Sept. 3, 1957 I. R. TAYLOR 2,805,414

ANTENNA STRUCTURE

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Fig. 1

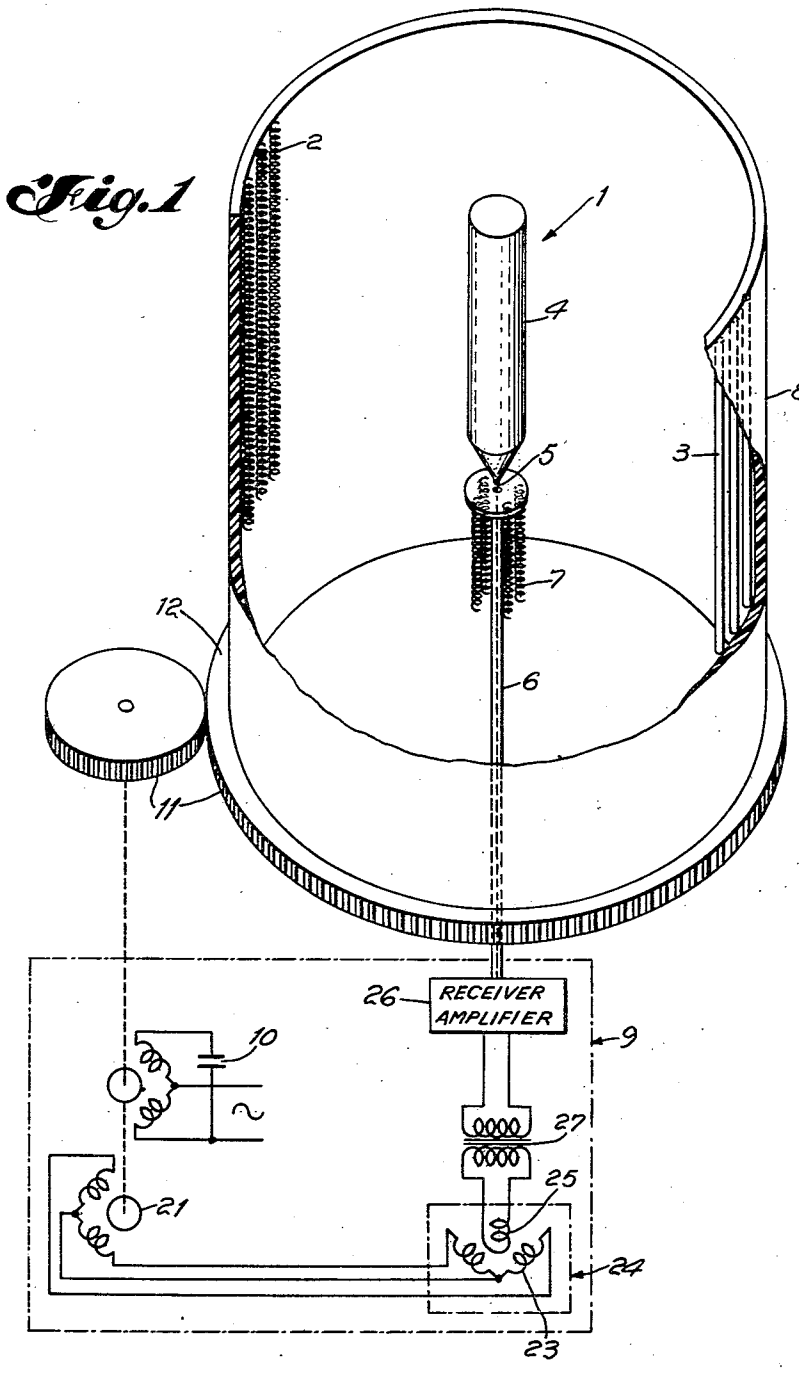
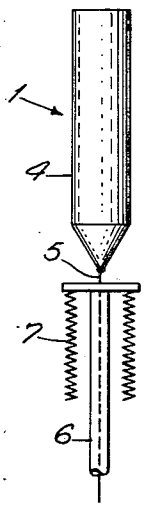



Fig. 2

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# ANTENNA STRUCTURE

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3 Claims. (Cl. 343—761)

This invention relates to an antenna structure and more particularly to a broad band coaxial dipole type antenna system of relatively short physical length operating at relatively high frequencies.

