

July 20, 1965

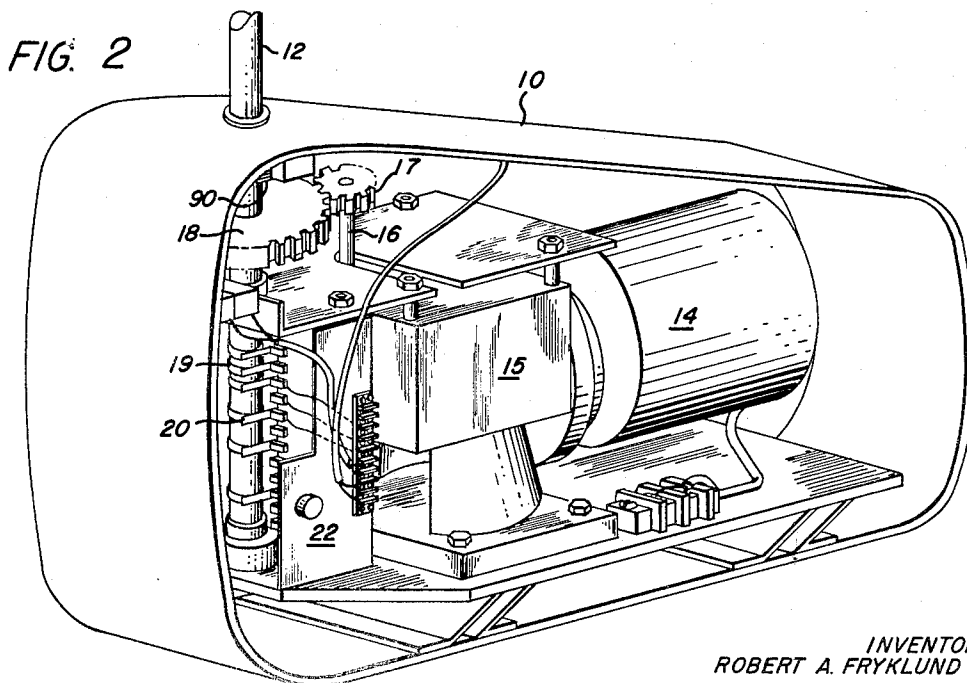
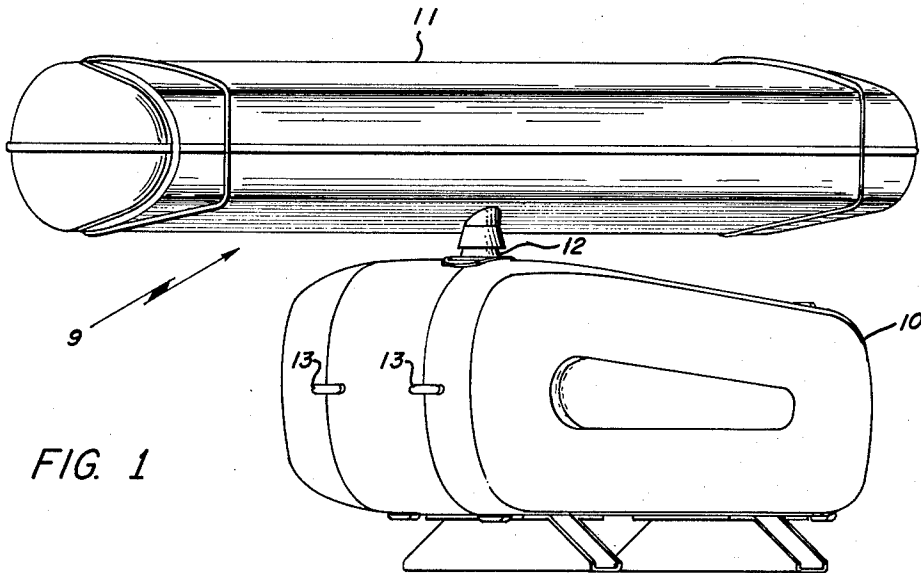
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3,196,349

