

United States Patent

[11] 3,604,011

[72]	Inventor	Robert Dale Hall La Mesa, Calif.
[21]	Appl. No.	750,444
[22]	Filed	Aug. 5, 1968
[45]	Patented	Sept. 7, 1971
[73]	Assignee	Rohr Corporation Chula Vista, Calif.

Primary Examiner—Eli Lieberman
Attorney—George E. Pearson

[54] **TURRET-TYPE LARGE APERTURE ANTENNA
PRECISION MOUNTED ON CIRCULAR TRACK
8 Claims, 28 Drawing Figs.**

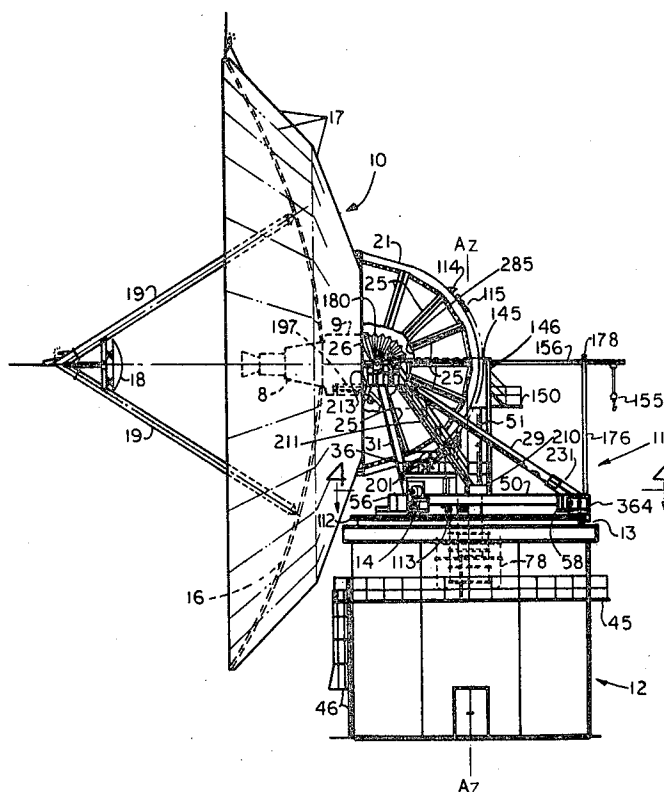
[52]	U.S. Cl.....	343/766, 343/912
[51]	Int. Cl.....	H01q 3/00
[50]	Field of Search.....	343/765, 766.912, 915.916

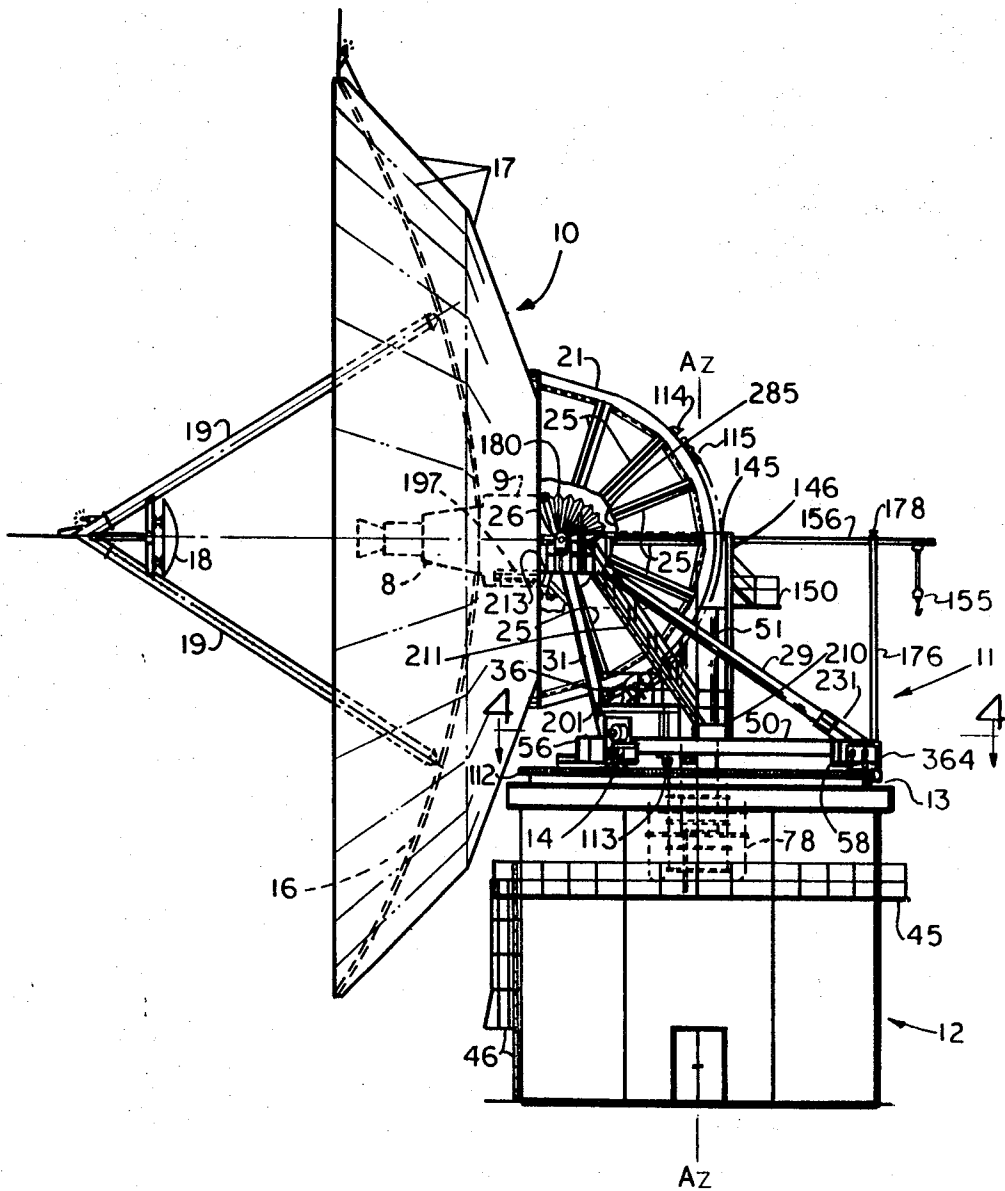
[56] **References Cited**

UNITED STATES PATENTS

3,141,168	7/1964	Ashton	343/765
3,153,789	10/1964	Ashton	343/765
3,375,523	3/1968	Laibson	343/766
3,407,404	10/1968	Cook et al.	343/765

ABSTRACT: An elevation over azimuth turret-type antenna provides roller and track supports for rotational movement of a turret on a pedestal about an Az—Az axis and provides spaced pivots and drive wheels for rotational movement of the antenna reflector on the turret about an El—El axis. The roller supports include radially directed rollers for constraining the movement of the turret support rollers coaxially with their circular track and further include holddown roller elements for preventing the turret from leaving the track due to the eccentric loading of the reflector on the turret. A tubular shaft disposed coaxially of the Az—Az axis is secured to the turret for rotation with it. The shaft extends upwardly through the several floors of the pedestal and through lower and upper rooms supported on the turret to which access is provided via an elevator mounted for operation within the shaft. An electronics room disposed between the spaced drive wheels increases the working area of the antenna, and bellows and jalousy ladder structures improve the access from the electronics room to functioning parts of the feed structure.





INVENTOR
ROBERT D. HALL

BY

George E. Carson

ATTORNEY

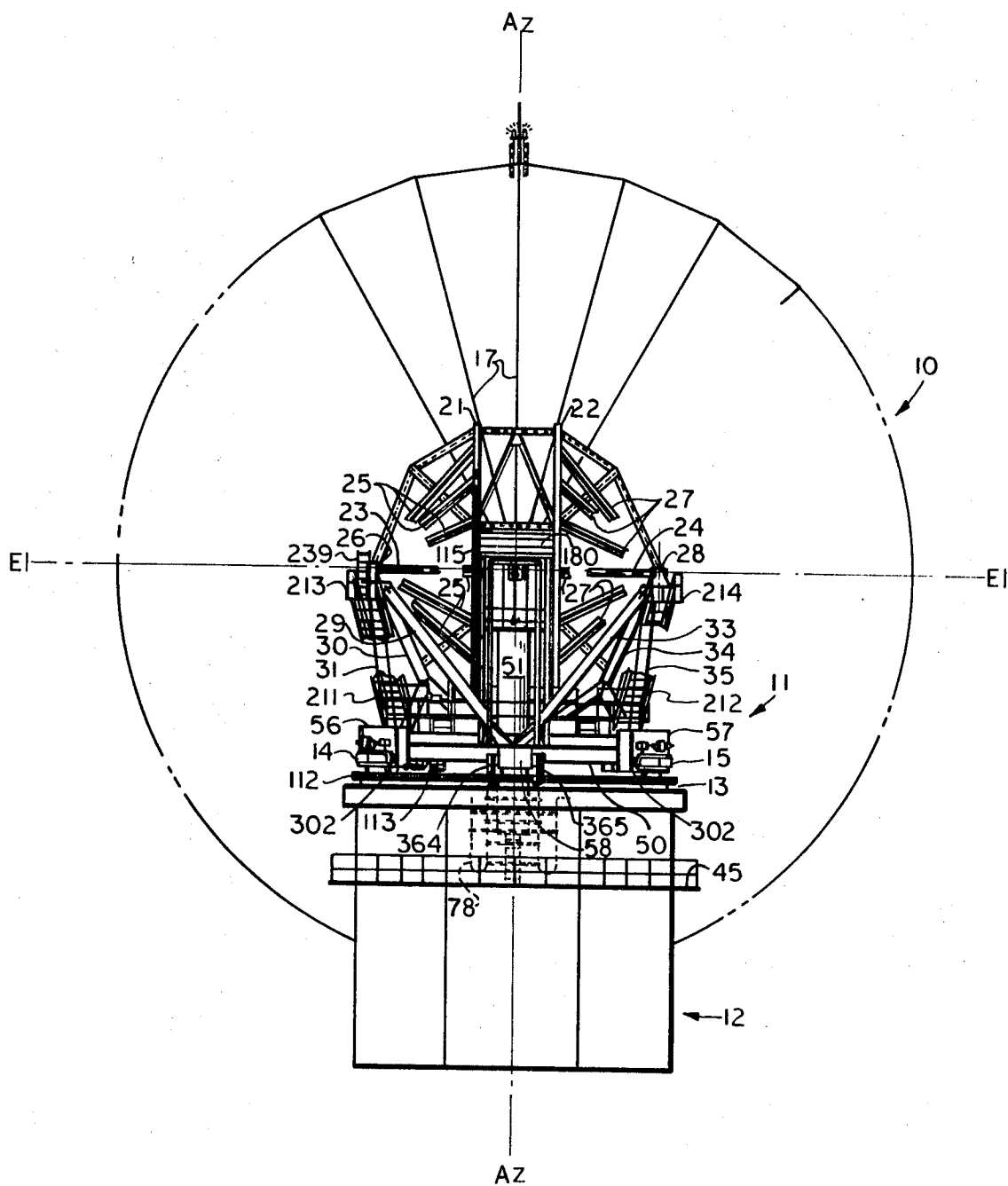


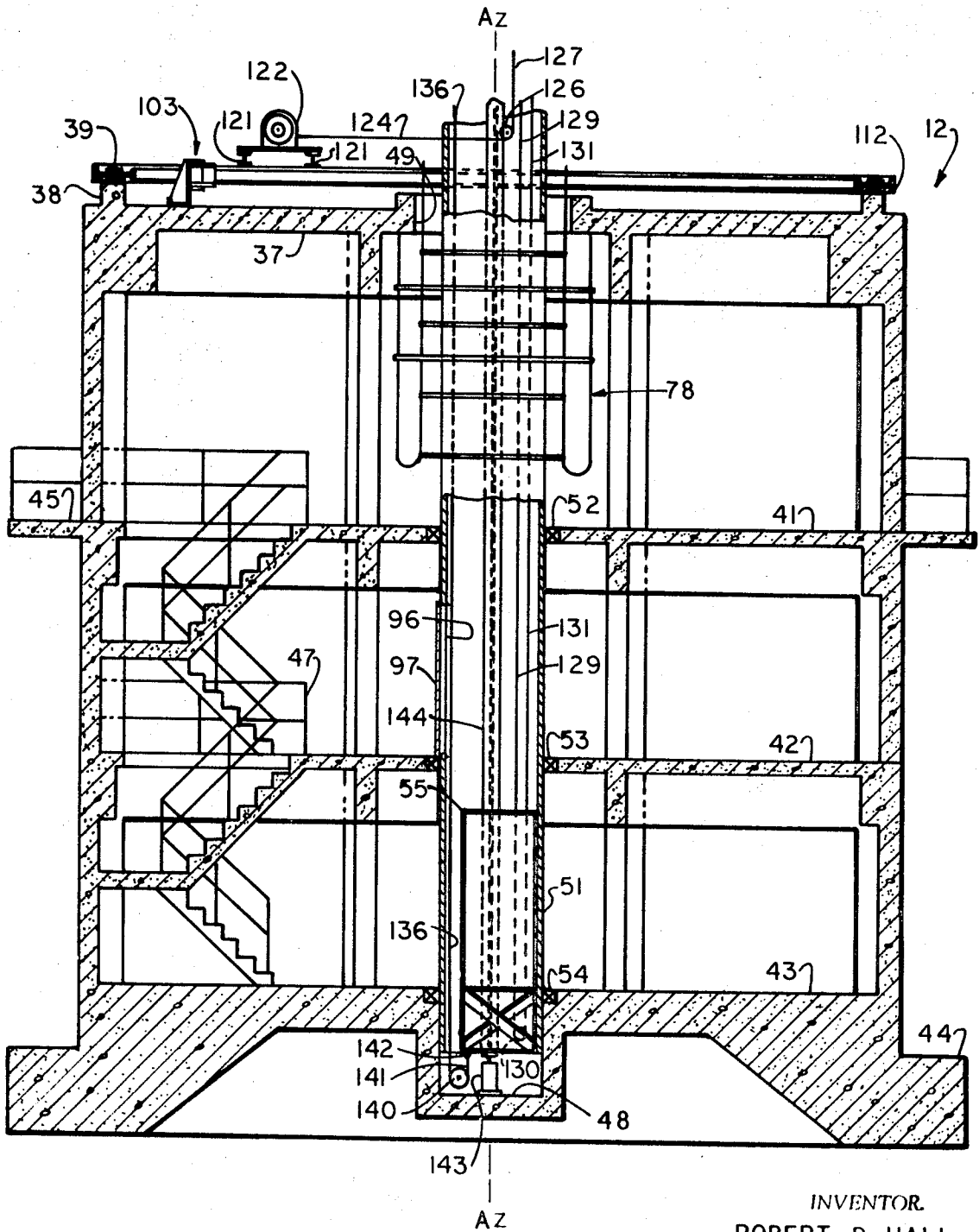
FIG. 2.

