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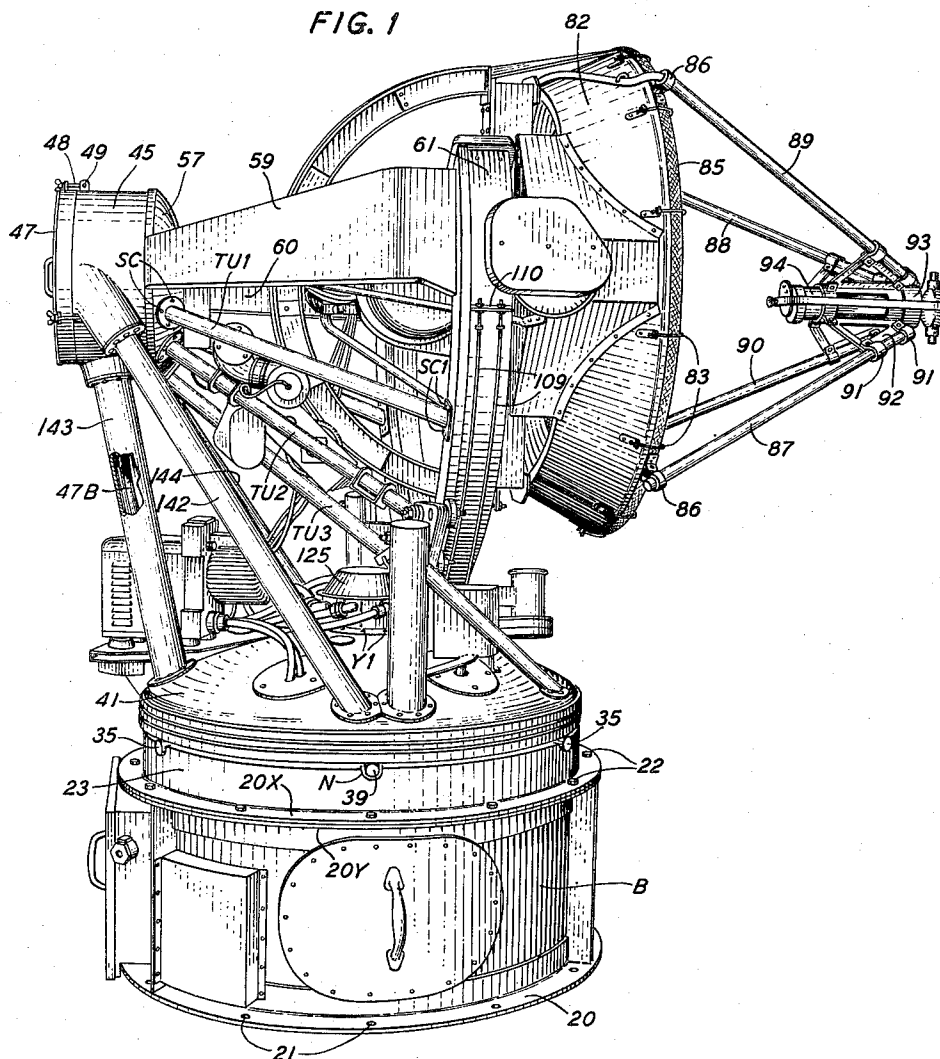
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RADAR ANTENNA DRIVING MECHANISM