RADAR ANTENNA TRANSMITTING AND RECEIVING SYSTEM

Filed Oct. 19, 1960

3 Sheets-Sheet 1



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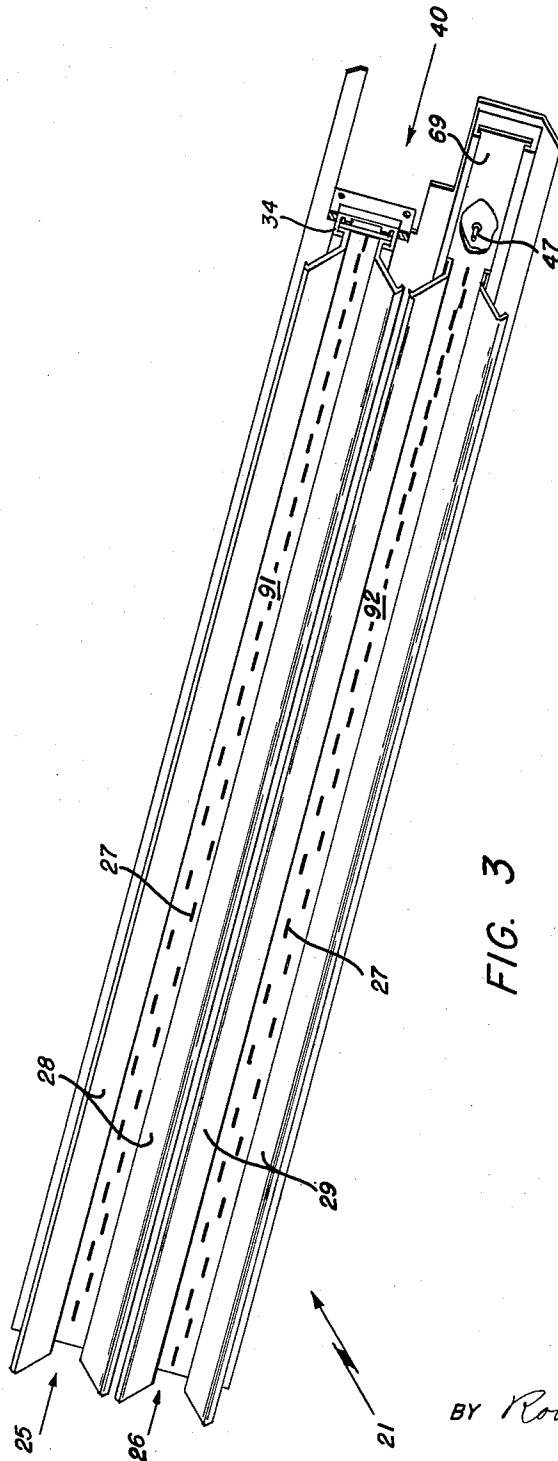


FIG. 3

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FIG. 4

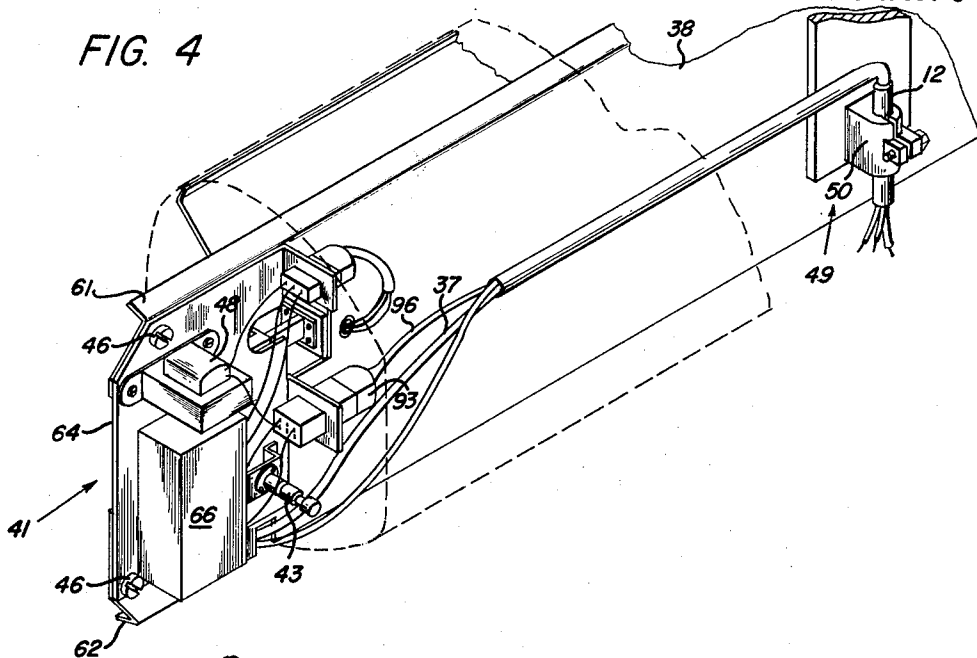
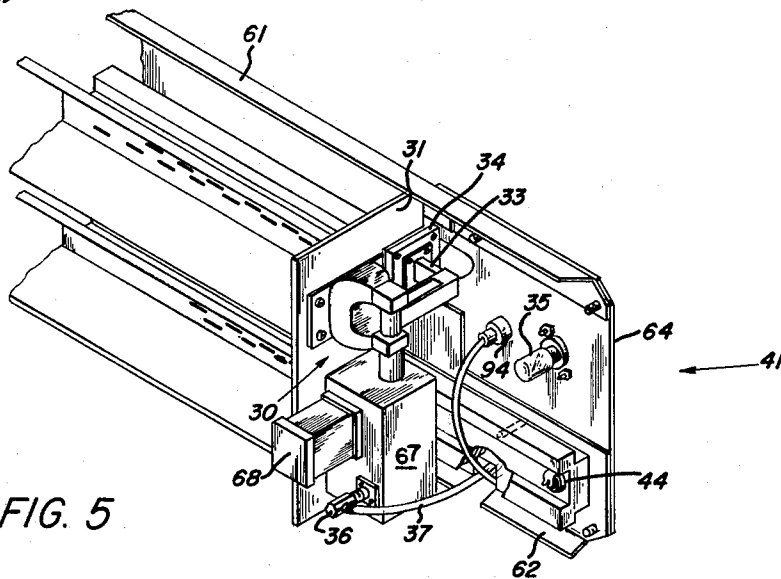