INVENTOR
ROBERT D. HALL

BY

George E. Pearson

ATTORNEY

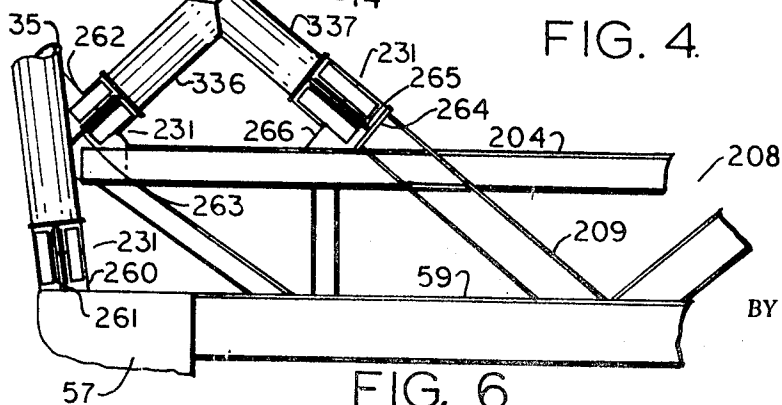
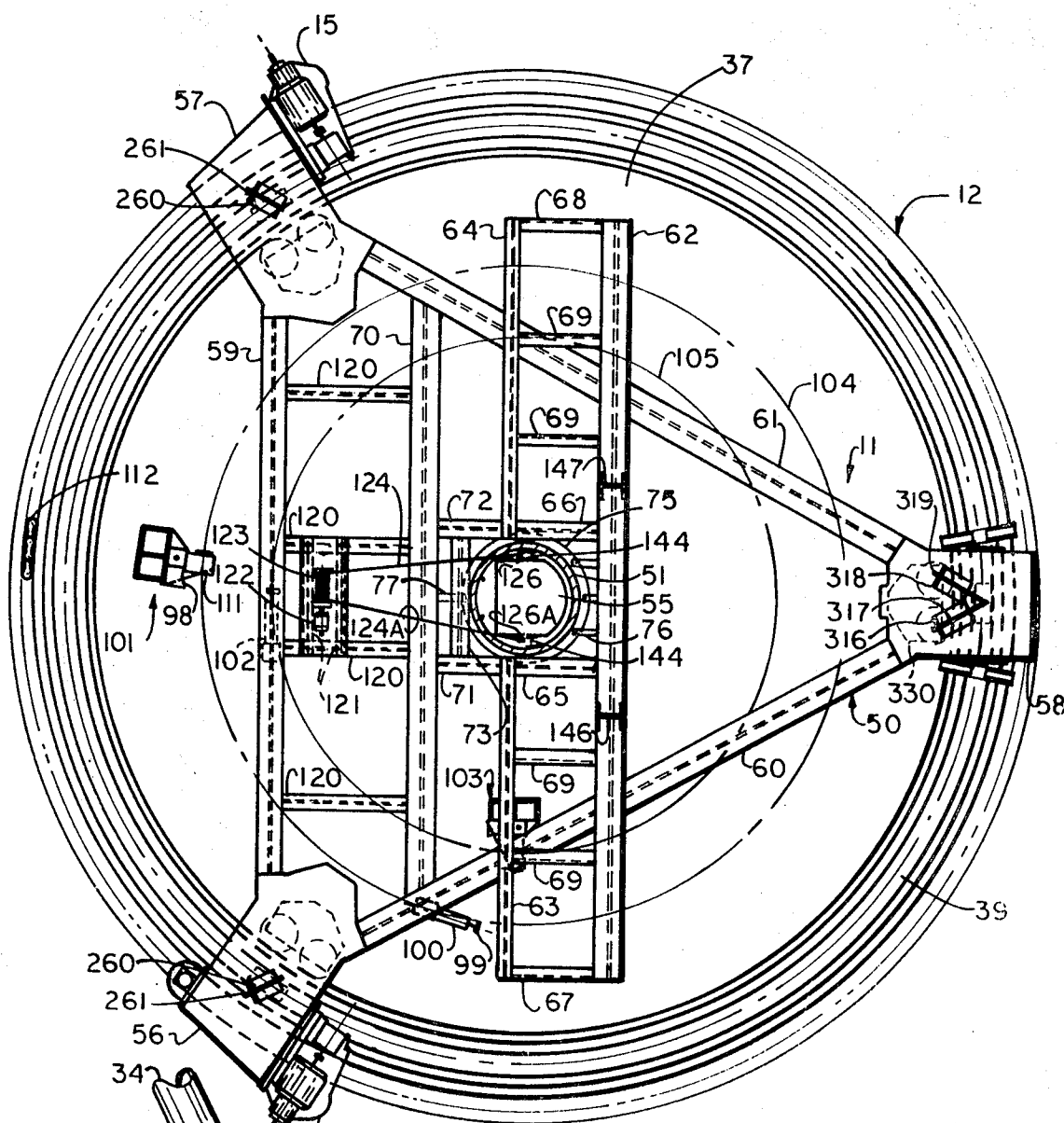


INVENTOR
ROBERT D. HALL

BY

Henry E. Pearson

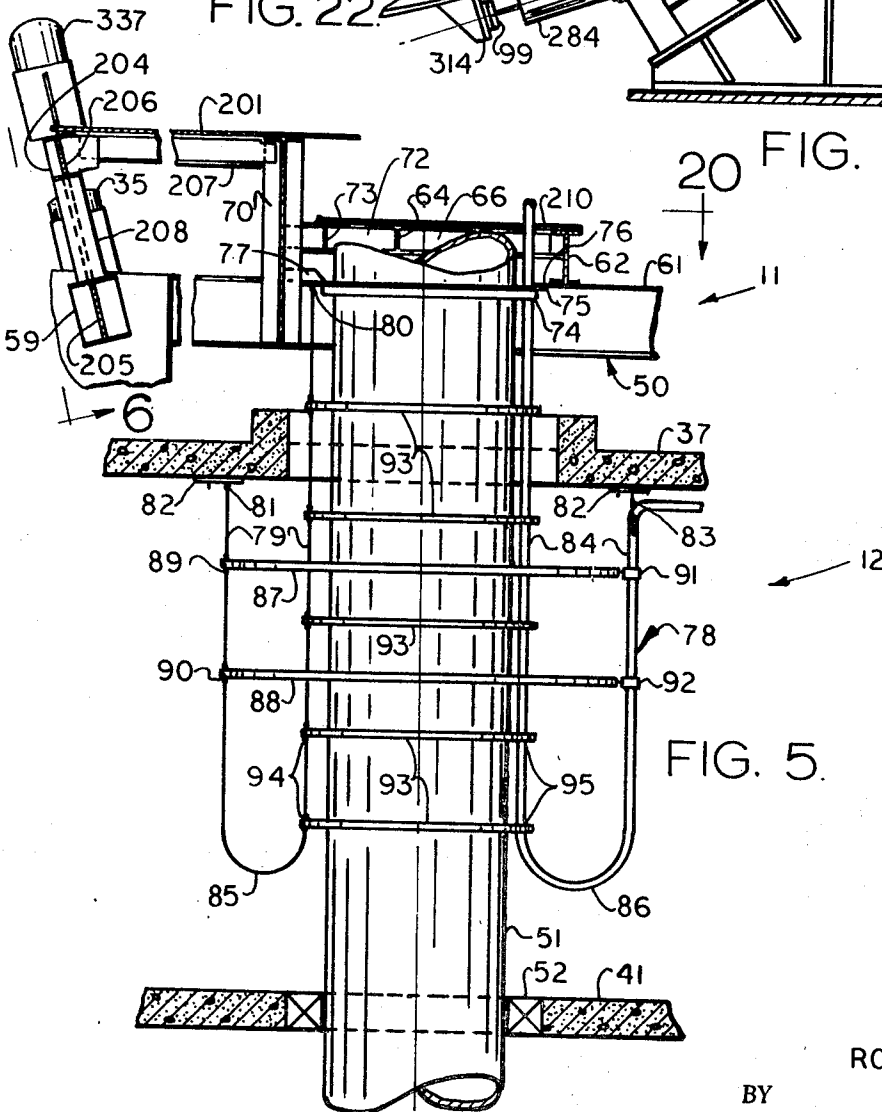
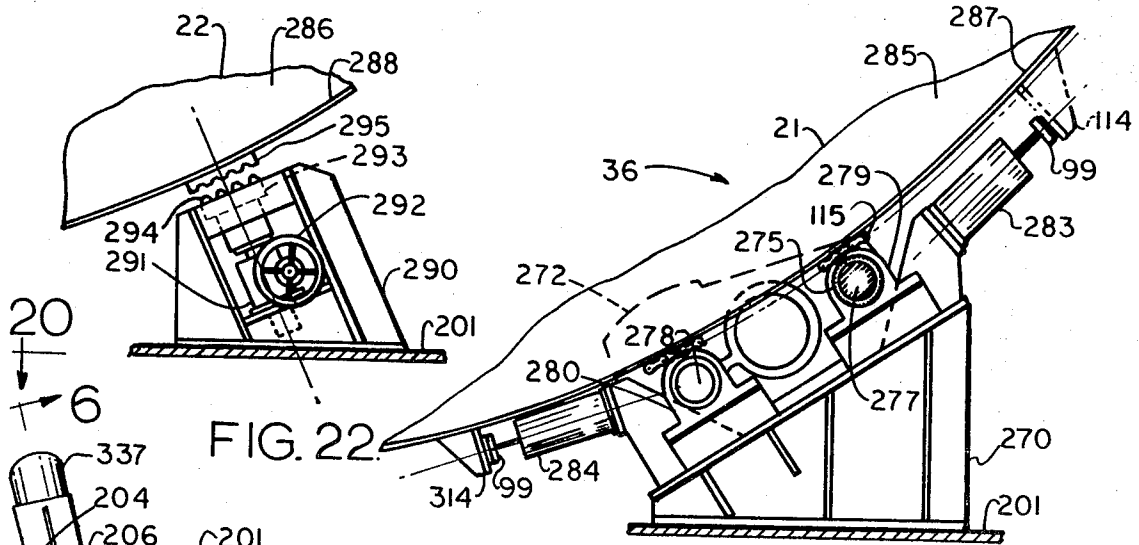
ATTORNEY



INVENTOR
ROBERT D. HALL

BY

George E. Carson
ATTORNEY



INVENTOR.
ROBERT D. HALL

BY

George E. Pearson
ATTORNEY

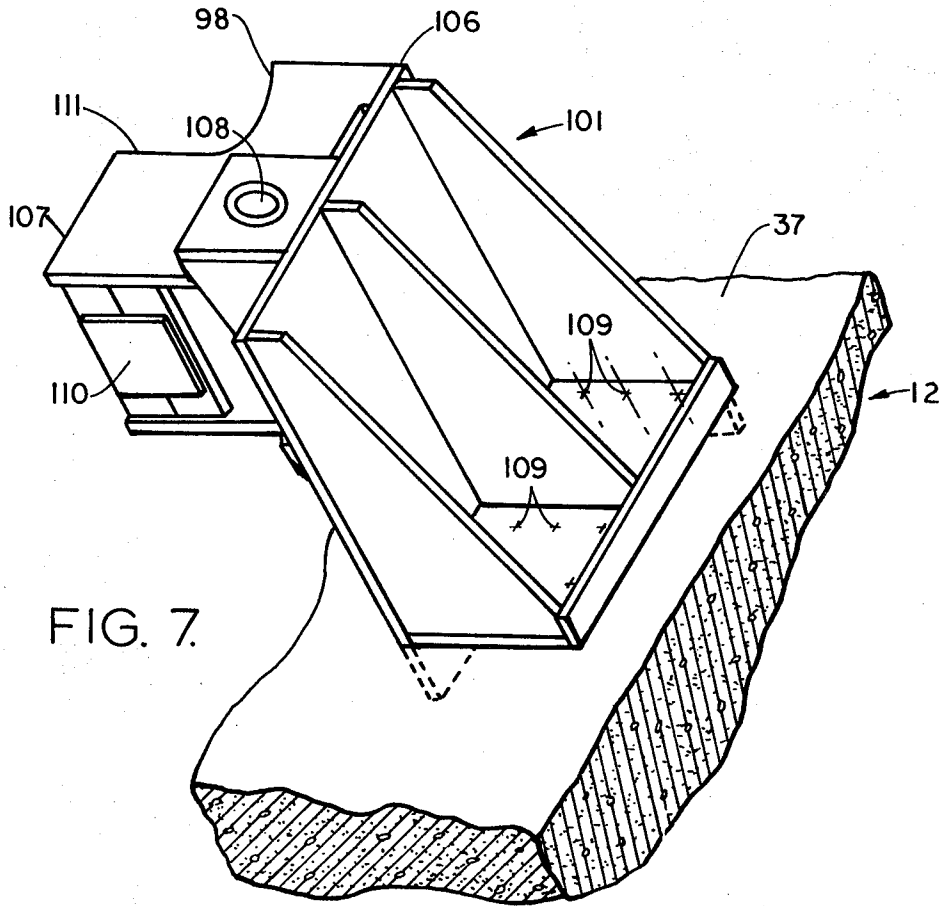


FIG. 7.

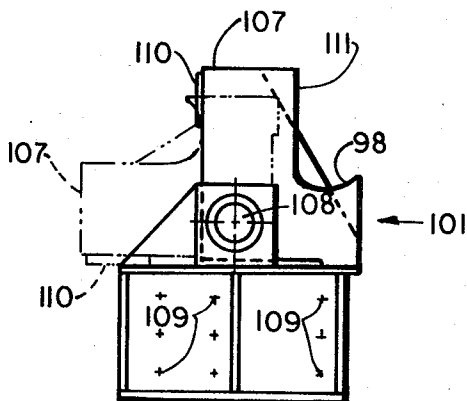


FIG. 8.

