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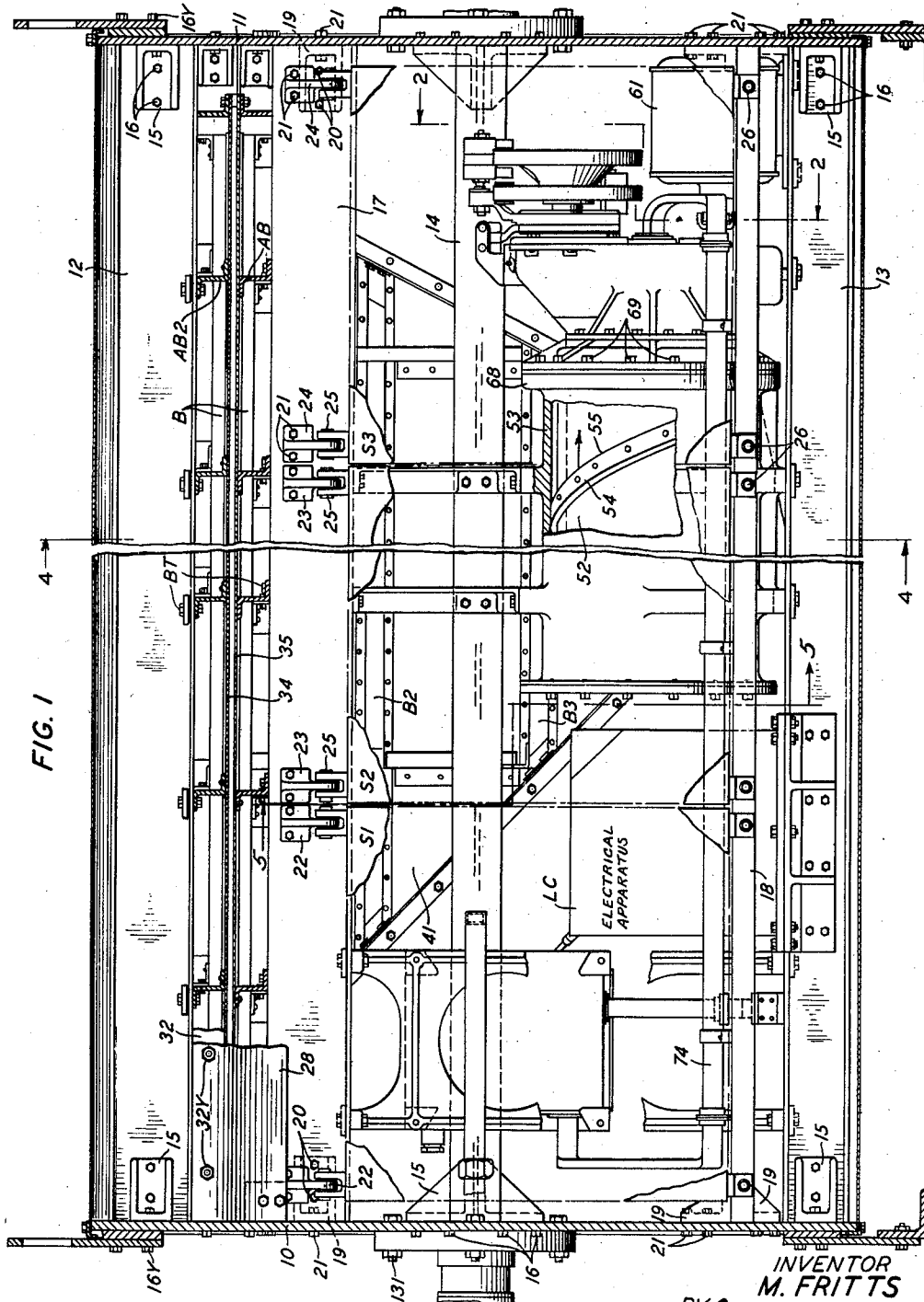
M. FRITTS

