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ELECTRICAL APPARATUS
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FIG. 1

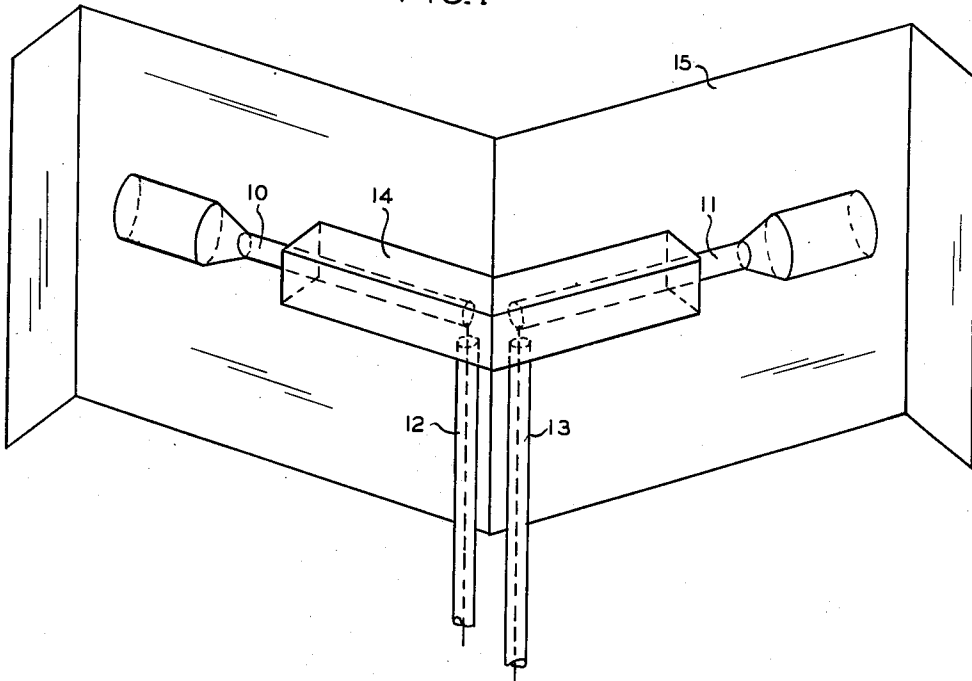
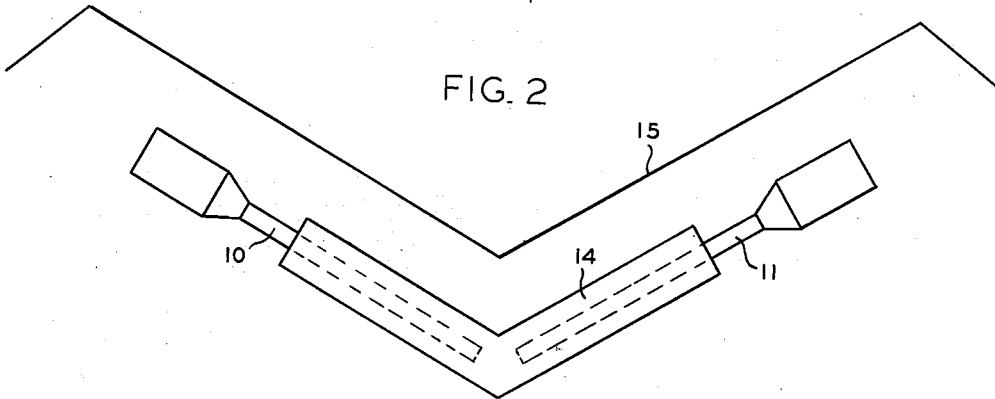


FIG. 2



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This invention relates generally to electrical apparatus and more particularly to antennas adapted for use with radio frequency direction finding systems.

Some of the more recent types of radio frequency direction finding systems not only sweep in azimuth but also employ a frequency scanning receiver. Such a direction finding system provides a presentation showing both the azimuth and the carrier frequency of received signals, thus increasing the intelligence obtainable from radio frequency transmitters. In these direction finding systems, the antennas employed must meet rigid requirements. It is desirable that these antennas not only be operable over a wide range of frequencies but that they also maintain a substantially constant response pattern, with regard to shape, as the operating frequency is varied. Generally, the response pattern of an antenna varies in shape or directivity as the operating frequency is varied.

