

June 24, 1947.

E. O. WILLOUGHBY

2,423,072

ANTENNA SYSTEM

Filed June 2, 1942

Fig. 1.

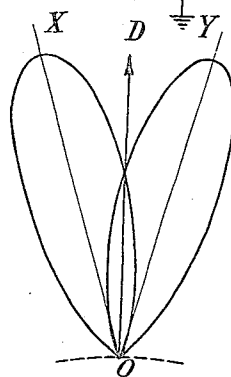
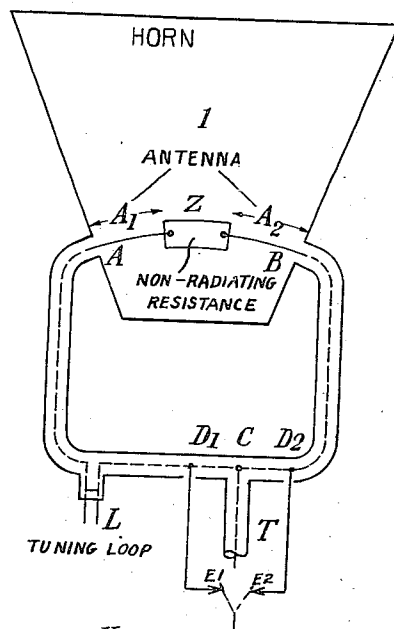


Fig. 2.

INVENTOR

E. O. Willoughby

BY

Lloyd Hall Sutton

ATTORNEY

UNITED STATES PATENT OFFICE

2,423,072

ANTENNA SYSTEM

Eric Osborne Willoughby, London W. C. 2, England, assignor to Standard Telephones and Cables Limited, London, England, a British company

Application June 2, 1942, Serial No. 445,506
In Great Britain May 2, 1941

Section 1, Public Law 690, August 8, 1946.
Patent expires May 2, 1961

14 Claims. (Cl. 250—11)

1

The present invention relates to antenna systems, the direction of whose principal radiation lobe can be varied and has for its object to provide a simple arrangement for oscillating the radiation lobe between two positions. Such systems are particularly useful in defining a path or direction by the space overlapped by the lobe in its two extreme positions, but may equally well be used for receiving electromagnetic waves from a particular direction substantially to the exclusion of all other directions. This has been commonly carried out by switching radiation lobes perpendicular to the plane of polarization, and the particular object of this invention is to switch the radiation lobe in the plane of polarisation.

This latter feature is of particular importance for path definition where horizontally polarised waves are to be used on account of their preferred propagation characteristics.

According to one aspect of the invention an antenna system, the direction of whose principal radiation lobe can be varied comprises a reflector capable of changing its radiation pattern with change in distribution of the operating wave energy relative thereto, a conductor antenna system (which may under some conditions with advantage include a non-radiating portion) located in front of said reflector, said antenna forming a part of a circuit which can be tuned exactly into resonance at the operating frequency, said circuit being coupled to a translation device and means for varying the centroid of current distribution in the conductor antenna in front of the reflector.

According to another aspect of the invention, an antenna system for use with plane polarised waves and the direction of whose principal radiation lobe can be varied in the plane of polarisation comprises a horn of rectangular cross-section, and closed by a reflecting surface at the back or throat thereof; a conductor antenna system having preferably a non-radiating part and located in the horn and disposed parallel to one pair of opposite sides of the said rectangular cross-section of said horn, said antenna forming part of a circuit tuned to the operating frequency, said circuit being coupled to a translating device; and means for varying the position of the centroid of current distribution in the conductor antenna.

In a practical embodiment as applied to an antenna system for producing a blind landing or blind approach path for air craft or other moving vehicles along the space or direction overlapped successively by two beams of horizontal

2

plane polarised waves, the antenna system according to the invention comprises a horn device of rectangular cross-section one pair of sides of said rectangular cross-section being disposed horizontally and a conductor antenna having a non-radiating portion located in said horn and disposed parallel to the horizontal sides of the said rectangular cross-section of the horn, said antenna forming part of a closed loop circuit tuned to the operating frequency and connected to a source of high frequency electrical power; and means for alternately earthing two points of said loop circuit.