INVENTOR
ROBERT D. HALL

BY

George E. Pearson

ATTORNEY

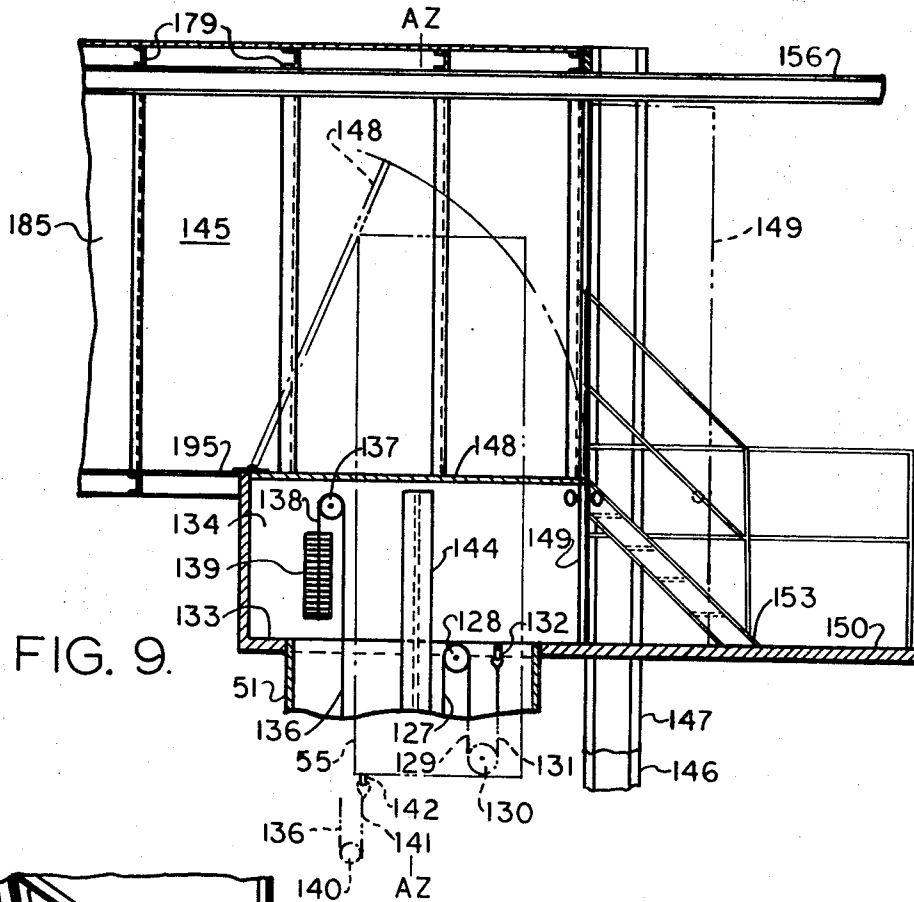


FIG. 9.

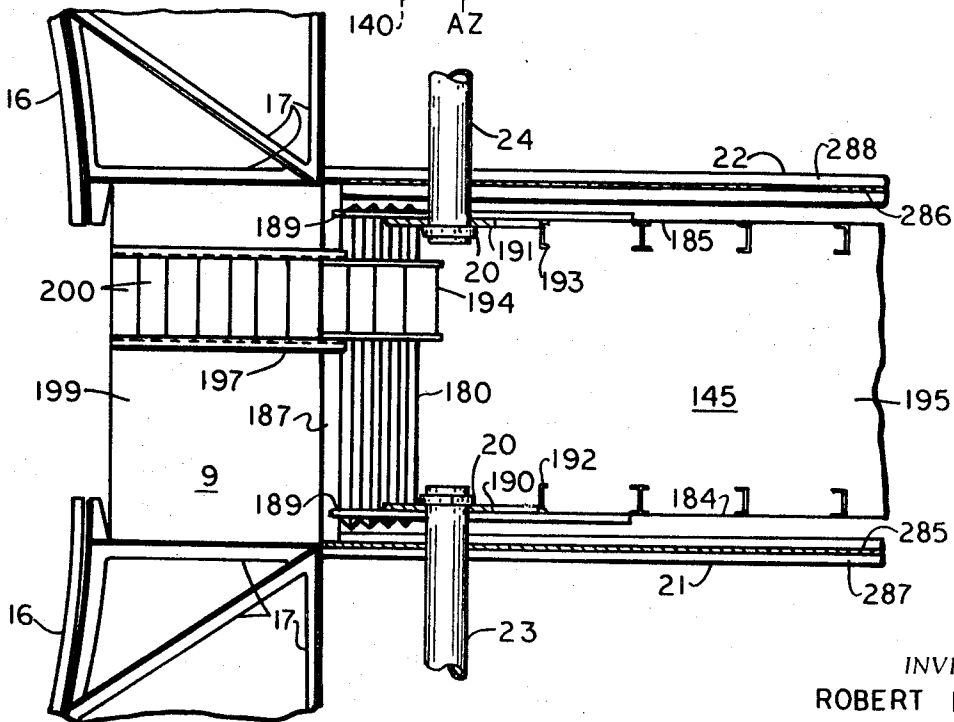


FIG. 11.

INVENTOR.
ROBERT D. HALL

BY

Henry E. Pomeroy

ATTORNEY

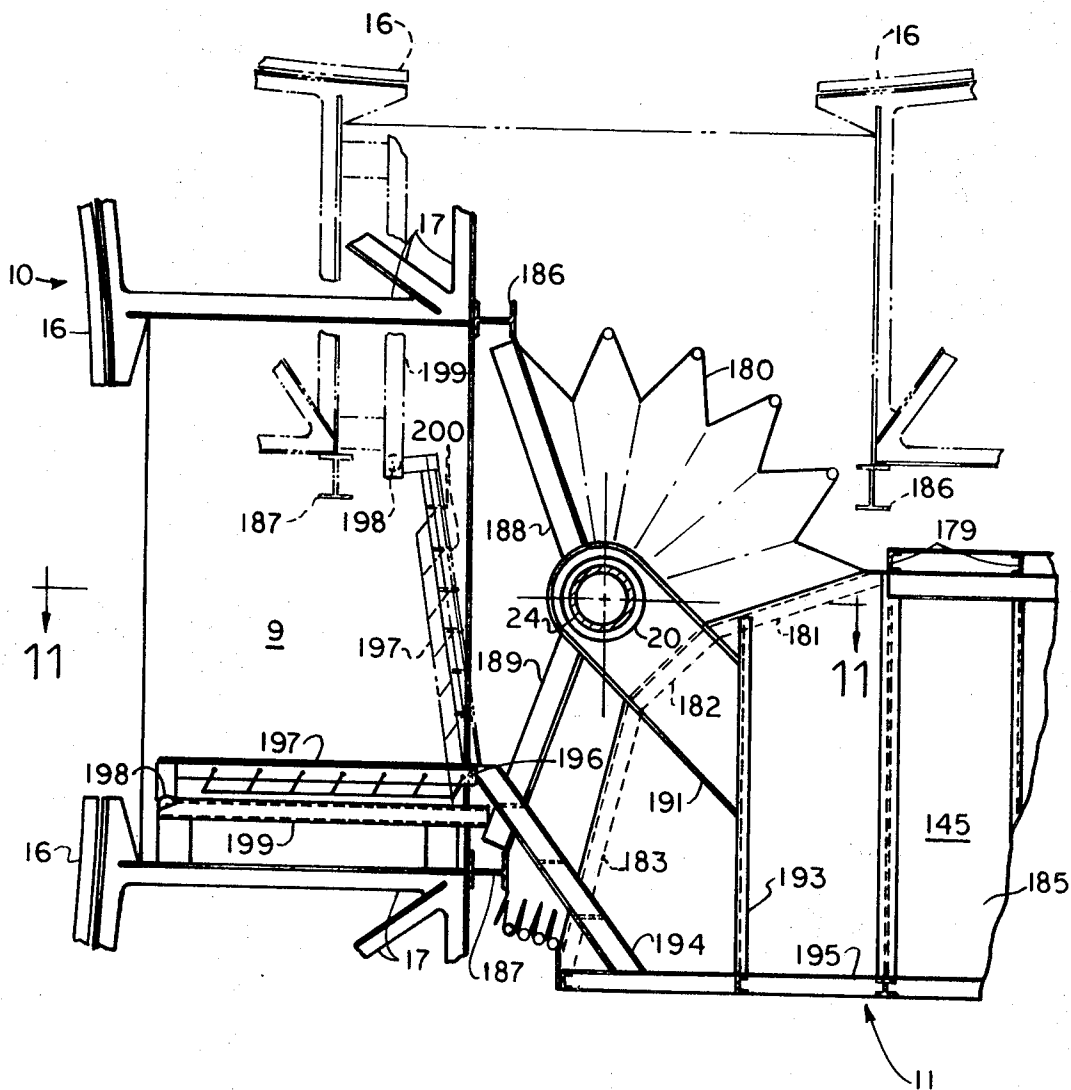


FIG. 10.

INVENTOR
ROBERT D. HALL
BY
George E. Pomeroy
ATTORNEY

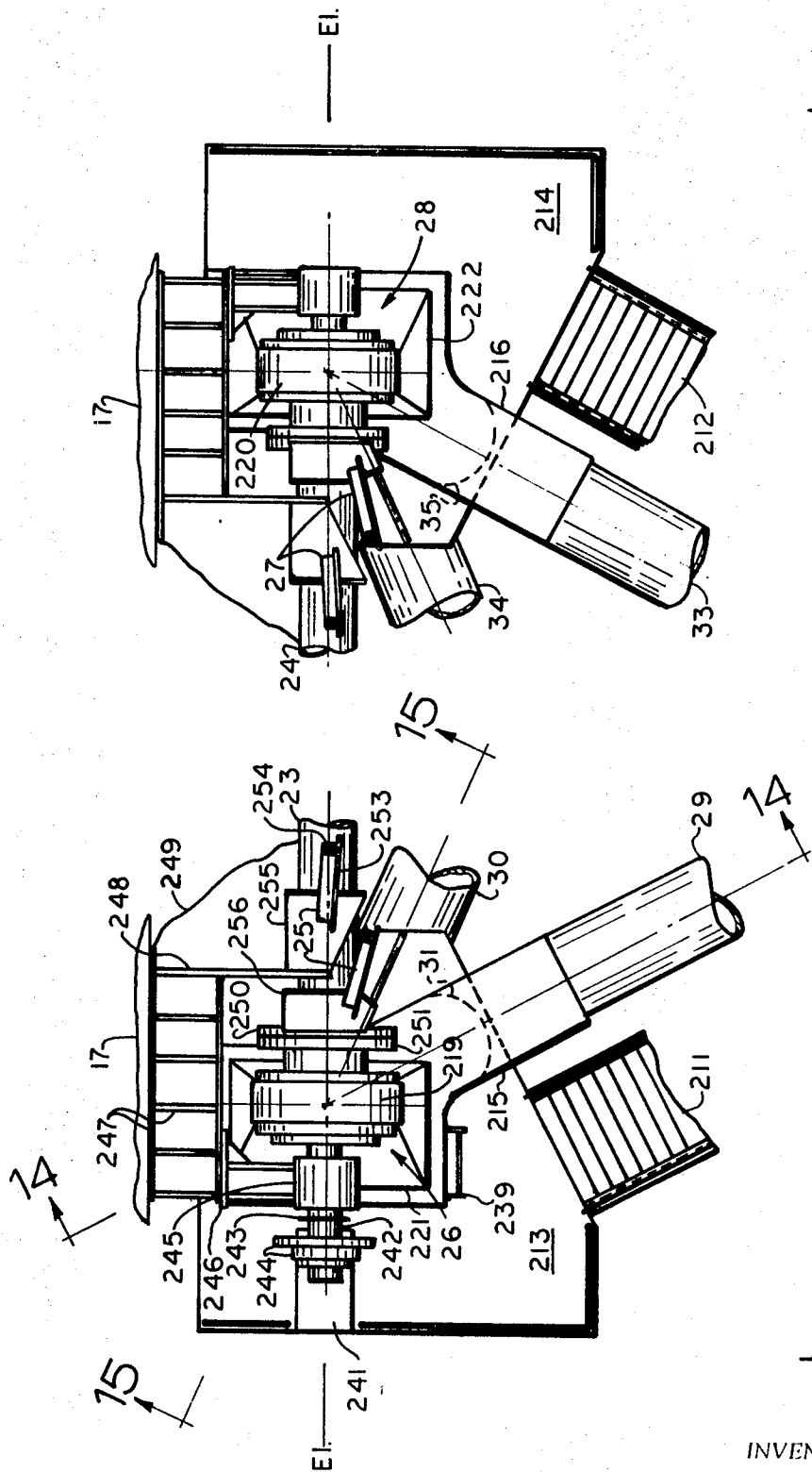


FIG. 12.

INVENTOR
ROBERT D. HALL

BY

Henry E. Parn
ATTORNEY

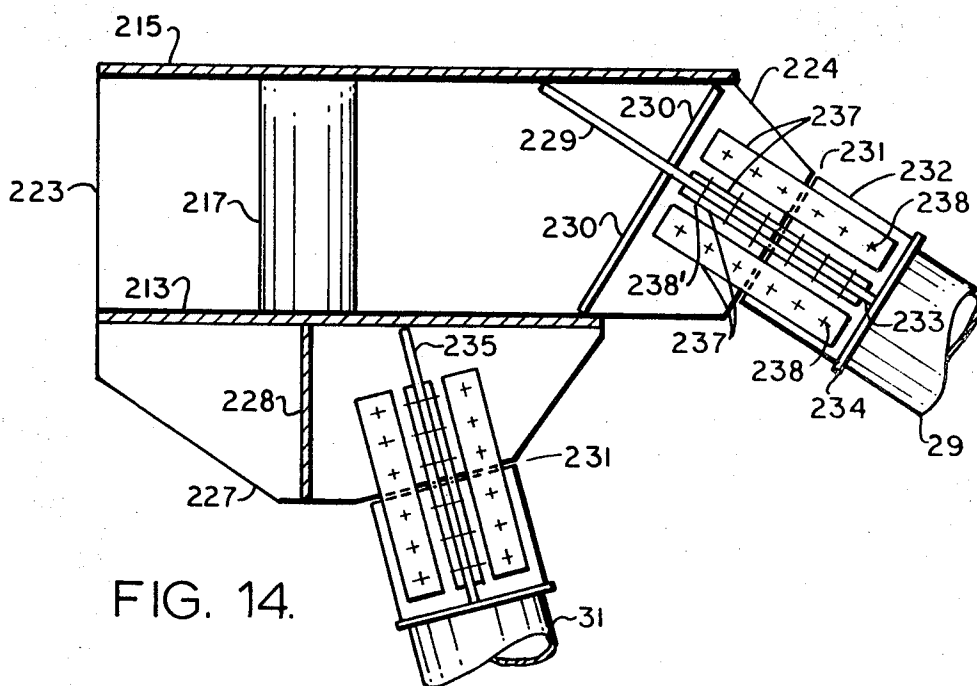


FIG. 14.