2,952,018

ANTENNA MECHANISM

Filed Oct. 23, 1947

5 Sheets-Sheet 1



INVENTOR  
M. FRITTS  
BY *J. MacDonell*  
ATTORNEY

Sept. 6, 1960

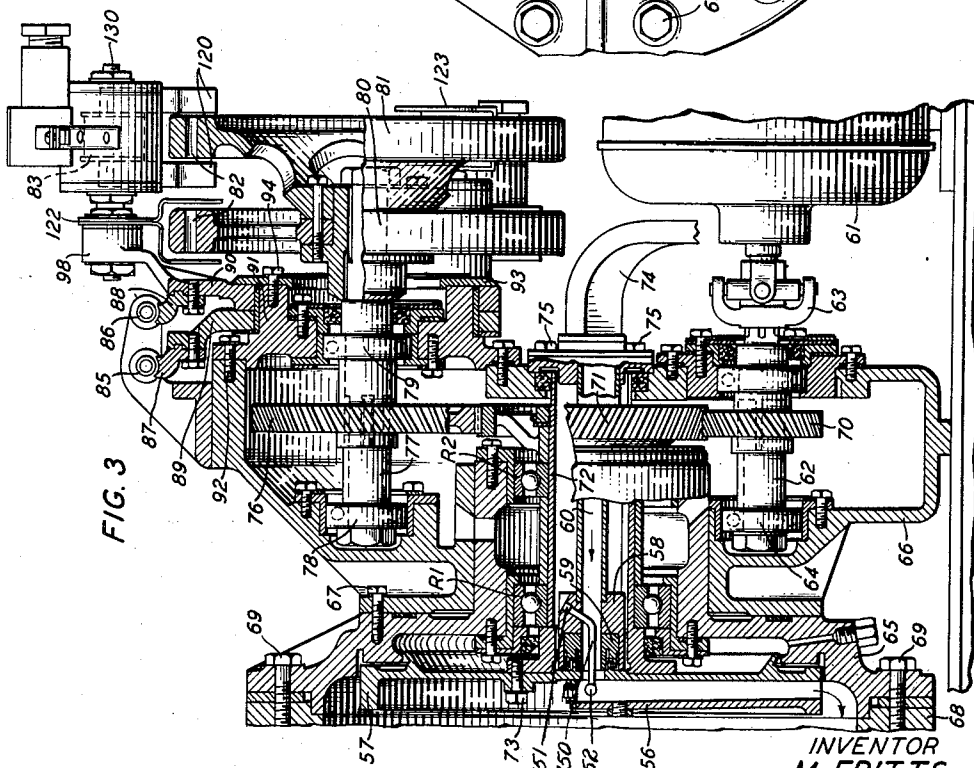
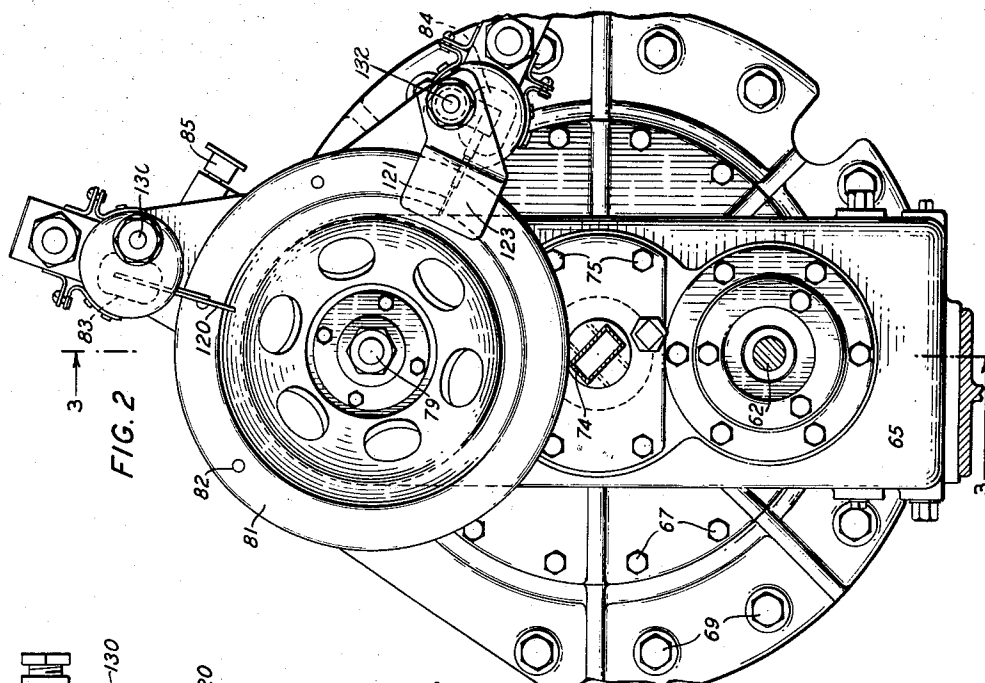
M. FRITTS

