

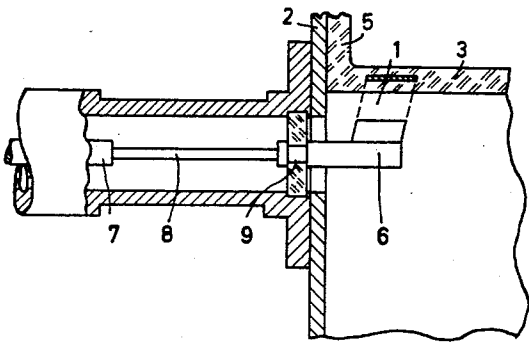
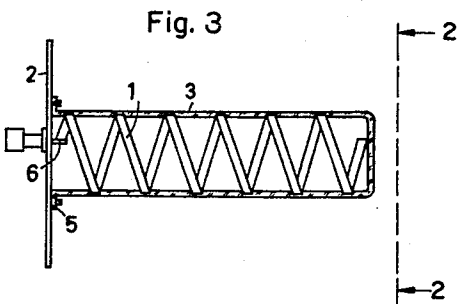
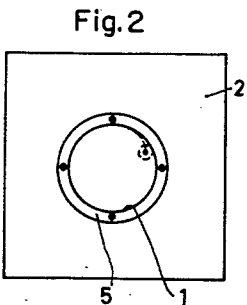
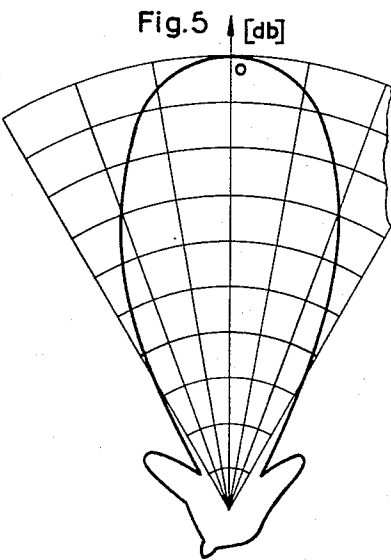
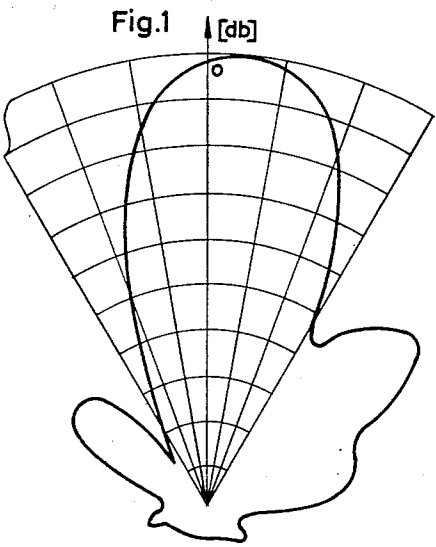
Sept. 13, 1960

R. HERZ

2,952,850

DIRECTIONAL HELICAL ANTENNA

Filed Aug. 7, 1957



Inventor:
Rudolf Herz.

By *[Signature]* Atty.

1

2,952,850

DIRECTIONAL HELICAL ANTENNA

Rudolf Herz, Munich, Germany, assignor to Siemens & Halske Aktiengesellschaft Berlin and Munich, a corporation of Germany

Filed Aug. 7, 1957, Ser. No. 676,822

Claims priority, application Germany Aug. 18, 1956

2 Claims. (Cl. 343—834)

This invention is concerned with a directional antenna for very short electromagnetic waves.

Directional broadcasting systems sometimes require lightweight antennae which may be quickly installed, for example, for operation within a frequency range between 200 and 2000 megacycles and having a gain of about 20 with reference to an isotropic radiator of similar polarization. A directional antenna suitable for these purposes is the helical antenna described in detail by Kraus in Proceedings of the IRE, October 1948, pages 1236 to 1242.

Antennae of this type as used until now have a radiation diagram with undesirably strong side maxima and require for the coupling of a feed line extensive transformation devices which are difficult to adjust.

The object of the invention is to show a way for overcoming these difficulties in a simple manner.

The invention proposes to provide a directional antenna for very short electromagnetic waves, comprising a helical antenna disposed preferably for operation in axial mode, one end of the antenna extending to the inner conductor of a coaxial line the outer conductor of which is connected to a reflector surface disposed opposite the end of the helix, the arrangement being such, that the spacing between the end of the helix and reflector surface which is disposed in a plane normal to the helix axis, is in the order of magnitude of one-hundredth of the mean operating wave length.

The invention will now be described with reference to the accompanying drawing.

Fig. 1 shows the radiation pattern of a known helical antenna;

Figs. 2 and 3 show respectively an end view and a cross-sectional view of a directional antenna according to the invention;

Fig. 4 shows the manner of connecting the antenna helix with the reflector; and

Fig. 5 shows the radiation pattern of an antenna according to the invention.

As is apparent from Fig. 1, the known antenna has a radiation pattern showing undesirably strong side maxima.