FIG. 5



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RADAR ANTENNA TRANSMITTING AND RECEIVING SYSTEM

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7 Claims. (Cl. 325—15)

This invention relates generally to radar systems and more particularly to a unique low cost compact construction of an antenna structure utilized in a radar system, or the like.

In designing radar systems for use in commercial fishing or pleasure boating, or the like, it is necessary to reduce production costs to a minimum while simultaneously maintaining adequate system performance characteristics to provide safe navigation. Conventional radars of this type utilize rotary joint antenna systems requiring extensive waveguide arrangements or coaxial cabling and T/R switching system, or dual antenna systems fed with a horn and waveguide configuration.

The antenna construction described in this invention provides a compact system that allows reduced production costs by eliminating portions of the equipment normally associated with radar antenna structures of similar types. In the antenna structure of the invention, a pair of slotted antenna arrays are mounted one above the other in a streamlined rotating enclosure. The magnetron transmitting tube, or other transmitting device, is mounted on a chassis at one end of the slotted array and its output is coupled directly to the transmitting antenna section of the slotted array system. The receiver circuit local oscillator, which may be a klystron, for example, and the receiver signal mixer and preamplifier circuitry are also mounted on the same chassis at the end of the slotted antenna array system and the output of the receiving antenna is coupled directly to the receiver signal mixing circuit. Such a construction eliminates the extensive waveguide configurations normally required between the transmitting tube and the transmitting antenna and between the receiver circuitry and the receiving antenna. The transmission losses and expensive construction normally associated with such waveguide structures is thereby eliminated.

The spacing of the slotted arrays is such that any energy coupled from the transmitter to the receiver is greatly attenuated so that crystals or other components utilized in the signal mixing circuit are not endangered by the transmitting energy pulse. This construction eliminates the necessity for providing an expensive T/R system as is usually required in antenna devices of this sort.

The electrical connections from the transmitter and receiver circuitry to power supplies, amplifiers, and display systems, or the like, are brought down through a hollow shaft from the antenna enclosure via a brush and slip-ring system located in the pedestal enclosure for the antenna system. The slip-rings and brushes are enclosed in a metal case to reduce radiation.

The antenna configuration of the invention may be utilized with the antenna azimuth transmission system described in my previously filed application, Serial No. 1,929, filed January 12, 1960. As explained in that application, the rotary converter which is housed in the pedestal enclosure of the antenna system structure of the invention is utilized both to supply A.C. power for the receiver and transmitter portions of the system and, concomitantly, to drive the antenna enclosure through gear speed reduction means.

The antenna structure of the invention may be described

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more clearly with the help of the accompanying drawings in which:

FIG. 1 shows a pictorial view of the antenna and pedestal structure;

FIG. 2 shows the pedestal enclosure of the structure of FIG. 1 with its side cover removed to expose the parts therein;

FIG. 3 shows a front pictorial view of a portion of the antenna array of the system that is housed within the rotating enclosure shown in FIG. 1;

FIG. 4 shows a more detailed rear pictorial view of a portion of the antenna array and component chassis of the system shown in FIG. 3; and

FIG. 5 shows a more detailed front pictorial view of a portion of the antenna array and component chassis of the system shown in FIG. 3.

