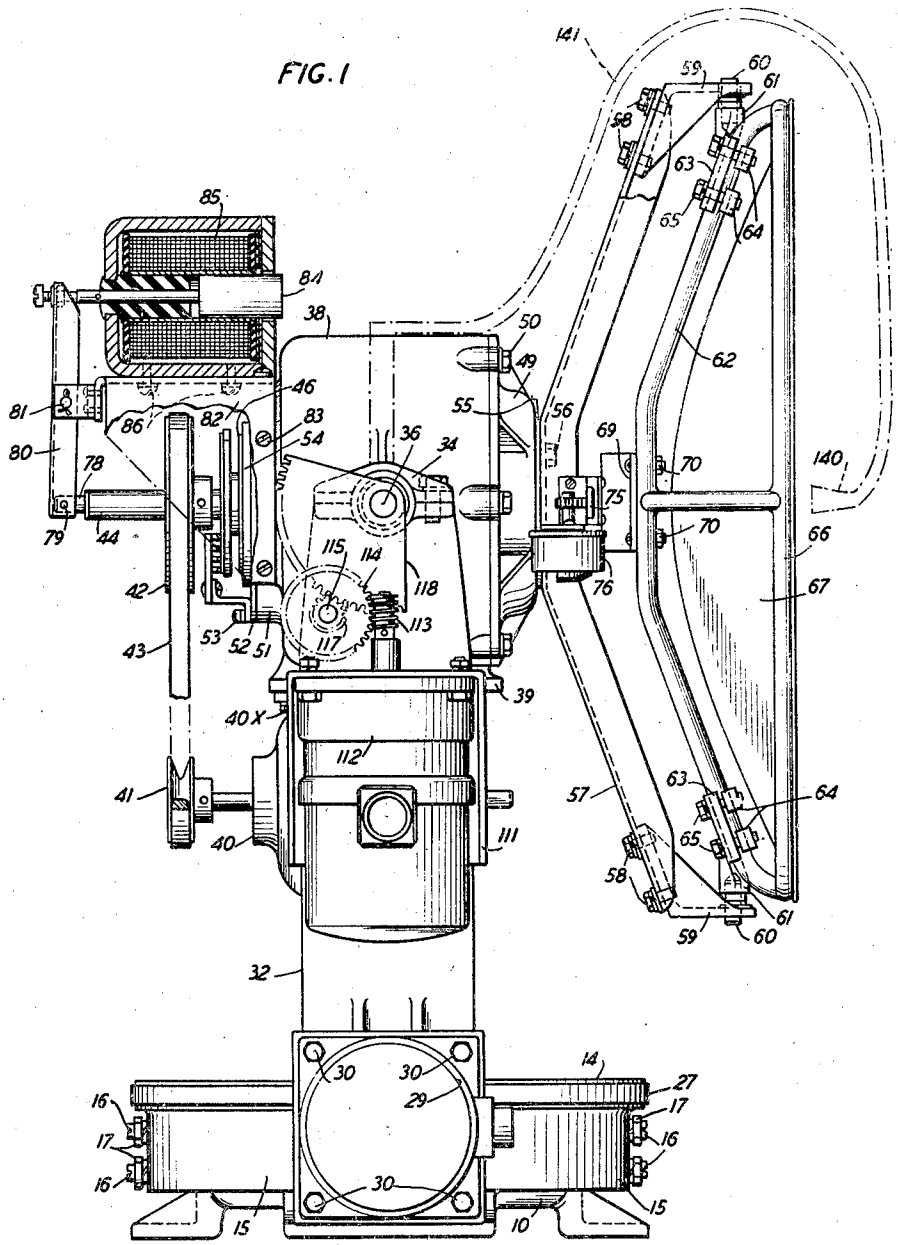
Aug. 23, 1949. H. A. BAXTER ET AL 2,479,897