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4 Sheets-Sheet 1

FIG. 1



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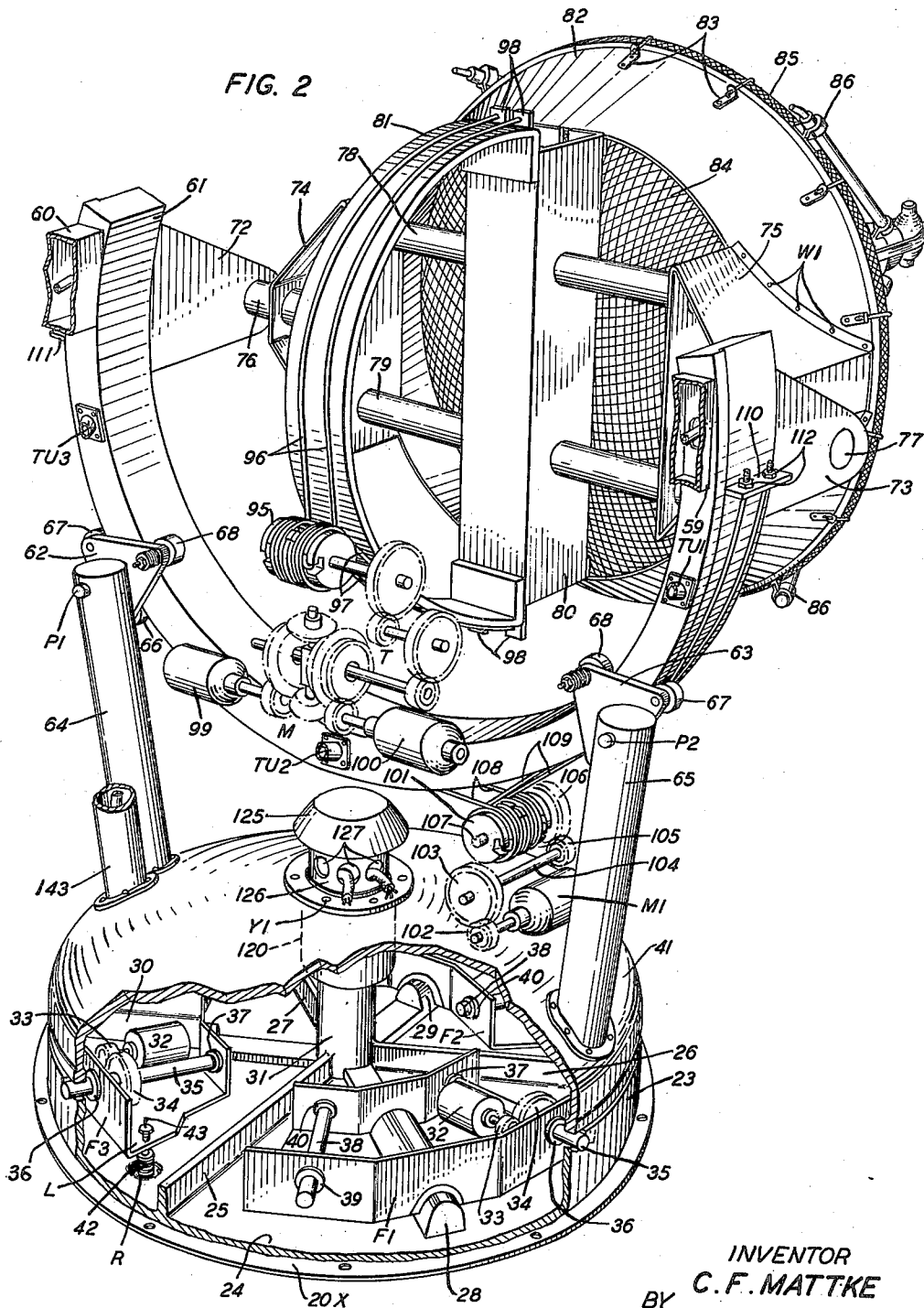
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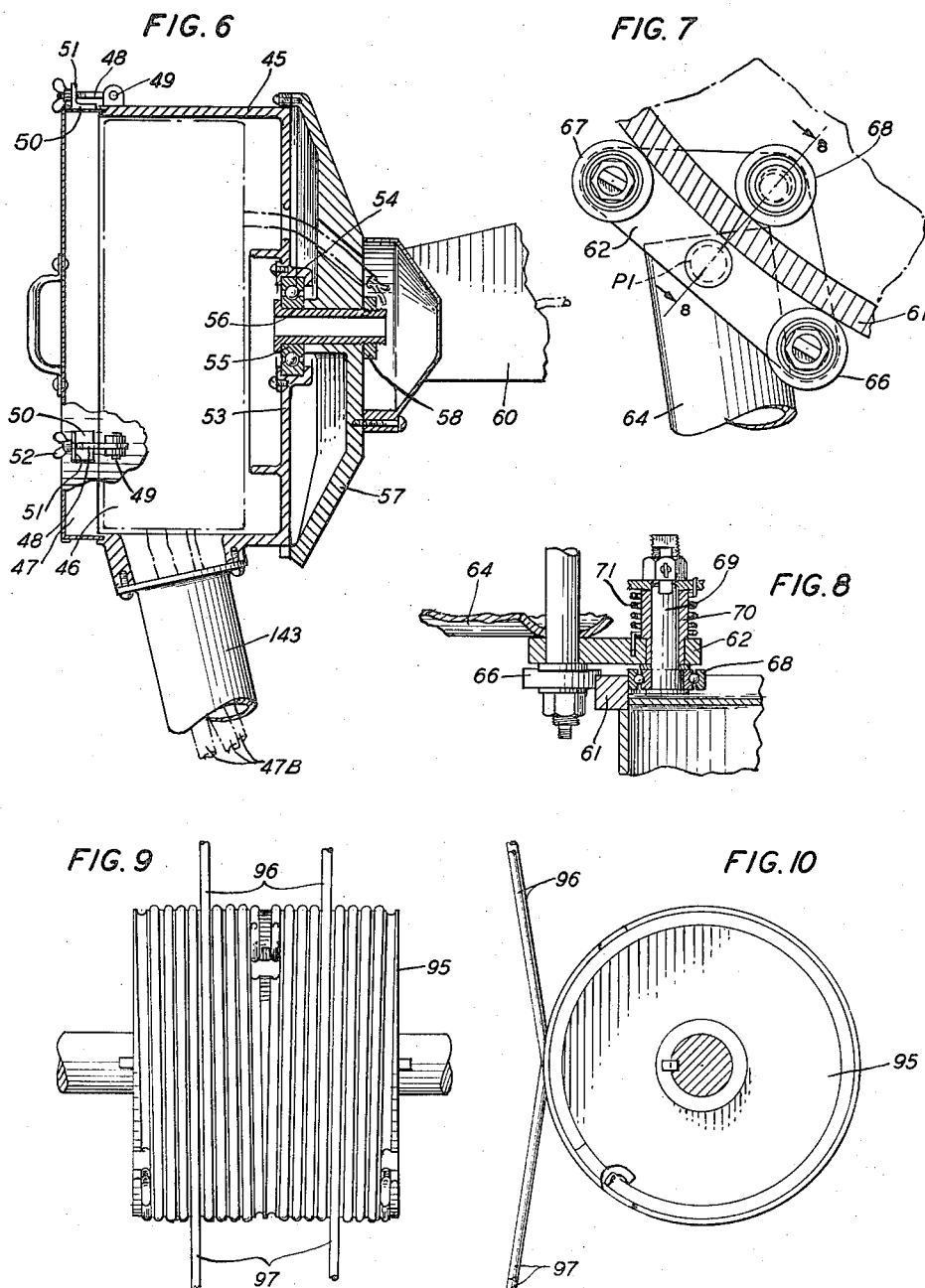
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RADAR ANTENNA DRIVING MECHANISM