The invention will be better understood from the following description taken in conjunction with the accompanying drawings which show by way of example only one practical embodiment thereof. In the drawings Figure 1 shows diagrammatically the antenna system and Figure 2 illustrates the principal lobe of the system of Figure 1 in two extreme positions.

In Figure 1 a horn reflector of rectangular cross-section is indicated at 1 with one pair of opposite sides of said cross-section arranged horizontally and the antenna system comprises two horizontal wire conductors AB connected together at one end by an impedance Z which is a non-radiating resistance and may comprise for instance a coil or length of folded conductor. The function of this impedance is to render the electrical length of the current path in the portion AZB such that the currents in the elements A₁ and A₂ of the conductor AB of the same sign, i. e. positive or negative. It will be apparent that Z should be substantially a pure reactance. The other ends of A and B of the antenna system are connected by separate paths to a translation device (transmitter or receiver, not shown) by a transmission line T which branches out at C to each end of the aerial system AB thus forming a loop circuit ABC, which is most conveniently a closed loop, although this is not essential.

The transmission line is shown as comprising a concentric conductor cable, the outer conductor of which is connected to the horn 1 at points convenient for connections of the inner conductors to the aerial system AB.

The impedance of the transmission line T is matched to the radiation resistance of the antenna system as seen along the two paths CA and CB for instance by the appropriate choice of the lengths CD₁ and CD₂ when the central conductor is connected to earth potential at D₁ or D₂ respectively. In most practical cases CD₁ and CD₂ will be substantially equal. The loop

ABC is tuned in known manner, as for example by a tuning loop L inserted in one branch of the loop ABC. The direction of the radiation lobe depends upon the current distribution in aerial AB with respect to the sides of the horn.

In order to change the direction of the radiation lobe from one position OX to another direction OY Fig. 2, the point of the antenna AB at which the centroid of current distribution occurs, must be moved from one position to another. To this end, in the example illustrated in Figure 1 of the drawings switch arrangements E1, E2 are shown provided for alternately connecting the points D1 and D2 to earth. These arrangements may comprise electromagnetic relay contacts, diodes or other known arrangements, mechanical, electrical or electromechanical. By earthing these points alternately the standing waves on the loop move relative to the loop circuit so that a node occurs at the earthed point of the circuit. Thus the current distribution in aerial AB is varied and the point at which the centroid of current distribution occurs is moved.

By the use of a system as described, plane polarised waves are produced, when used as a transmitter the plane of polarisation being in the plane of the paper, that is, the plane containing the antenna AB. When used as a receiving system, the antenna is most efficient for polarised waves in the plane containing the antenna AB.

The outer conductor of the loop circuit should preferably be screened from outside radiation or to prevent radiation thereby.

Whilst the loop circuit ABC is shown and described as associated with a horn of rectangular section, any other type of reflector may be employed. The advantage of using a rectangular section horn is that plane polarised waves may be set up therein without the use of a wave guide. Approximately plane polarised waves may be set up in a horn of circular section.

Whilst a specific embodiment of the invention has been described it is to be understood that the invention is not limited to this embodiment and modifications thereof will occur to those skilled in the art and which fall within the scope of the appended claims.

What is claimed is:

1. An antenna system, the direction of whose principal radiation lobe can be varied comprising a reflector, a conductor antenna system located in front of said reflector, said antenna forming part of a circuit which can be tuned into resonance at the operating frequency, said circuit being coupled to a translation device, and means for varying the position of the centroid of current distribution in the conductor antenna in front of the reflector.

2. An antenna system for use with plane polarised waves and the direction of whose principal radiation lobe can be varied in the plane of polarisation comprising a horn of rectangular cross-section, and closed by a reflecting surface at the back or throat thereof, a conductor antenna system having preferably a non-radiating part and located in the horn and disposed parallel to one pair of opposite sides of the said rectangular cross-section of said horn, said antenna forming part of a circuit tuned to the operating frequency, said circuit being coupled to a translation device, and means for varying the position of the centroid of current distribution in the conductor antenna.

3. An antenna system for producing a blind landing or blind approach path for aircraft or other moving vehicles along the space or direction overlapped successively by two beams of horizontal plane polarised waves comprising a horn device of rectangular cross-section one pair of sides of said rectangular cross-section being disposed horizontally and a conductor antenna having a non-radiating portion located in said horn and disposed parallel to the horizontal sides of the said rectangular cross-section of the horn, said antenna forming part of a closed loop circuit tuned to the operating frequency and connected to a source of high frequency electrical power, and means for alternately earthing two points of said loop circuit.