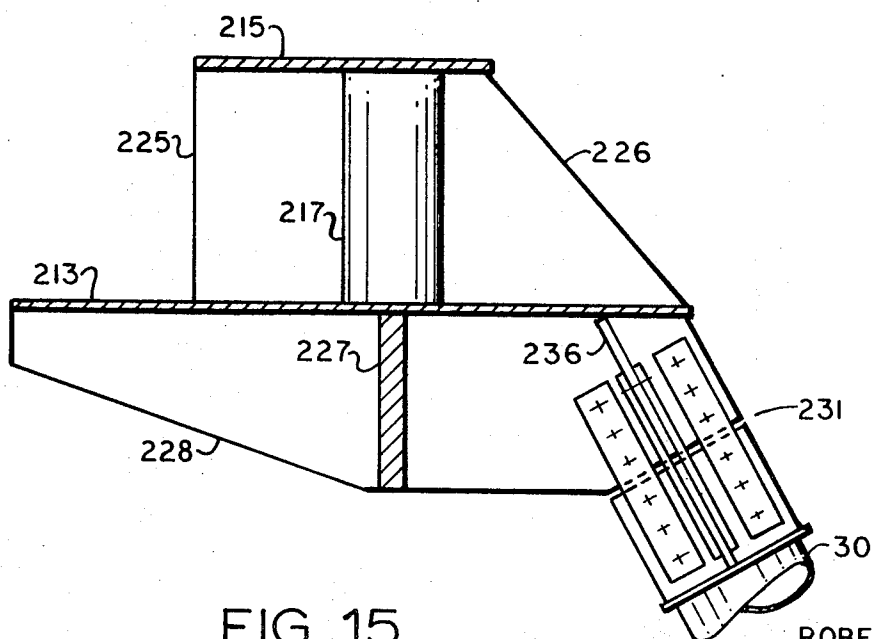


FIG. 15.

INVENTOR
ROBERT D. HALL

BY

Henry E. Parn

ATTORNEY

FIG. 18.

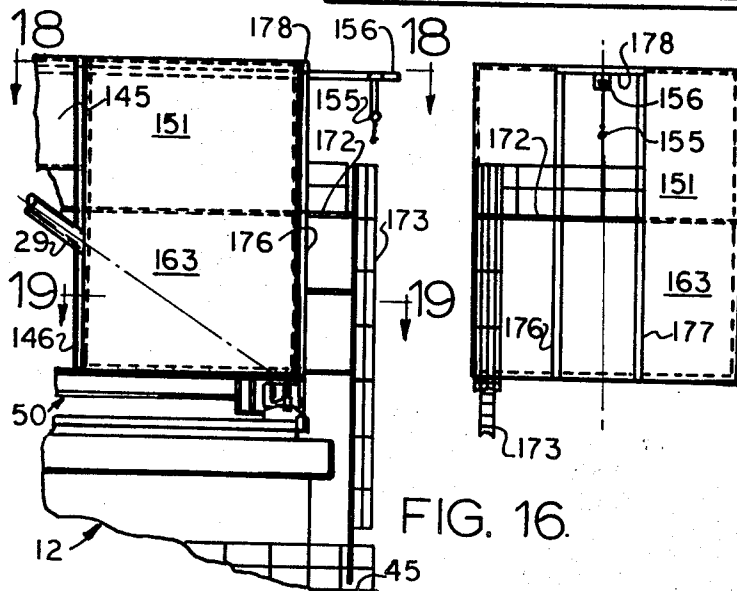
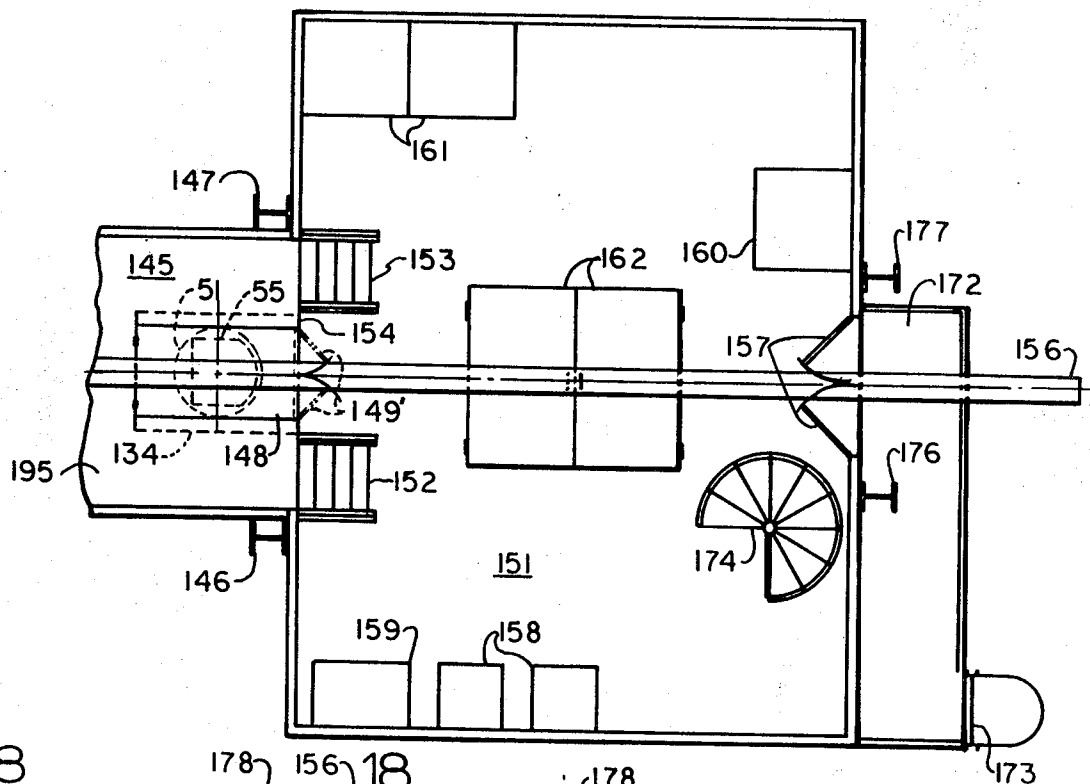


FIG. 17.

FIG. 16.

INVENTOR
ROBERT D. HALL

BY

Henry E. Pearson

ATTORNEY

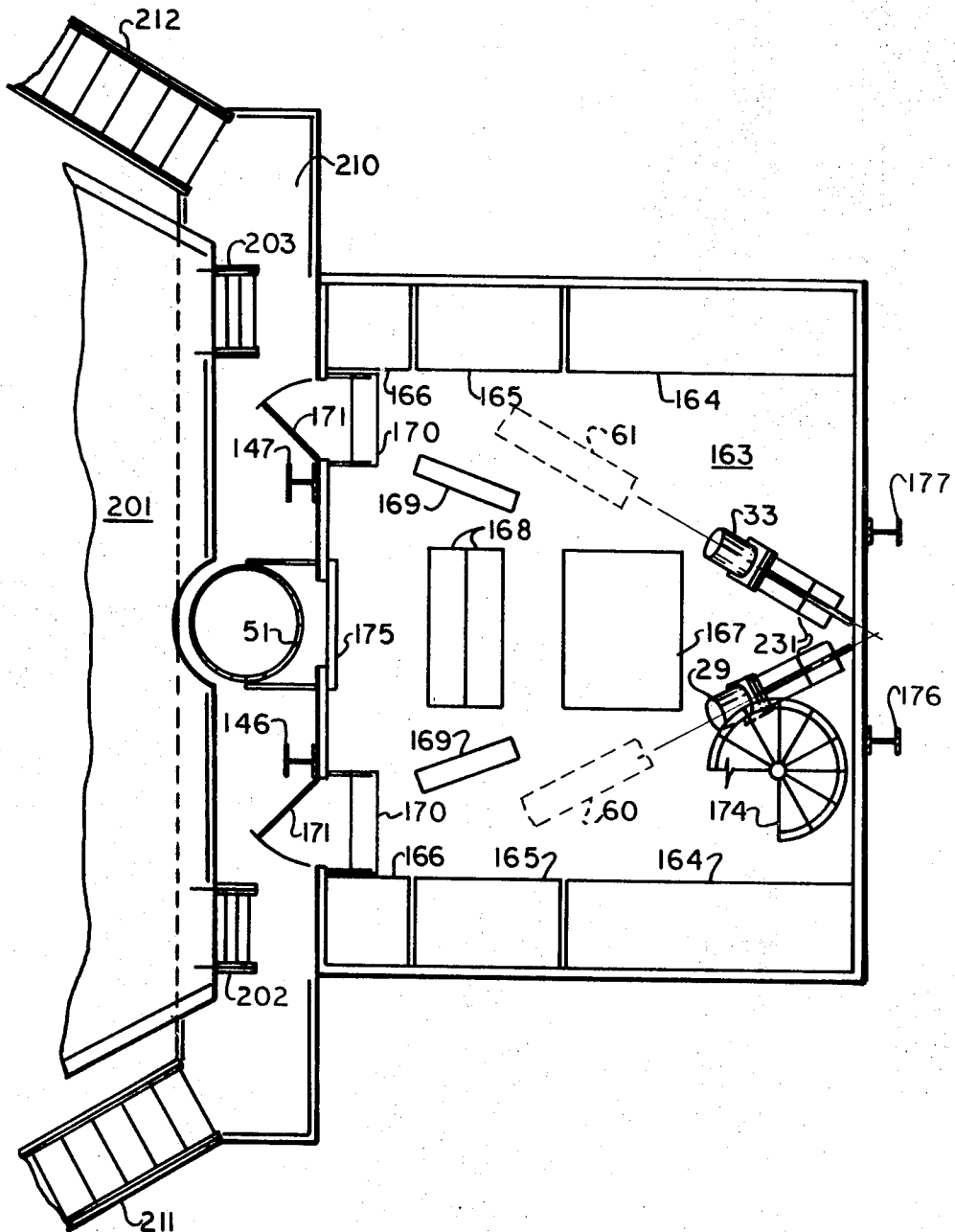


FIG. 19.