RADAR ANTENNA DRIVING MECHANISM

Filed April 17, 1947 4 Sheets-Sheet 1

FIG. 1



INVENTORS: H.A. BAXTER
H.T. BUDENBOM
BY J. MacDonald
ATTORNEY

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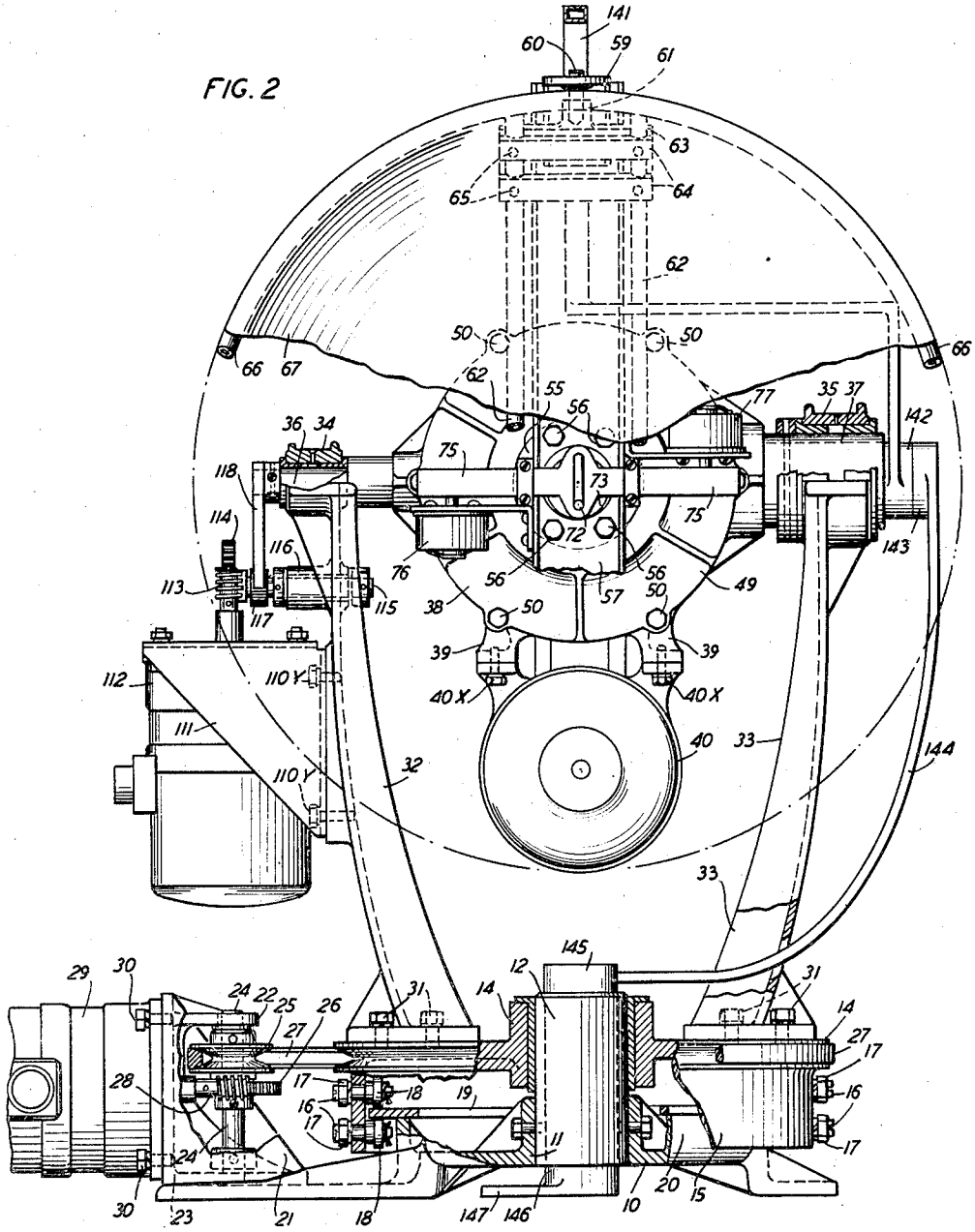
Filed April 17, 1947 4 Sheets-Sheet 2

FIG. 2



INVENTORS: H.A.BAXTER
H.T.BUDENBOM

BY J. MacDonald

ATTORNEY

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Filed April 17, 1947 4 Sheets-Sheet 3

FIG. 3.

