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ANTENNA SYSTEMS

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Fig. 1

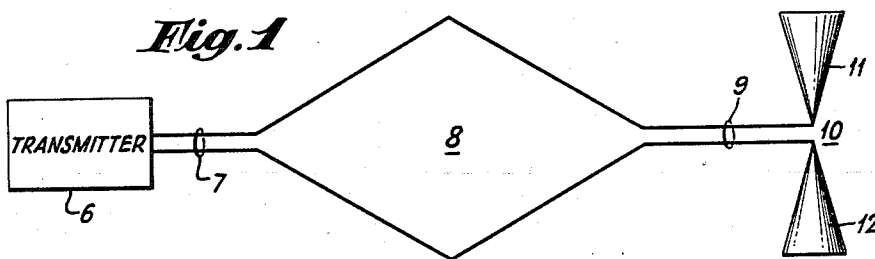


Fig. 2

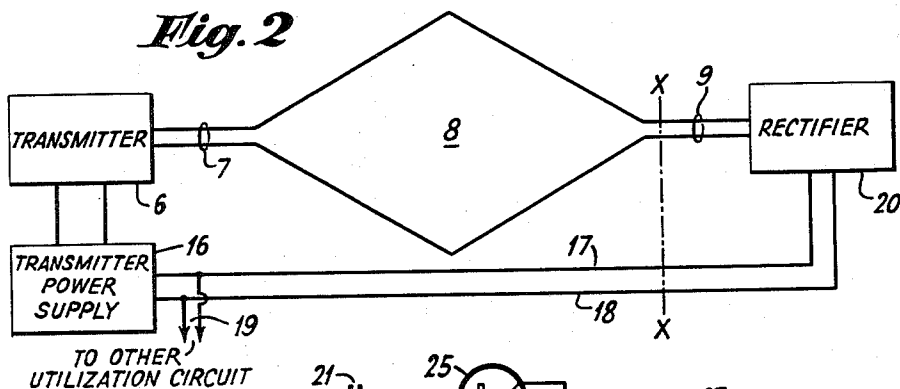


Fig. 3

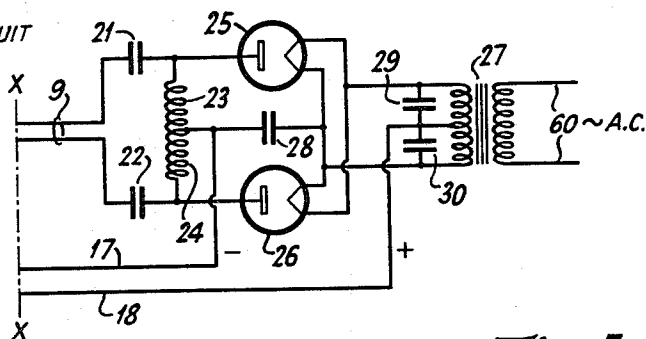


Fig. 4

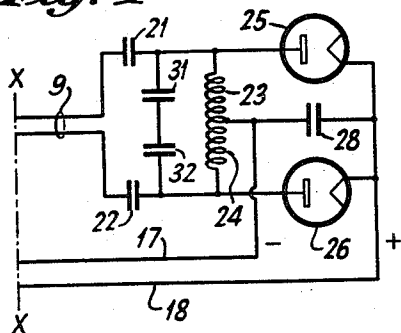
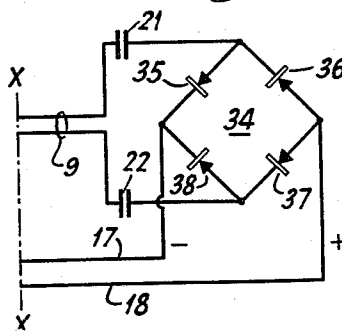


Fig. 5



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ANTENNA SYSTEM

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9 Claims. (Cl. 250—33)

The present invention relates to antenna systems and, more particularly, to directive antenna systems which are useable over a wide range of frequencies.

An object of the present invention is to improve the efficiency of antenna systems generally, and more particularly, those which are designed for wide band frequency coverage and, at the same time, which are directive in their transmitting pattern.

A further object of the present invention is to provide means for utilizing the power which is ordinarily wasted in the terminating resistance at the end of a directive antenna array.

A further object of the present invention is a provision of means in an antenna system, as aforesaid, for rectifying the energy appearing at the far end of the transmitting antenna and applying the rectified energy to a useful purpose.

