Jan. 29, 1952 M. L. POTTER 2,583,747

ROTARY ANTENNA

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Fig. 1

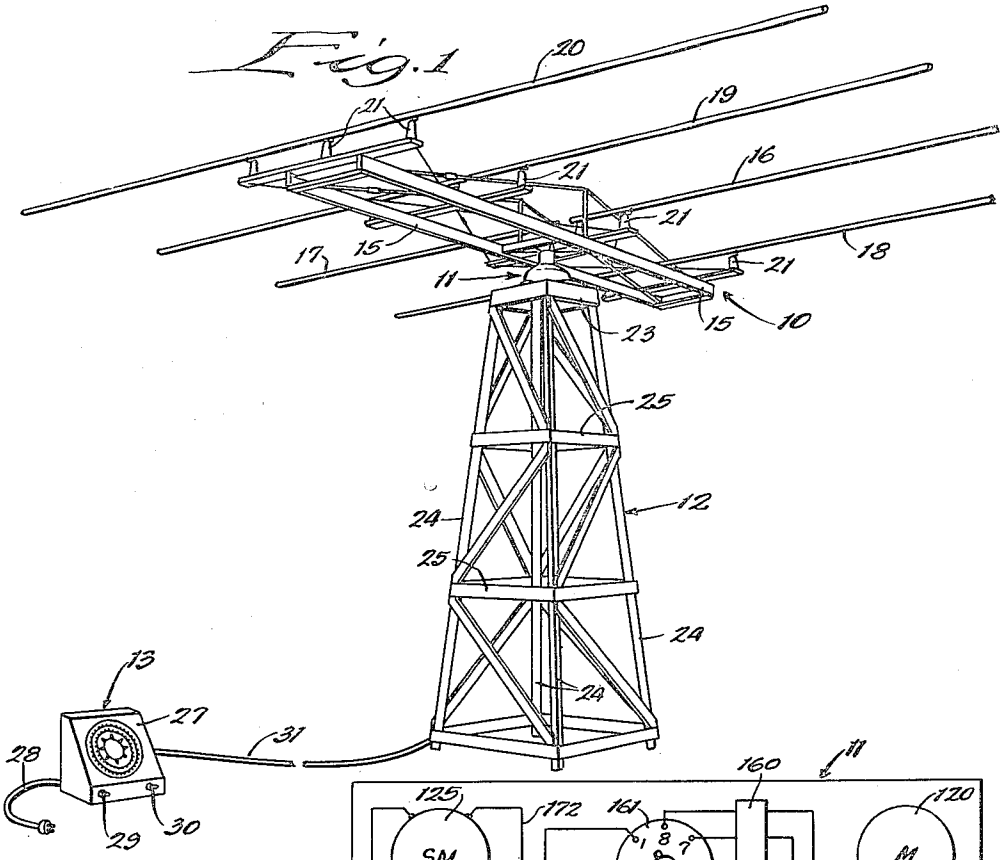
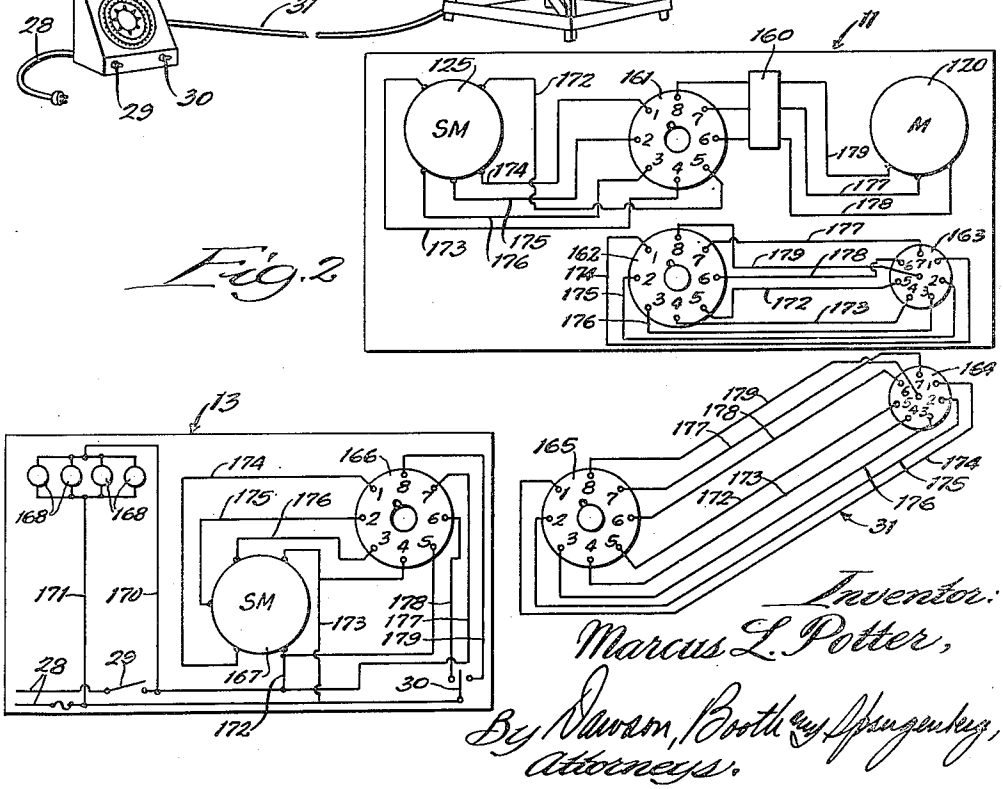