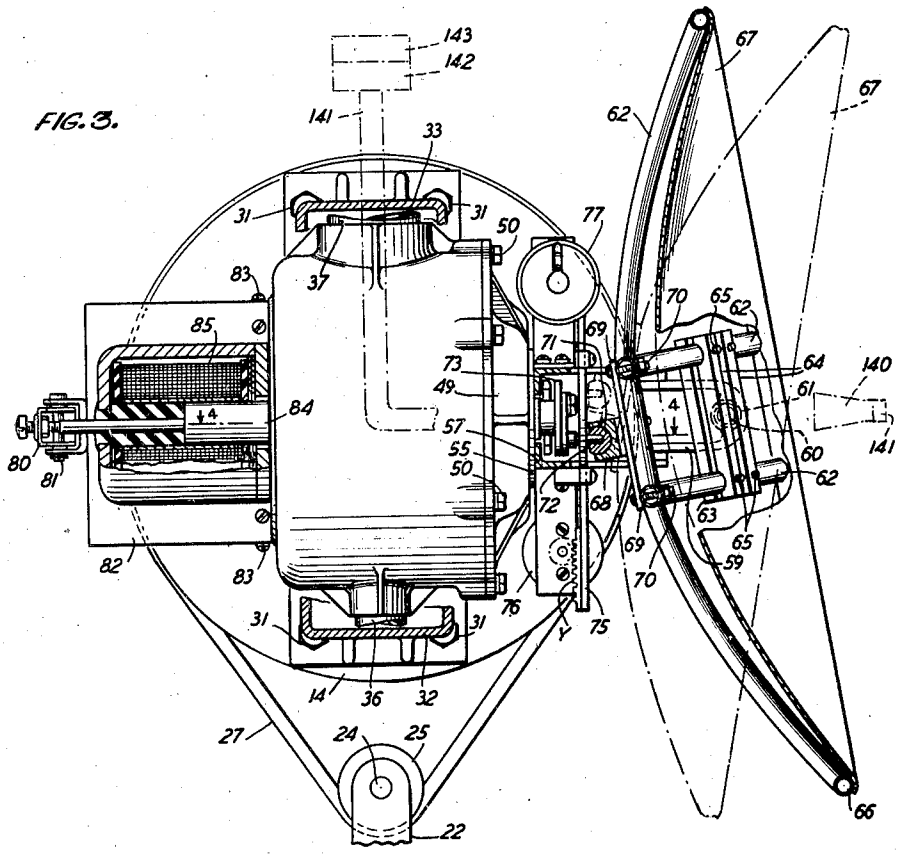


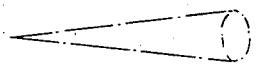
FIG. 5B

FIG. 5C

FIG. 5D

FIG. 5F

FIG. 5E



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BY J. MacDonald
ATTORNEY

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Filed April 17, 1947 4 Sheets-Sheet 4