In many antenna structures, in order to obtain a rotating unilateral response radiation pattern, parasitic reflectors and directors are utilized which are rotated about a central radiator by a motor drive which is in proximity to the lower half of a coaxial dipole. The reflector element is normally designed to have a physical length which is resonant immediately beneath the desired frequency band and the directors are designed to be resonant at a frequency immediately above the desired frequency band thus enabling the antenna system to have a wide band coverage. However, it has been found that in order to obtain this wide band coverage, the size of the reflector units are so large that a practical embodiment is unobtainable particularly so if a rapid rotation of the reflectors is to be made around the central radiator portion. Another disadvantage of the known systems is that due to the proximity of the metal mass, such as motors and gears, which are necessary to rotate the reflectors around the central radiator, there is a deterioration in the radiation pattern and thus a deterioration in the ability to distinguish received signals. This deterioration is due substantially to the proximity of the metal mass to the lower or skirt portion of the coaxial dipole antenna.

One of the objects of this invention, therefore, is to provide a coaxial dipole antenna structure of short physical length in which director and reflector portions can be rotated about a central radiator.

Another object of this invention is to provide an antenna structure having a rotating unilateral radiation pattern which is relatively unaffected by the close proximity of the driving members to the radiating elements.

A further object of this invention is to provide a broad band antenna system having a rotating unidirectional pattern capable of rapid and continuous rotation wherein the central radiator and parasitic elements are of relatively short physical length.

According to one of the features of my invention, a wide band coaxial dipole antenna structure comprises a central radiator of a generally coaxial dipole antenna type having a plurality of helical reflectors tuned to resonance which are rotated about the central radiator. The coaxial dipole antenna has its lower or skirt portion composed of a plurality of small helices in order to provide an impedance equal to the impedance of the upper dipole but of a physically shorter length so that the coupling effect between the lower helices and the metal mass including the driving motor and base structure is reduced resulting in a decrease in the voltages induced in radiating element. In order to decrease the physical size of the antenna structure, so that a practical embodiment of the director-reflector combination can be realized, each of the reflector elements are constructed in the form of a helix and the skirt portion of the coaxial dipole antenna



consists of a plurality of helices equally spaced around the transmission line to conserve the physical lengths and thus place the lower half of the coaxial dipole at a greater distance from the driving mass than heretofore possible.

The above mentioned and other features and objects of this invention and the manner of obtaining them will become more apparent by reference to the following description taken in conjunction with the accompanying drawings wherein;

Fig. 1 is a perspective view partly in cross section of one embodiment of an antenna structure in accordance with the principles of this invention; and,

Fig. 2 is a schematic diagram in elevation of the coaxial dipole antenna utilized as the central radiator in the system shown in Fig. 1.

Referring to Fig. 1 of the drawing, a perspective view with parts broken away of a preferred embodiment of the antenna system in accordance with the principles of my invention is illustrated wherein it is shown that the antenna structure comprises a central radiator **1** around which are rotatably mounted a plurality of reflector elements **2** and director elements **3**. The central radiator **1** includes an upper conductive element **4** to which is coupled the inner conductor **5** of transmission line **6**. The lower or skirt portion of the coaxial dipole type central radiator **1** includes a plurality of helices **7** coupled to the outer conductor of the transmission line **6**. Mounted for rotation around the central radiator **1** is a plurality of director elements **3** and diametrically opposite each of the director elements **3** is a reflector unit **2** formed of a helical shaped conductor. The director **3** and reflector elements **2** may be mounted on a cylinder **8** composed of an insulating material, such as fibreglass, which does not affect the radiation pattern of the antenna structure. The reflector and director elements **2** and **3** are spaced on the periphery of the cylinder **8**.

In order to make the antenna system of my invention cover a relatively broad frequency band, the director elements **3** are of a physical length causing the elements to be resonant at a frequency immediately above the frequency band to be received. The reflector elements **2** are made of conductive material wound in the form of a helix and each helix is designed to be resonant at a frequency immediately below the frequency band of interest.