The antenna system 9 shown in FIG. 1 comprises a pedestal enclosure-type container 10 and a rotatable slotted array antenna enclosure-type container 11 mounted above the pedestal enclosure. The pedestal may be located on a flat surface of a vessel, for example, so that large masses are not in the direct radiation pattern of the rotating antenna and so that the antenna will not undesirably strike objects placed nearby, either physically or with its radiated wave. Antenna enclosure 11 rotates on a shaft 12 driven by suitable means located within pedestal enclosure 10. The pedestal case may be made of cast aluminum and arranged so that its sides are easily removable by providing latches 13 at strategic locations. Antenna enclosure 11 is made of a material which is physically rugged and which provides no loss for the transmitting or radiating energy. For example, the antenna may be enclosed in a high impact, thermoplastic resin housing.

The antenna pedestal enclosure 10 shown in FIG. 2 with its side covers removed, houses a rotary converter 14, a gear reduction system 15 and an extension shaft 16 which has mounted at one end thereof a driving gear 17 meshed with a driven gear 18 connected to a rotating shaft 12 which is utilized to rotate antenna enclosure 11. D.C. power applied to the rotary converter is converted to A.C. power for the operation of the radar transmitting and receiving circuits. The armature of the converter is connected to gear reduction system 15 which in turn rotates the antenna through extension shaft 16, gears 17 and 18 and shaft 12, as shown. The voltages necessary for connection to the rotating antenna system and its associated components are provided through rhodium-plated slip-rings 19 mounted on the shaft. Slip-rings 19 and corresponding brushes 20 are enclosed in a metal housing 22 to reduce radiation. Housing 22 is shown broken away in the figure. The upper portion of shaft 12 is grounded through brushes 20 to the metal case to prevent the shaft from acting as an antenna.

Pictorial views of the antenna array 21 and associated components housed within enclosure 11 are shown in FIGS. 3-5, like reference numerals being used to identify corresponding elements in the figures. There is mounted within enclosure 11 a transmitting antenna 25 and a receiving antenna 26. Both antennas are of the slotted waveguide type having a plurality of staggered longitudinal slots 27 placed therein. The transmitting antenna is positioned above the receiving antenna and both have flared sections 28 and 29 attached to slotted waveguide sections 31 and 32 which extend substantially along the length of enclosure 11. Because of this configuration very little energy is coupled from the transmitting antenna to the receiving antenna or its associated circuitry and a T/R system is not, therefore, required. Antennas 25 and 26 are secured to enclosure 11 by means of a back-

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ing plate 33 which has upper and lower flanges 61 and 62 attached to the upper and lower surfaces of enclosure 11. Backing plate 33 has a cut-out section 40 at one end thereof which has attached thereto a chassis 41 (shown in FIGS. 4 and 5 but not shown in FIG. 3) comprising a removable service plate 64 and a perpendicular mounting plate 31, as shown most clearly in FIGS. 4 and 5. RF energy is supplied to the transmitting antenna by a magnetron 30 mounted at one end of the antenna array on mounting plate 31. The output electromagnetic energy from the magnetron is directly coupled to the transmitting antenna via a short, self-contained waveguide coupling section 33 attached to and feeding transmitting antenna 25 by way of a choke flange 34 (shown broken away in FIG. 3).

Service plate 64 has mounted on one side thereof a vacuum tube 35 which is part of the receiver preamplifier circuitry, the major portion of said circuitry being mounted on the other side of plate 64 and enclosed by a shield cover 66. A cable connector 36 to which a cable 37 is attached is mounted on a second shield cover 67 housing a portion of the magnetron circuitry. A pulsing transformer 68 is also mounted on shield cover 67. Cable 37 is connected to suitable terminals in pedestal enclosure 10 by way of shaft 12 as is explained more fully in latter paragraphs.

As shown in FIGS. 4 and 5, the principle components of the receiver circuitry are mounted on the side of service plate 64 shown in FIG. 5. These components include a receiver local oscillator, which in this case is a klystron 43, a crystal 44 and signal preamplifier circuitry, of which tube 35 is a part, the major portions of said circuitry being enclosed by shield cover 66. Plate 64 on which the receiving circuits are mounted is secured to backing plate 38 by screws 46 so that it is easily removable and the components are made available for maintenance and inspection. The klystron probe 47 (shown most clearly in FIG. 3) is directly coupled to the receiver antenna slotted array waveguide extension 69 so that extensive waveguide coupling that is normally required in conventional radar systems is eliminated. A filament transformer 48 is also mounted on service plate 64.