Fig. 2



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Fig. 4

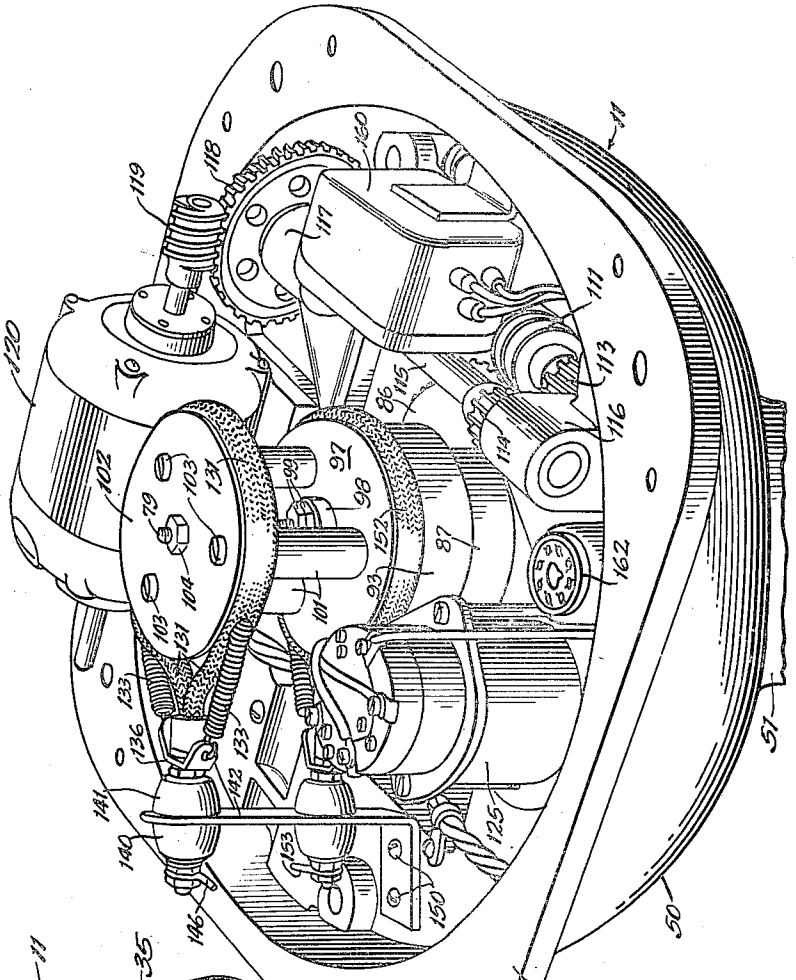
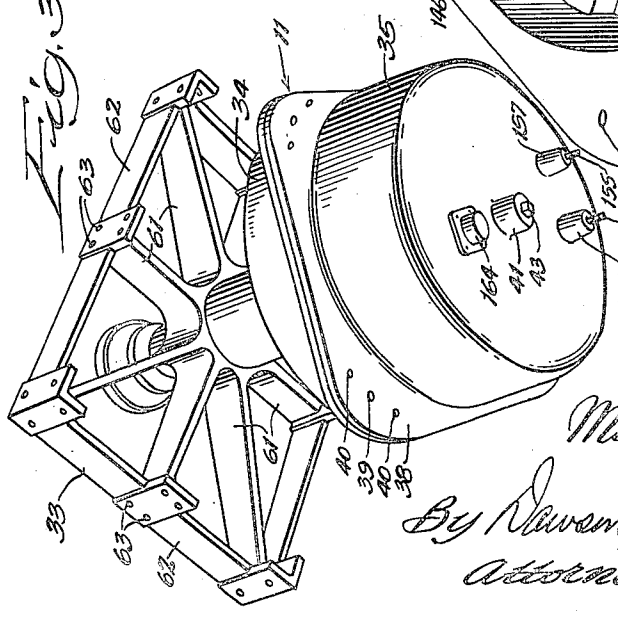


