Dec. 27, 1966 R. C. FENWICK ET AL 3,295,137

SHORTENED FOLDED MONOPOLE WITH RADIATION EFFICIENCY INCREASED BY FERRITE LOADING

Filed Sept. 8, 1964 2 Sheets-Sheet 1

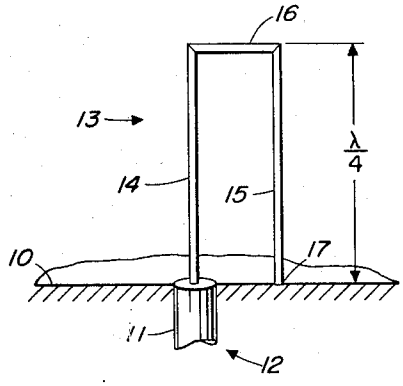


FIG 1

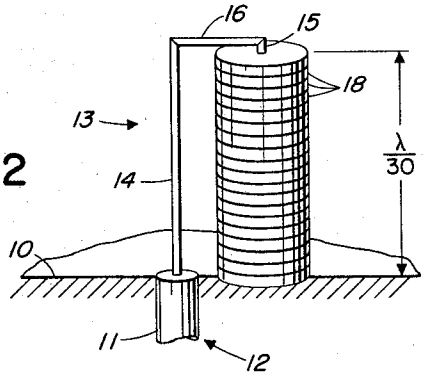


FIG 2

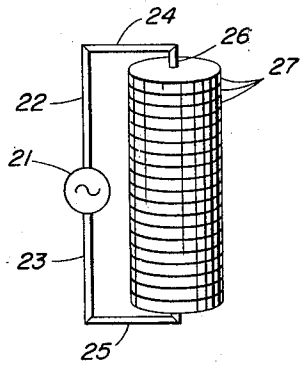


FIG 3

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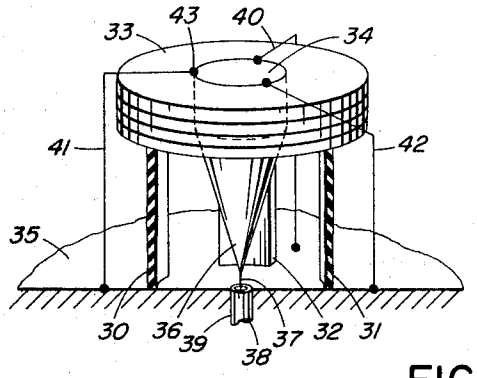


FIG 4

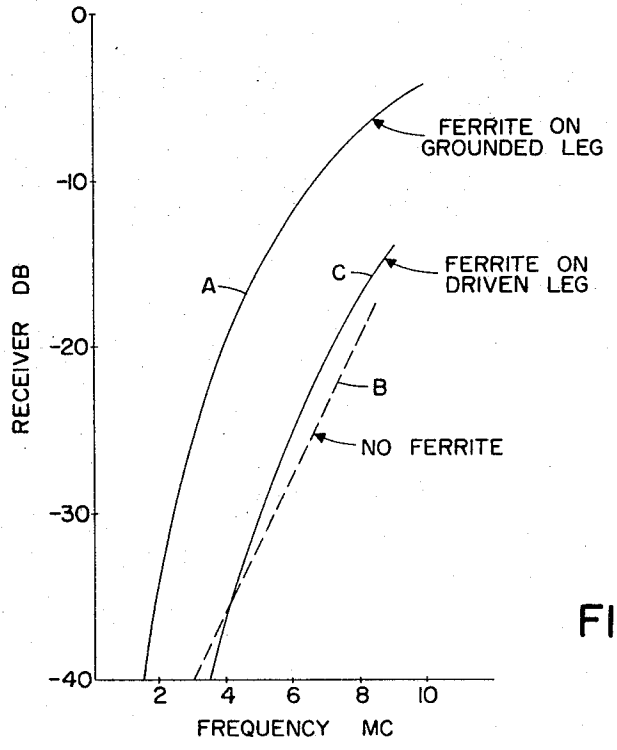


FIG 5

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SHORTENED FOLDED MONOPOLE WITH RADIATION EFFICIENCY INCREASED BY FERRITE LOADING

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2 Claims. (Cl. 343—787)

This invention relates in general to antennas and in particular to a means for increasing the efficiency and decreasing the length of an antenna structure.

Antenna structures are often very large. For example, a folded monopole generally is one-quarter wave length in height and for lower frequencies such a structure can be a hundred feet or more.

The present invention comprises an antenna in which the height may be reduced to a fraction of what it would normally be while still maintaining good efficiency.

A feature of this invention is found in the provision for an antenna which has been partially surrounded by magnetic material.

Another object of this invention is to provide an increased efficiency shortened folded monopole.

Yet another object of this invention is to provide means for shortening and increasing the efficiency of an antenna.