Cables 37, 96 and 39 which, through connectors 36 and 94 and plug 93, respectively, supply transmitting and receiving signals as well as power supply voltages, extend from the chassis at one end of antenna array 21 to the pedestal enclosure through hollow shaft 12 as shown in FIG. 4. Shaft 12 is attached to backing plate 38 by way of a clamp structure 49. The cables extend through the upper opening of the shaft and the shaft is fixedly secured to antenna array by tightening clamping collar 50.

The use of the structure of the invention provides a compact equipment which is easily mounted on a vessel and which can be easily maintained and repaired. Variations of the structure of the antenna structure which are within the scope of the invention will occur to those skilled in the art. Hence, the invention is not to be construed as limited to the specific embodiments shown except as defined by the appended claims.

What is claimed is:

1. In a radar system, an enclosure-type container, antenna means mounted within said enclosure-type container, chassis means secured to said antenna means, a magnetron oscillator mounted on said chassis directly coupled to said antenna means and receiving circuit means within said enclosure-type container including a local oscillator and mixer circuitry mounted on said chassis within said enclosure-type container and directly coupled to said antenna means.

2. In a radar system, an enclosure-type container antenna means mounted within said enclosure-type container, chassis means secured to said antenna means, a magnetron oscillator mounted on said chassis within said

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enclosure-type container and directly coupled to said antenna means, and receiving circuit means including a local oscillator and mixer circuitry mounted on said chassis within said enclosure-type container and directly coupled to said antenna means, and means for rotating said enclosure-type container.

3. In a radar system, an enclosure-type container, a transmitting antenna mounted within said enclosure-type container, a receiving antenna mounted within said enclosure-type container, a magnetron oscillator mounted on a chassis within said enclosure-type container and directly coupled to said transmitting antenna, a receiving circuit means including a local oscillator and mixer circuitry, said oscillator and mixer circuitry mounted on a chassis within said enclosure-type container and directly coupled to said receiving antenna, and means for rotating said enclosure-type container.

4. In a radar system, an enclosure-type container, a transmitting antenna mounted within said enclosure-type container, a receiving antenna mounted directly below said transmitting antenna within said enclosure-type container, means for generating electromagnetic energy directly coupled to said transmitting antenna, and mounted within said enclosure-type container receiving circuit means directly coupled to said receiving antenna and mounted within said enclosure-type container and means for rotating said enclosure-type container.

5. In a radar system, an enclosure-type container, a slotted transmitting antenna mounted within said enclosure-type container, a slotted receiving antenna mounted directly below said transmitting antenna within said enclosure-type container, means for generating electromagnetic energy directly coupled to said transmitting antenna, and mounted within said enclosure-type container, receiving circuit means directly coupled to said receiving antenna and mounted within said enclosure-type container and means for rotating said enclosure-type container.

6. In a radar system, an enclosure-type container, a transmitting antenna mounted within said enclosure-type container, a receiving antenna mounted within said enclosure-type container, a magnetron oscillator mounted on a chassis within said enclosure-type container and directly coupled to said transmitting antenna, a receiving circuit means including a local oscillator and mixer circuitry, said oscillator and mixer circuitry mounted on a chassis within said enclosure-type container and directly coupled to said receiving antenna, hollow shaft means secured to said transmitting and receiving antenna for rotating said antenna and enclosure-type container, cable means inserted within said shaft and connected at one end to transmitting and receiving circuit means and at the other end a plurality of rotatable contacts mounted on said shaft.

7. In a radar system, an enclosure-type container, a transmitting antenna mounted within said enclosure-type container, a receiving antenna mounted within said enclosure-type container, a magnetron oscillator mounted on a chassis within said enclosure-type container and directly coupled to said transmitting antenna, a receiving circuit means including klystron and crystal circuitry, said klystron and crystal circuitry mounted on a chassis within said enclosure-type container and directly coupled to said receiving antenna, and means for rotating said enclosure-type container.

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GEORGE WESTBY, *Examiner.*

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,196,349

July 20, 1965

Robert A. Fryklund

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 65, after "chassis" insert -- within said enclosure-type container and --; line 66, after "means" insert a comma; line 67, strike out "within said enclosure-type container"; same column 3, line 71, and column 4, line 24, after "container", each occurrence, insert a comma.

Signed and sealed this 18th day of January 1966.

(SEAL)

Attest:

ERNEST W. SWIDER

Attesting Officer

EDWARD J. BRENNER

Commissioner of Patents