4. An antenna system the direction of the principal lobe of whose radiation pattern can be varied in the plane of polarisation of the operating electromagnetic waves comprising a reflecting means, a conductor antenna located in front of said reflecting means, a translating device coupled to said conductor antenna and means for varying the position of standing waves on said conductor antenna.

5. An antenna system the direction of the principal lobe of whose radiation pattern can be varied in the plane of polarisation of the operating electromagnetic waves comprising a reflecting means, a conductor antenna located in front of said reflecting means and forming part of a circuit tuned to the operating frequency, a translating device coupled to the tuned circuit and means for varying the position of standing waves in said tuned circuit.

6. An antenna system the direction of the principal lobe of whose radiation pattern can be varied in the plane of polarisation of the operating electromagnetic waves comprising a reflecting surface, a circuit tuned to the operating frequency and including a series connected conductor, said conductor being located in front of said reflecting surface, a translating device coupled to the tuned circuit and means for varying the position of standing waves in said tuned circuit.

7. An antenna system the direction of the principal lobe of whose radiation pattern can be varied in the plane of polarisation of the operating electromagnetic waves comprising a reflecting surface, a tuned circuit tuned to the operating frequency having a conductor thereof in front of said reflecting surface and means for varying the position of the standing waves on said conductor.

8. An antenna system the direction of the principal lobe of whose radiation pattern can be varied in the plane of polarisation of the operating electromagnetic waves comprising a reflecting means, a conductor antenna located in front of said reflecting means, means for creating standing waves on said conductor antenna and means for varying the centroid of current distribution in said conductor antenna.

9. A directive antenna whose direction of maximum radiant action can be varied in the plane of polarisation of the operating electromagnetic waves comprising a horn reflector, a loop circuit tuned to the operating frequency, a part of a conductor of said loop circuit being accommodated within the said horn reflector, a translating device coupled to said loop circuit and means for varying the centroid of current distribution in said part.

10. A directive antenna whose direction of maximum radiant action can be varied in the plane of polarisation of the operating electromagnetic waves comprising a horn reflector, a conductor located in said horn and forming part of a circuit tuned to the operating frequency, a translating device coupled to said circuit and means for varying the positions of nodal points of the standing waves in said circuit.

11. A directive antenna whose direction of maximum radiant action can be varied in the plane of polarisation of the operating electromagnetic waves comprising a horn reflector, a loop circuit tuned to the operating frequency and comprising a length of coaxial line and a conductor in series with the inner conductor of said coaxial line located within said horn, a translating device coupled to said loop circuit and means for connecting alternative points on the inner conductor for said coaxial line to earth potential.

12. A directive antenna whose direction of maximum radiant action can be varied in the plane of polarisation of the operating electromagnetic waves comprising a horn reflector of rectangular cross-section and closed by a reflecting surface at the throat thereof, a loop circuit tuned to the operating frequency and comprising a length of coaxial line the inner conductor of which is in series with two radiating conductors and a non-radiating impedance element, said non-radiating impedance element together with one of said radiating conductors on either side thereof being located within said horn, the said radiating conductors being disposed parallel to

one pair of opposite sides of said horn, a translating device coupled to said circuit and means for connecting alternative points on said internal conductor to earth potential.

13. An antenna system for defining a path for mobile receivers indicated by a continuous dash when the receiver is on said path and by complementary signals of different strengths when the receiver is to the right or left of said path comprising a horn reflector of rectangular cross-section and closed by a reflecting surface at the throat thereof, a loop circuit tuned to the operating frequency and comprising a length of coaxial line, the inner conductor of which is in series with a radiating conductor located within said horn and disposed parallel to one pair of opposite sides of said horn, a source of operating frequency current coupled to excite said loop circuit and means for alternately connecting two different points of said inner conductor to earth potential.

14. An antenna system according to claim 13 further comprising a non-radiating impedance element in series between two separate portions of said radiating conductor.

ERIC OSBORNE WILLOUGHBY.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,002,181	Ilberg	May 21, 1935
2,160,857	Gothé	June 6, 1939