Elevation tracking drive mechanism, see FIGS. 8 and 9, comprises a power driven ball screw jack 173, which is trunnioned on a support weldment 185, see FIG. 9. One member of the support weldment is connected to a horizontally disposed tube 187, the ends of which are

connected to support tubes 137 and 140, and another member thereof is connected to a beam 18 of the turret base frame 16. A platform 142, see FIGS. 1, 8 and 9 has holes through which members of the support weldment 185 extend, and the jack screw 173 is pivotally connected by trunnions 188 to the support weldment 185 for pivotal movement about an axis parallel to the elevation axis. The upper end of the jack screw is adapted to be pivotally connected to any of the clevises 171 within its reach.

Also fixedly mounted on the support structure 185, and closely adjacent the path of movement of the clevises 171 upon rotative movement of the wheel 148, is a lug 189 having a hole therein located to register with a corresponding hole in each clevis 171 on elevation wheel 148 brought into register therewith upon rotating movement of the wheel. An anchor pin 191 is provided for inserting in such aligned holes and thereby anchoring the wheel 148 and the antenna reflector while changing the connection of the jack screw 173 from one clevis 171 to another.

A walkway tube 193, see FIGS. 1, 2 and 10, is fixedly mounted on the back of reflector 146, and comprises a hemicylindrical wall 195 concentric with shaft 144 and projecting from both sides of elevation wheel 148. Walkway tube 193 also comprises two end walls 197 and 199, spaced inwardly from the ends of said wall 195 and joined to said wall in perpendicular relation to the elevation axis. End wall 197 has a circular hole 201 therein, the edge of which is represented by a broken line in FIG. 10.

Spaced circumferentially about hole 201 are a plurality of locking lugs 203, each of which is mounted on the end wall 197 by a bolt 205, which passes through a hole in the lug and through a hole in end wall 197, and which is screwed into a nut 207 welded to said end wall (see FIG. 11). Each lug 203 has a spacer 208 welded thereto, and the edge of disk 209 is disposed between lugs 203 and the margin surrounding the hole 201. Two friction reducing rollers 211A and 211B are rotatively mounted on said end wall adjacent said hole to engage and assist in supporting the disk 209. Thus, the edge of disk 209 overlaps the edge of hole 201 so that the disk seals the hole when the locking lugs 203 are tightened against the outer surface of said disk. The disk 209 has a rectangular door opening 215 therein, and a door 217 is provided to seal the door opening when in closed position. A pair of handles 213A and 213B are provided on the disk 209 to facilitate turning the disk to position the door opening upright in any angle of elevation of the reflector.

A curved step plate 219 is fixedly joined to the end wall 197 and projects therefrom to a point even with the end of the curved wall 195. This step plate facilitates personnel in stepping from door 217 and a platform 221 and vice versa.

Various ladders, steps and platforms, not shown, may be provided as required and in accordance with usual practice for reaching and working on various parts of the antenna. Since such addenda are subjects of individual preference and design, and are not per se features of the invention, they are omitted herein to avoid unnecessarily complicating the drawings.

OPERATION

It is assumed initially that the base plates 96A and 96B are secured in selected locations to the surface 12

to position their respective slide plates 100A and 100B for movement of the turret slide blocks 101A and 101B therealong. In this adjusted position, extension of the jack screw 120 by motor 121 moves the weldment 24, see FIGS. 3, 6 and 7, away from the bearing 118 and thereby rotatably moves the turret 14, see FIG. 3, clockwise about the pintle 30. Conversely, retraction of the jack screw 120 moves the turret in a counterclockwise direction.

The range of pivotal adjustment of the turret 14 in each location of the base plates 96A and 96B is limited to the relatively short distance which slide blocks 101A, 101B can travel along the slide plates 100A, 100B, respectively, while remaining supported thereon. However, when it is desired to swing the turret to a newly adjusted position beyond the limits permitted by the slide plates 101A and 101B, but within the limits permitted by the size and shape of the pedestal top surface 12, for example as shown in FIG. 3, a dolly 222, broken lines FIG. 3, or other suitable means can readily be employed to support beam 18 of the base frame of turret 14 as the latter is moved to such newly adjusted position. Hence, if the limited tracking in azimuth permitted with the turret 14 in a first adjusted position on the pedestal 10 becomes operationally unsuitable, for example, due to a shift in orbit of a communications satellite, the turret can thus be swung to a desired new position on the pedestal, and base plates 96A and 96B relocated as described previously herein so that their slide plates 100A and 100B support the turret slide blocks 101A, 101B respectively in this new position.

