

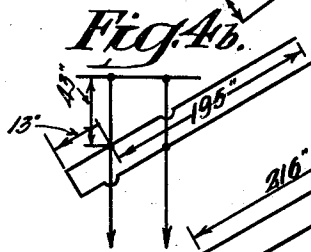
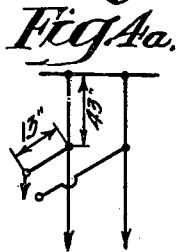
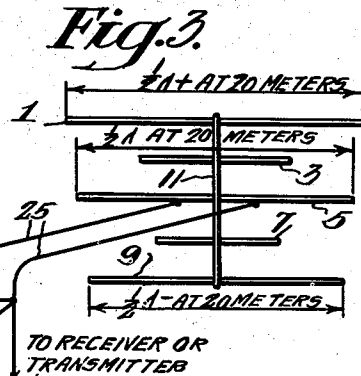
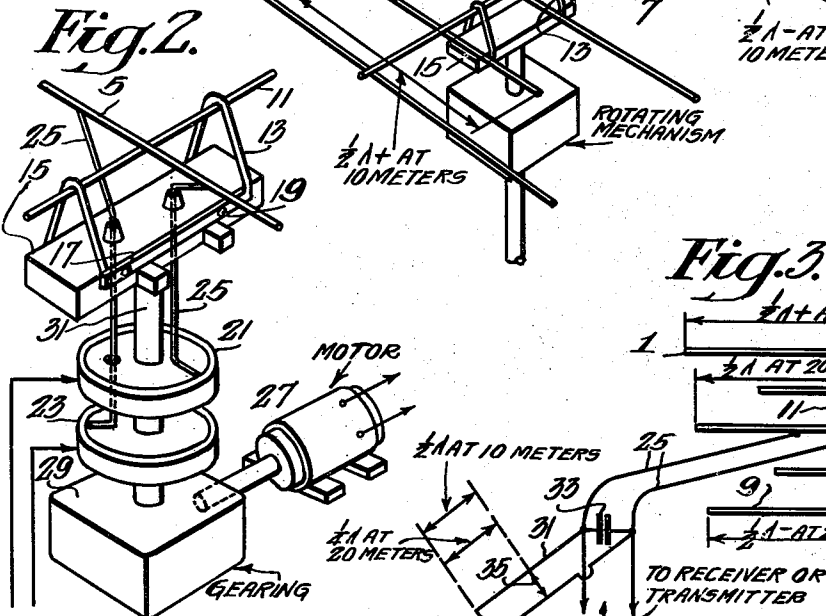
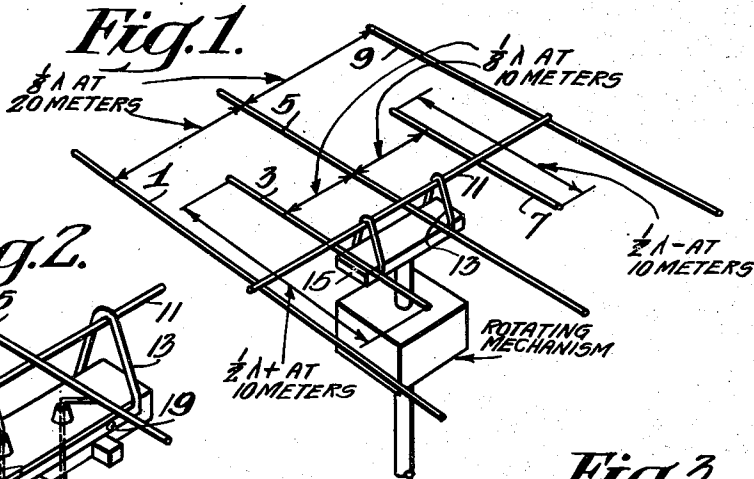
Jan. 6, 1942.

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2,268,640

ROTARY BEAM ANTENNA

Filed Nov. 15, 1940



UNITED STATES PATENT OFFICE

2,268,640

ROTARY BEAM ANTENNA

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Application November 15, 1940, Serial No. 365,743

13 Claims. (Cl. 250-11)

This invention relates to radio beam antennas and particularly to a radio beam antenna including means for operating the same at either of two related wave lengths.

Yagi U. S. Patent No. 1,745,342 describes a system in which a driven antenna is coupled to a parasitic director and a parasitic reflector which are parallel to and respectively in front of and behind the antenna. Such a system is directive and efficient. However, it is only efficient within a narrow frequency range about the resonant point of the antenna.

It is an object of the present invention to provide means for operating a directive antenna at either of two wave lengths. Another object is to provide a beam antenna which may be operated at two related frequencies by means of an automatically selective circuit. An additional object is to provide means whereby a rotary beam antenna may be operated at either of two wave lengths bearing a two to one ratio.