Fig. 3



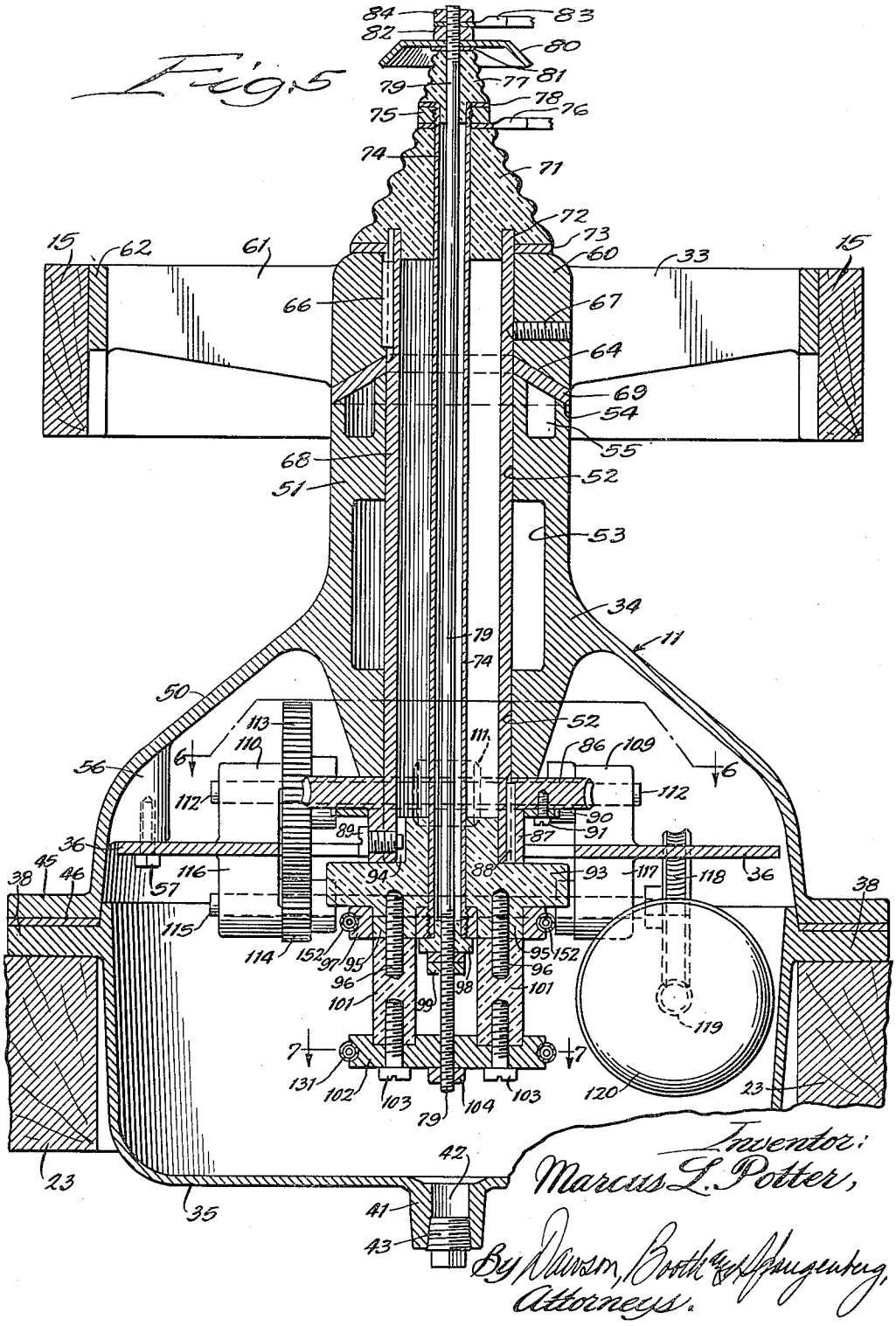
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Fig. 5