In order to allow the slide blocks 101A and 101B to conform to their respective slide plates in the event that either base plate 96A, 96B is not level lengthwise thereof, each slide block is made in two relatively superposed parts as best shown in FIG. 7. A cylindrically curved interface shown in broken lines in FIG. 7 permits the lower portion to conform longitudinally to the slide plate upon which it is supported, while side flanges 104 prevent lateral displacement between the upper and lower slide block portions.

For adjusting the elevation angle of the reflector as shown in FIG. 9, extensible member 173 is shown connected to a clevis 171 which is next to the lowest clevis on the rim 152 of the elevation wheel 148. Limited elevational tracking movement of reflector 146 in this condition is effected by operating motor 179 in a selected direction to extend or retract said member 173 axially of its bearing 177.

In the event that it becomes necessary to change the elevation of the antenna beyond the limits permitted by extension and retraction of the member 173, in this condition, the motor 179 is operated to retract member 173 to move the lowermost clevis 171'', see FIG. 9, into register with anchor lug 189 on support structure 185 as shown in FIG. 1 and in broken lines in FIG. 9.

Locking pin 191 is then inserted into the aligned holes in the anchor lug 189 and registering clevis 171'', thereby anchoring the reflector 146 to the turret 14. Extensible member 173 is then released from the clevis 171, and motor 179 is operated to extend the member 173 to bring the hole in its upper end into register with that in the clevis 171' therebeyond and the pin 175 is inserted in the thus aligned holes. Upon removal of locking pin 191 to free the wheel from the anchor lug 191, extension and retraction of the member 173 again pivots reflector 146 over its thus newly established lim-

ited range of elevational tracking movement. By thus changing the connection of the extensible member 173 from one clevis 171 to another it is possible to connect member 173 to any selected one of the clevises 171 to provide for limited tracking in elevation within the limits provided by each such connection.

The walkway tube 193 connected to the back of reflector 146 provides protected access to usual electrical components located at the center of the reflector on the front side thereof, these components being connected to the electrical cable 94. Since reflector 146 will be tilted upward at various angles during the use of the disclosed antenna structure for tracking objects in space, walkway tube 193 will be rotated to different angular positions about the elevation axis of the antenna. However, workmen who enter the walkway tube through door 217 will always be able to walk without difficulty along the portion of hemicylindrical wall 195 which is disposed under shaft 144 irrespective of the angular position of the reflector. Furthermore, since disk 209 can be rotated relative to end wall 197 of the walkway tube, door 217 can be maintained in vertical position at any angular position of the reflector, thus providing convenient access to the interior of the walkway tube from platform 219. Since the step plate 219 is curved to conform substantially to the edge of the door disk 209, workmen going between the platform 221 and the door opening 215 can step onto and from this platform regardless of the elevation angle of the reflector.

The read-out device 80 mounted on support ring 79 (see FIG. 5) is connected to a usual indicator (not shown) which is calibrated to show the azimuthal position of turret 14 as it pivoted about pintle 30. Since the movement of the turret is limited to the distance which slide blocks 101A, 101B can safely move along their respective slide plates 100A, 100B, the limit switch 92 is arranged to stop the azimuth drive motor 121 when said slide blocks reach predetermined limits.

The base and slide plates and the azimuth drive mechanism preferably are located with their major axes approximately tangent to the arc of movement of their respective slide blocks. However, in the event that for some reason such manner of attachment should be unfeasible or undesirable, the base and slide plates and drive mechanism may be mounted with their respective major axes at any desired angle to such tangents short of radially from the axis of the support pintle 30.

What is claimed as new and useful and desired to be secured by U.S. Letters Patent is:

1. A limited tracking turret type antenna comprising:
 - a pedestal having a pintle and a pair of slide plates fixedly supported on the upper surface thereof, the longitudinal axis of said pintle being disposed substantially perpendicular to said upper surface and said slide plates being substantially equidistant from said pintle and spaced apart circumferentially thereof;
 - a turret comprising two slide blocks respectively slidably supported on said slide plates and a bearing portion supported on and pivotally engaged with said pintle;
 - a reflector mounted on said turret; and
 - positioning means including an axially extensible member connected between said pedestal and said turret and adapted to pivot said turret in opposite direction about said pintle and on said slide plates.

2. The apparatus defined in claim 1 wherein said positioning means comprises power drive means adapted to selectively extend and retract said extensible member relative to said support member.

3. The apparatus defined in claim 1 wherein said positioning means comprises a support member fixedly supported on said pedestal, a bearing connected to said support member by a universal joint arrangement, an extensible member carried by said bearing and pivotally connected at one end to said turret, and drive means connected to said bearing and adapted to selectively extend and retract said extensible member relative to the bearing.