It is an object of this invention to provide an antenna particularly adapted for use with radio frequency direction finding systems.

It is also an object to provide an antenna having a response pattern, which remains constant with regard to shape, over a wide range of operating frequencies.

It is also an object to provide an antenna which has a unidirectional response pattern.

It is a further object to provide an antenna which is physically small with respect to a wavelength corresponding to the operating frequency and which has a low value of input impedance.

An antenna which accomplishes the above objects consists of a sleeved dipole with a sheet reflector. The dipole elements are center fed and their central portions are enclosed by a sleeve. The ends of the dipole elements which extend beyond the ends of the sleeve, are enlarged to approximately the size of the sleeve. The function of this dipole is to excite the sleeve rather than to serve as a radiator which is the normal function of a conventional dipole.

Rather than being aligned end to end along a common axis like the conventional dipole, the two elements of the dipole in this invention are bent to form a V. A sheet reflector is placed behind the sleeved dipole so that the direction of response is in the direction of the apex of the V formed by the radiators.

Other objects, features and advantages of this invention will suggest themselves to those skilled in the art and will become apparent from the following description of the invention taken in connection with the accompanying drawing in which Fig. 1 is an isometric view of an antenna embodying the principles of this invention and;

Fig. 2 is a top view of the apparatus shown in Fig. 1.

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Referring now to the drawing, a bent dipole consisting of elements 10 and 11, is center fed by a balanced transmission line consisting of coaxial cables 12 and 13. The inner conductor of cable 12 is connected to dipole element 10, and similarly, the inner conductor of cable 13 is connected to dipole element 11. The outer conductors of cables 12 and 13 terminate in contact with a bent sleeve 14 which encloses the central portion of the dipole. The extremities of dipole elements 10 and 11, which protrude beyond the ends of sleeve 14, are enlarged so that they are approximately the same size as sleeve 14.

A sheet reflector 15, bent in the general shape of the letter W, is oriented behind the sleeved dipole with the inner legs of reflector 15 generally parallel with respective dipole elements 10 and 11.

For purposes of explanation, the antenna will be considered as transmitting rather than receiving. Generally, antennas have the same reception characteristics as transmitting characteristics.

Dipole elements 10 and 11 are center fed and are excited by equal and opposite voltages. The enlarged end of element 10 radiates a small amount of energy but most of its energy is used to excite sleeve 14. The major function of sleeve 14 is that of a radiator. Similarly, dipole element 11 excites the other half of sleeve 14 which also radiates energy. Being connected at its midpoint, to the outer conductors of cables 12 and 13, the sleeve 14 remains at ground potential at its midpoint. However, the two ends of sleeve 14 become electrically charged due to the presence of dipole elements 10 and 11 and sleeve 14 contributes most of the radiated energy from this antenna system.

Since the circumference of sleeve 14 is large with respect to its length, there is close coupling between space and the sleeve. Being closely coupled to space, radio frequency waves traveling longitudinally along sleeve 14, due to excitation by the dipole, suffer appreciable attenuation in transit. This attenuation phenomenon is not noticeable in conventional thin wire antennas where the diameter of the radiator is small compared to its length. Consequently, with the conventional thin wire dipole, maximum radiation occurs in a direction perpendicular to the longitudinal axis of the dipole. With the antenna herein disclosed, the direction of maximum radiation does not occur in a direction perpendicular to the radiator. Accordingly, the radiator of the antenna is bent until the lobe patterns of each half of sleeve 14 occur in the desired direction. With sleeve 14 bent to form an included angle of 120 degrees, the two forward lobes of each half of sleeve 14 add together causing maximum radiation in the direction of the apex of

the V formed by bending the sleeve 14. Without the use of a reflector, the antenna pattern thus obtained, is generally unidirectional but has large amounts of side response. To limit this side response and to increase the forward directivity of the antenna, a sheet reflector 15 has been added to the array.