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Fig. 6

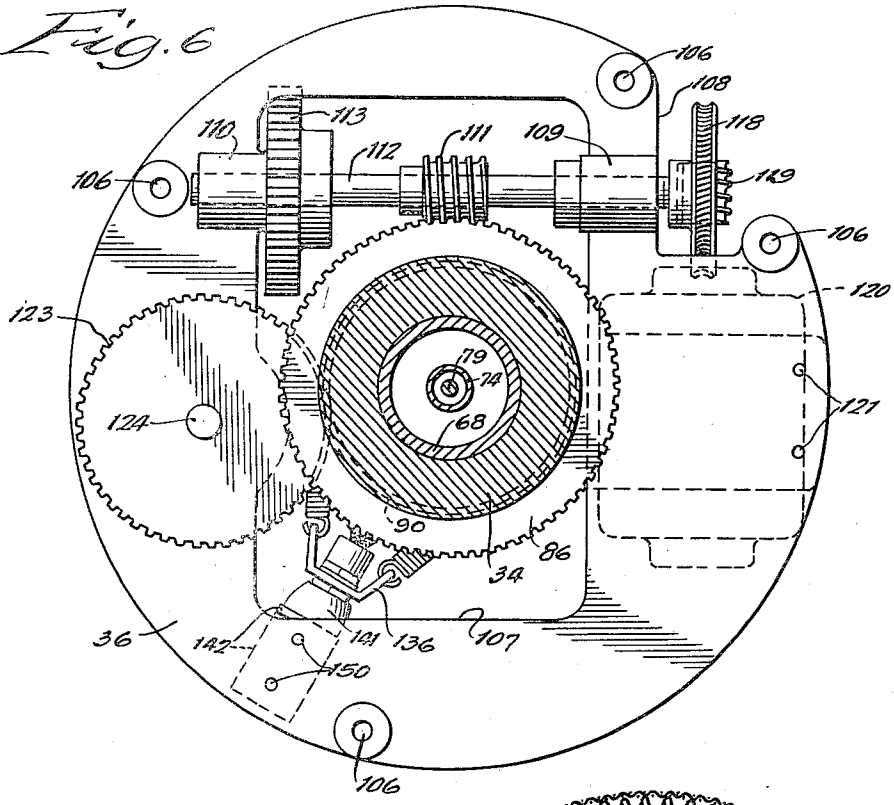


Fig. 7

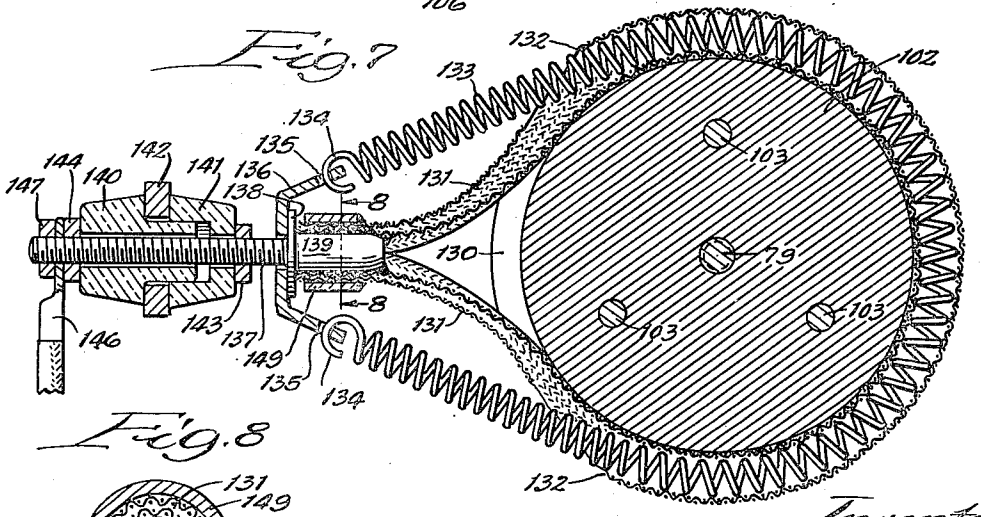
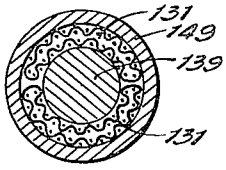


Fig. 8



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Patented Jan. 29, 1952 2,583,747

UNITED STATES PATENT OFFICE

2,583,747

ROTARY ANTENNA

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Application January 26, 1946, Serial No. 643,661

13 Claims. (Cl. 250—33)

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This invention relates to directional antennas and more particularly to means for rotating the same.

The principal object of this invention is to provide an improved mechanism for rotating directional antennas wherein the rotation of the antenna may be remotely controlled, wherein the rotative position of the antenna may be remotely indicated, and wherein the radiator of the antenna may be conductively coupled to the antenna transmission line in a manner to permit complete or continuous rotation in either direction of the antenna and still prevent the occurrence of man made noise in the radio either during transmission or reception.

In carrying out this object of the invention, the directional antenna is rotated in one direction or another by a reversible electric motor, the operation of which is remotely controlled. An indicating system, such as a Selsyn or voltage divider system, has a transmitter Selsyn or voltage divider positioned in accordance with the rotative position of the antenna and a receiver Selsyn or voltage divider controlled thereby for remotely indicating the rotative position of the antenna. An improved coupling system, including rotating collector rings or discs and braided wire collectors engaging the same, conductively couples the radiator or antenna to the transmission line leads which permits complete and continuous rotation in either clockwise or counter-clockwise direction of the antenna but still keeps the impedance in the leads to the radiator substantially constant. Noise in the radio, either during transmission or reception, due to rotation of the antenna is substantially eliminated in the rotating slip rings and braided wire collectors due to the large contact area over approximately 300 degrees of arc.

Further objects of the invention reside in the details of construction of the rotating mechanism, such as the rotative bearing support for the antenna, the drive mechanism for the antenna and direction indicating system, the conductive coupling and the location and interaction of the component parts of the mechanism.

Other objects and advantages will become apparent to those skilled in the art upon reference to the accompanying specification, claims, and drawings, in which—

Fig. 1 is a perspective view of the rotary directional antenna and the remote control and indicating cabinet;

Fig. 2 is a schematic wiring diagram of the remote controlling and indicating system;

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Fig. 3 is a perspective view looking upwardly at the rotating mechanism;

Fig. 4 is a partial perspective view of the rotating mechanism in inverted position and with the bowl or cover removed;

Fig. 5 is a vertical sectional view through the rotating mechanism;

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

Fig. 7 is an enlarged sectional view taken along the line 7—7 of Fig. 5; and

Fig. 8 is a sectional view taken along the line 8—8 of Fig. 7.