The antenna according to the invention comprises a helix 1 and a member 2 forming a reflecting surface. The helix 1 which may, for example, have from 2 to 8 turns, is formed by a ribbon-shaped conductor. The helix is, for reasons of stability, enclosed or embedded in a novel and advantageous form, in a tubular member 3 made of synthetic material, preferably of polyester Fiberglas.

The pitch of the helix is suitably determined to amount to one-fifth of the mean wavelength; dimensions amounting to about three-hundredth of the mean operating wave length have been found suitable for the width of the helix ribbon. The diameter of the helix amounts to about one-fourth of the operating wave length.

The helical antenna is, accordingly, constructed for operation in the axial mode, that is, the principal radiation direction coincides with the direction of the helix axis.

A plate 2 made of conductive material forms the re-

2

flector surface which has, for reasons of better electrical behavior, the form of a square having sides of a length, for example, amounting to 0.9-times the mean wave length.

The helical antenna is mounted centrally of the reflector 2, by means of an annular flange 5. The helix line extends almost directly to the reflector surface and is carried through an opening in the reflector by means of a pin 6, as shown particularly in Fig. 4. The spacing between the end of the helix 1 and the neighboring surface of the reflector 2 amounts, in accordance with the teaching of the invention, to one-hundredth of the mean wave length, constituting a radical departure from the dimensioning applied in the past, as the corresponding dimension determined in the case of prior helical antennae amounted to 0.13-times the means operating wave length. The new dimensioning results in surprising advantages.

The close proximity avoids practically completely the radiation occurring in known arrangements in the conductor section disposed between the end of the helix and the reflector surface, resulting in a radiation pattern as shown in Fig. 5. The side maxima are approximately symmetrical and greatly reduced. In addition, better matching results between the antenna helix and the coaxial feed line. While a value of about 120 ohm appeared in helical antennae used in the past as input impedance at the end of the helix, which had to be transformed by plural transformation to the customary impedance for coaxial lines, amounting to 60 ohm, the input impedance already has, in the case of the invention, a real amount lying in the order of magnitude of the characteristic impedance of customary coaxial lines and having an input impedance. This input impedance may be in simple manner transformed into the real impedance by intermediate connection of a short transformation device particularly shown in Fig. 4.

In the embodiment according to Fig. 4, the helix end 6 is for this purpose not directly connected to the inner conductor of a coaxial line 7 but over a member 8 with higher impedance, preferably about 100 ohms, assuming the cable impedance to amount to 60 ohms. Ahead of the transformation section of high characteristic impedance there is disposed a short line portion 9, with a length of about 0.03-times the mean operating wave length, such portion being directly adjacent the reflector surface and its characteristic impedance amounting to that of the feed line (for example, 60 ohms). The electrical length of the transformation section amounts in this case suitably to 0.06–0.07-times the mean operating wave length, thus resulting in a matching curve which extends substantially within a narrow range about the matching value $m=1$, where m is the ratio of voltage maximum to voltage minimum within the feed line.

The directional antenna according to the invention may in this manner be matched better than $m=1.2$ within a frequency range of about 1:1.6, where m is the ratio of voltage maximum to voltage minimum in the feed line of the antenna. The dimensions of the antenna correspond approximately to the dimensions given for the embodiment according to Figs. 2 and 3.

Changes may be made within the scope and spirit of the appended claims.

I claim:

1. Directional antenna for very short electromagnetic waves, comprising a helical antenna for axial mode operation, a reflector of square configuration, facing the corresponding antenna end in a plane extending normal to the helix axis of said antenna with the helix thereof disposed centrally of said reflector, said reflector being connected to the outer conductor of a coaxial line, means for conducting the adjacent end of said helix through an

3

opening formed in said reflector close to the plane of nearest proximity of such end to the reflector surface for connecting such end with the inner conductor of said coaxial line, the spacing between the reflector surface and the adjacent end of said helical antenna being substantially one-hundredth of the mean operating wave length, said helix extending substantially uniformly from said end.

2. A directional antenna according to claim 1, comprising transformation means disposed between said helix and said coaxial line for transforming the capacitive input impedance of the helical antenna into a real impedance amounting to the value of the characteristic impedance of the coaxial line, said transformation means comprising a conductor for interconnecting the helix of said antenna with the inner conductor of the coaxial feed line, said con-

4

ductor having an impedance which exceeds that of the coaxial feed line.

References Cited in the file of this patent

UNITED STATES PATENTS

5	2,246,151	Vrooman	June 17, 1941
	2,405,123	Fyler	Aug. 6, 1946
	2,763,003	Harris	Sept. 11, 1956

OTHER REFERENCES

10 "A Helical Beam for Citizen's Radio," by Harris Electronics, March 1953, pp. 134 to 135.

"Antenna System for Missile Telemetry," by Bower et al., Electronics, June 1955, pp. 164 to 167.

15 I.R.E. Transactions, "An Experimental Investigation of Cavity-Mounted Helical Antennas," vol. AP4, No. 1, January 1956, pp. 53 to 58.