2,952,018

ANTENNA MECHANISM

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INVENTOR  
M. FRITTS

BY *J. MacLond*

ATTORNEY

Sept. 6, 1960

M. FRITTS

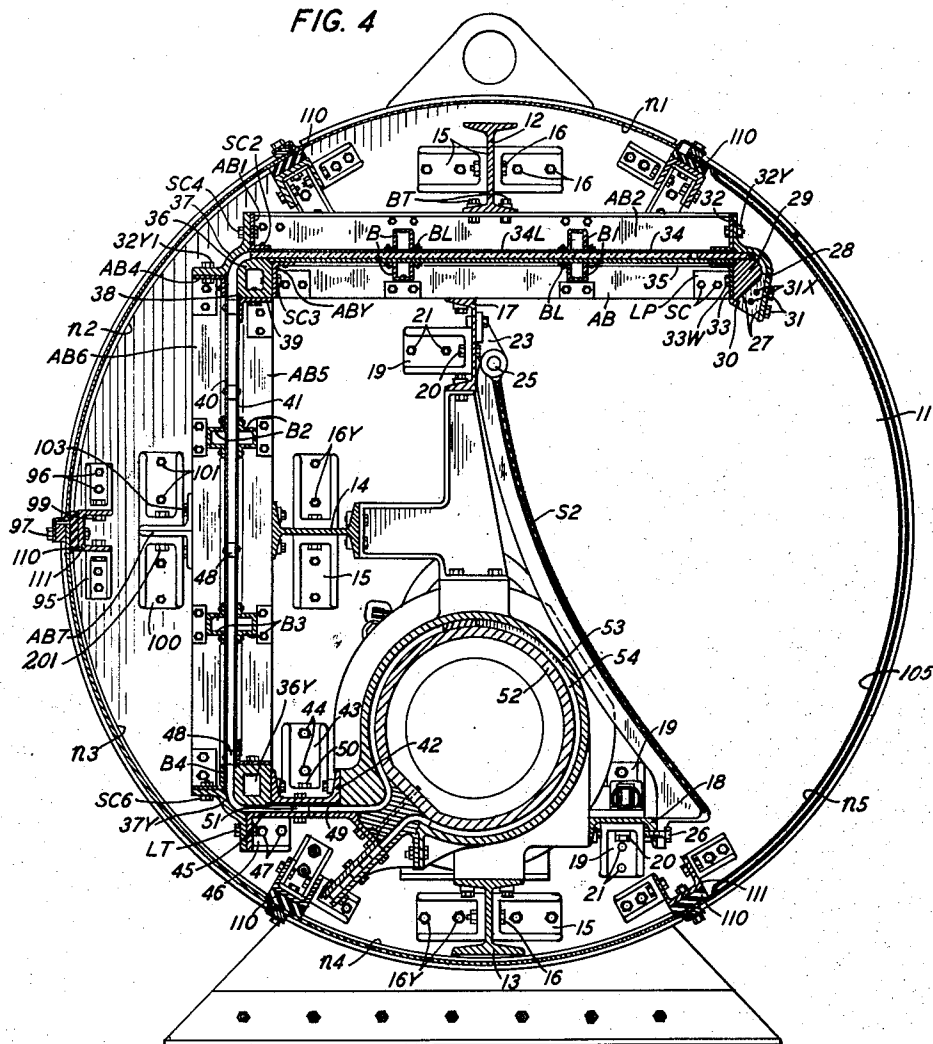
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ANTENNA MECHANISM