The length of this antenna is not critical with respect to frequency, however, to obtain good performance, the length of the dipole should be at least one-fourth of a wavelength long corresponding to the lowest operating frequency.

The antenna shown in the drawing is fed by a balanced transmission line, however, it could readily be adapted for use with an unbalanced line, such as a single coaxial transmission line, by the use of a balun. A balun is an impedance balancing device which permits apparatus which is at an impedance balance with respect to ground, to be connected to apparatus which is unbalanced with respect to ground.

While there has been here described what is at present considered to be the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the scope of the invention as set forth in the appended claims.

What is claimed is:

1. A broad band horizontally polarized antenna including a center fed dipole having a length of the order of one-fourth of a wavelength corresponding to the lowest operating frequency with the outer extremities of said dipole enlarged and with said dipole bent to form a V whose included angle is of the order of 120 degrees, said dipole comprising a pair of elements each having inner and outer ends, a metallic sleeve with a rectangular cross-section bent to form a V concentrically enclosing the central portion of said dipole, a feed line comprising a first coaxial transmission cable and a second coaxial transmission cable with the inner conductor of said first cable inserted through a hole in said sleeve and connected to one end of one element of said dipole and with the inner conductor of said second cable inserted through a hole in said sleeve and connected to one end of the other element of said dipole and with the outer conductors of said cables terminated in contact with said sleeve and a sheet reflector bent to form a W oriented behind said dipole so that the inner legs of said reflector are parallel with respective elements of said dipole whereby the direction of maximum response of said antenna is in the direction of the apex of the V formed by said sleeve and whereby the response pattern of said antenna is substantially constant in shape over a wide range of operating frequencies.

2. A broad band plane polarized antenna including a sleeve radiator bent to form a V, a bent, center fed, two-element, exciting dipole inserted coaxially in said sleeve with the ends of said dipole protruding out of said sleeve and with said ends enlarged to approximately the diameter of said sleeve, a W-shaped sheet reflector oriented behind said sleeve radiator with the inner legs of said W reflector substantially parallel to respective elements of said dipole so that the direction of maximum response of said antenna is in the direction of the apex of the V formed by said

radiator, a two conductor transmission line inserted through a hole in said radiator and connected to the two halves of said dipole whereby the response pattern of said antenna is substantially constant in shape over a wide range of operating frequencies.

3. A broad band plane polarized antenna including a sleeve radiator bent to form a V, a W-shaped sheet reflector, means for supporting said sleeve radiator in front of said reflector with the arms of said V substantially parallel to the inner arms of said W, the outer arms of said W-shaped reflector each extending forwardly and transversely to the direction of one of said arms of said sleeve radiator, and means for exciting said sleeve radiator at the two ends thereof in phase opposition.

4. Apparatus as claimed in claim 3 wherein the diameter of said sleeve radiator is a large fraction of its length thereby causing said radiator to be closely coupled to space.

5. A broad band antenna comprising a hollow sleeve radiator bent to form a V, a W-shaped sheet reflector, means for supporting said sleeve radiator in front of said reflector with the arms of said V substantially parallel to the inner arms of said W, means for exciting said sleeve radiator at the ends thereof comprising a first and a second exciting element disposed coaxially with the ends of said sleeve and spaced therefrom a distance equal to a small fraction of their length, said exciting elements being of substantially the same diameter as said sleeve and of a length that is a small fraction of the length of said sleeve, and an electrical transmission system for supplying energy to said exciting elements.

6. Apparatus as described in claim 5 wherein said electrical transmission system comprises a first and a second conductor disposed internally and coaxially of said sleeve and electrically joined to said first and second exciting elements respectively, and a first and a second coaxial transmission line perpendicularly joining said sleeve radiator at points near the center thereof, the outer conductors of said transmission line making electrical junction with said sleeve radiator and the inner conductors of said transmission lines passing through first and second openings in said sleeve radiator and making electrical junction respectively with said first and second conductors disposed internally of said sleeve radiator.

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