Referring first to Fig. 1, the directional antenna is generally designated at 10 and it is rotated in one direction or the other by a rotating mechanism generally indicated at 11. The antenna and rotating mechanism may be supported in the air by a tower generally indicated at 12. The remote controlling and indicating cabinet, generally designated at 13 controls and indicates the rotative position of the antenna 10.

The directional antenna 10 includes a frame 15 for carrying radiators 16 and 17, a reflector 18, and directors 19 and 20, all of which are carried by the frame 15 through insulators 21. The frame 15 is suitably secured to the rotating mechanism 11 which, in turn, is carried by a cradle platform 23 of the tower 12. The tower may comprise uprights 24 and braces 25.

The remote indicating and control cabinet 13 includes a panel 27 cooperating with the pointer of a Selsyn or voltage divider receiver unit for indicating the rotative position of the antenna 10. Power is supplied to the indicating and control cabinet 13 from a source of alternating current through an extension cord 28. A switch 29 renders the electrical system operative or inoperative and the switch 30 controls the direction of rotation of the antenna 10. A multi-wire electrical cable 31 extends between the control cabinet 13 and the rotating mechanism 11.

Referring now to Figs. 3 and 5, the rotating mechanism includes a spider 33 for carrying the frame of the antenna, an enclosed frame or dome 34 rotatably mounting the spider 33, a bowl or cover 35 for the frame 34, and a carriage or cradle 36 mounted within the frame or dome 34 and supporting the driving mechanism for the spider 33.

The bowl or cover 35 includes a mounting flange 38 provided with holes 39 through which bolts or screws may secure the rotating mechanism to the cradel support of the tower 12. The flange 38 also includes holes 40 by which the

bowl or cover 35 is secured to the frame or dome 34. The bottom of the bowl or cover 35 is provided with a boss 41 having an opening 42 to permit attaching a receptacle of dehydrating material to absorb moisture from sweating or leakage that might occur in the rotating mechanism. The opening 42 may be closed by the plug 43 if a dehydrating agent is not used.

The frame or dome 34 is provided with a flange 45 mating with the flange 38 of the bowl or cover 35. A gasket 46 is interposed between the two flanges and the flange 45 is provided with holes 47 and 48 by which the frame 34 and cover 35 may be secured together and the rotating mechanism mounted on the cradle support 23 of the tower. The frame or dome 34 comprises a housing portion 50 and a tubular extension 51 having an inner opening and bearing surface 52. The tubular extension has an annular opening 53 in the internal bearing surface. The upper edge of the tubular extension 51 is tapered to provide a tapered bearing surface 54 having an annular opening 55 therein. The frame 34 is internally provided with bosses 56 to which the carriage 36 may be fastened by screws 57.

The spider 33 is provided with a hub 60 and spokes 61 radiating therefrom and terminating in a flange 62. The flange 62 is provided with pads having holes 63 for securing the frame 15 of the antenna to the spider. The hub 60 of the spider is tapered at 64 to provide a bearing surface and is also provided with a key slot for accommodating a key 66 and a tapped hole for accommodating a set screw 67. The key 66 and set screw 67 secure the hub 60 of the spider 33 to a sleeve 68 which extends downwardly in the bearing surfaces 52 of the tubular extension 51 of the frame 11. An oilless type of bearing 69 is interposed between the bearing surfaces 54 and 64 to provide free rotation of the spider 33 with respect to the frame 34. Because of the tapered construction as shown, moisture and rain is kept out of the interior of the frame 34. Furthermore, this bearing is self centering for the spider 33.

An insulator 71 is provided with an annular opening 72 for accommodating the upper end of the sleeve 68 and is mounted on the hub 60 of the spider with a gasket 73 interposed therebetween. The insulator 71 is provided with a central opening for receiving the upper end of an outer conductor of a coaxial line formed of a hard drawn copper tube 74 which forms one of the conductive paths to the radiator of the antenna. A collar 75 is screw threaded on the end of the sleeve 74 and is in electrical connection with a lead fitting 76 which in turn is electrically connected by a wire to the radiator 16 of the antenna.

A second insulator 77 is carried by the sleeve 74 with a gasket 78 interposed between it and the collar 75. The insulator 77 is provided with a central opening therethrough to receive the inner conductor of a coaxial line formed of a copper rod 79. A weather shield 80 is carried by the insulator 77 with a gasket 81 interposed therebetween and is held in place on the insulator 77 by a nut 82 screw threadedly mounted on the rod 79. A lead fitting 83 is also secured to the rod 79 by a nut 84 and the fitting 83 may be electrically connected by a wire to the radiator 17 of the antenna. The rod 79, therefore, forms part of the electrical circuit to the radiator 17. Both outer and inner members 74 and 79 of the coaxial line are insulated from ground.

A worm gear 86 having an annular extension 87 is secured to the lower end of the sleeve 68 by a key 88 and a set screw 89. A spur gear 90 for driving the direction indicating transmitter is fastened to the under side of the worm wheel 86 by screws 91.

An insulator 93 having an extension fitting into the ilower end of the sleeve 68 is provided with a slot 94 for receiving the end of the screw 89 so that the insulator 93 is caused to rotate with the sleeve 68 and the worm wheel 86. The insulator 93 is provided with extensions 95 in which are mounted studs 96.