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FIG. 4



INVENTOR  
M. FRITTS  
BY *J. MacDonald*  
ATTORNEY

**Sept. 6, 1960**

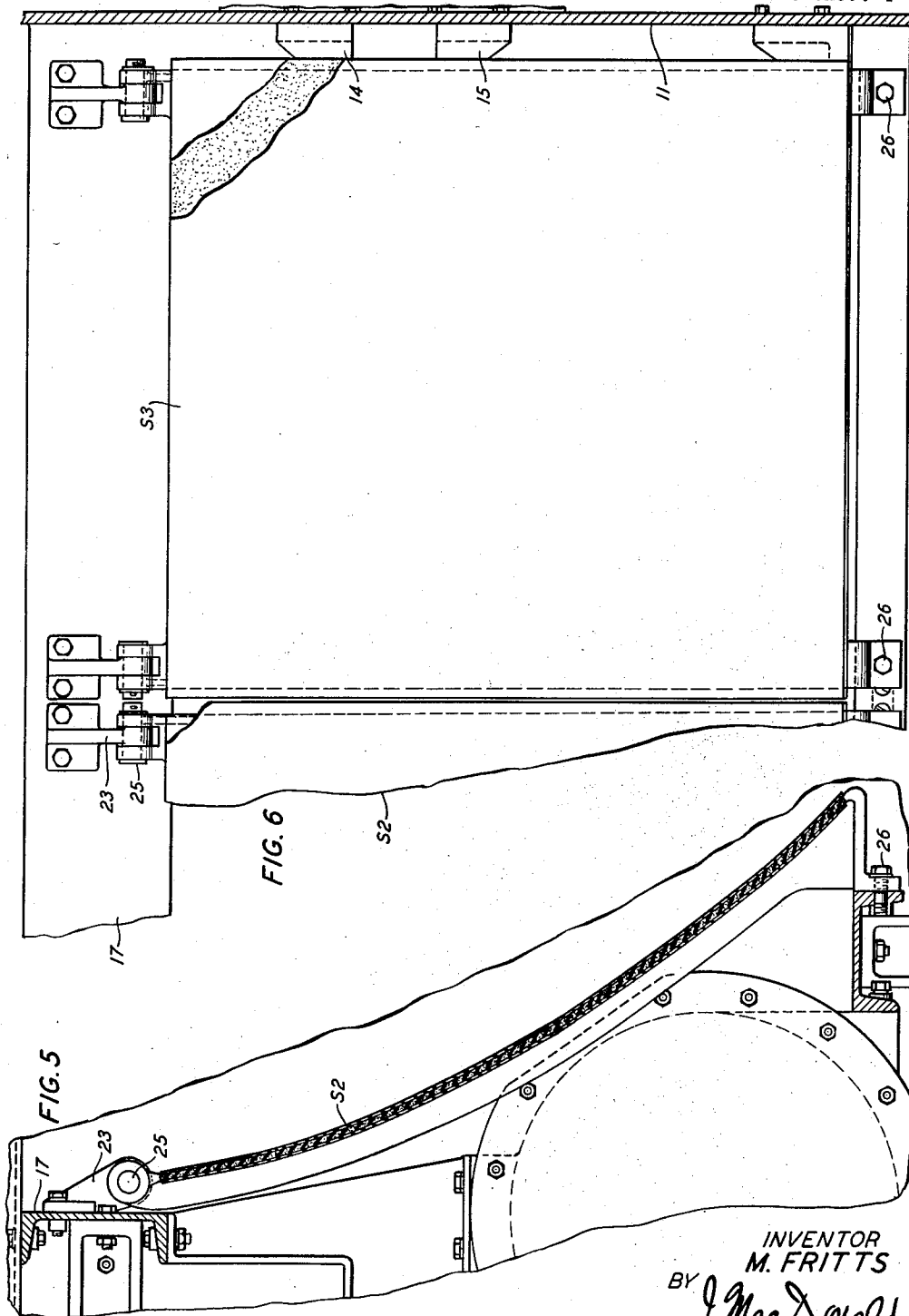
M. FRITTS

**2,952,018**

## ANTENNA MECHANISM

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INVENTOR  
M. FRITTS

BY *J. MacDonald*

ATTORNEY

Sept. 6, 1960

M. FRITTS

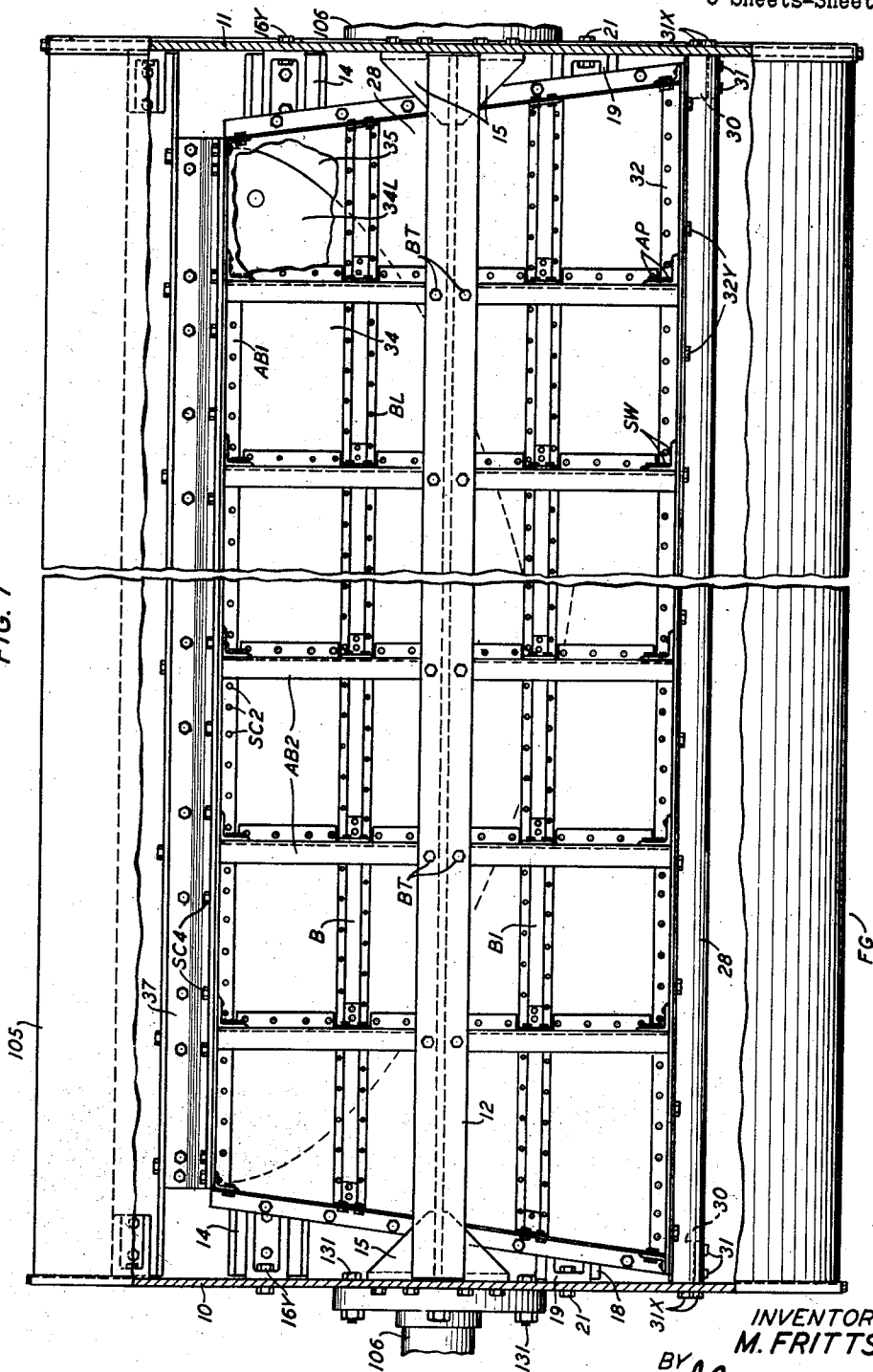
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ANTENNA MECHANISM