INVENTOR
 ROBERT D. HALL
 BY *Henry E. Pearson*
 ATTORNEY

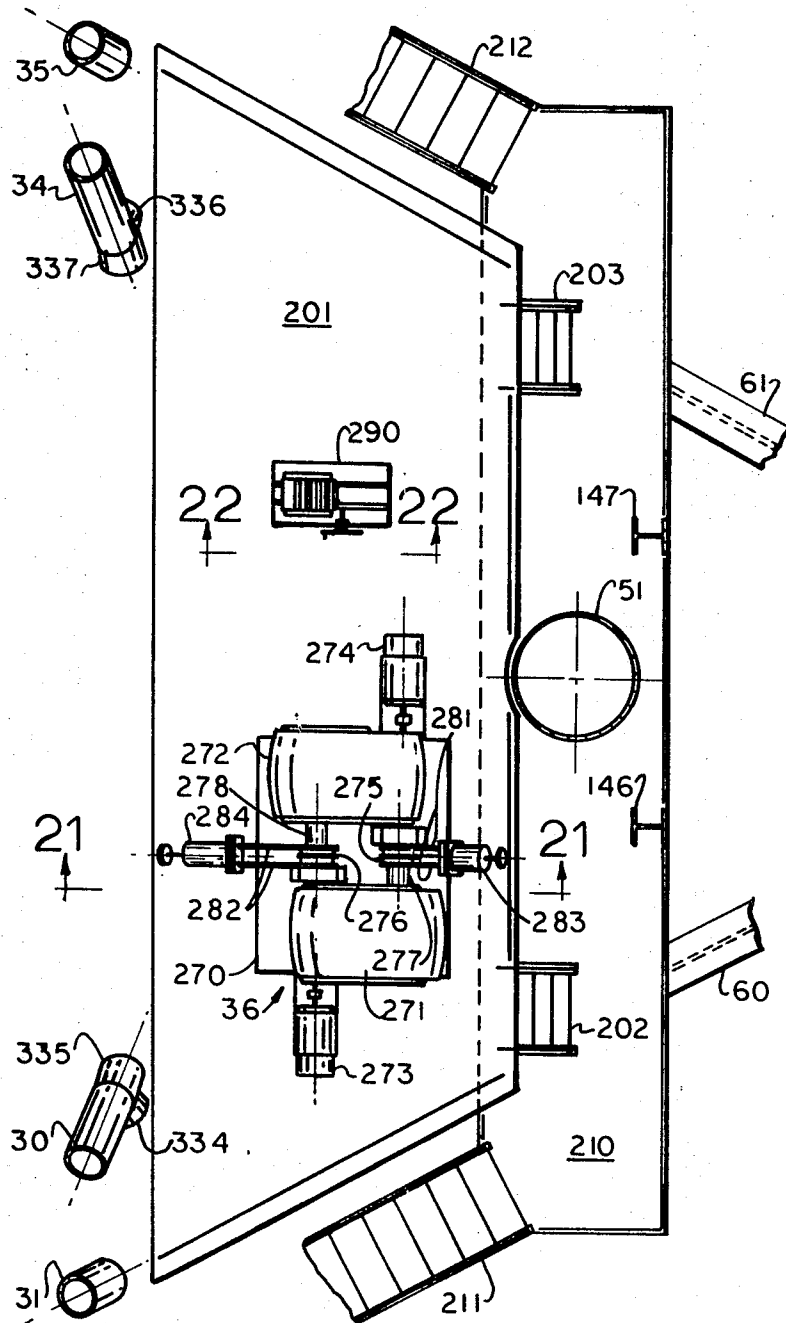


FIG. 20

INVENTOR
ROBERT D. HALL

BY

George E. Pann

ATTORNEY

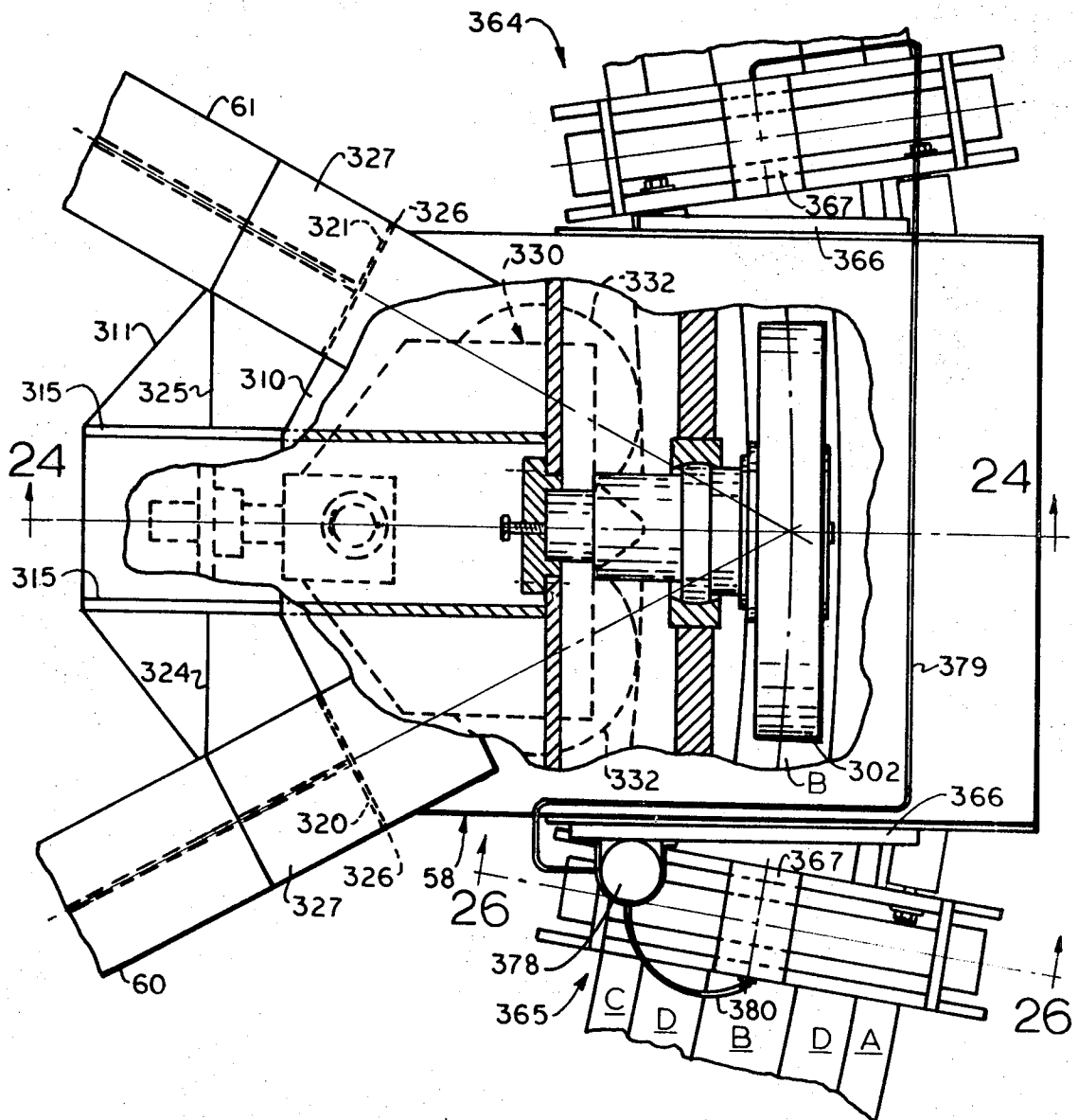


FIG. 23.

INVENTOR

ROBERT D HALL

BY

Henry E. Pearson

ATTORNEY

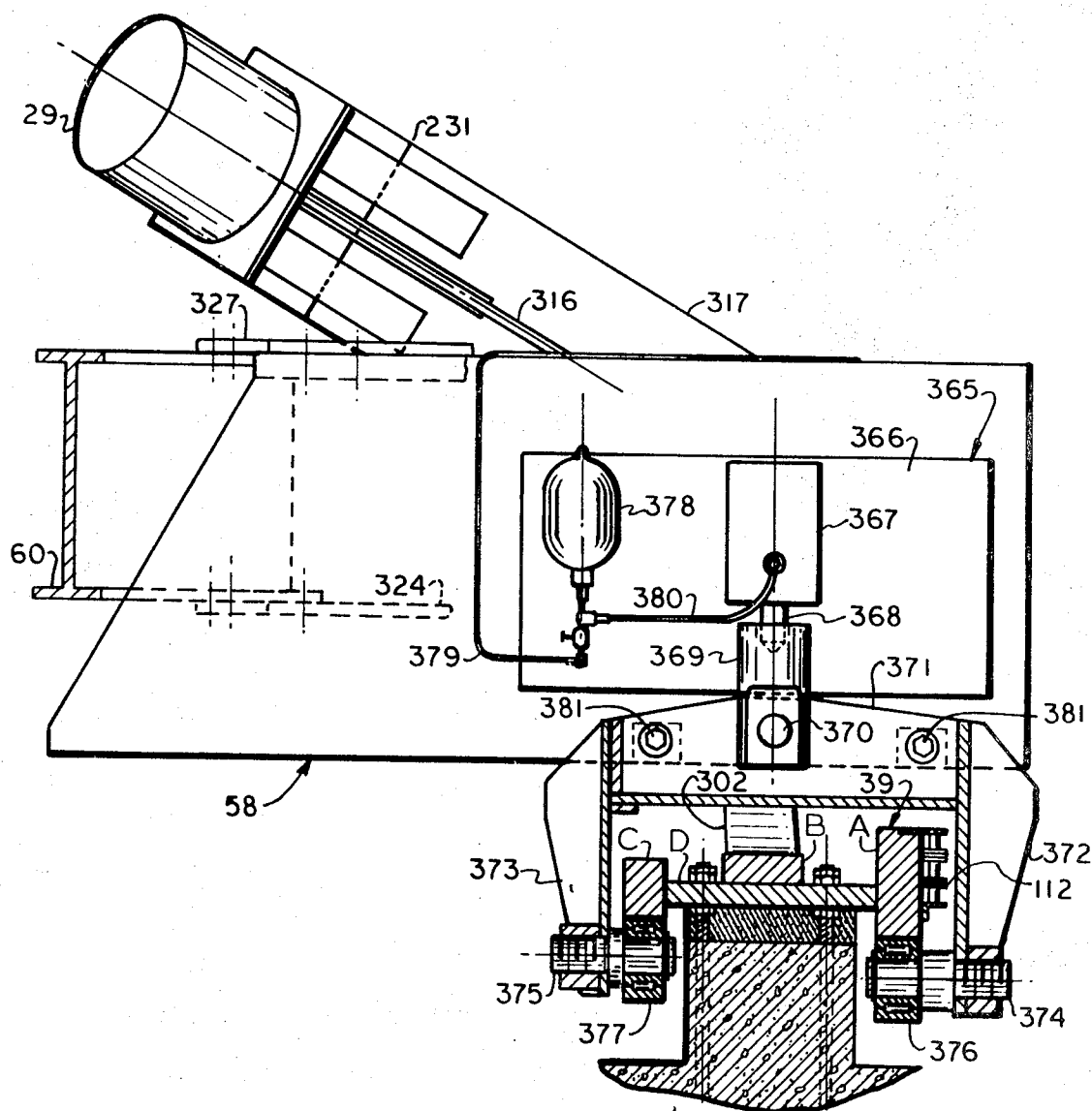


FIG. 26.

INVENTOR
ROBERT D. HALL

BY

George E. Pearson

ATTORNEY

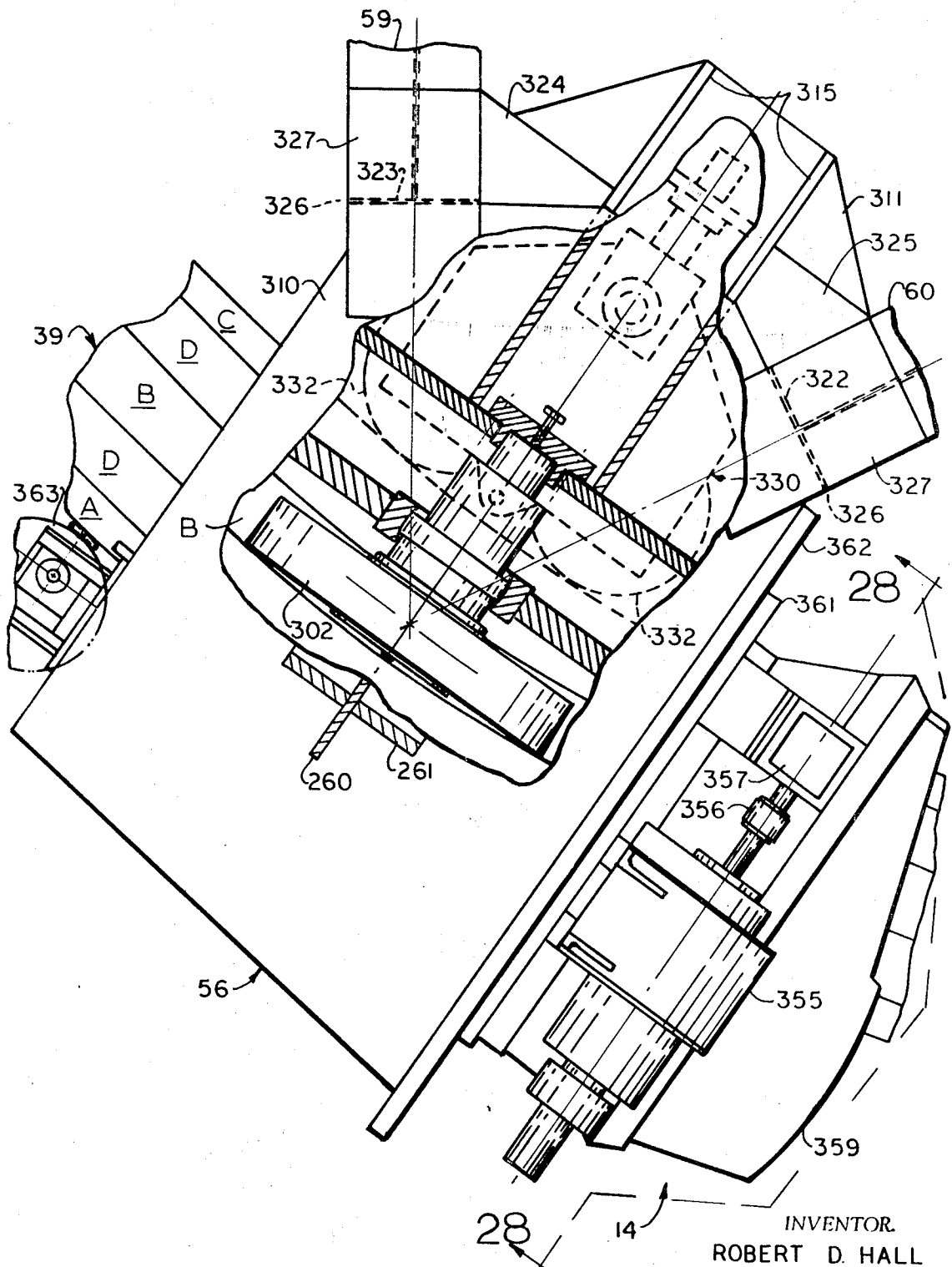


FIG. 27.

INVENTOR.
ROBERT D. HALL

BY

George E. Pearson

ATTORNEY

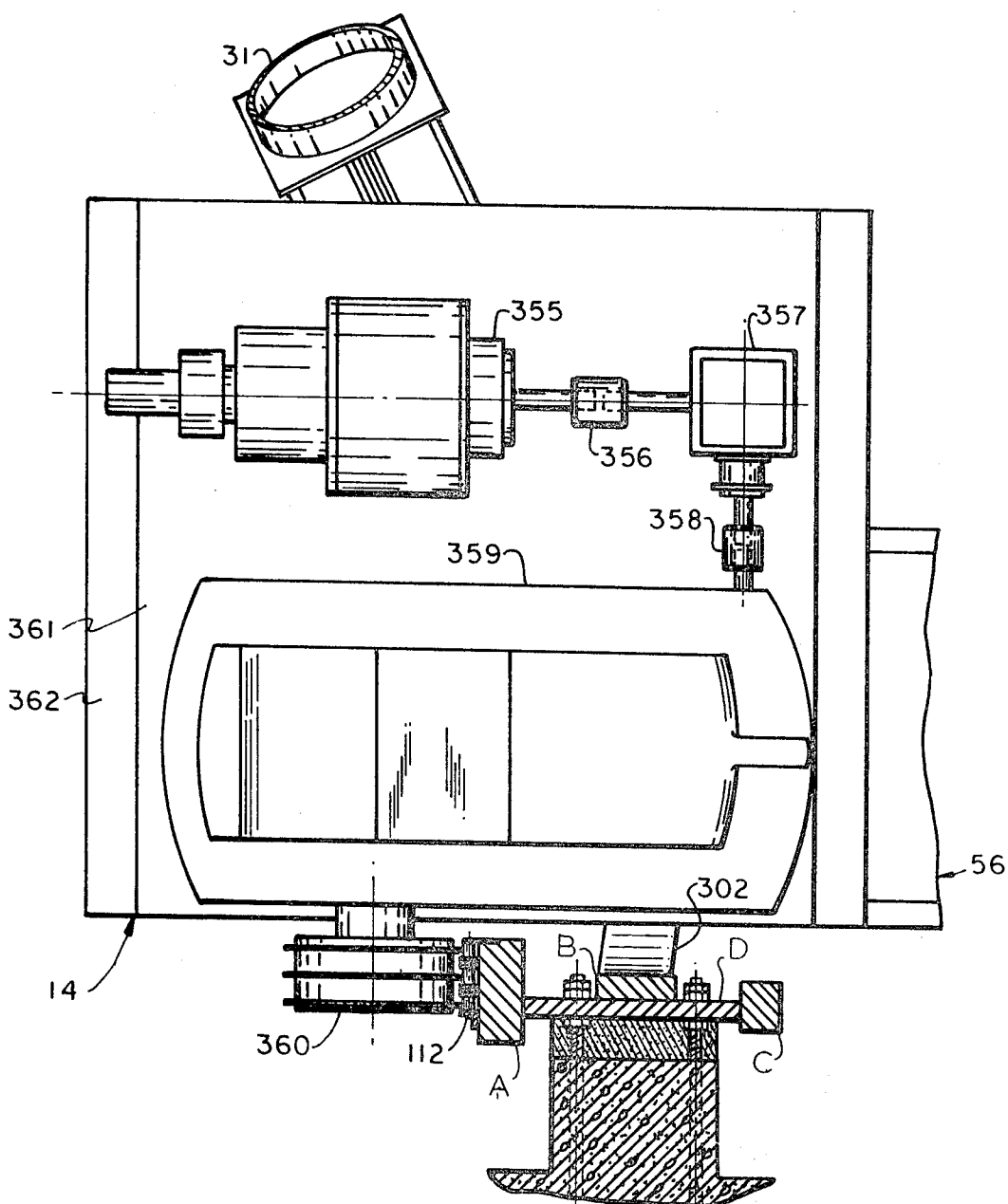


FIG. 28.

