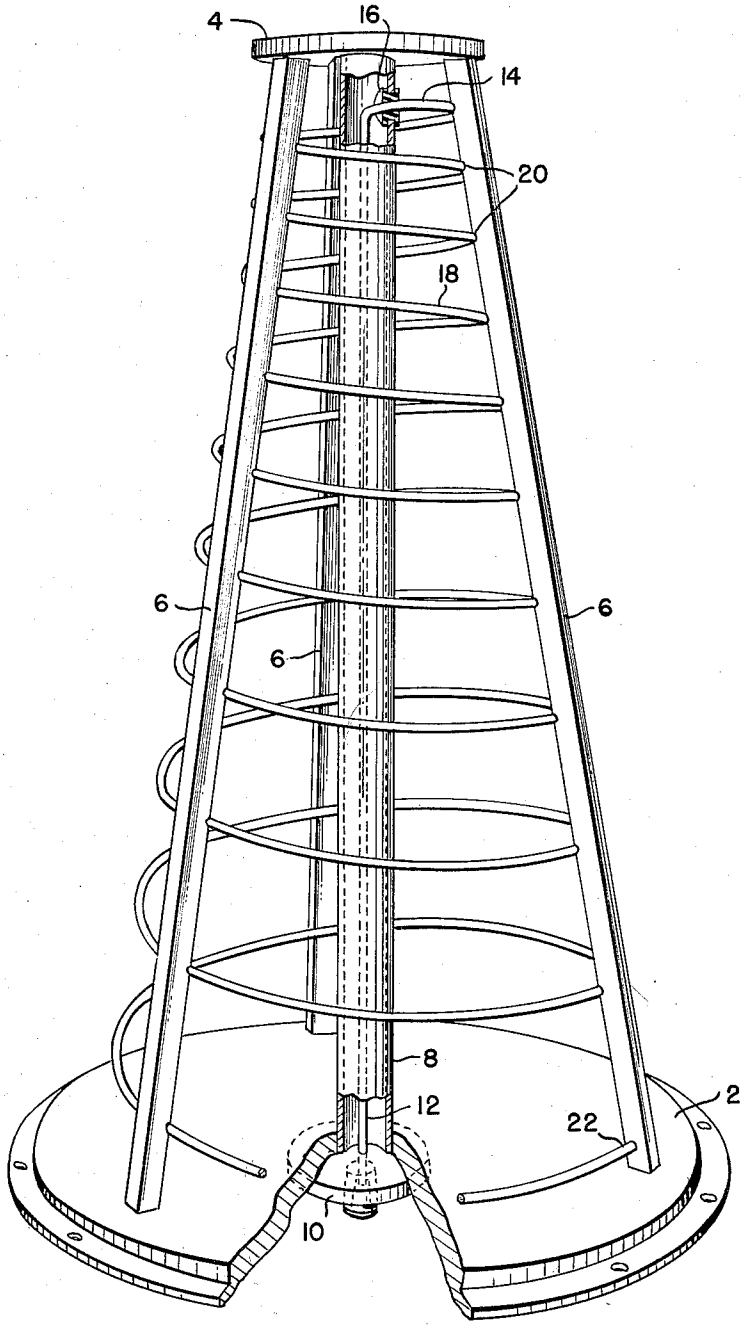
Dec. 29, 1959 M. NUSSBAUM 2,919,442

ANTENNA

Filed Dec. 9, 1955



INVENTOR.

MILTON NUSSBAUM

BY

Busser, Smith & Harding

ATTORNEYS

United States Patent Office 2,919,442
Patented Dec. 29, 1959

2,919,442

ANTENNA

Milton Nussbaum, Philadelphia, Pa., assignor to American Electronics Corporation, Philadelphia, Pa., a corporation of Pennsylvania

Application December 9, 1955, Serial No. 552,083

4 Claims. (Cl. 343—895)

This invention relates to antennas for use in the radio frequency ranges.

Helical antennas are well known, having the characteristic that in the axial mode of radiation the field is a maximum in the direction of the helix axis and is circularly polarized or nearly so. For a given helix, this mode of radiation persists over a relatively wide frequency range.

It is the general object of the present invention to provide antennas of the helical type and in particular of the conical helical type having extensive band width, improved circular polarization, low beam tilt, and side lobes of negligible amplitude. Further, in accordance with the invention, an antenna is provided which is rugged and has high rigidity.

The attainment of these objects and of other objects of the invention particularly relating to details of construction, will become apparent from the following description read in conjunction with the accompanying drawing in which the figure shows in perspective and partially in section a typical antenna provided in accordance with the invention.