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FIG. 7



INVENTOR  
M. FRITTS

BY  
J. Mac Donald

ATTORNEY

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2,952,018

## ANTENNA MECHANISM

Morris Fritts, Chatham, N.J., assignor to Bell Telephone Laboratories, Incorporated, New York, N.Y., a corporation of New York

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6 Claims. (Cl. 343—781)

This invention relates to scanning mechanisms and more specifically to a scanning mechanism which is particularly well adapted for use in radio signaling systems such as those installed on gun turrets on board warships and coast defense gun batteries.

It is known that effective linear scanning at a high rate can be obtained through the use of a parallel plate type antenna in which a portion of the parallel plate structure is in effect rolled into a cylindrical section. When thus rolled the opening of that portion assumes an annular shape and is substantially perpendicular to the plane of the other opening of the parallel plates. Energy fed into the annularly shaped end by an arm rotating along the annular path will then produce linear scanning at the other opening.

The object of the present invention is to provide a scanning mechanism of the type above referred to which is of rugged construction while using a minimum number of simple operating parts.

In the drawing:

Fig. 1 is a front elevation view partly in vertical longitudinal cross-section showing sections of an energy reflector and other operating parts with portions broken away;

Fig. 2 is an end view of the driving mechanism for actuating a wave guide rotary joint viewed in the direction of the arrows on lines 2—2 of Fig. 1;

Fig. 3 is a sectional view taken on line 3—3 of Fig. 2;

Fig. 4 is a vertical cross-sectional view taken on line 4—4 of Fig. 1;

Fig. 5 is a partial view enlarged showing one of the reflector sections assembled, the common supports for the reflector sections being shown in vertical cross-section taken on line 5—5 of Fig. 1;

Fig. 6 is a front view of Fig. 5; and

Fig. 7 is a top view of a wave guide and its supports shown with the casing housing the operating mechanism and the mounting end plates with portions broken away.

In the construction of the scanning mechanism of this invention two mounting plates 10 and 11 are held in spaced parallel relation to each other by a plurality of rails or beams 12, 13 and 14 secured at both ends to similarly shaped angle pieces 15 by bolts 16. While the angle pieces 15 are secured to the plates 10 and 11 by a number of bolts 16Y. Similarly, two rail members 17 and 18 shown in Figs. 1 and 4 are secured to angle pieces 19 by bolts 20 and these angle pieces in turn are secured to the circular mounting plates 10 and 11 by bolts 21.

An energy reflector is constructed of a plurality of rectangularly-shaped sections S1, S2 and S3, best seen in Fig. 1, supported at their top disposed edge portions by hinge pins 25 engaging respective hinge flaps 22—22, 23—23 and 24—24 secured to rail 17, while the reflector sections S1, S2 and S3 are each secured at their lower disposed edge portions to the channel-shaped rail 18 by a pair of bolts 26. The effective surface of each reflector section S1, S2 and S3, as best seen in Fig. 4,

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is of parabolic form while a horn portion 27 of a wave guide, which will be hereinafter described in detail, is formed of rectangular cross-section and extends the whole length and, at the focus of the energy reflector formed as above mentioned by the contiguously side-by-side disposed reflector sections S1, S2 and S3.