The invention will be described by referring to the accompanying drawing in which Fig. 1 is a perspective view of one embodiment of the rotary beam antenna of the invention; Fig. 2 is a perspective view of the rotating mechanism of Fig. 1; Fig. 3 is a schematic circuit diagram of the antenna of Fig. 1; Fig. 3A is a circuit diagram of a portion of Fig. 3; and Figs. 4A, 4B, 4C, 4D and 4E are circuit diagrams of modifications of the matching circuit of Fig. 3A. Similar reference characters will be applied to similar elements in the drawing.

Referring to Fig. 1 an antenna array including reflectors 1, 3, antenna 5, and directors 7, 9 are suitably secured to a supporting member 11 which may be a conductor. The supporting member 11 is fastened to a cradle 13, which is mounted on the rotating mechanism shown in Fig. 2. The rotating mechanism includes a plate 15 for supporting the cradle by means of pins or bolts 17, 19. Either bolt may be withdrawn to tilt the antenna array toward the vertical plane. The antenna 5 is connected to slip rings 21, 23 by a transmission line 25. The transmission line is connected to the antenna to include, for long wave operation, an impedance matching portion. The antenna array may be rotated by means of a motor 27, connected through gearing 29 to the supporting shaft 31. While a power mechanism is preferable, any rotational means may be employed if the beam is to be directed in the azimuth.

The schematic diagram of Fig. 3 shows the relation of the conductors of the array. The

reflector 1 for the longer wave is slightly more than a half wave length long and is spaced approximately one-eighth wave length behind the antenna conductor 5 which has an effective length of half the longer wave. The director 9 for the longer wave is slightly less than a half wave long and is spaced approximately one-eighth wave length in front of the antenna conductor. For the shorter waves the reflector 3 and the director 7 are spaced one-eighth of the shorter wave length behind and ahead, respectively, of the antenna conductor 5. The short wave reflector is slightly longer and the short wave director is slightly shorter than a half of the shorter wave length.

Since the longer wave is twice the length of the shorter, it follows that the shorter wave elements will have no appreciable effect on the longer wave elements. The antenna conductor 5 operates as a half wave dipole for the longer waves, and as two half wave cophased dipoles for the shorter waves.

The transmission line 25, as stated, is connected to the antenna conductor at points insuring a proper match for the longer waves. The problem remaining is to provide means whereby the antenna may function automatically and efficiently at either the longer or shorter wave length. This may be accomplished in a number of arrangements of which the following is preferred. A matching stub 31 is connected at a suitable distance from the antenna. A capacitor 33 may be shunted across the line 25 at the stub 31. In some installations the slip or collector rings will provide sufficient capacity. The stub 31 and associated capacity 33 will provide the desired match at the shorter wave, but an improper match at the longer wave. To avoid mechanical switching, the shorting member 35 may be moved a half wave from its initial position. The shorting member removed a half wave will still act as a short circuit at the shorter wave length. But at the longer wave length the shorting member will be a quarter wave removed and therefore the matching section 31 will be terminated in a high impedance. Thus the line is restored to its match at the longer wave length and at the same time is matched at the shorter wave length.

By way of example in Fig. 3A the dimensions of the matching lines are shown in inches for operating wave lengths of the order of ten and twenty meters. Several modifications are shown in Figs. 4A to 4E. In Fig. 4A the dimensions are for proper termination of the line at 29

megacycles with the switch S closed. At the lower frequency the switch S is opened and the input reactance becomes high and consequently does not affect the line termination at 14.2 megacycles. In Fig. 4B the circuit becomes parallel resonant at 14.2 megacycles and at 29 megacycles the inductive stub is only effective since the input reactance of the open section becomes extremely high. In Fig. 4C the stub acts like an inductive stub 13 inches in length at the high frequency and as a high impedance at the lower frequency. In Fig. 4D the circuit LC becomes series resonant at 29 megacycles and hence places an inductive stub of the proper length across the line; at 14.2 megacycles the circuit LC becomes parallel resonant and the input reactance of the stub across the line becomes very high. In Fig. 4E the circuit constants are chosen so that the combination acts as an inductive stub of the correct length at the high frequency and as a high impedance at the low frequency.

Thus the invention has been described as a rotating beam antenna which may be operated for receiving or transmitting waves of a predetermined length ratio, for example 10 meters and 20 meters. The antenna conductor is used as a pair of cophased half wave dipoles at the short wave length and as a half wave dipole at the longer wave length. By means of one of a number of novel transmission line connections the antenna is matched to the line for waves of either length. No switching is required for either short or long wave operation. The several dimensions, wave lengths, or frequencies have been cited by way of illustration rather than limitation. Furthermore, it has been found that the automatic operation is entirely satisfactory over a band of wave lengths in both ranges. Reflectors and/or directors may be used to make the beam sharply directive although either or both may be omitted on either wave length range to make the pattern less directive. The receiver or transmitter which is associated with the antenna is simply tuned to either wave length band.