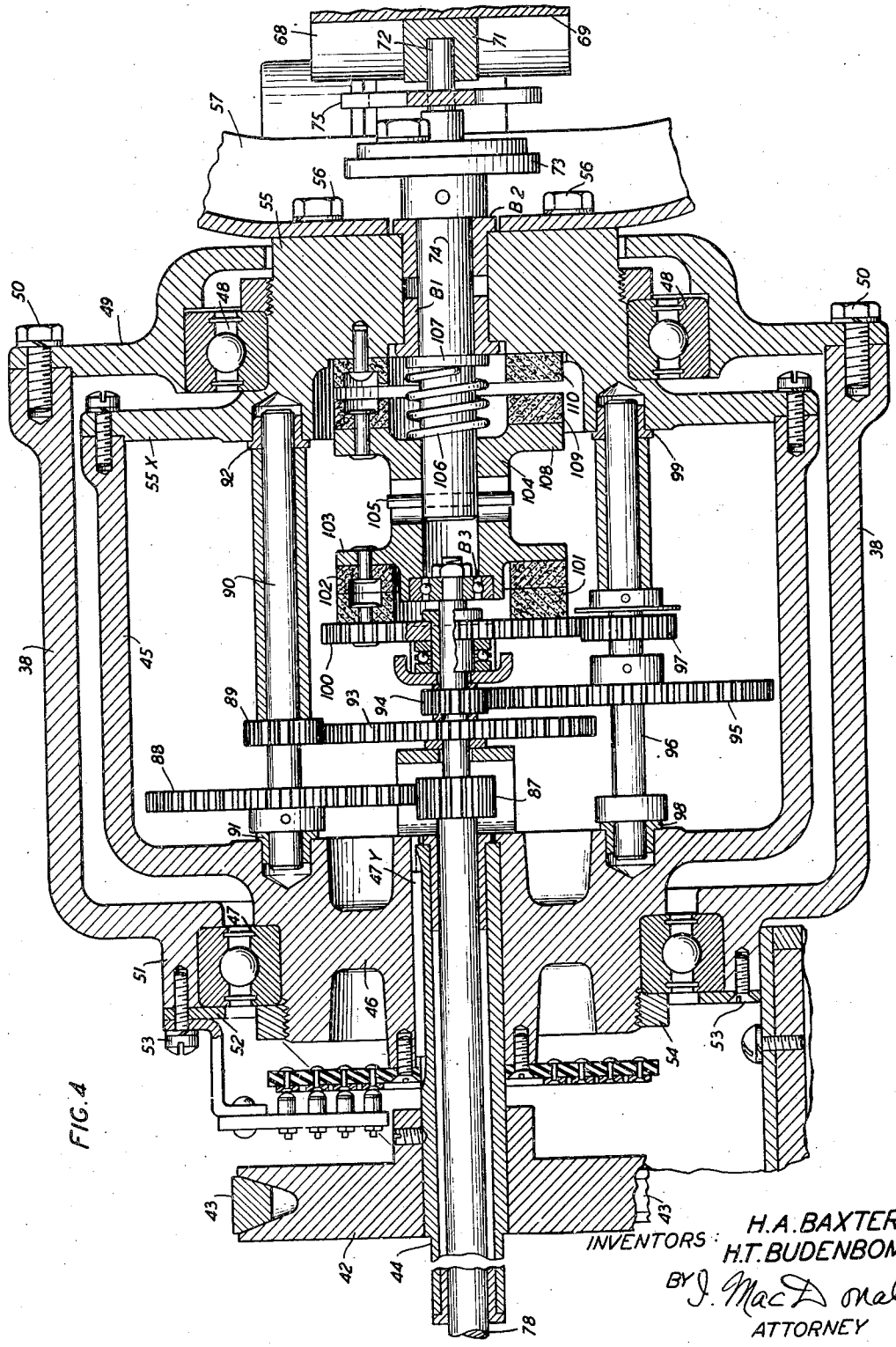

FIG. 4

INVENTORS: H.A. BAXTER
H.T. BUDENBOM

BY J. MacDonald
ATTORNEY

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RADAR ANTENNA DRIVING MECHANISM

Howard A. Baxter, Green Village, and Horace T. Budenbom, Short Hills, N. J., assignors to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

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1 Claim. (Cl. 250—33.65)

1

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

The object of the present invention is the provision of a scanning mechanism of the type above referred to which will be simple in construction, and positive in operation.

In the drawing:

Fig. 1 is a side elevation view shown with a number of operating parts in section and the reflector in normal position;

Fig. 2 is a rear elevation view shown with the wave guide and a number of operating parts with portions broken away;

Fig. 3 is a top view shown with the wave reflector in operated position and a number of operating parts partly in section;

Fig. 4 is an enlarged view of a gear and clutch operating mechanism used in the scanning mechanism of the invention, the casing being shown in horizontal section taken on line 4—4 of Fig. 3; and

Figs. 5B, 5C, 5D, 5F and 5E are diagrammatic views of scanning fields obtained by the scanning mechanism of this invention.