The horn portion 27 of the wave guide above mentioned is formed of an oblong-shaped strip 28 of substantially S cross-section in cooperation with a bar 29. The strip 28 is secured at both ends by screws 31 to similarly shaped block members 30, while the block members 30 themselves are secured to their respective adjacent side plates 10 and 11 as by a plurality of screws 31X shown in Figs. 4 and 7. The bar 29 is held along its length in adjusted spaced relation to strip 28 by an angle bar 33 best seen in Fig. 4 secured thereon by a plurality of screws 33W, while the angle bar 33 as shown in Fig. 4 in turn is reinforced at equal spaced distances therealong by a plurality of cross bars AB having their similar disposed ends secured by a number of screws SC to lug portions LP formed with the bar 33. Similarly, the oblong strip 28 is secured along its upper disposed edge to a longitudinally disposed angle bar 32 as by a number of bolts 32Y, while this bar in turn is secured to the front disposed end of a plurality of cross bars AB2 shown in Figs. 4 and 7 by angle pieces AP and screws SW.

A pair of taper plates 34 and 35 form a length portion or section of the wave guide from the horn 27 to a bend of substantially 90 degrees which is formed by a longitudinally disposed bar 36 in cooperation with an oblong-shaped strip 37 while a lens 34L is clamped between the plates 34 and 35 by longitudinally disposed bars B—B and B1—B1 of U-shaped cross-section and secured as by a plurality of screws BL to their respective plates 34 and 35. The plates 34 and 35 are further reinforced by the cross bars AB and AB2 above described, the bars AB2 in turn being collectively secured as by bolts BT to the beam 12 as shown in Figs. 1, 4 and 7.

The rear disposed edge of plate 34 is secured as by clamping between the bar 36 and the angle bar AB1 by the tightening action of a plurality of screws SC2 extending through drilled holes in the lens 34L, while the plate 35 is secured to the bar 36 through an angle bar ABY shown in Fig. 4 by screws SC3. The oblong-shaped strip 37 is secured along one of its longitudinal edges to the angle bar AB1 by a number of screws SC4 and along its opposite longitudinal edge to an angle bar AB4 as by a number of ordinary bolts 32Y1, the bar 36 as above mentioned cooperating with the oblong-shaped strip 37 to form the waveguide section extending to the horn 27 while serving for securing as by angle pieces 38 and 39 the upper disposed edges of two taper plates 40 and 41 in registering relation to the rear edges of plates 34 and 35 as best seen in Figs. 1 and 4, the lower edges of which are secured to a bar 36Y and to a metallic strip 37Y, the bar 36Y being in turn secured as by a number of ordinary screws to a beam 42 of U-shaped cross-section itself secured at both ends to the mounting discs 10 and 11 by angle pieces 43 and bolts 44.

The metallic strip 37Y is secured along its lower disposed longitudinal edge as by a plurality of bolts LT to an oblong-shaped strip 45, itself secured at both ends to the mounting discs 10 and 11 by similarly shaped angle pieces 46 and screws 47 and its opposite parallel edge to an angle bar B4 as by a plurality of bolts SC6.

A plurality of spacer members in the form of discs 48, best seen in Fig. 4, serve for holding the plates 40 and 41 in parallel spaced relation to each other while pairs of parallelly disposed bars B2—B2 and B3—B3 serve

for reenforcing the plates 40 and 41 at points intermediate the spacer members 48 in addition to a plurality of vertically disposed bars as AB5 and AB6 secured at their opposite ends to the bars 36 and 36Y and angle bars AB4 and B4 respectively, for reenforcing the plates 40 and 41. The bars AB6 in turn are collectively secured to a beam AB7 of T-shaped cross-section by bolts 103 and the beam itself is secured at its opposite ends to the mounting discs 10 and 11 by similar pairs of angle pieces 100 and bolts 101 and 201.