A collector ring or conductor disc 97 is provided with openings for receiving the extensions 95 of the insulator 93 and is also provided with a central screw threaded opening for screw threadedly receiving the lower end of the coaxial outer conductor or sleeve 74. When the sleeve 74 is screw threaded into the collector ring or conductor disc 97, the collector ring or conductor disc 97, the insulator 93, the sleeve 68, and the insulator 71 are all held in assembled relation. The sleeve 74 is, therefore, electrically connected to the collector ring or conductor disc 97.

An insulator 98 is provided with an extension fitting into the coaxial sleeve 74 and is also provided with a central opening for receiving the coaxial inner conductor or rod 79. Nuts 99, screw threaded on the rod 79, hold the insulators 98 and 77 in place.

Insulators 101 are carried by the studs 96 for supporting a collector ring or conductor disc 102 through the agency of screws 103. The collector ring or conductor disc 102 is provided with a central opening for receiving the lower end of the rod 79 and electrical connection between the rod 79 and the collector ring or conductor disc 102 is assured by both solder and a nut 104.

By reason of the above construction the spider 33, the worm wheel 86, and the collector rings or conductor discs 97 and 102 all operate and rotate as a unit.

The carriage or cradle plate 36 is provided with holes 106 for accommodating the screws 57 whereby the carriage or cradle plate is secured within the frame or dome 34. The carriage is also provided with a central opening 107 and a marginal opening 108 for accommodating the operating parts extending therethrough. The carriage is also provided with upper oilless type bearings 109 and 110 for supporting a worm 111 mounted on a shaft 112. The worm 111 meshes with the worm gear 86 for causing rotation of the latter. The shaft 112 also carries a spur gear 113 meshing with a spur gear 114 carried by a shaft 115 mounted in lower oilless type bearings 116 and 117. The shaft 115 is also provided with a worm gear 118 which meshes with a worm 119 operated by a reversible electric motor 120. The motor may be a 1/20 horse power, 3-wire series reversible, or an induction motor operating on 110 volts alternating current and, depending upon the circuit connections thereto, may be driven in one direction or another for operating through the gearing just enumerated to rotate the spider 33 in one direction or the other.

Because of the large amount of gear reduction utilized, the motor 120 may be of relatively small size for providing sufficient power for rotating the antenna. The motor 120 is mounted on the under side of the carriage or cradle plate 36 by means of screws mounted in tapped holes 121 in the carriage 36.

A gear 123 carried by the drive shaft 124 of a Selsyn or voltage divider transmitter unit 125 meshes with the spur gear 90 secured to the worm gear 86 so that the Selsyn or voltage divider

transmitter unit 125 is positioned in exact accordance with the position of the spur gear 90 and hence in exact accordance with the rotative position of the antenna 10.

The conductive couplings to the rotating collector rings of conductor discs 97 and 102 are best shown in Figs. 7 and 8. Here the conductor disc 102 is provided with an annular groove 130 for receiving a braided wire sleeve 131. The braided wire sleeve 131 is provided with slits at 132 whereby a coil spring 133 may be inserted into the braided wire sleeve 131 at those points. The coil spring 133 is provided with hooks 134 located in openings 135 in a bracket 136 carried by a screw threaded stud 137 provided with a flange 138. The spring 133 holds the bracket 136 against the flange 138. The stud 137 is provided with an extension 139 for receiving the ends of the braided wire sleeve 131. The screw threaded stud 137 is provided with an insulator 140 coupling with an insulator 141 for securing the stud 137 to a stationary bracket 142. Nuts 143 and 144 clamp the stud and insulators to the bracket 142. A connecting lug 146 is secured to the stud 137 by a nut 147 to provide an electrical connection.

The ends of the braided wire sleeves 131 are encased in a collar 149 where they engage the extension 139 and they are soldered to the extension 139 adjacent the flange 138. The collar 149 operates to localize the soldering of the braided wire sleeves 131 to the extension 139 at a point adjacent the flange 138 and thereby prevent excessive solder from flowing along the braided wire with resultant brittleness of the same. In other words, this assembly and manner of soldering prevents the braided wire sleeves 131 from becoming brittle beyond the line 8—8 by reason of solder intermingling therein.

The coil spring 133 maintains the braided wire sleeve 131 in firm contact with the major portion of the groove 130 of the conductor disc 102 and it does so with a uniform force over this entire distance whereby good electrical contact is at all times maintained between the braided wire sleeve 131 and the conductor disc 102. Because of this large surface of contact the resistance between the braided wire sleeve 131 and the conductor disc 102 remains substantially constant regardless of the rotation of the disc 102 and is therefore far superior to the usual or conventional commutator or collector arrangement. By maintaining the resistance at this point substantially constant, noise in the radio normally resulting because of change in resistance, is substantally eliminated. This system which provides direct connections from the transmission line to the antenna permits noise free reception when the antenna is rotating.

The bracket 142 is secured to the carriage or cradle plate 36 by means of screws 150.