According to this invention, a base in the form of a casting 10 is formed with an upright extending sleeve portion 11, in which is secured as by set screws, a hollow spindle 12 serving for pivotally mounting a circular turntable 14 having a V-shaped groove at its periphery for receiving a belt 27 of trapezoidal cross-section. The turntable 14 is formed with a circular rim portion 15 best seen in Figs. 1 and 2 serving for mounting a plurality of equally spaced radially disposed studs 16 held securely on the rim portion 15 by nuts 17 and on these studs are mounted the rollers 18 bearing against the sides of a horizontally disposed flat ring 19, the ring 19 forming a race track for the turntable 14 supported by a circular ridge 20 formed with the base 10.

The base 10 is provided with a machined surface on which is secured an angle-shaped bracket 21 formed with two parallelly-disposed arms 22 and 23 serving for rotatably supporting a shaft 24 on which is keyed a pulley 25 and a worm gear 26. The pulley 25 is operatively connected to the turntable 14 by the belt 27 while the worm gear 26 is operatively connected to a worm 28 keyed on the armature shaft of a motor 29 secured to the angular-shaped bracket 21 by a plurality of bolts 30. On turntable 14 is secured as by a number of bolts 31 two upwardly extending arms 32 and 33 formed at their free ends with bearing portions 34 and 35, respectively provided for rotatably supporting the pivots 36 and 37 formed with a casing 38, the latter serving for housing a combined gear and clutch mechanism which will be hereinafter described in detail.

2

Casing 38 is provided with downward extending projections 39 best seen in Figs. 1 and 2 serving for securing as by a number of screws 40x a motor 40 to the armature shaft of which is keyed a V-grooved pulley 41 operatively connected to a similar pulley 42 by a belt 43 of trapezoidal cross-section best seen in Figs. 1 and 4. Pulley 42 is keyed on one end of a hollow shaft or sleeve 44, the opposite end of which is keyed to the hub portion 46 of a cylindrical casing 45 by a key member 47y. Casing 45 is rotatably mounted on ball bearings 47 and 48. Bearing 48 is fitted into a counterbore in a cover member 49 secured to the front end of casing 38 by a number of screws 50, while bearing 47 is fitted into a counterbore in the hub portion 51 of casing 38, and is held in place therein by a flat ring 52 secured to hub 51 of casing 38 by a plurality of screws 53, a screw-threaded ring 54 being provided for holding the inner ring of bearing 47 securely on the hub 46 of casing 45, best seen in Fig. 4.

On the hub portion of a cover 55x secured to the front end of casing 45 there is secured as by a plurality of bolts 56, a yoke-shaped member 57 of U-shaped cross-section to the ends of which are secured as by a plurality of bolts 58, similar angularly-shaped pieces 59 best seen in Figs. 1 and 2. These angular pieces are each provided with a pivot 60 for receiving bearings as 61 secured to a tubular frame 62 by respective clamping devices in the form of plates 63 and 64 and screw 65.

The tubular frame 62 is provided with a ring of circular tubing 66 to which is secured as by a plurality of bolts (not shown) a parabolic reflector 67. The tubular frame 62 and the reflector 67 carried thereby may be moved as a unit on the pivots 60 from the position shown in Figs. 1 and 2 to the positions shown in Fig. 3 by a mechanism comprising a socket member 68 carried by a plate 69 which is secured on the tubular frame 62 by a plurality of bolts 70 and a cylindrically shaped piece 71 fitted into the socket 68 in the manner of a so-called knuckle joint, the cylindrical piece 71 having a drilled hole engaged by a crank pin 72 extending perpendicularly from a disc member 73 keyed on one end of a shaft 74 best seen in Fig. 4 journaled in bearings B1 and B2 fitted in the hub 55 of cover 55x for casing 45. According to this construction the rotation

of casing 45 is effective to rotate the tubular frame 62 and the reflector 67 carried thereby in position perpendicular to the longitudinal axis of casing 45, while the rotation of shaft 74 and the crank mechanism formed by disc 73 and crank pin 72 is effective to impart a swinging movement to the tubular frame and to the reflector from the position shown in Figs. 1 and 2 to the positions shown in Fig. 3.