The wave guide from its 90-degree bent portion formed by strip 37Y and bar 36Y extends in a path formed by the strip 45 and a plate 49 secured to the under side of rail 42 by a number of bolts as 50, and from the end of this path to a circular path formed by two concentrically disposed casings 52 and 53 held in spaced relation to each other by a sleeve 54 having a helically formed edge 55 best seen in Figs. 1 and 4 from which the energy is collimated toward a cylindrical path leading toward the free end of a rotatable hollow arm member 56 shown in Fig. 3. The casings 52 and 53 do not extend the full length of the energy reflector which is composed of the units S1, S2, and S3. The wave guide comprising the plates 34, 35 and 40, 41 is therefore trapezoidal in shape, tapering down in width from the full reflector length of the horn portion 27 to the length of the casings. The helically formed edge 55, which reflects the radio frequency to or from the horn 27 depending on the operation of the antenna as a transmitter or receiver, completes slightly less than one revolution around the inner casing. The hollow arm 56 is carried by a counterbalancing wheel 57, itself secured as by a plurality of screws 73 to the flange portion of a sleeve 72 supported by ball bearings R1 and R2 fitted into a section 56 of a casing which will be hereinafter described in detail, serving for housing a driving mechanism for the hollow arm 56 and its balancing wheel 57. Casing section 65 is secured to a casing section 66 as by a plurality of screws 67 and onto casing section 66 is secured in position concentric to sleeve 72 as by a plurality of screws 75 a sleeve 60 forming part of the wave guide extending from the hollow arm 56 to a section of the wave guide in the form of a tubing 74, held collectively with the flange portion of sleeve 60 to the casing section 66 by the screws 75 above mentioned, while on to the end portion of sleeve 60 adjacent the rotary hollow arm 56 are mounted two collar members 58 and 59 forming a joint between the stationary sleeve 60 and the rotatable sleeve 72. In order to couple the sleeve 60 to the arm 56 through the rotary joint formed by collar members 58 and 59, which are circular in cross-section, there is used a coaxial coupling member 150 held by a collar 58 as at 151 and having a spherical portion 152. Energy passing through the sleeve 60 from the tubing 74 is collected by the coupling member 152 which forms a coaxial conductor with the collar portions 58 and 59. The energy is then radiated from the spherical portion 152 into the hollow arm 56.

The balancing wheel 57 which carries the arm 56 is rotated by a motor 61, shown in Figs. 1 and 3, the armatured shaft of which is operatively connected to a shaft 62 by a universal joint device 63. The shaft 62 is journaled at both ends in ball bearings as 64 fitted into counterbores in the casing section 66 secured as above mentioned to casing section 65, the latter in turn being secured to the flange 68 of the outer disposed cylindrical casing 53 by a number of screws 69.

On shaft 62 is keyed a gear 70 meshing with a gear 71 keyed onto the rotary sleeve 72 for rotating the latter and thereby the wheel 57 and arm 56. The gear 71 meshes with a gear 76 keyed on a shaft 77, supported at one end by a ball bearing 78 fitted in a counterbore in casing 66 and at its middle length portion by a ball bearing 79 fitted in a hub portion 91 secured to casing 66 by a plurality of screws 92, while to the opposite end of shaft 77 there is mounted a pair of flywheels 80 and 81, each

having magnetized cores as 82 serving for generating voltage in coils 83 and 84 mounted on studs as 130 and 132 carried by rings 89 and 90 for angular adjustment relative to each other by respectively associated worms 85 and 86, disposed in meshing relation with worm gear sectors 87 and 88 carried by supporting rings 89 and 90 respectively, mounted for free rotation on the supporting hub element 91, the rings 89 and 90 being held against sideways movement on the hub 91 by a ring 93, itself secured to the hub 91 by a plurality of screws 94.

A cylindrically-shaped casing 105, best seen in Fig. 4, consists of a plurality of oblong-shaped strips n1, n2, n3, n4 of metallic material and a strip n5 of a material which is transparent to radio waves curved laterally to form portions of a cylinder with their longitudinal edges resting in overlapping relation on bars 110 of insulating material and secured onto metallic supporting bars 111 of U-shaped cross-section secured at both ends to angle pieces as 95 by bolts as 99, the angle pieces 95 being in turn secured to the mounting discs 10 and 11 by bolts 96. To the discs 10 and 11 at the center thereof are secured as by a number of bolts 131 the spindles 106 serving for pivotally mounting the mechanism assembly on a pair of supports, not shown, which may be carried by a gun turret of the type mounted on warships, for example, for movement of the scanning mechanism in an azimuth direction while the spindles 106 permit the movement of the mechanism for vertical scanning operations.

In the operation of the scanning mechanism of the invention, the radio waves received by the apparatus are directed by the reflector sections S1, S2 and S3 toward the horn 27 and through the lens 34L provided for determining the character of the scanning lobe and through the wave guide section formed by the plates 40 and 41, through the wave guide section formed by support 45 in cooperation with strip 49, and through the path formed by the concentrically disposed casings 52 and 53 to be collimated by the helical surface 55 of sleeve 54 towards the arm 56 which, as above mentioned, is rotated by the motor 61 through the gears 70 and 71. The sleeve 60 and tubing 74 then lead the radio waves to the electrical apparatus enclosed in a casing LC, but which forms no part of the present invention. The magnetized cores 82 in the flywheels 80 and 81 generate voltage into their respective coils 83 and 84 appearing as coordinate lines or screens onto a cathode ray tube for a purpose well known in radio signaling apparatus, while armature 120 of coil 83 is protected from interference by the core 82 of flywheel 81 by a fork-shaped shielding member 122 and the armature 121 of coil 84 by a shield member 123.

It is understood that minor changes may be made to the scanning mechanism of this invention without departing from the scope of the appended claims.