The collector ring or conductor disc 97 is also contacted by a braided wire sleeve 152 in the same manner as illustrated in Fig. 7 and the electrical connection from the braided wire sleeve 152 is made at 153. Wires, suitably spaced to maintain proper impedance, extend from the electrical terminals 146 and 153 to terminals 154 and 155 extending through the bowl or cover 35 and insulated therefrom by insulators 156 and 157 respectively. The high frequency leads then extend from the terminals 154 and 155 to the radio apparatus through a transmission line.

A filter 160 is provided for the motor 120 and is suitably mounted on the carriage or cradle plate 36. A multiple female connector socket 161 is also carried by the carriage 36 to which the various electrical devices carried by the carriage 36 are electrically connected. A male connector 162 and multiple cable electrically connects the terminals of socket 162 to an upper portion 163 of a multiple electrical male plug 164 mounted in the bottom of the bowl or cover 35. The lower portion of that plug 164 extends outwardly from the bowl or cover 35. The multiple cable 31 connects this lower portion of the connector 164 to a connector in the remote controlling and indicating cabinet 13, which connector has an outer portion 165 and an inner portion 166, as diagrammatically illustrated in Fig. 2.

Located within the control cabinet 13 is a Selsyn or voltage divider direction indicator receiver unit 167 having a pointer cooperating with the dial on the panel 27. The dial on the panel 27 may be illuminated by lamps 168 connected across the line wires 28 by conductors 170 and 171. Power is transmitted from the line wires 28 through conductors 172 and 173 to the Selsyn or voltage divider transmitter unit 125. The position of the Selsyn or voltage divider receiver unit 167 is controlled by the position of the Selsyn or voltage divider transmitter unit 125 by means of conductors 172, 173, 174, 175 and 176 extending therebetween.

Power is supplied to the reversible electric motor 120 from the line wires 28 and through the reversing switch 30 by means of conductors 177, 178 and 179. When the reversing switch 30 is in the middle position as shown, the reversible motor 120 is deenergized so that the antenna remains stationary. When the reversing switch 30 is moved to one side, the reversible motor operates in one direction to rotate the antenna in one direction and when it is moved to the opposite side, the reversible motor operates in the opposite direction. The movement and position of the antenna is transmitted through the Selsyn or voltage divider system to the control cabinet 13 to advise the operator as to the position of the antenna so that he may properly control the same remotely. When the master switch 29 is closed the direction indicating system in control cabinet 13 immediately shows the direction in which the antenna is pointed, regardless of power motor control switch 30.

While for purposes of illustration one form of this invention has been disclosed, other forms thereof may become apparent to those skilled in the art upon reference to this disclosure, and, therefore, this invention is to be limited only by the scope of the appended claims and prior art.

I claim as my invention:

1. A rotating mechanism for an antenna comprising an enclosed frame having an upwardly projecting tubular extension, a spider carrying the antenna, a frusto-conical bearing on the upper end of the tubular extension for rotatably mounting the spider on the tubular extension for rotation in a horizontal plane, a reversible motor mounted within the enclosed frame, and a driving connection between the motor and the spider including a part extending through the tubular extension and the bearing.

2. A rotating mechanism for an antenna comprising an enclosed frame having an upwardly projecting tubular extension, a spider carrying the antenna, a frusto-conical bearing on the upper end of the tubular extension for rotatably mounting the spider on the tubular extension for rotation in a horizontal plane, a sleeve carried

by the spider and extending downwardly through the tubular extension and the bearing, a reversible electric motor mounted within the enclosed frame, and gearing between the motor and the sleeve.

3. A rotating mechanism for an antenna comprising an enclosed frame having an upwardly projecting tubular extension, a spider carrying the antenna and mounted for rotation in a horizontal plane on the upper end of the tubular extension, a sleeve carried by the spider and extending downwardly through the tubular extension, a reversible motor mounted within the enclosed frame, a driving connection between the sleeve and the motor, electrical conductors from the antenna extending downwardly through the sleeve into the enclosed frame, and stationary electrical connections in the frame conductively coupled to the electrical conductors.

4. A rotating mechanism for an antenna comprising an enclosed frame having an upwardly projecting tubular extension, a spider carrying the antenna and mounted for rotation in a horizontal plane on the upper end of the tubular extension, a sleeve carried by the spider and extending downwardly through the tubular extension, a reversible motor mounted within the enclosed frame, a driving connection between the sleeve and the motor, insulators adjacent the spider and the upper end of the sleeve, coaxial electrical conductors carried by the insulators extending downwardly through the sleeve into the enclosed frame and adapted to be connected to the antenna, and stationary electrical connections in the frame conductively coupled to the electrical conductors.

5. A rotating mechanism for an antenna comprising, an enclosed frame, a spider for carrying the antenna and mounted for rotation in a horizontal plane on the upper side of the frame and including a part extending downwardly into the enclosed frame, a carriage in the frame, a reversible electrical motor carried by the carriage, gearing carried by the carriage and coupling the motor to the downwardly extending part of the spider, an electrical direction transmitter carried by the carriage and geared to the downwardly extending part of the spider, a multiple electric socket carried by the carriage, electrical connections between the socket and the motor and electrical direction transmitter, a multiple electric plug carried by the frame, and a multiple electrical cable connecting the socket and plug.