In accordance with the principles of my invention, I propose to substitute for the terminating resistance in a rhombic antenna, or other travelling wave antenna, a utilization means which applies the energy arriving at this end of the antenna to a useful purpose.

In accordance with one feature of my invention I may apply this energy to a cone radiator which radiates the energy arriving at the terminal end of the antenna generally in all directions. In some instances where extreme directivity is not necessary, this may be highly desirable. In other circumstances where it is not desired to disturb the radiating pattern of the diamond antenna, I propose to substitute for the terminating resistance a rectifying arrangement having the same characteristic impedance as a terminating resistance. The energy applied to the rectifier is rectified and then brought back to the transmitter location and utilized for charging storage batteries, for heating the transmitter house or re-applied to the power supply for the transmitter and again utilized.

The present invention will be more clearly understood by reference to the following detailed description which is accompanied by a drawing in which Figure 1 shows, diagrammatically, one embodiment of the present invention, while Figure 2 shows a modification thereof; Figures 3, 4 and 5 show, in more detail, modifications of a portion of the embodiment shown in Figure 2.

With reference to Figure 1, reference character 6 indicates, generally, a transmitter which may be of any conventional form of construction. The particular type of transmitter used does not constitute a part of the present invention. The

transmitter 6 is connected by means of transmission line 7 to a rhombic or diamond antenna 8. As the energy passes along the conductors of the antenna 8 a large portion of the energy is radiated in a predetermined manner but approximately 40 percent arrives at the far end without being radiated. Ordinarily, this energy is dissipated in a terminating resistance in order to prevent reflection back along the wires of the antenna in the opposite direction which would disturb the radiating pattern of the antenna.

In accordance with my invention, instead of attaching a terminating resistance to the far end of diamond antenna 8, I connect thereto a transmission line 9 which may be of any desired length and at the far end thereof, I connect a cone antenna 10 which is composed of conical radiators 11 and 12. The cone antenna 10 has a wide band frequency characteristic so that for all frequencies efficiently handled by antenna 8 the antenna 10 appears as a substantially pure resistance. It will, therefore, be seen that instead of the power left over from antenna 8 being wasted it is, in this case, radiated in cone antenna 10. By adjusting the location of antenna 10 with respect to antenna 8 the signal indicated by antenna 10 will along a predetermined direction combine in an additive relationship with the signal from antenna 8.

In Figure 2 I have shown a modification of my invention in which the energy arriving at the terminal transmission line 9 is rectified by means of rectifier 20. The rectified direct current output of rectifier 20 is carried by means of conductors 17 and 18 to the transmitter power supply 16 and/or another utilization circuit 19, as indicated by arrows. The utilization circuit may include storage batteries which are to be charged or heater elements for heating the transmitter building in cold weather. The direct current from conductors 17, 18 will supply a large portion of the plate energy of transmitter 6 either simultaneously with or instead of the general utilization circuit. It is to be understood that for convenience in expression I may refer to utilization circuits connected to conductors 17, 18 and include therein the power supply 16.

In Figure 3 I have shown in more detail one circuit diagram of rectifier 20. The circuit shows two condensers 21 and 22 which are connected between a transmission line 9 from the diamond antenna 8 (Figure 2) and the inductance coils 23 and 24. Condensers 21 and 22 block the flow of direct current from the rectifier back into transmission line 9 so that all of the direct cur-

rent is carried by conductors 17 and 18 while at the same time they present substantially no impedance to the radio frequency from antenna 8. Also, to the junction of condenser 21 and coil 23 and to the junction of condenser 22 and coil 24 are connected the anodes of two rectifier tubes 25 and 26. The other ends of coils 23 and 24 are joined together and connected to lead 17. If desired, coils 23 and 24 may be constructed as a single coil having the equivalent inductance of both coils and equipped with a center tap. The cathodes of tubes 25 and 26 are connected together and to a source of heating current through transformer 27. The center tap or the point of connection between coils 23 and 24 is connected to the cathodes of rectifier tubes 25 and 26 by means of by-pass condenser 28 which allows the harmonic rectifier current to flow. The center tap of the filament heating transformer 27 is connected to lead 18 of the direct current circuit. The rectifier cathode connections are by-passed by means of condensers 29 and 30 to lead 18 as shown. Either conductor 17 or conductor 18 may be grounded, if desired, depending upon which polarity is to be considered above ground potential.