4. The apparatus defined in claim 1 wherein said reflector is pivotally mounted on said turret for rotation about an elevation axis disposed substantially perpendicularly to the longitudinal axis of said pintle.

5. The apparatus defined in claim 4 including an elevation wheel fixedly secured to the back of said reflector with its axis of rotation substantially coincident with said elevation axis, a plurality of attachment elements fixedly mounted on the periphery of said elevation wheel and spaced apart thereabout, locking means fixedly secured to said turret adjacent the path of movement of the attachment elements upon rotative movement of the reflector and wheel about the elevation axis, and adapted for engagement with any one of said attachment elements when moved by rotative movement of the wheel adjacent thereto to thereby anchor said reflector in a selected angular position relative to said turret, an extensible member pivotally mounted on said turret for rotation about an axis disposed substantially parallel to said elevation axis and having one end adapted for engagement with selected ones of said attachment elements, with the wheel anchored by said locking means in selected angular position, and drive means carried by said turret and adapted for extending and retracting said extensible member relative to its point of attachment to said turret upon release of the wheel by said locking means to thereby control tracking movement of the wheel and reflector in elevation.

6. The apparatus defined in claim 5 wherein said locking means comprises an apertured lug fixedly secured to said turret each attachment element having also an aperture therein located to register with a lug adjacent thereto, and a pin insertable in the aperture in said lug and in the aperture of one of the clevises mounted on said elevation wheel when in register therewith.

7. The apparatus defined in claim 5 including a walkway housing joined to the back of said reflector and formed with a hemicylindrical wall the axis of which is coincident with said elevation axis, and projecting laterally from at least one side of said elevation wheel.

8. The apparatus defined in claim 6 wherein said housing comprises an end wall disposed perpendicular to said elevation axis and having a circular hole therein, a disk the periphery of which is rotatably engaged with said side wall around said circular hole and the central portion of which has a door opening therein, a door hinged to said disk adjacent said door opening therein and adapted to close the latter when in a closed position.

9. A turret type antenna comprising:
a pedestal having a pintle and a pair of slide plates fixedly supported on the planar upper surface

thereof, the longitudinal axis of said pintle being disposed substantially perpendicular to said upper surface and said slide plates being substantially equidistant from said pintle and spaced apart circumferentially thereof;

a turret comprising a triangular base frame, a bearing rotatably mounted on the upper end of said pintle and fixedly secured to said base frame adjacent one apex thereof, means for maintaining said bearing in fixed longitudinal position on said pintle to support the apex portion of the turret to which the bearing is secured, a pair of slide blocks respectively mounted to said base frame adjacent the other two apices thereof and slidably supported one on each said slide plate, each of said slide blocks having a layer of bearing material bonded to the lower surface thereof, a pair of support structures fixedly mounted on said base frame and projecting upwardly therefrom, a pair of reflector bearing structures respectively fixedly mounted in spaced, coaxial relation on said support structures, and a shaft journaled in said reflector bearing structures and extending therebetween;

positioning means comprising a support member fixedly supported on said pedestal, an extensible member carried by said support member and connected at one end to said turret, and drive means adapted to extend and retract said extensible member relative to said support member;

a reflector fixedly secured to said shaft;

an elevation wheel fixedly secured to the back of said reflector with its axis of rotation substantially coincident with said elevation axis, and having a plurality of clevises fixedly mounted on, and spaced about the periphery thereof;

locking means fixedly secured to said turret in the path of movement of the clevises upon rotation of the wheel and adapted for engagement with different ones of said clevises to thereby maintain said reflector in different angular positions relative to said turret; and

an extensible member pivotally mounted on said turret for rotation about an axis disposed substantially parallel to the longitudinal axis of said shaft and having one end adapted for engagement with different ones of said clevises, and drive means carried by said turret and adapted for extending and retracting said extensible member relative to its point of attachment to said turret for elevation tracking movement of the antenna and to move different ones of said clevises into register with said locking means.

10. The apparatus defined in claim 9 including a housing joined to the back of said reflector and comprising a hemicylindrical wall concentric with said shaft and projecting laterally from at least one side of said elevation wheel, an end wall disposed perpendicularly to the longitudinal axis of said shaft and having a circular hole therein, a disk the periphery of which is rotatably engaged with said side wall around said circular hole, and the central portion of which has a door opening therein, a door hinged to said disk adjacent said hole therein and adapted to close the latter when in a closed position, and means for locking said disk in different angular positions relative to said disk to position the door opening upright with the antenna in any selected angle of elevation.

11. The apparatus defined in claim 9 wherein said pintle is tubular and has at least one electric conduit extending therethrough.

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