INVENTOR
 ROBERT D. HALL
 BY *Henry E. Pearson*
 ATTORNEY

TURRET-TYPE LARGE APERTURE ANTENNA PRECISION MOUNTED ON CIRCULAR TRACK

BACKGROUND OF THE INVENTION

This invention relates generally to large, massive, precise, antenna structures such as employed, for example, in satellite communications, solar and galactic studies, precision doppler ranging of satellites or planets, and missile tracking and telemetry, and more particularly to a novel turret-type antenna structure in which the mount is elevation over azimuth, hereinafter sometimes referred to as Az/El.

Roller and track supported turret-type elevation over azimuth antenna structures have heretofore been known and used, and the space thus rendered available in the region of the Az—Az axis has been utilized for various purposes such as for the passage of electrical cables and the accommodation of electronic gear and equipment. It has been known, moreover, to employ elevators with such turret-type structures and to provide work areas and housing structures in connection therewith. The present invention, however, resides in new and improved arrangements, constructions and combinations of such structures, elements, and components providing advantages and features of invention not heretofore available from the prior art antenna structures.

SUMMARY OF THE INVENTION

According to the present invention, the Az/El antenna, hereinafter more fully disclosed, generally comprises a pedestal, a turret and a reflector in which the turret supports the antenna reflector for movement about its elevation and azimuth axes. The turret has a roller and track support on the pedestal base structure, and azimuth drive means carried by the turret engages a driving element carried by the track to thus provide the required azimuthal rotation of the reflector. The turret mounts the reflector on spaced pivot supports, and spaced elevation wheels located at these supports have driving engagement with elevation drive means carried by the turret to thus provide the required elevational rotation of the reflector.

A circular track secured to the pedestal is engaged by turret support, guide, and holddown rollers carried by the turret. The support rollers engage an upper surface of the track in the usual manner to provide rotative support for the turret for rotation about the Az—Az axis. The guide rollers are radially directed to engage an inner side surface of the track and are urged against this track surface to constrain the support rollers to move along the circular path of the track. The holddown rollers engage an under surface of the track to prevent the support rollers from leaving the track because of the eccentric turret loading due to the laterally disposed and offcenter mounting of the antenna reflector on the turret.

An endless roller chain secured to the track is engaged by sprockets comprising the azimuth drive which is supported on the turret. Similarly, at least one of the elevation drive wheels carries a length of roller chain which is engaged by sprockets comprising the elevation drive which is also supported on the turret. Coacting buffer and stop members carried by the pedestal and turret limit the rotational movements of the antenna.

The space between the elevation drive wheels provides an area conveniently occupied by an electronics room. A bellows structure extended flexibly from the electronics room to the center hub room provides covering between these work areas. The bellows and a jalousy-type ladder mounted in the center hub render access to the antenna feed from the electronics room entirely feasible for the full rotational movements of the reflector about its elevation axis.

The region of the Az—Az axis provides space for an elongated tubular shaft which is secured to the turret and extends from a pit in the pedestal to the uppermost regions of the turret. The turret shaft accommodates an elevator to provide access to the various floor levels in the pedestal as well as to the

room levels provided on the turret, while also accommodating the cable wrap function of the antenna.

OBJECTS OF THE INVENTION

An object of the invention is to provide a new and improved turret-type elevation-over-azimuth antenna which retains all of the advantages while obviating many of the disadvantages of the prior art antenna structures of this type.

Other objects in terms of specific improvements reside in the novel construction, combination and arrangement of parts including primary base, turret and reflector structures to effect simplicities and economies in the construction, installation and maintenance, as well as reliability in the performance and operation of these structures, and further resides in the provision of increased work room areas on the turret structures while also facilitating the ease of access from such areas to the reflector feed structures.

Another object resides in the provision of an antenna turret structure movable about an azimuth axis on track and roller supports while also providing roller restraints Az—constrain the rotative movements of the turret to follow the track coaxially with the azimuth axis and to prevent lifting of the turret from the track in response to upsetting forces due to the eccentric loading of the antenna reflector on the turret.

Yet another object is to utilize the azimuth axial region of the turret to provide elevator service throughout the several floors of the turret and its supporting pedestal structure.

A further object is to accommodate cable wrap facilities in conjunction with the tubular shaft used for the elevator.

An additional object resides in the provision of split or spaced elevation drive wheels to provide therebetween an electronics room, and further resides in the provision of a flexible access covering and articulated ladder from the electronics room to the feed cone area of the reflector structures to provide access thereto notwithstanding changes in the elevational position of the antenna reflector about its El—El axis.

Still other objects, features and advantages of the present invention reside in the novel combination, construction and arrangement of parts constituting the preferred embodiment of the invention which is disclosed in the accompanying drawings wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view in side elevation of the turret-type Az/El antenna system of the present invention;

FIG. 2 is a rear view of the antenna system of FIG. 1;

FIG. 3 is a side sectional view of the pedestal of FIG. 1 as seen along the Az—Az axis;

FIG. 4 is a sectional view of the turret base frame and pedestal as viewed along the line 4—4 of FIG. 1;

FIG. 5 is a somewhat enlarged fragmentary sectional view of the pedestal as disclosed in FIG. 3 and showing portions of the turret base frame structure;

FIG. 6 is a sectional view taken along the line 6—6 of FIG. 5;

FIG. 7 is a view in perspective of a pedestal mounted azimuth stop;

FIG. 8 is a plan view, on a reduced scale, of the stop of FIG. 7;

FIG. 9 is an enlarged side sectional view of the electronics room disclosed in FIG. 1 as seen in the plane of the Az—Az axis;

FIG. 10 is an enlarged side sectional view of the electronics and center hub rooms disclosed in FIG. 1 as viewed in the plane of the Az—Az axis;

FIG. 11 is a sectional view taken along the line 11—11 of FIG. 10;

FIG. 12 is a plan view of the elevation bearing service platforms;

FIG. 13 is a view in elevation of the elevation bearing service platforms;

FIGS. 14 and 15 are sectional views taken along the lines 14—14 and 15—15 of FIG. 12;

FIG. 16 is a view in side elevation and on a somewhat reduced scale of a modified turret room structure arrangement;

FIG. 17 is a rear view of the turret room structure shown in FIG. 16;

FIG. 18 is a plan view, somewhat enlarged, of the turret rooms as viewed along the line 18—18 of FIG. 16;

FIG. 19 is a plan view, somewhat enlarged, of the turret room construction as viewed along the line 19—19 of FIG. 16;

FIG. 20 is a plan view of the elevation platform as viewed along the line 20—20 of FIG. 5;

FIGS. 21 and 22 are sectional views taken along the lines 21—21 and 22—22 of FIG. 20;

FIG. 23 is a plan view of the rear roller support weldment and its holddown roller construction and arrangement;

FIG. 24 is a sectional view taken along the line 24—24 of FIG. 23;

FIG. 25 is a plan view of the radially directed roller construction as viewed along the line 25—25 of FIG. 24;

FIG. 26 is a view in elevation, certain parts being shown in section, of a roller holddown system disclosed in FIG. 3;

FIG. 27 is a plan view of a front roller support weldment and its associated azimuth drive; and

FIG. 28 is a view in elevation of the azimuth drive disclosed in FIG. 27 as viewed along the line 27—27 thereof.

Referring now to the drawings for a more complete understanding of the invention, and first more particularly to FIGS. 1 and 2, there is shown thereon, a turret-type elevation-over-azimuth (Az/El) antenna which generally comprises a reflector 10, a turret 11 which mounts the reflector, and a pedestal 12 support for the turret and its reflector. As will more fully appear as the description proceeds, the pedestal and turret have coaxial track and roller supports generally depicted at 13, FIGS. 1 and 2, which support the turret and reflector for rotation about the azimuth axis designated as Az—Az. The track includes an element 112 engageable by the azimuth drives 14 and 15 to thus move the turret and reflector in azimuth. Buffer-stops, such as depicted at 113, FIG. 1, and subsequently to be described, limit the rotation of the turret and reflector about the Az—Az axis to the order of 270°.

Reflector 10 comprises a reflector surface 16 which may be formed, for example, of aluminum panels adjustably supported by steel backup structure 17 which, in turn, may be formed from structural steel plate and standard structural shapes. A feed cone 8 is disposed at the vertex of the reflector surface 16 and is supported in association with the center hub room 9 on the backup structure 17. A subreflector 18 is supported by bipod supports 19 which, in turn, are supported by the backup structure 17, the focal point being spaced from the vertex to provide a focal length of the order of 36 feet, for example, and the diameter of the reflector surface being of the order of 100 feet, for example.

A pair of elevation wheels 21 and 22, best seen in FIGS. 2 and 11, are suitably secured to and spaced apart on the reflector backup structure 17. Wheels 21 and 22 are also respectively secured, as by welding, to a pair of axially aligned tubular shafts 23 and 24 which are disposed coaxially with the elevation axis designated El—El. Wheel 21 is additionally supported on shaft 23 (See also FIGS. 12 and 13) by a plurality of spoke members 25 which are secured to the shaft adjacent to a bearing structure 26 in which the shaft is journaled. Similarly, elevation wheel 22 is supported by a plurality of spoke members 27 on shaft 24 which similarly is journaled in a bearing structure 28. Bearing structure 26 is supported on turret 11 by a system of three beams 29, 30 and 31 which depend from the bearing structure and are secured to the turret base frame 50, FIG. 4. Similarly, bearing structure 28 is supported by an identical system of beams 33—35 which are similarly secured to turret base frame 50.

Spaced bearing structures 26 and 28 define the elevation axis and thus support the reflector 10 on turret 11 for rotation

about the elevation axis. Buffer-stops such as depicted at 114, FIG. 1, and subsequently to be described, limit the rotation of the reflector about the El—El axis to the order of 94°. An elevation drive element 115 is carried by elevation wheel 21, which is the drive wheel, and this element is engageable by the elevation drive 36, FIG. 1, to thus move the reflector in elevation.

Referring now to FIGS. 1—3, it will be seen that pedestal 12 is a massive concrete structure which is octagonal in cross section and comprises an upper level 41—having a circular rim of ridge 38 upon which a multisurface track 39 is supported. Track 39 comprises a portion of the aforementioned track and roller support 13 depicted generally in FIGS. 1 and 2 and, as will subsequently more fully appear, also supports the azimuth drive element 112. Pedestal 12 further comprises intermediate floor levels 41 and 42 and a ground level 43 which is supported by a massive subsurface peripheral footing 44. Intermediate floor level 41 extends laterally of the pedestal structure to support a railed walkway 45 which extends around the pedestal and may be reached by way of the externally disposed ladder structures 46, FIG. 1. An internal stairway 47 provides access between the pedestal room areas disposed respectively at the room levels 41—43.

A central well 48 in the pedestal ground floor 43 is axially aligned with an opening 49 provided in pedestal floor 37 and with additional openings provided in floors 41—43 for accommodating bearings 52—54 respectively. An elongated tubular shaft 51 is disposed within these openings and bearings and the axis thereof is disposed concentrically with track 39 and thus coaxially with the azimuth axis Az—Az. Tube 51 is secured to turret 11 for rotation therewith and extends from the ground well 48 through the several pedestal and turret floor levels to provide access of electrical cables, and the like, thereto as well as to provide for the movement of equipment, supplies and operating personnel between these areas. For the latter purpose, tube 51 may support on the inner wall thereof an access ladder (not shown). Preferably an elevator 55 is provided for movement up and down within the shaft.

Referring now to FIGS. 1 to 6, and more particularly to FIG. 4, it will be seen that the turret base frame 50 is of triangular configuration having at the corners thereof roller supporting weldments 56, 57 and 58. Weldments 56 and 57 are disposed at the front of the antenna, that is, are disposed on the reflector side of the Az—Az axis whereas weldment 58 lies on the opposite side of the Az—Az axis and to the rear of the antenna. Front weldments 56 and 57 are connected by a main beam 59, and rear weldment 58 similarly is connected to the forward weldments 56 and 57 by beams 60 and 61, respectively.

An elongated beam 62 extends laterally of the triangle beams 60 and 61 and is suitably supported thereon. Similarly, a pair of aligned beams 63 and 64 extend parallel to beam 62 in laterally extending relation to triangular beams 60 and 61 upon which they are similarly supported. Beams 63 and 64 terminate at tube 51 and are interconnected at these ends with beam 62 by short beams 65 and 66. Beams 63 and 64 extend coextensively with beam 62 and are joined at these ends by short interconnecting beams 67 and 68. Similar interconnecting beams 69 further interconnect beam 62 to members 63 and 64 intermediate the ends thereof. A second laterally extending beam 70 extends parallel to beams 62—64 and short beams 71 and 72 extend in alignment with short beams 65 and 66 respectively in interconnecting relation between beam 70 and the ends of beams 63 and 64. A short beam 73 interconnects beams 71 and 72 to thus, together with short beams 65 and 66, enclose tubular shaft 51.

As best seen in FIG. 5, tube 51 has a ring 74 suitably secured thereto as by welding. Ring 74 has a flange 75 which is secured by interconnecting brackets 76 to beam 62. Similar brackets, such as bracket 77, similarly interconnect the flange with beam 70 to thus secure shaft 51 to the turret base frame 50 for rotation therewith.

Tube flange 75 also serves as an anchor ring for operation of the cable wrap up generally designated 78, FIGS. 1, 3 and 5.

As best seen in FIG. 5, each of a plurality of peripherally spaced cable support lines, such as line 79, is secured at one end, as depicted at 80, to flange 75 on tube ring and each line is secured at the other end thereof, as depicted at 81 to a ring plate 82, in turn, secured to the underside of pedestal floor 37. Also secured to plate 82, as depicted rings is an electrical cable 84 which is exemplary of a plurality of peripherally spaced cables which may comprise the cable wrap up 78 and which may pass from the stationary pedestal room A and upwardly along tubular shaft 51 to room areas in the rotating turret.