What is claimed is:

1. A radio signaling apparatus comprising a rectangularly-shaped reflector constructed of a plurality of side-by-side disposed sections, a wave guide having a horn element extending the whole length of said reflector, a pair of concentrically disposed casings forming a section of said wave guide, a sleeve disposed between said casings for holding them in spaced relation to each other, said sleeve having a helically-shaped edge for collimating the energy to one end of said concentrically disposed casing, a tubing forming another section of said wave guide and a wave guide element having a rotatable arm connecting the wave guide portion formed by said concentric casing and said tubing.

2. A radio signaling apparatus comprising a rectangularly-shaped reflector constructed of a plurality of independent sections disposed in side-by-side relation and having a focus, a pair of disc-shaped mounting members, a pair of beams secured at their ends to said discs for supporting said reflector sections, a wave guide having a horn element extending along said reflector sections at the focus thereof, said wave guide comprising a first

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pair of taper parallelly disposed plates having one of their edges connecting with said horn element, a lens fitted between said plates, a second pair of taper plates disposed contiguous to said first pair, means for securing each pair of plates in spaced relation to each other, a pair of cylindrically-shaped casings disposed in concentric relation to each other forming a substantially annular wave guide path therebetween, a sleeve fitted in said annular wave guide path having a helix formed edge for collimating the energy waves toward one end of said annular wave guide path, a rotatable arm having its free end portion disposed adjacent the casing forming said annular wave guide path, a motor for actuating said arm, a sleeve operatively connected to said arm, radio receiving apparatus and a wave guide tubing connected to said sleeve and leading the energy wave to the radio receiving apparatus.

3. In a radio signaling apparatus, an oblong-shaped energy reflector comprising a plurality of side-by-side disposed sections of parabolic cross-section, a wave guide having a horn element extending along said sections at the focus thereof, a wave guide section formed by a plurality of taper plates contiguous to said horn element, a pair of cylindrically-shaped casings disposed in concentric spaced relation to each other forming a circular portion of the wave guide contiguous to the small end of said taper plates, a sleeve disposed between said cylinders having a helically formed edge for collimating the energy wave toward one end of said cylinders, a hollow arm member mounted for rotation adjacent the end of said cylinder with its free end in the field of the collimated energy, a stationary sleeve communicating with the opposite end of said arm forming a section of said wave guide and a rectangularly-shaped tubing forming another section of said wave guide connecting with said sleeve and with electrical devices in the signaling apparatus.

4. In a radio signaling apparatus, an oblong-shaped energy reflector constructed of a plurality of side-by-side disposed sections of parabolic cross-section, a wave guide, a horn element at one end of said wave guide, extending the whole length of said reflector and at the focus thereof, a pair of cylindrical concentrically disposed casings, a sleeve interposed between said casings for holding them in spaced relation to each other, said sleeve having a helically formed edge for collimating the energy towards one end of said concentric cylinder, a pivoted hollow arm having its free end disposed for rotation in the path of the collimated energy, a motor, a gear mechanism actuated by said motor for rotating said arm, and a wave guide tubing connecting with said arm and the electrical devices in the signaling apparatus.

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5. In a radio signaling apparatus, a pair of circularly-shaped mounting elements, a plurality of beams secured at both ends to said elements for holding the latter in parallel spaced relation to each other, an oblong-shaped energy reflector constructed of a plurality of side-by-side disposed sections supported by a number of said beams and having a focus, said reflector having a horn portion extending the whole length of said reflector at the focus thereof, a pair of beams secured at both ends to said mounting elements for supporting said reflector sections, a taper wave guide of rectangular cross-section having connection with said horn portion, a pair of concentrically disposed cylindrical casings forming a section of said wave guide, a sleeve fitted between said cylindrical casings having an edge forming a helix for collimating the energy towards one end of said concentrically disposed casings, a tubing, electrical translating apparatus, another wave guide section leading to the electrical translating apparatus, and a rotary arm forming a section of said wave guide connecting with said tubing and the end of said casing toward which the energy is collimated.

6. A radio signaling apparatus comprising a pair of mounting plates, a plurality of spacer elements secured at their ends to said plates for holding the latter in parallel relation to each other, an energy reflector of parabolic cross-section, a pair of supports secured at their ends to said plates for securely mounting said reflector, a wave guide formed of a number of sections of different character, one of said sectors having a horn extending in lines parallel to said reflector and at the focus thereof, a pair of parallelly disposed plates forming a section of said wave guide, a lens disposed between said plates for defining the shape of the scanning lobe, another pair of plates disposed at right angles relative to the first-mentioned plates forming another section of said wave guide, a pair of spaced concentrically disposed casings forming a circular wave guide section contiguous to the second-mentioned section, means in the annular space formed by said casings for collimating the energy towards one end of said circular wave guide section, a hollow arm having its free end portion extending in position adjacent said circular wave guide section forming another section of said wave guide, and a motor for rotating said arm.

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