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7 Claims. (Cl. 250—33.65)

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This invention relates to radio signaling systems and more specifically to a scanning mechanism for use in such a system.

The object of the present invention is the provision of a scanning mechanism which is of simple and rugged construction and accurate in operation.

In the drawing:

Fig. 1 is an elevation view shown in perspective;

Fig. 2 is a partial view shown in perspective with a number of operating parts with portions broken away;

Fig. 3 is a partial view enlarged showing in vertical section one of a plurality of driving mechanisms used for driving a turn-table and a reflector assembly supported by the turn-table in the azimuth direction;

Fig. 4 is a top view of the driving mechanism shown in Fig. 3, shown with the turn-table which supports the reflector assembly removed;

Fig. 5 is a detailed view showing a spring tensioning arrangement for adjusting the friction between the turn-table supporting the reflector assembly and the driving shaft of its actuating mechanism;

Fig. 6 is a partial view in vertical cross-section of a casing serving for pivoting a support for the reflector and for housing a bank of terminal connecting wires leading to a scanning head associated with the reflector;

Fig. 7 is a partial view showing one of a pair of self-adjusting brackets having rollers serving for supporting a race track formed with the support for the reflector;

Fig. 8 is a cross-sectional view taken on line 8—8 of Fig. 7;

Fig. 9 is a view of one of a pair of windlass drums actuated by the operation of synchronous motors for actuating the support of the reflector assembly in vertical and azimuth direction; and

Fig. 10 in a side view of Fig. 9.

According to the construction of the scanning mechanism of this invention, a cylindrically-shaped casing section B is provided with a rim 20 at its lower disposed end having a plurality of equally spaced drilled holes 21 for securing the casing section in an upright position on a mounting base, not shown. The upper disposed end portion of casing section B is formed with a rim element 20Y for receiving the rim 20X of the casing section 23, the latter section being secured to casing section B by a plurality of bolts 22 as shown in Fig. 1.