In order to show more clearly how the present invention saves power we may assume a typical example wherein the antenna terminating resistance is 600 ohms and the power to be absorbed is 20 kilowatts. An analysis shows that for a proper operation the following values exist in the rectifier circuit:

	Ohms	Amps. R. M. S. current	R. M. S. volts	Watts power
Line 9	600	5.775	3.460	20
Condensers 21 and 22 (each)	300	5.775	1,730	
Coils 23 and 24 (each)	600	4.08	2,450	
Tubes 25 and 26 (each)	600	4.08	2,450	10

The direct current power obtained for reutilization is, of course, somewhat less than indicated above due to rectifier losses. It will run somewhere on the order of 2000 watts with a current of about 8 amperes.

In Figure 4 I have shown a modification of the rectifier circuit shown in Figure 3 in which a parallel tuned circuit is used. The line 9 is connected to the ends of coils 23 and 24 through blocking condensers 21 and 22. The coils are tuned by condensers 31 and 32 to the operating frequency of antenna 8. The rectifier tubes 25 and 26 have their anodes connected to opposite sides of the tuned circuit composed of coils 23 and 24 and condensers 31 and 32. Since, in this case, the tuned circuit offers almost infinite impedance to line 9, the rectifier resistance must equal the line surge impedance and also, of course, the line surge impedance must be equal to the terminal impedance of the antenna in order to prevent reflection back into antenna 8 (Figure 2).

In Figure 5 I have shown a further modification in which the rectifier is composed of four rectifying elements 35, 36, 37 and 38 arranged in a bridge circuit 34. The rectifying elements may either be thermionic tubes or they may be oxide type rectifiers, as desired.

Among the modifications I have shown, the circuits shown in Figures 3 and 4 are more particularly adapted for ultra high frequency use and, therefore, preferably use the high vacuum type rectifier tubes.

The circuit shown in Figure 5 operates more

satisfactorily at the lower frequencies, particularly if oxide type rectifiers are used.

While I have shown and particularly described several embodiments of my invention, it is to be distinctly understood that my invention is not limited thereto but that modifications within the scope of my invention may be made.

I claim:

1. In combination, a travelling wave antenna, means for energizing said antenna connected thereto at one end and reflection preventing means connected to the other end of said antenna, said means comprising a rectifier and means for utilizing the output of said rectifier.
2. In combination, an antenna having a length at least as great as the operating wavelength thereof, means for energizing said antenna connected thereto at one end and reflection preventing means connected to the other end of said antenna, said means comprising a rectifier and means for utilizing the output of said rectifier.
3. In combination, a travelling wave antenna, means for energizing said antenna connected thereto at one end, a rectifier having an input and an output, said input being connected to the other end of said antenna and a utilization circuit connected to said output.
4. In combination, an antenna having a length at least as great as the operating wavelength thereof, means for energizing said antenna connected thereto at one end, a rectifier having an input and an output, said input being connected to the other end of said antenna and a utilization circuit connected to said output.
5. In combination, an antenna having a length at least as great as the operating wavelength, means for energizing said antenna connected thereto at one end, a rectifier having an input and an output, said input being connected to the other end of said antenna and a utilization circuit connected to said output, the input impedance of said rectifier being substantially equal to the impedance of the other end of said antenna.
6. In combination, an antenna having a length at least as great as the operating wavelength, means for energizing said antenna connected thereto at one end, a rectifier having an input and an output, said input being connected to the other end of said antenna and a utilization circuit connected to said output, the input impedance of said rectifier being substantially equal to the impedance of the other end of said antenna, said utilization circuit being included in the source of supply for said energizing means.
7. In combination, a travelling wave antenna, means for energizing said antenna connected thereto at one end, a rectifier circuit including an inductance coupled to the other end of said antenna through a pair of condensers, a pair of rectifier tubes having anodes connected to the ends of said inductance and cathodes connected to a utilization circuit, and a connection from a midpoint on said inductance to said utilization circuit.
8. In combination, a travelling wave antenna, means for energizing said antenna connected thereto at one end, a rectifier circuit including an inductance coupled to the other end of said antenna, capacity means across said inductance for tuning to the operating wavelength of said antenna, a pair of rectifier tubes having anodes connected to the ends of said inductance and cathodes connected together and a utilization circuit connected to said cathodes and to a midpoint on said inductance.

9. In combination, a travelling wave antenna, means for energizing said antenna connected thereto at one end, a rectifier circuit including an inductance coupled to the other end of said antenna, capacity means across said inductance for tuning to the operating wavelength of said antenna, a pair of rectifier tubes having anodes 5 connected to the ends of said inductance and cathodes connected together and a utilization circuit connected to said cathodes and to a midpoint on said inductance, said utilization circuit being included in the source of supply for said energizing means.

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