In its preferred form the antenna comprises a base plate of aluminum or other conductor or of insulating material indicated at 2 which may be circular or of other shape. A set of insulators 6, shown as three in the drawing, provide supports for a coil and are supported by the base 2 and an upper circular plate 4 which is of conductive material such as aluminum or brass. The supports 6 may be of any suitable dielectric material, desirably of low-loss characteristics, and it has been found highly satisfactory to provide such supports of glass-based melamine resin, which has the desirable electrical characteristics and mechanical rigidity and strength. Welded or otherwise conductively secured to the plate 4 and secured to the base 2 and mounting the plate 4 is a conductive tube 8 of brass, aluminum or other metal. At the lower end of the tube as shown there is a panel connector 10 through which there extends the conductor 12 of wire or tubing, for example, silver plated copper, passing centrally upwardly through the tube 8 and at its upper end extending laterally at 14 through the insulated bushing 16 mounted in a hole in the tube. The conductor 12 then extends spirally downwardly as indicated at 18, supported in slots or notches 20 in the supports 6, terminating at 22 adjacent to, but electrically disconnected from, the plate 2, if the plate 2 is metallic.

The helix 18 provided by the conductor desirably has about 10 to 12 turns (though more turns may be provided) and is conically wound as shown tapering from a large to a small diameter in the direction from the plate 2 to the plate 4. It has been found advantageous to wind the helix with exponential variation of spacing which follows from the maintenance of a constant pitch angle. However, this latter point is not critical and excellent results are secured if the pitch is uniform along the axis or has other variation characteristics. The vertex angle of the cone defined by the helix is not critical but may

be of the order of 15° as illustrated, but may vary up to 45° or even considerably more.

To give an idea of the dimensions of the antenna, it may be stated that for use at 500 to 1,300 megacycles the height may be approximately 17 inches if the cone angle is 21° or 8½ inches if the angle is 42°; for use at 1,000 to 2,000 megacycles the height may be about 12 inches if the cone angle is 21° or about 6 inches if the angle is 42°; and for use at frequencies of 2,000 to 4,500 megacycles the height may be about 6 inches if the cone angle is 21° or less if the cone angle is greater. In still smaller sizes the antenna has been operated up to a frequency of 10,000 megacycles.

For use in transmission, the antenna is fed at the lower end illustrated of the conductor 12, the conductor and the tube up to the point of emergence of the conductor from the tube forming a coaxial transmission line. As a receiver the antenna output is taken from the lower end of the conductor 12.

For optimum results the plate 4 is of considerable importance. The diameter of this plate may be of the order of one-half the diameter of the widest portion of the helix. The presence of the plate 4 greatly improves the characteristics of the antenna. When present it broadens the band width tremendously. Prior to this invention a ratio of 1.8 between the highest and lowest operating frequencies for a conical antenna was theoretically the maximum obtainable, whereas antennas of the type herein described provide a ratio of approximately 2.5 between the highest and lowest operating frequencies. Furthermore, the circular polarization is greatly improved and very low beam tilt is achieved. The side lobes of the characteristics are quite negligible. It may be remarked that the diameter of the wire forming the helix is not critical, and may be varied throughout the length of the helix for effecting slight changes in the characteristics. Precise conformity of the helix to a conical surface is not essential.

The plate 2 is provided merely for support and may be a conductor if its diameter is not substantially greater than the diameter of the larger end of the helix. If a conductor plate 2 is substantially greater in diameter it detracts from the operating characteristics and when a large base is used it is desirably of plastic or other nonconductive material. It is necessary to avoid any extended conductor in the vicinity of the wide end of the helix.

The antenna may be used for both reception and transmission, in the former case being disposed with its axis pointed toward the source. Maximum radiation is also in the direction of the axis from the plate 2 toward the plate 4.

The use of the tube 8, which is important in securing proper operation, is also advantageous in that matching transformers may be incorporated within it to form part of the central transmission line.

The arrangement is highly rigid and rugged so as not to be changed readily accidentally.

It will, of course, be evident that various details of construction and relative dimensions may be changed to secure various characteristics without departing from the invention as defined in the following claims.

What is claimed is:

1. An antenna for use at radio frequencies comprising a substantially conical conductive helix, a conductive plate extending transversely of the axis of the helix at its end of smaller diameter and spaced therefrom, said plate having a maximum dimension transversely of the helix axis which is less than the maximum diameter of the helix, and a coaxial line extending axially through the helix with its inner conductor connected to the small diameter end of the helix.

2. An antenna according to claim 1 in which the external conductor of said coaxial line is conductively connected to said plate.

3. An antenna according to claim 1 in which the helix has approximately exponentially increasing spacing between its turns from its smaller end to its larger end.

4. An antenna according to claim 2 in which the helix has approximately exponentially increasing spacing between its turns from its smaller end to its larger end.

References Cited in the file of this patent

FOREIGN PATENTS

430,548	Great Britain	June 20, 1935
741,897	Great Britain	Dec. 14, 1955

OTHER REFERENCES

Electronics (April, 1947), Helical Beam Antenna by J. D. Krauss (pages 109–111).