Since the reflector director assembly must be rotated to obtain a rotating unilateral radiation pattern, a metal mass **9** including the motor **10**, gears **11** and supporting plate **12** necessary for this rotation is located under the cylinder **8**. The proximity of this metal mass **9** to the lower half or skirt portion of the coaxial dipole antenna **1** causes a deterioration in the radiation pattern for signals arriving at angles of incidence greater than 30°. To overcome this difficulty, the lower half of the coaxial dipole antenna **1** was shortened by utilizing the plurality of helices **7** arranged as previously described. Thus, the use of the helical reflectors **2** reduces the physical length of the parasitic element and thus allows a reasonable mechanical structure capable of high speed rotation to be designed and, in addition, the lower portion of the coaxial dipole antenna **1** being made of a plurality of helices **7** provides an impedance match equal to the upper portion of the dipole but physically much shorter so that it may be located at a greater distance from the driving members and the coupling from the lower portion of the dipole or helices to the metal mass **9** is reduced for the purpose of decreasing the effect of voltages induced in the antenna element.

In order to have a response over a comparatively wide frequency range, the coaxial dipole antenna is of a low Q design. The reflector elements **2** should have an elec-

trical length substantially equal to one half of the wave length at the lower end of the frequency band of a low Q dipole. The spacing between each of the reflector and director elements **2** and **3** should be small enough to provide adequate reflection of the vertically polarized waves and wide enough to prevent excess capacitance between the strips which might change the electrical length of the strip or might present the equivalent of a solid reflective area and thus reflect horizontally polarized radiation. The distance between the dipole and the reflector strip should be of the order of .07 to .12 wave length.

In my preferred embodiment the cylinder **8** is rotated by means of the motor **10** which also drives alternator **21** in synchronism therewith. The alternator **21** feeds a reference voltage to the stator windings **23** of a phase meter **24**. The antenna transmission line **6** is coupled to the rotor winding **25** of the phase meter **24** through a receiver and amplifier **26** and a high impedance **27**. The azimuth of the received signal may be indicated by the rotation of the rotor **25** of phase meter **24** in response to the phase relation of the received signal from the dipole antenna **1** and the reference voltage from the alternator **21**.

When a received signal is fed to the rotor winding **25**, the phase meter **24** will act as a motor. To counteract the tendency of the phase meter to act as a motor, it is necessary to reduce the current in the rotor winding **25**. This may be done by introducing a high impedance into the transmission line **6** between the amplifier **26** and the rotor winding **25** of the phase meter. This high impedance may take the form of a high impedance transformer **27** between the amplifier **26** and the rotor winding **25** of the phase meter **24**.

Of course it is apparent that other embodiments of my invention are possible without departing from the principles, for example, the director elements may be formed of helices or a different formed central radiator than that shown may be used.

While I have described above the principles of my invention in connection with specific apparatus, it is to be clearly understood that this description is made by way of example only and not as a limitation to the scope of my invention as set forth in the objects thereof and in the accompanying claims.



I claim:

1. An antenna system comprising a coaxial dipole antenna vertically disposed having a rod-like radiator portion composed of a conductive element forming the upper part of said dipole antenna and plurality of helices having their longitudinal axes mounted on a circle coaxially disposed to and below said rod-like element forming the ground sleeve lower part of said antenna, a plurality of reflector helices of conducting material coaxially disposed in an arc of a circle about said dipole antenna and means to rotate said reflector helices about said antenna.

2. An antenna system according to claim 1 which further includes the plurality of director strips of conducting material each disposed diametrically opposite to one of said reflector helices and having their axes parallel to the axis of said dipole antenna.

3. An antenna system comprising a coaxial dipole antenna vertically disposed having a rod-like radiator portion composed of a conductive element forming the upper part of said dipole antenna and plurality of helices having their longitudinal axes mounted on a circle coaxially disposed to and below said rod-like element forming the ground sleeve lower part of said antenna, a cylinder composed of insulating material disposed coaxially to said antenna, a helical reflector composed of conducting material carried by said cylinder, a director element located on said cylinder diametrically opposite to said reflector and means to rotate said cylinder about said antenna.

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