The casing section 23 is formed with a wall in the form of a disc 24 reinforced by a plurality of radially disposed fin members 25, 26 and 27 and

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a number of rib elements 28, 29 and 30, while a hub 31, best seen in Figs. 2 and 3, is secured at its lower end as by welding to the wall center portion of 24, to the end of the fin members 25, 26 and 27 and to the end of rib elements 28, 29 and 30. The opposite end of each rib element 28, 29 and 30, as shown in Fig. 2, is formed with a semicircular portion serving for pivoting similarly shaped frames F1, F2 and F3 and on each of these frames is mounted a motor 32 on the armature shaft of which is keyed a pinion 33 disposed in meshing relation with the gear 34 keyed on a shaft 35, this shaft being journaled in ball bearings 36 and 37 while an idle shaft 38 is journaled in ball bearings 39 and 40. The casing section 23 at its upper disposed edge portion is provided with semicircular notches N as shown in Figs. 1 and 4 through which the similar disposed ends of shafts 35 and 39 of the frame F1, F2 and F3 extend. A dome-shaped mounting or turn-table 41, as best seen in Figs. 1, 2 and 3, is provided with an opening at its center portion for receiving a cup-shaped member 120, secured thereto by a number of screws Y1. The cup-shaped member 120 in cooperation with hub 31 forms an annular space provided for receiving a thrust bearing 121 and a ball bearing 122. Bearings 121 and 122 are held against longitudinal movement on the hub 31 by a number of spring washers 123 while a nut 124 engaging a similarly screw-threaded portion of hub 31 is provided for tensioning the spring washers 123 for a purpose which will be hereinafter described in detail.

A hood-shaped member 125 is formed with a cylindrical portion 126 which is fitted with a press fit adjustment onto the upper disposed end of hub 31 while drilled holes 127 in the cylindrical portion 126 of hood member 125 serve as outlet for the different wires connecting electrical apparatus, not shown, located into the casing portion B with the motors of the different driving mechanisms which will be hereinafter described in detail. For each frame F1, F2 and F3, as shown in Figs. 2, 3 and 5 there is provided a coil spring 42 having its lower disposed end resting in a cup-shaped recess R formed in the wall 24 of casing section 23 and the upper disposed end of this spring is fitted with a washer W engaged by a screw 43 threaded into a lug L formed with each bracket F1, F2 and F3 to serve for tensioning their respective springs 42 and thereby causing the tilting movement of the frames on pivots 28, 29 and 30 so as to control the friction between the shafts 35 of each frame 55 and the race track of the turn-table 41.

On turn-table 41, as best seen in Fig. 1, is secured, at one of their ends as by a number of

bolts or rivets, a plurality of tubings 142, 143 and 144 forming a tripod assembly for supporting a cylindrically-shaped casing 45 serving for housing a bank terminal 46 provided for effecting a number of different electrical connections from apparatus house in casing B having their conductors as 47B extending into the tripod tubing 143 as shown in Figs. 1 and 6, a cover 47 being secured to the casing 45 by a plurality of bolts 48 having one of their ends pivoted on lugs as 49 formed with casing 45 and their opposite ends extending between a pair of prongs 51 formed with angle pieces 50 which are secured as by welding to the cover 47, the prongs 51 permitting the quick disengagement of the bolts from the angle pieces 50 following the loosening of the wing nuts 52.

The wall 53 of casing 45 is provided at its center portion with a hub element 54 fitted with a ball bearing 55 serving for rotatably mounting a bushing 56 while a disc-shade member 57 is secured to the pushing 56 by a nut 58 this nut collectively securing the inner race of ball bearing 55 and the disc-shaped member 57 on the bushing 56.

The disc-shaped member 57, as best seen in Figs. 1, 2 and 6, is formed with two diametrically opposite hollow arms 59 and 60 to the free end of which is secured as by welding an arcuate track element 61 of substantially 220 degrees in length supported by rollers in the form of ball bearings as 66, 67 and 68. Bearings 66 and 67, as best seen in Fig. 7, are mounted on spindles secured to and laterally extending from triangularly shaped plates or brackets 62 and 63 mounted on pivots or spindles as P1 and P2 carried by tubular supports 64 and 65 which are riveted at their lower ends to the turn-table 41, while the roller 68 of each bracket as shown in Figs. 7 and 8 is mounted on similar eccentric spindles 69 rotatably mounted in bushings 70 carried by brackets 62 and 63. Torsion springs 71 tend to turn the spindles 69 for pressing the ball bearings 68 against the inner periphery of the arcuate race track element 61 so as to prevent any loose motion therebetween. A plurality of spacer members in the form of tubings TU1, TU2, TU3 are secured as by a number of screws SC and SC1 to the disc member 57 and to the race track member 61 being provided in addition to the arms 59 and 60 for holding the element 61 perpendicularly relative to the axis of rotation of disc member 57.