I claim as my invention:

1. An antenna responsive to a long and a short wave including an antenna conductor, said conductor having a length effectively equal to half of the long wave and to the length of the short wave, a transmission line connected to said antenna and designed to match the antenna impedance at the long wave length, and means connected to said transmission line for matching the impedance at said short length so that said line is properly terminated for either wave.

2. A combined long and short wave antenna including an antenna conductor having a length equal to said short wave and to half said long wave, a transmission line connected to said antenna conductor and terminated in a proper impedance for the application of currents of said long wave, and means connected to said transmission line to terminate the line properly for currents of said short wave, said means offering high impedance to said long wave so that said line is properly terminated for said long and short waves.

3. A combined long and short wave rotary beam antenna including an antenna conductor having a length equal to said short wave and to half said long wave, a transmission line connected to said antenna conductor and terminated in a proper impedance for the application of cur-

rents corresponding to said long wave, and means connected to said transmission line for matching said line to said antenna conductor for currents corresponding to said short wave without altering substantially said termination impedance for long wave currents.

4. A combined long and short wave rotary beam antenna including an antenna conductor having a length equal to said short wave and to half said long wave, a long wave reflector spaced behind said antenna conductor, a transmission line connected to said antenna conductor and terminated in a proper impedance for the application of currents corresponding to said long wave, and means connected to said transmission line for matching said line to said antenna conductor for currents corresponding to said short wave without altering substantially said termination impedance for long wave currents.

5. A combined long and short wave rotary beam antenna including an antenna conductor having a length equal to said short wave and to half said long wave, a long wave reflector spaced behind said antenna conductor, a long wave director spaced in front of said antenna conductor, a transmission line connected to said antenna conductor and terminated in a proper impedance for the application of currents corresponding to said long wave, and means connected to said transmission line for matching said line to said antenna conductor for currents corresponding to said short wave without altering substantially said transmission impedance for long wave currents.

6. A combined long and short wave rotary beam antenna including an antenna conductor having a length equal to said short wave and to half said long wave, a short wave reflector spaced behind said antenna conductor, a transmission line connected to said antenna conductor and terminated in a proper impedance for the application of currents corresponding to said long wave, and means connected to said transmission line for matching said line to said antenna conductor for currents corresponding to said short wave without altering substantially said termination impedance for long wave currents.

7. A combined long and short wave rotary beam antenna including an antenna conductor having a length equal to said short wave and to half said long wave, a short wave reflector spaced behind said antenna conductor, a short wave director spaced in front of said antenna conductor, a transmission line connected to said antenna conductor and terminated in a proper impedance for the application of currents corresponding to said long wave, and means connected to said transmission line for matching said line to said antenna conductor for currents corresponding to said short wave without altering substantially said termination impedance for long wave currents.

8. A combined long and short wave rotary beam antenna including an antenna conductor having a length equal to said short wave and to half said long wave, a long wave reflector spaced behind said antenna conductor, a short wave reflector spaced between said long wave reflector and said antenna conductor, a long wave director spaced in front of said antenna conductor, a short wave director spaced between said antenna conductor and said long wave director, a transmission line connected to said antenna conductor and terminated in a proper impedance for the

application of currents corresponding to said long wave, and means connected to said transmission line for matching said line to said antenna conductor for currents corresponding to said short wave without altering substantially said termination impedance for long wave currents.

9. An antenna of the character of claim 3 in which said reflectors and directors are arranged parallel to each other and are in the same plane and are supported by a conductive member located at the centers of said reflectors and directors.

10. An antenna of the character of claim 8 in which said reflectors and directors are arranged parallel to each other and are in the same plane and are supported by a conductive member located at the centers of said reflectors and directors.

11. A combined long and short wave rotary beam antenna including an antenna conductor having a length equal to said short wave and to half said long wave, a transmission line connected to said antenna conductor and terminated in a proper impedance for the application of currents corresponding to one of said waves, and means connected to said transmission line for matching said line to said antenna conductor for currents corresponding to the other of said waves without altering substantially said termination impedance for said one wave.

12. A combined long and short wave rotary beam antenna including an antenna conductor having a length equal to said short wave and to

half said long wave, a long wave reflector spaced behind said antenna conductor, a long wave director spaced in front of said antenna conductor, a transmission line connected to said antenna conductor and terminated in a proper impedance for the application of currents corresponding to one of said waves, and means connected to said transmission line for matching said line to said antenna conductor for currents corresponding to the other of said waves without altering substantially said termination impedance for said one wave.

13. A combined long and short wave rotary beam antenna including an antenna conductor having a length equal to said short wave and to half said long wave, a long wave reflector spaced behind said antenna conductor, a short wave reflector spaced between said long wave reflector and said antenna conductor, a long wave director spaced in front of said antenna conductor, a short wave director spaced between said antenna conductor and said long wave director, a transmission line connected to said antenna conductor and terminated in a proper impedance for the application of currents corresponding to one of said waves, and means connected to said transmission line for matching said line to said antenna conductor for currents corresponding to the other of said waves without altering substantially said termination impedance for said one wave.

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