6. A rotating mechanism for an antenna comprising an enclosed frame, a spider carrying the antenna and mounted for rotation in a horizontal plane on the upper side of the frame, a sleeve carried by the spider and extending downwardly into the enclosed frame, a reversible motor mounted within the enclosed frame, gearing between the motor and the sleeve for rotating the spider, an electrical conductor carried by the spider adapted to be connected to the antenna and extending downwardly through the sleeve into the enclosed frame, a conductor disc carried by the sleeve within the enclosed frame and electrically connected to the conductor, a braided wire member engaging the periphery of the disc, and a stationary electrical connection to the braided wire member.

7. A rotating mechanism for an antenna comprising an enclosed frame, a spider carrying the antenna and mounted for rotation in a horizontal plane on the upper side of the frame, a sleeve carried by the spider and extending downwardly

into the enclosed frame, a reversible motor mounted within the enclosed frame, gearing between the motor and the sleeve for rotating the spider, an electrical conductor carried by the spider adapted to be connected to the antenna and extending downwardly through the sleeve into the enclosed frame, a conductor disc carried by the sleeve within the enclosed frame and electrically connected to the conductor, a braided wire member around the periphery of the conductor disc, spring means around the periphery of the conductor disc for holding the braided wire member in engagement with a relatively large portion of the periphery of the conductor disc, and a stationary electrical connection to the braided wire member.

8. A rotating mechanism for an antenna comprising an enclosed frame, a spider carrying the antenna and mounted for rotation in a horizontal plane on the upper side of the frame, a sleeve carried by the spider and extending downwardly into the enclosed frame, a reversible motor mounted within the enclosed frame, a gearing between the motor and the sleeve for rotating the spider, an electrical conductor carried by the spider adapted to be connected to the antenna and extending downwardly through the sleeve into the enclosed frame, a conductor disc carried by the sleeve within the enclosed frame and electrically connected to the conductor, a braided wire member engaging the periphery of the conductor disc, a stationary stud within the enclosed frame, the ends of the braided wire member engaging the stud, a sleeve around the ends of the braided wire member where they engage the stud, and a soldered connection between the stud and the ends of the braided wire member.

9. A rotating mechanism for an antenna comprising an enclosed frame having an upwardly projecting tubular extension, a spider carrying the antenna, bearing and sealing means interposed between the upper end of the tubular extension and the spider for supporting and mounting the spider for rotation in a horizontal plane on the upper end of the tubular extension and for sealing the interior of the enclosed frame, a reversible motor mounted within the enclosed frame, and a driving connection between the motor and the spider including a part extending through the tubular extension.

10. A rotating mechanism for an antenna comprising an enclosed frame having an upwardly projecting tubular extension, a spider carrying the antenna, bearing and sealing means interposed between the upper end of the tubular extension and the spider for supporting and mounting the spider for rotation in a horizontal plane on the upper end of the tubular extension and for sealing the interior of the enclosed frame, a sleeve carried by the spider and extending downwardly through the tubular extension, a reversible motor mounted within the enclosed frame, and gearing between the motor and the sleeve.

11. A rotating mechanism for an antenna comprising an enclosed frame having an upwardly projecting tubular extension, a spider carrying the antenna, bearing and sealing means interposed between the upper end of the tubular extension and the spider for supporting and mounting the spider for rotation in a horizontal plane on the upper end of the tubular extension and for sealing the interior of the enclosed frame, a carriage mounted within the enclosed frame, a reversible motor mounted on the carriage within

the enclosed frame, and a driving connection between the motor and the spider including gearing mounted on the carriage and a part extending through the tubular extension.

12. A rotating mechanism for an antenna comprising an enclosed frame having an upwardly projecting tubular extension, a spider carrying the antenna, bearing and sealing means interposed between the upper end of the tubular extension and the spider for supporting and mounting the spider for rotation in a horizontal plane on the upper end of the tubular extension and for sealing the interior of the enclosed frame, a sleeve carried by the spider and extending downwardly through the tubular extension, a carriage mounted within the enclosed frame, a reversible motor mounted on the carriage within the enclosed frame, and gearing mounted on the carriage between the motor and the sleeve.

13. A rotating mechanism for an antenna comprising an enclosed frame having an upwardly projecting tubular extension, a spider carrying the antenna and having a part extending downwardly through the tubular extension into the enclosed frame, bearing and sealing means interposed between the upper end of the tubular extension and the spider for supporting and mounting the spider for rotation in a horizontal plane on the upper end of the tubular extension and for sealing the interior of the enclosed frame, a carriage within the enclosed frame, a reversible motor carried by the carriage within the enclosed frame, gearing carried by carriage and

coupling the motor to the downwardly extending part of the spider, and an electrical direction transmitter carried by the carriage within the enclosed frame and geared to the downwardly extending part of the spider.

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