The race track element 61 is formed with two laterally extending arms 72 and 73 serving for pivotally mounting, as on pivots 76, 77, a frame structure consisting of two V-shaped brackets 74 and 75 constructed of sheet metal held in spaced relation to each other by a pair of parallelly disposed tubings 78 and 79, such tubings supporting a tubular member 80 of square cross section serving for securing as by welding the ends of a semi-circular rim 81 and a truncated cone-shaped sheet metal member 82, the latter being secured to the V-shaped brackets 74 and 75 by a plurality of rivets W1, while a plurality of hook members 83 carried by the truncated cone-shaped member 82 serves for securing a parabolic reflector 84 in adjusted position into the truncated cone member 82 as shown in Figs. 1 and 2.

To the rim 85 of member 82 are secured as by rivets four equally spaced similar clamping elements 86 provided for securing one of the ends of tubings 87, 88, 89 and 90 converging toward each other at their free ends for connection as by

a plurality of similar clamping elements 91 with four angularly-shaped brackets 92, these brackets in turn connecting with outwardly extending lug portions formed with a sleeve 93 provided for receiving a so-called scanning head 94 which will form the subject of a succeeding patent application.

The reciprocating vertical movement of the reflector assembly on pivots 76 and 77 is effected by the rotation of a windlass drum 95 for winding a pair of cables 96 while unwinding a similar pair of cables 97. The opposite ends of cables 96 and 97 are secured to similarly shaped lug members 98 which are in turn secured to the ends of the square tubular member 80 as by welding. The drum 95 is rotated in opposite direction by the cooperation of two motors 99 and 100 geared to a differential mechanism M and a gear reduction train T, best seen in Fig. 2. Similarly reciprocating movements are imparted to the race track 61 by a windlass drum 101 operatively connected to a motor MI through a gear reduction mechanism comprising a pinion 102 keyed on the armature shaft of motor MI, the gear 103 and pinion 105 keyed on shaft 104 and a gear 106 keyed on the shaft 107 of windlass drum 101. The rotation of windlass drum 101 is effected to wind or unwind the pairs of cables 108 and 109 as the case may be depending upon the direction of motor MI. The ends of cables 108 and 109 are secured to angle-shaped bars 110, 111, secured as by welding to the race track 61 while nuts 112 are provided for adjusting the tension of the cables.

In the operation of the radio signaling system of this invention as for moving the reflector assembly in the azimuth direction, the simultaneous energization of motors 32 is effective to rotate their respective shafts 35 in frictional engagement with the race track formed at the edge of the turn-table 41, the motors 32 being cooled by the air streams generated by the fans 130, while the amount of pressure contact between each driving shaft 35 and the race track of the turn-table support 41 is controlled by the tightening of screws 43 while the additive tension effect of springs 42 is resisted by the spring rings 123 tensioned by the nut 124 at the upper end of hub 31.

The movement of the reflector 82 as for generating a straight vertical line is effected by the operation of windlass drum 95 by the motors 99 and 100 through the differential mechanism M and the gear train T, the rotation of windlass drum 95 winding or unwinding the pair of cables 96 and 97 as above mentioned depending upon the direction of drum 95, while the pivotal movement of race track 61 as effected by motor 101 in cooperation with the vertical movement of reflector 82 is effective to generate geometrical figures representing spirals or cones depending upon the relative speed of motor 99—100 relative to motor MI, the scanning angle of the cone or signal being dependent upon the angular vertical movement and the transverse angular movement of the reflector.

What is claimed is:

1. A radio signaling apparatus comprising a base, a circular casing section secured to said base having a hub element extending perpendicularly from said section at the center thereof, a plurality of ribs radially disposed at substantially equal spaced relation on said casing section, a plurality of brackets mounted for tilting movement on said ribs, a motor and a driving shaft

mounted on each of said brackets, gear mechanisms operatively connecting said driving shafts to said motors, a circular mounting pivoted on said hub element and having a race track frictionally engaging said driving shafts for rotation upon the collective operation of said motors, a reflector carried by said circular mounting and means for moving said reflector in a plane of rotation at an angle to the plane of said race track.