Each of the support lines, including line 79, and each of the electrical cables, including cable 84, falls into a loop or bight portion, depicted at 85 for line 79 and at 86 for cable 84. The downwardly extending portion of each support line and of each cable is connected to a plurality of rigid support rings 87 and 88 which encircle tube 51, the downwardly extending portion of line 79, for example, being connected to rings 87 and 88 as depicted at 89 and 90, respectively. Similarly, the downwardly extending portion of cable 84 is secured to rings 87 and 88 as depicted at 91 and 92, respectively. A plurality of smaller diameter support rings 93, which also encircle tube 51, are each secured to the upwardly extending portions of the support lines and cables. Support line 79, for example, is secured to each of rings 93 as depicted at 94, and cable 84 is secured to each of rings 93 as depicted at 95.

As the turret and tube 51 rotate, this rotary movement is imparted first to the upwardly extending portions, and thereafter to the downwardly extending portions, of the support lines and cables, and this first causes the inner rings 93, and thereafter causes the outer rings 87 and 88, to rotate and rise upwardly along tube 51.

The aforementioned buffer-stop combination depicted at 113, FIG. 1, comprises a buffer 100 and a stop 101, FIG. 4. A similar buffer-stop combination comprises buffer 102 and 103. Buffer 100 is carried by triangle beam 60 and is supported subadjacently thereto. Buffer 102 is similarly supported on triangle beam 59 and is disposed subadjacently thereof. Buffer 100 moves along the circular path depicted by the dashed line 104 to coast with stop 101 to limit rotation of the turret in the counterclockwise direction as viewed in FIG. 4 and, similarly, buffer 102 moves along the dashed line depicted at 105 to coast with stop 103 to limit rotation of the turret in the clockwise direction, stops 101 and 103 being secured in the positions shown in FIG. 4 to the upper floor level 37 of pedestal 12.

Buffers 100 and 102 are shock absorber devices of any suitable type such as manufactured by Efdyn of Chicago, Ill. It suffices to state that buffers 100 and 102 are identical and each generally comprises a movable piston 99 which upon engagement with its associated stop member is moved relative to its cylinder a distance of about 4".

Stops 101 and 103 are identical and have the special construction best described with references to FIGS. 7 and 8 wherein stop 101 is disclosed. Stop 101 is a two-part device comprising a weldment 106 to which an L-shaped member 107 is hinged at the base of the L by a hinge pin 108, fixed part 106 being secured to the concrete floor 37 by anchor bolts (not shown) located at the points 109. L-member 107 has a stop plate 110 which is engaged by the piston 99 of its associated buffer 102. The pivotal movement of L-member 107 is depicted by the dashed lines in FIG. 8 wherein it may be seen that the member moves through about 90° between the full line and dashed line positions. This movement is utilized in the turret stop action depicted in FIG. 4.

Referring again to FIG. 4, when the turret is turning clockwise from the position shown, the back of the cylinder of buffer 100 engages the back side 111 of L-member 107 of stop 103 and moves it to the dashed line position of FIG. 8 to clear buffer 100 for further movement clockwise. On return counterclockwise movement of the turret, piston 99 of buffer 100 engages inside surface 98 of the L to again move L-member 107 to its full line position as shown in FIG. 8, thus placing L-

member 107 of stop 103 in the position as shown in FIG. 4 to be engaged by piston 99 of buffer 100 upon continued counterclockwise movement of the turret to bring this buffer-stop combination into coacting engagement to stop the turret. Stop 101 and its L-member operate in the same manner to clear its associated buffer 102 for counterclockwise movement of the turret.

Turret frame 50 further comprises a plurality of frame members 120 which interconnect beam 59 and frame member 70. The center two frame members 120 support and are interconnected by a pair of spaced frame members 121 which, in turn, support an elevator drive unit comprising a motor 122 and a cable drum 123 which is rotated by the motor, selectively in either direction, to pay out or draw in, as the case may be, the end portions 124 and 124A of the cable which is secured to the drum.

Motor 122 and cable drum 123 are thus supported on the turret for rotation with the shaft 51 as the turret rotates. The cable 124 at one end of the drum extends around a guide pulley 126, FIG. 3, mounted within tube 51 and from thence extends, as depicted by the cable length 127, upwardly and around a second pulley 128, FIG. 9, secured within the tube 51 near the top thereof. The cable then extends downwardly, as depicted by the cable length 129, to a pulley 130, FIG. 3, secured to the elevator 55. The cable then extends upwardly from pulley 130, as depicted by cable length 131, to the upper end of tube 51, FIG. 9, where it is suitably anchored, as depicted at 132, to the floor 133 of the elevator well 134 which comprises a portion of the electronics room 145, subsequently to be described.

The other cable end portion 124A and its associated pulleys and other components, also designated by the suffix "A," are disposed and mounted diametrically on the opposite side of shaft 51 from cable 124 and its associated elements and act in parallel therewith. Cable length portion 136, FIG. 9, extends to and passes around a pulley 137 suitably mounted in the elevator well 134 from whence it passes downwardly, as depicted by cable portion 138 to which a plurality of elevator counterbalancing weights 139 are secured. Cable portion 136, FIG. 3, also extends to and passes around a pulley 140 mounted on the elevator 55 from whence it passes upwardly, as depicted by cable portion 141, to make connection with elevator 55 as depicted at 142.

Elevator 55 has a buffer-type bottom stop 143 suitably disposed in well 48 and has the usual ways 144, best seen in FIG. 4, which are disposed along the opposite inner sidewalls of tube 51 for guiding the movement of the elevator therealong. It will be understood that tube 51 has several openings therein, such as opening 96, FIG. 3, which is closed by a sliding door 97, for ingress and egress to the elevator 55 at each of the several rooms in the turret and pedestal where elevator service is desired.

Electronics room 145, FIGS. 9 and 18, is supported by spaced upright beams 146 and 147 which extend upwardly along the sides thereof. Beams 146 and 147 are secured to and extend upwardly from lateral beam 62 of turret base frame 50, FIG. 4. Elevator well 134 is normally closed by a trap door 148 in the floor 195 of the electronics room 145, and this door is swung open by the elevator, as depicted by the dashed lines, FIG. 9, when the elevator rises above the top end of tube 51. When this occurs, occupants in the elevator exit the elevator and the elevator well area 134 through double doors 149 to a raised platform 150, FIG. 9, or alternatively into an R. F. equipment room 151, FIG. 18, in the case of the modified turret room construction as depicted in FIGS. 16-19. The electronics room 145 is then entered by way of spaced stairways 152 and 153 and through suitable doorways (not shown) which are provided in the FIG. 9 arrangement. In the corresponding FIG. 18 arrangement, the electronics room 145 may be completely open into the R. F. equipment room 151, in which case, double doors 149' need be only as high as the wall 154 defining the split floor level of these adjoining rooms.

In the FIG. 9 arrangement, the electronics room wall space occupied by doors 149 must be cleared, as by opening these doors, so that equipment may be moved into electronics room 145 by means of a hoist 155, FIGS. 1, 16 and 17, which is arranged to move along the boom 156. In the FIG. 18 arrangement, rooms 145 and 151 open to each other to provide the required boom operating clearance. R. F. equipment room 151, however, is provided with floor to ceiling double doors 157 for movement of equipment and supplies into the equipment room as well as into the electronics room. Such equipment may be used or stored at the several work areas 158-161 in the equipment room, or may be lowered through the floor doors 162 to the first floor machinery room 163, FIG. 19, which has several work or storage areas designated 164-169.

Referring to the modified turret arrangement of FIGS. 16 to 19, it will be seen that the R. F. equipment room 151 and the machinery room 163 are added to the turret structure as disclosed in FIGS. 1 and 2 and are supported by triangle beams 60 and 61 of the turret base frame 50, as well as by upright beams 146 and 147 which, as aforescribed, extend upwardly from lateral base frame member 62, FIG. 4. Spaced stairways 170, FIG. 19, and doors 171 in machinery room 163 lead and open to a somewhat raised and railed platform 210, subsequently to be described. Elevation-bearing support beams 29 and 33 extend into and through the machinery room.

R. F. equipment room 151 has an external railed platform 172, FIG. 18, accessible through doors 157, and a caged ladder 173 which leads to pedestal peripheral platform 45, FIG. 16, notwithstanding the particular rotational position of the turret 11. An internal circular stairway 174 extends between the R. F. equipment room 151 and the machinery room 163 to provide for access therebetween. Elevator 55 also provides for access, as through the doors 149' to room 151, and by way of the sliding door 175, FIG. 19, to the elevator shaft 51.

The R. F. equipment room 151 and machinery room 163 at the rear walls thereof are supported by upright beams 176 and 177 which are secured to and extend upwardly from turret frame 50 to support the cross beam 178 which, in turn, supports boom 156.

Boom 156 is also supported by roof beams 179 of the electronics room 145, FIGS. 9 and 10, and extends the full length of this room to the bellows-type enclosure 180 which connects the electronics room to the center hub room 9, it being noted in FIG. 10 that the bellows 180 at one open end thereof connects to beams 181, 182 and 183 provided at the terminal ends of each of the sidewalls 184 and 185 of the electronics room. The other open end of the bellows is connected to beams 186 and 187, which are secured to the reflector backup structure 17, and at each of the sides to beams 188 and 189 which connect respectively with beams 186 and 187. Beams 188 and 189 also connect with each other in the region of shafts 23 and 24, FIG. 10, and may be connected to these shafts.

Sidewalls 184 and 185 of electronics room 145 respectively have bracket members 190 and 191 extended from the ends thereof to the shafts 23 and 24, FIGS. 10 and 11, and these brackets are suitably apertured, and such has an affixed bearing 20, to receive the shafts rotationally with respect thereto to thus suspend that end of the electronics room therefrom, it being noted that each bracket is supported by its associated sidewall terminal beam 182 and sidewall stud 192 or 193, as the case may be.

A ladder 194, FIGS. 10 and 11, extends from the floor 195 of electronics room 145 and hingedly connects, as at 196 with a jalousy-type ladder 197, the other end of which is pivotally connected, as at 198 by sliding engagement with channel 199 secured to the wall of hub room 9. Thus, in the extreme rotated position of reflector 10, as depicted by the dashed lines of FIG. 10, as well as in any intermediate rotated position of the reflector and jalousy ladder 197, the steps 200 of the jalousy ladder will have become adjusted by the jalousy action

so as to remain substantially horizontal for ease of access to the hub room areas, the steps together forming a platform in the full line position of FIG. 10 and as depicted in FIG. 11.

Referring now to FIGS. 5, 19 and 20, the aforementioned railed platform 210 is coextensive with and is supported on turret base frame lateral beams 62-64 and the associated interconnecting beams such as beams 66, 72 and 73, FIG. 5. A pair of ladders 211 and 212 lead to elevation bearing service platforms 213 and 214, FIGS. 12 and 13.

Platforms 213 and 214 are suitably railed for the purpose and constructionwise are plates which, together with their spaced plates 215 and 216 and interconnecting tubes 217 and 218 and other interconnecting members, not shown for the sake of clarity, constitute parts of weldments which respectively provide support for the bearing structures 26 and 28. Bearing housings 219 and 220 have generally four sided conical shaped mounts 221 and 222 which are suitably secured to their respective weldment plates 215 and 216.

The bearing support weldments are identical except that one (for bearing structure 26) is left hand, and the other (for bearing structure 28) is right hand as viewed in FIGS. 12 and 13. Accordingly, only one (for bearing structure 26) of these weldments will be described with particular reference to FIGS. 14 and 15 wherein it will be seen that a principal function of each weldment is to provide attachment for its associated bearing support tubes 29-31 or 33-35, as the case may be.

Referring now to FIGS. 14 and 15, a first pair of weldment plate members 223 and 224, FIG. 14, extend in alignment between plates 213 and 215 and from opposite sides of weldment tube 217. Similarly, a second pair of weldment plate members 225 and 226, FIG. 15, disposed on opposite sides of tube 217, extend therefrom between plates 213 and 215. A pair of weldment plates 227 and 228 disposed subadjacently to plate 213 intersect along the axis of weldment tube 217.

A pair of weldment members 229, FIG. 14, extend in alignment from opposite sides of plate 224, and each of these members is joined on its side of plate 224 by aligned plate members 230. Intersecting plate members 224 and 229, constitute one part of a joint 231 for attaching bearing support tube 29 to the weldment for bearing structure 26. The other or complementary part of joint 231 comprises matching intersecting members 232 and 233 which are welded to each other and to a cap plate 234, in turn, welded to tube 29. The joints for bearing support tubes 30 and 31 are similarly constructed and, accordingly, are similarly designated 231.

A pair of weldment plates 235, FIG. 14, extend in alignment from opposite sides of plate 227, and with this plate constitute the complementary portion of joint 231 for tube 31. Similarly, a pair of plate members 236, FIG. 15, extend in alignment from opposite sides of plate 228 and together therewith form the complementary portion of joint 231 for tube 30.

In the case of each joint 231, the complementary tube and weldment members constituting the joint are bolted together using, for this purpose, a system of eight identical splice members 237, the bolts being placed as depicted at 238 and 238'.

Referring again to FIGS. 12 and 13, a ladder 239 is supported by weldment plates 213 and 215 and provides access to a bore sight hole (not shown) on reflector 10 used to check R. F. beam alignment. Plate 213 also mounts a support 240, FIG. 13, for the elevation readout 241 which is driven from bearing shaft 242 by the chain drive 243, other elements 244 of the readout system being mounted on the shaft.

A support 245 suitably secured to bearing shaft 242 comprises a weldment 246, FIG. 12, which is secured to a truss member 247. Truss 247, in turn, is secured to the reflector backup structure 17 and includes plate members 248 and 249 which extend to elevation shaft 23 to which they are secured, as by welding. Shaft 23 terminates in a collar 250 which is bolted to a complementary collar 251 on bearing shaft 242.

Elevation wheel spoke members 25 comprise angle members 253 and 254 which are bolted together and at the ends thereof to attachment plates such for example, as plates 255

and 256 which, in turn, are secured, as by welding, to other parts of the elevation shaft 23 and associated structure such, for example, as the truss plate 59—and shaft collar 250. It will be understood that the right-hand bearing structure 28 is similarly constructed and arranged, and it therefore has been considered sufficient to describe in detail only those elements associated with the left hand bearing structure 26.

The elevation drive support platform 201, FIGS. 5, 19 and 20, is reached by way of spaced stairways 202 and 203 which rise from the railed platform 210. Platform 201, as best seen in FIG. 5, is supported on turret base frame member 70 which rises several feet above the level of turret 59—frame members 59–61. Triangle frame member 59 and a frame member 204, disposed above it at the top level of beam 70, are tilted outwardly somewhat so that their central web 205 and 206, respectively, lie in the plane of elevator bearing support tubes 30, 31 and 34, 35, see also FIG. 6. Beams 70 and 204 are interconnected by frame members such as beam 207 to thus provide the frame support for elevation platform 201.