The operation of crank pin 72 in addition to imparting a swinging movement to the reflector 67 is effective to impart a linear reciprocating movement to a longitudinally movable bar 75 having gear rack portions Y as best seen in Fig. 3 for actuating potentiometer devices 76 and 77 connected in the electrical circuit of the radio signaling device (not shown) and which forms no part of the present invention.

The shaft 74 is actuated in conjunction with casing 45 by a combined gear and friction clutch mechanism best seen in Fig. 4 comprising the hollow shaft 44 keyed to the casing 45 and a shaft 78 slidably mounted in hollow shaft 44 but held against rotation therein by a pin 79 best seen in Fig. 1, extending diametrically through the shaft and through prongs formed at one end of a double armed lever 80, pivoted as at 81 on a bracket 82 secured on casing 38 as by a plurality of screws 83. The opposite end of lever 80 is operatively connected to one end of a plunger 84 of a solenoid 85 secured on bracket 82 by a number of screws 86. The shaft 78 is formed with a screw-threaded reduced portion for mounting a ball bearing B3 and carries a pinion 87 serving to cause the rotation of a gear 88 and that of a pinion 89 keyed on a shaft 90 upon the rotation of casing 45 and therefore the planetary movement of gear 88 and pinion 87.

The shaft 90 is journaled in bearings 91 and 92 carried by casing 45. Pinion 89 meshes with a gear 93 formed with a pinion 94 mounted for free rotation as a unit on the reduced end portion of shaft 78, while the pinion 94 meshes with a gear 95 keyed on a shaft 96 for rotating the latter and a pinion 97 formed with the shaft 96, this shaft being journaled in bearings 98 and 99 fitted in counterbore holes in casing 45 and its cover element 55x. Pinion 97 meshes with a gear 100 mounted for free rotation on the reduced end portion of shaft 78 and carries a friction clutch element 101 disposed for engaging a cooperating clutch element 102 carried by a disc portion 103 formed at one end of a sleeve 104 mounted for sliding movement on the shaft 74 but held against rotary movement thereon by a pin 105 diametrically extending from shaft 74, the clutch elements 101 and 102 being normally held in frictional engagement against each other by a spring 106 having one of its ends abutting against a collar 107 formed with the shaft 74 and its other end against a disc portion 108 formed with sleeve 104, thus holding the slidable shaft 78 and the plunger 84 of the solenoid 85 in the retracted position through the ball bearing B3, which also serves for holding the reduced end of shaft 78 in coaxial alignment with the sleeve 104.

To the disc portion 108 is secured a friction clutch element 109 for engagement with a friction clutch element 110 secured on the hub portion 55 of cover 55x, for operatively connecting the shaft 74 with the casing 45 which, as above mentioned is rotated by pulley 42, the gear reduction mechanism for operating the shaft 74 when the clutch elements 109 and 110 are engaged being of the order of 625 turns of hollow shaft 44 for each turn of shaft 74.

On the upward extending arm 32, as best seen in Figs. 1 and 2 is secured as by a number of screws 110Y, an angle-shaped bracket 111 serving for mounting a motor 112. On the armature shaft of this motor is keyed a worm 113 meshing with a worm gear 114, keyed at one end of a spindle 115 mounted for free rotation in a bushing portion 116; formed with arm 32 and on spindle 115 is keyed a pinion 117 engaging a gear sector 118 keyed on the spindle 36 for imparting vertical reciprocating rotary movement to the gear assembly thus formed and to the reflector 67 carried thereby independently of or in cooperation with the operation of motors 29 and 40 to cause the reflector to generate scanning fields as shown in Figs. 5B to 5F, inclusive, in a manner which will be hereinafter described in detail.

In a typical example of operation of the scanning mechanism of this invention, considering the reflector 67 in position as shown in Figs. 1 and 2, i. e., perpendicular to the longitudinal axis of casing 45, the operation of motor 29 is effective to rotate the turntable 14 and thereby moving the reflector 67 in an azimuth direction as shown diagrammatically in Fig. 5D which may be continued in either clockwise or counter-clockwise direction or reciprocally by alternatively reversing the operation of motor 29.