2. A radio signaling apparatus comprising a reflector, a rotary support for said reflector, a tripod carried by said rotary support, a casing supported by said tripod, an arcuate-shaped member having a pair of arms converging towards each other at one of their ends and having means forming a pivot journaled in a bearing at the center of said casing, said reflector being supported by said arcuate-shaped member, a pair of upright members carried by said rotary support, a pivoted plate mounted on each of said upright members having roller elements engaging said arcuate-shaped member for supporting it, a motor, means actuated by said motor for imparting reciprocating movement to said arcuate-shaped member independently of the operation of said rotary support for actuating said reflector, and a scanning mechanism carried by said reflector.

3. A radio signaling apparatus comprising a turn-table, motor means for actuating said turn-table, a tripod carried by said turn-table, a casing mounted on said tripod, a rotatable semi-ring-shaped support having a race track and spacer members extending towards said casing, a bearing carried by said casing cooperating with said spacer members, upright members carried by said turn-table having means for engaging said race track for supporting said ring-shaped support, a motor for actuating said ring-shaped support, a pair of arms carried by said ring-shaped support, a reflector, means pivotally mounted on said arms for securing said reflector, and a mechanism for actuating said pivoted means.

4. A radio signaling apparatus comprising a cylindrically-shaped base, a turn-table mounted on said base, a casing, supporting means for said casing carried by said turn-table, a pair of diametrically oppositely disposed supports carried by said turn-table, a spindle carried by each of said supports, a plate pivotally mounted on each of said spindles, a plurality of bearings mounted on each of said plates, a reflector, a semi-ring-shaped support for said reflector, said semi-ring-shaped support having a spindle portion supported by means in said casing and a race track portion formed with said semi-ring-shaped support engaging said bearings, a motor mounted on said turn-table, a drum actuated by said motor, and a plurality of cables having one of their ends and a portion of their length wound in opposite directions on said drum and having their other ends attached to diametrically oppositely disposed means carried by said semi-ring-shaped support for rotating it in either of two directions upon the operation of said motor in said directions.

5. A radio signaling apparatus comprising a cylindrically-shaped base, a turn-table mounted on said base, a reflector, a semi-ring-shaped support pivotally mounted on said turn-table and supporting said reflector, a driving mechanism for said support, said mechanism comprising a motor, a drum, a gearing mechanism operatively connecting said motor to said drum, a plurality

of pairs of cables wound on said drum, one pair of said cables winding and the other pair unwinding on said drum upon the rotation of said motor in either one of two directions for actuating said reflector in that direction, another semi-ring-shaped support pivotally mounted on the first-mentioned semi-ring-shaped support, a driving mechanism for the last-mentioned semi-ring-shaped support, said driving mechanism comprising a pair of motors, a drum, a differential mechanism operatively connecting said pair of motors to said drum, and a plurality of pairs of cables wound on said drum and attached to means carried by the last-mentioned support so that said supports are separately rotated to cause said reflector to generate a number of geometrical figures dependent upon the direction and speed of the first-mentioned motor and said motors relatively to each other.

6. A radio signaling apparatus comprising a base, a turn-table mounted for rotating movement on said base, a pair of supports carried by said turn-table, a first semi-ring element carried by said supports for movement in a plane perpendicular to the plane of rotation of said turn-table, a reflector carried by said first semi-ring element, means for rotating said first semi-ring element, said means including a drum, cables wound on said drum and attached to said semi-ring element and a motor operatively connected to said drum, a second semi-ring element attached to said reflector and in a plane at right angles to the plane of said first semi-ring element, means for rotating said second semi-ring element, said second means including a drum, cables wound on said drum and attached to said second element, a pair of motors and a differential gear mechanism, said pair of motors being operatively connected to said drum through said differential gear mechanism, and a scanning mechanism carried by said reflector.

7. A radio signaling apparatus comprising a reflector, a base, a turn-table mounted for rotating movement on said base, means mounted by said turn-table and supporting said reflector for actuating said reflector in a plane at right angles to the plane of rotation of said turn-table, and second means supported by said first means for rotating said reflector in a plane at right angles to each of said other planes, both of said means including a semi-ring element each connected to said reflector, a drum, cables wound on said drum and attached to the respective element, and a motor for rotating said drum whereby said semi-ring element and said reflector are rotated.

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