A truss structure 208, FIGS. 5 and 6, provides the support for beam 204 on triangle beam 59 and is also the support for elevation bearing support tubes 30 and 34, it being noted that these tubes, as exemplified by tube 34, FIG. 6, and as disclosed in FIG. 20, have branch portions 334, 335 and 336, 337, of which tube branch 337, FIG. 6, not only connects with truss beam 204 but also with truss member 209, and branch 336 is connected both to truss beam 204 and elevation-bearing support tube 35.

The elevation bearing support tubes have the same manner of spliced joint connection 231 with the turret base frame members as employed at the upper ends of these tubes, as aforescribed, to make connection with the elevation bearing support weldments, FIGS. 13 and 14. In the case of the joint 231 connection of tube 35 to roller support weldment 57, FIGS. 4 and 6, intersecting members 260 and 261 form the weldment portion of the joint, and this arrangement is substantially the same for roller support weldment 56, FIG. 4. Joint 231 for branch tube 336 comprises intersecting members 262 and 263 which are welded to each other and to tube 35, member 262 being suitably bolted to truss member 204 (bolts not shown). Joint 231 for branch tube 337 comprises an end cap or plate 264 welded to truss member 209 and intersecting members 265 and 266 welded to each other and, in turn, welded to cap member 264, member 266 being additionally welded to truss member 204.

Referring now to FIGS. 20 to 22, the aforementioned elevation drive 36, FIGS. 1, 20 and 21, is supported on an inclined base 270 which conveniently is the form of a weldment, this weldment, in turn, being suitably secured, as by bolts (not shown) to the elevation platform 201. The elevation drive per se comprises a pair of motor driven (gear reductions) reducers 271 and 272 which together with their respective drive motors 273 and 274 are supported on the inclined surface of base 270 so as to align the reducer output sprockets 275 and 276, best seen in FIG. 20, with the driven element 115 of the elevation drive 36. Element 115 for this purpose preferably is a triple stranded roller chain, and each of sprockets 275 and 276 includes three separate sprockets which respectively engage the three strands of the chain.

Multiple sprockets 275 and 276 are secured to their respective reducer output shafts 277 and 278, the ends of these shafts being supported in pillow block bearings 279 and 280, in turn, are supported on the inclined surface of base 270.

Also supported on the inclined surface of base 270 is a pair of bracket supports 281 and 282 for a pair of buffers 283 and 284, respectively. These buffers may be shock absorbers of the type, as aforescribed, in connection with the azimuth buffers 100 and 102. In this case, for limiting the rotation of the antenna in elevation, elevation wheel 21 carries a pair of spaced stops 114, FIG. 1, and 314, FIG. 21, stop 114 also being shown in dashed lines in FIG. 21 in the position in which it has engaged piston 99 of buffer 183 to thus become effective to limit further clockwise rotation of elevation wheel 21.

Similarly, stop 314 is shown by the full line showing thereof in FIG. 21 to be engaged with piston 99 of buffer 284 to thus be in position to limit further rotation of the elevation wheel 21 in the counterclockwise direction.

As best seen in FIGS. 11, 21 and 22, elevation wheels 21 and 22 comprise plate portions 285 and 286, which, respectively are welded to shafts 23 and 24, and rim portions 287 and 288 which are suitably secured to their respective plate portions. Stops 114 and 314 are secured to rim 287 on wheel 21, and chain 115 which is also secured to this rim portion, extends between stops 114 and 314 thereon.

The antenna may also be set against rotation in elevation by manually adjustable stop means disclosed in FIGS. 20 and 22 wherein a weldment base 290 is shown supported on elevation platform 201. Weldment 290 mounts gearing 291 driven by a hand wheel 292 to move a piston 293 radially with respect to elevation wheel 22 so that teeth 294 carried by the piston become engaged with complementary teeth 295 carried by rim 288 of the wheel to thus lock the same against rotation.

The construction of the roller engaging track 39, FIGS. 3 and 4, is best disclosed in FIGS. 23 to 28 wherein it may be seen that the track comprises three discrete sections A, B and C and a common support member D to which each of the track sections is suitably secured, as by welding. Member D is attached to concrete rim 38 of the concrete pedestal by anchor bolts 300 and associated nuts, a layer of grouting 301, or other suitable material, being disposed beneath the track to support the same on rim 38 at the desired spacing above pedestal floor 37, as determined by the setting of the nuts on the anchor bolts 300.

Each of roller support weldments 56, 57 and 58, FIG. 4, comprises a tapered roller 302 which is mounted for engagement with the upper surface of track section B. Each wheel has a roller bearing support 303, FIG. 24, on a stub shaft 304. A spherical self-alignment bearing support 305 for the shaft enables the roller to bring its tapered surface into conformity with the upper surface of track section B. Bearing 305, in turn, is supported on a plate 306 which constitutes one of the members of the roller support weldment 56, 57 or 58, as the case may be. An end cap member 307 engages the end of shaft 304 and provides, by way of adjustment screw 308, a means for adjusting roller 302 radially with respect to the track section B to thus center the roller on the track. Cap member 307 is secured, as by suitable bolts or screws (not shown), to the weldment member 309 which, together with weldment member 306, the top and bottom plates 310 and 311, side plates 312 and 313, intermediate plates 315, and other weldment members subsequently to be described, constitute the weldment structure per se.

Upper plate 310 for rear weldment 58, FIGS. 4, 19, 24 and 26, has welded thereto two sets of intersecting plates 316, 317 and 318, 319 which constitute the weldment portions of the joints 231 for connecting elevation bearing support tubes 29 and 33 to weldment 58. Similar tube joint construction 260, 261, heretofore disclosed, is employed at weldments 56 and 57 (see for example, FIGS. 27 and 28).

The manner of attachment of the turret base triangle beams 59 to 61 is best disclosed in FIGS. 23 and 27 wherein it may be seen that the upper end portions of these I-beams abut the edges of upper plate 310 of weldment 58 as depicted at 320 and 321, FIG. 23, and that the other ends of beams 60 and 61 similarly abut the corresponding edges of the upper plates 310 of weldments 56 and 57, as depicted at 322, FIG. 27. Similarly, the opposite ends of triangle beam 59 abut corresponding edge portions of the upper plates 310 of weldments 56 and 57, as depicted at 323, FIG. 27. It will be understood, moreover, that the lower end portions of these I-section triangle beams, FIGS. 23, 24 and 26, 27, are attached, as by bolts (not shown) to weldment members 324 and 325 which act in conjunction with weldment members 315 to complete and strengthen the joint connections between the beams and weldments. In the case of each such joint, which is designated 326, a splice plate 327 is employed to secure the

beam to its upper weldment plate 310, bolts (not shown) being used for the purpose.

Each of the roller support weldments 56 to 58 comprises a radially directed roller assembly generally designated 330 which may best be seen in FIGS. 24 and 25. Each assembly 330 comprises a clevis-type yoke or roller truck 331 in which a pair of rollers 332 are mounted for rotation about spaced axes 333 to present the rollers for side-by-side engagement with the inner circular surface of track section C. Clevis member 338 of yoke 331 has a bearing portion 339 disposed between the spaced plates 341 of the complementary member 340 of the clevis joint, these joint members being pivotally secured together by the clevis pin 342. Clevis joint member 340 has a threaded shank 343 which carries a locknut 344. The shank extends into a clearance opening 345 provided therefor in weldment plate 346 which depends from weldment bottom plate 311. The reduced end 347 of shank 343 extends through plate 346 for engagement with suitable jack means (not shown) which is positionable against the backup weldment plate 348 which also depends from bottom plate 311. A bolt 349 loosely secures the radial bearing assembly 330 in suspended relation from bottom plate 311 in track-engaging position of the rollers 332 with track section C.

The loading of rollers 332 on track section C is preset by inserting the aforementioned jack means between weldment plate 348 and clevis shank 347 and building up the pressure therebetween until the required preloading condition of the rollers on the track is obtained. The locknut 344 is then tightened against weldment plate 346 to thus lock the assembly 330 in the preloaded condition. Thus, by this radial adjustment and preloading of the rollers of the three assemblies 330 for the three roller support weldments 56 to 58, their respective support rollers 302 are constrained to follow the circular path of track section B about the Az—Az axis.

Each weldment 56-58 is open at the outer end for access to its roller support 302, and this opening is closed by a removable cover plate 350, FIG. 24, secured to angle bracket 351 and side plates 352.

The aforementioned azimuth drives 14 and 15, FIGS. 2 and 4, are carried by the front roller support weldments 56 and 57, respectively. As best disclosed in FIGS. 27 and 28, each azimuth drive comprises a motor 355 connected by a coupling 356 to a right-angle drive 357, in turn, connected by a coupling 358 to a reducer (gear reduction) 359 which has a multiple output sprocket 360. Sprocket 360 is mounted for engagement with the aforementioned azimuth drive element 112 which, for the purpose, is a triple-stranded roller chain, the three strands of which respectively engage the three separate sprocket elements of the output sprocket 360. Chain 112 is suitably secured to the outer circular surface of track section A.

Motor-reducer assembly 355-359 is mounted on a base 361, in turn, mounted on a plate 362 which attaches the drive to weldment 56 so that the sprocket elements are disposed in proper relation to operatively engage their respective elements of chain 112. An azimuth readout 363, FIG. 27, which is also carried by roller support weldment 56, is similarly mounted thereon for engagement of a sprocket (not shown) with chain 112.

Rear roller support weldment 58, FIG. 23, has mounted on opposite sides thereof a pair of roller holddown assemblies generally designated 364 and 365. Each assembly comprises a mounting plate 366 which is suitably secured to its side of weldment 58. Suitably mounted on plate 366 is a hydraulic actuator cylinder 367 whose piston 368 carries a clevis 369 which is pivotally secured by pin 370 to a yoke 371. The spaced depending arms 372 and 373 bridge sections A and C of track 39 and have stub shafts 374 and 375 upon which rollers 376 and 377 are rotatively supported for engagement with the underside surfaces of tracks A and C, respectively.

Mounting plate 366 for holddown assembly 365 has supported thereon a pressure tank 378 which connects by way of lines 379 and 380 with the respective cylinders 367 for hold-

down assemblies 364 and 365. Pressure tank 378, the hydraulic actuators 367, the lines interconnecting the same, and other elements, not shown, together constitute a well-known accumulator system by operation of which, in this instance, the pressure of the rollers 376 and 377 on both sides of weldment 58 and on their respective track sections A and C is kept constant notwithstanding irregularities in the underside surfaces of these track sections.

Bolts 381 serve to loosely retain each yoke 371 to its respective side of weldment 58, thereby to position the rollers 376 and 377 on both sides of the weldment in relation to their respective track sections A and C.

From the foregoing, it should now be apparent that an elevation over azimuth turret-type antenna has been provided which is well adapted to fulfill the aforesaid objects of the invention, and it will be apparent that the same may be embodied in other forms or carried out in other ways without departing from the spirit or essential characteristics thereof. The present embodiment of the invention is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims, and all changes coming within the meaning and range of equivalency of the claims are intended to be embraced therein.

Having thus described the invention, what is claimed as new and useful and desired to be secured by Letters Patent is:

1. A turret-type elevation over azimuth antenna of the type having a reflector, a turret, a pedestal, track and roller means supporting the turret on the pedestal for rotation about a selected Az—Az axis, and pivot means on the turret supporting the reflector for rotation about an El—El axis, said track and roller means comprising

a circular track fixedly mounted on the pedestal with the track axis substantially coincident with such selected Az—Az axis,

a side surface of the track of true circular shape with its axis exactly coincident with such selected Az—Az axis,

a plurality of at least three support roller elements mounted in selected spaced relation on the lower portion of the turret and positioned to roll along the upper surface of said track to support the turret on the track for rotation about such Az—Az axis,

a plurality of at least three radially directed guide roller elements mounted in selected spaced relation on the lower portion of the turret and positioned to roll along said true, circular side surface of the track, and

means urging said guide roller elements radially toward said truly circular side surface of the track by an adjusted pre-load force with the turret exactly centered on such Az—Az axis for constraining the turret to rotative movement coaxially of such Az—Az axis.

2. An antenna as defined in claim 1, said track and roller means further comprising a horizontal, downwardly facing, exposed, marginal track area, a plurality of holddown rollers mounted on the turret, and positioned beneath the exposed, downwardly facing marginal track area, and means powerfully biasing each holddown roller upwardly into preloaded rolling engagement with said underside track area to prevent lifting of the turret support rollers from the track.

3. An antenna as defined in claim 2 wherein each holddown-roller-biasing means comprises a hydraulic cylinder operatively connected to each holddown roller and to an accumulator system for maintaining a constant, powerful, pre-load force on each holddown roller.

4. A turret-type elevation-over-azimuth antenna of the character disclosed comprising, in combination, a reflector, a turret, a pedestal, track and roller means for supporting the turret on the pedestal for rotation about an azimuth axis Az—Az, pivot means on the turret for supporting the reflector for rotation about an elevation axis El—El, said track and roller means comprising a circular track member secured on the pedestal and roller elements secured to the turret and engageable with the upper surface of said pedestal track member to

13

provide said rotational support of the turret on the pedestal, said track and roller means also comprising radially directed roller elements engageable with a side surface of the track member to constrain the rotative movements of the turret to follow the track coaxially with said Az—Az axis, and further comprising azimuth drive means supported on the turret for driving the turret about said Az—Az axis, and elevation drive means supported on the turret for driving the reflector about the El—El axis, said reflector comprising a pair of spaced elevation wheels secured thereto for rotation therewith about the El—El axis, and having a drive element secured to at least one of said wheels for driving engagement with said elevation drive means.

5. Antenna apparatus as in claim 4 and further comprising an electronics room structure mounted on the turret and disposed between said reflector elevation wheels.

14

6. Antenna apparatus as in claim 4, said elevation drive means comprising a reducer having an output sprocket and a motor for driving said output sprocket through the reducer, and said elevation-wheel-driving element comprising a length of chain engageable with said output sprocket.

7. Antenna apparatus as in claim 5 and further comprising a bellows extending from said electronics room to the feed area of the reflector to provide a covering therebetween notwithstanding the rotational position of the reflector about said El—El axis.

8. Antenna apparatus as in claim 5 and further comprising a jealousy ladder providing access from the turret to the feed area of the reflector notwithstanding the rotational position of the reflector about said El—El axis.

20

25

30

35

40

45

50

55

60

65

70

75