The operation of motor 112 independently of the operation of motor 29 in a clockwise and counter-clockwise direction is effective through the worm gear 113, worm 114, pinion 117 and gear sector 118 keyed on spindle 36 to impart vertical reciprocating movements to the reflector 67 as shown diagrammatically in Fig. 5C whereas the combined clockwise and counter-clockwise operation of motors 29 and 112 in timed relation to each other is effective to actuate the reflector 67 in a manner to generate a scanning field representing a zigzag as shown in Fig. 5F.

The independent operation of motor 40 is effective to rotate the pulley 42 keyed on hollow shaft 44 and thereby the casing 45 relative to its supporting casing 38. The rotation of casing 45 and thereby the planetary movement of gear 88 meshing with stationary pinion 87 is effective through the pinion 89, the gear 93, the pinion 94, the gear 95 and pinion 97 to rotate the gear 100 at a reduced speed relative to that of casing 45 and thereby of the shaft 74 through the pin 105 and the clutch elements 101 and 102 now held in engagement by the normal tension of spring 106. The rotation of casing 45 is effective to rotate reflector 67 in position perpendicular to the longitudinal axis of casing 45, while the rotation of shaft 74 simultaneously with the rotation of casing 45 as above described is effective to impart oscillatory movements to the reflector as effected by the crank pin 72, such combined movements causing the reflector to generate a scanning field representing a spiral as shown in Fig. 5B.

The operation of the clutching mechanism, as effected by the longitudinal movement of shaft 78 under control of the solenoid 85 is effective through the end thrust bearing B3 to disengage the clutch elements 101 and 102 and engage the clutch elements 109 and 110 for connecting the shaft 74 direct with the casing 45, thereby rendering the crank mechanism ineffective to impart oscillatory movements to the reflector during the rotation of casing 45, thus causing the reflector to generate a scanning field representing a cone as shown in Fig. 5E which may have any

angle within the capacity of the crank mechanism. The wave guide consists of the feed horn 140 connected to the tubular member 141. This tubular member is formed with a ring-shaped portion 142 cooperating with a ring portion 143 at one end of a tubing 144 to form a so-called rotary joint, while the opposite end of tubing 144 terminates in the form of a cylindrical portion 145 to form in cooperation with a cylindrical portion 146 a rotary joint at the center of the turntable, this joint connecting with a tubing 147 leading to the electrical apparatus not shown and which form no part of the present invention.

What is claimed is:

In a radio signaling apparatus, a wave reflector, a base, a mounting table rotatably supported on said base, a motor to rotate said mounting table, a pair of arms carried by said table, a first casing pivoted on said arms, a motor operable to tilt said first casing, a second casing supported in said first casing and operable to rotate in said first casing, a yoke secured to said second casing, a frame pivotally supported in said yoke and supporting said reflector, a motor to rotate said second casing, a rotatable shaft supported in and extending from said second casing, a crank on said rotatable shaft and extending into mechanical connection with said frame, a gear mechanism in said second casing, a clutch device between said second casing and said rotatable shaft and between said gear mechanism and said rotatable shaft, said clutch device being operable in one position to clutch connect said second casing to said rotatable shaft and being operable in another position to clutch connect said gear mechanism to said rotatable shaft, said second

casing when clutch connected to said rotatable shaft being operable to cause said crank to rotate at the same speed as that of said second casing, said gear mechanism when clutch connected to said rotatable shaft being operable to cause said rotatable shaft and said crank to rotate at a speed different from the speed of rotation of said second casing and reflector and operating to cause said frame and said reflector to move in an oscillatory manner at a speed different from that of said second casing, and an electromagnetic device to control the position of said clutch device relative to said second casing and said gear mechanism, said wave reflector being operable to reflect a wave in a circular pattern when said clutch device connects said second casing to said rotatable shaft, and being operable to reflect a wave in a spiral pattern when said clutch device connects said gear mechanism to said rotatable shaft.

HOWARD A. BAXTER.
HORACE T. BUDENBOM.

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