Further objects, features, and advantages of this invention will become apparent from the following description and claims when read in view of the drawings, in which:

FIGURE 1 illustrates a folded monopole with one end connected to the ground plane;

FIGURE 2 illustrates a folded monopole according to this invention with the grounded end surrounded by magnetic material;

FIGURE 3 illustrates a folded dipole surrounded by suitable magnetic material;

FIGURE 4 illustrates a folded tripole antenna; and

FIGURE 5 is a plot of characteristics of an antenna.

When the length of a folded monopole is short as measured in wavelength, current in the two legs of the monopole is substantially equal and little radiation occurs. Under such circumstances the small amount of radiation obtained results from the loop formed between the two legs of the monopole and is in the direction of the plane of the two legs. When the height of the monopole is substantial, measured in wavelengths, the radiation efficiency is quite good because of the difference in current flow or phase of the signal in the different legs. The present invention obtains the advantage of the difference in phase in a structure that is relatively short as measured in wavelengths by surrounding the grounded leg by ferromagnetic toroids.

A folded monopole is a well-known radiating structure. Such a monopole is shown in FIGURE 1 which illustrates a ground plane **10** to which the outer conductor **11** of cable **12** is connected. The inner conductor **13** of the conductor **12** comprises a first portion **14** and a second portion **15** connected together by a joining portion **16**. The end **17** of the portion **15** is connected to the ground plane. The lengths of portions **14** and **15** are generally one-quarter wavelength at the desired operating frequency. As frequency is lowered, one quarter wavelength becomes impractically large. However, a structure appreciably shorter than one-quarter wavelength is very inefficient and the input impedance is usually unfavorable.

It has been discovered that by adding a number of ferrite disks about the grounded leg **15** the radiation efficiency

can be maintained high when the legs **14** and **15** are only one-thirtieth of a wavelength in height.

FIGURE 2 shows such a structure. A plurality of toroid disks **18** are mounted about the grounded leg **15**. In addition to lowering the resonant frequency of the structure the ferrite toroids cause the currents to be reduced between the grounded leg and the driven leg, thereby increasing the radiation.

FIGURE 3 illustrates a folded dipole **26** connected to a generator **21** by feedlines **22** and **23** and coupling sections **24** and **25**. The radiating portion **26** of the dipole is surrounded by ferrite toroids **27**.

FIGURE 4 illustrates a folded tripole antenna. This antenna comprises three insulated legs **30**, **31** and **32** which support thereon ferrite disks **33**. A center cylindrical structure **34** extends through the disks **33** and is formed with a conical lower portion **36** which is electrically connected to the inner conductor **37** of a feedline **38**. The outer conductor **39** is connected to the ground plane **35** and leads **40**, **41** and **42** extend from the top **43** of the cylindrical member **34** to the ground plane **35**. In a particular structure tested, the outside diameter of the disks **33** was two feet and their total thickness was eight inches. The height of the insulating support members **30**, **31** and **32** was two feet so as to obtain an antenna 32 inches from the ground plane and 24 inches in diameter. In such a structure, the radiation efficiency was substantially increased over a cylindrical radiator without the ferrite disks.

FIGURE 5 is a graph showing the increased efficiency using the structure shown in FIGURE 2. For the particular structure plotted, the height of the monopole was 40 inches and the outside diameter of the ferrite members **18** on the grounded leg **15** was 2½ inches. In FIGURE 5 frequency is plotted against received decibels. It is to be noted that curve A for the structure shown in FIGURE 2 gives a substantially higher efficiency than curve B showing a monopole of the same size with no ferrite about the grounded leg. Curve C illustrates ferrite about the driven leg **14**. It is to be noted that placing ferrite on the driven leg does not substantially increase the efficiency over a structure with no ferrite at all. Thus, a marked increase in efficiency is obtained by mounting ferrite toroids on the grounded leg **15**.

It is seen that this invention provides a method of substantially shortening an antenna while maintaining high efficiency. The ferrite might be Ferramie Q, for example. The ferrite unbalances the current in the grounded and driven legs to thereby increase the radiation.

Although this invention has been described with respect to particular embodiments thereof, it is not to be so limited, as changes and modifications may be made therein which are within the spirit and scope of the invention as defined by the appended claims.

We claim:

1. An antenna structure that can be substantially shortened while maintaining high efficiency of radiation comprising a coaxial conductor with the outer conductor connected to a ground plane, an inner conductor having a driven and grounded section coupled by a coupling section and with the grounded section connected to the ground plane, and a disk of magnetic material mounted about the grounded section to substantially increase the efficiency of radiation.

2. An antenna structure comprising a coaxial conductor with the outer conductor connected to a ground plane, an inner conductor having a driven and grounded section coupled by a coupling section and with the grounded

section connected to the ground plane, and ferrite toroids mounted about the grounded section to substantially increase the efficiency of radiation.

References Cited by the Examiner

UNITED STATES PATENTS

2,285,669	6/1942	Lehmann	343—825
2,748,386	5/1956	Polydoroff	343—787
3,103,011	9/1963	Seeley	343—845

FOREIGN PATENTS

220,059	3/1942	Switzerland.

OTHER REFERENCES

Noll et al.: Television and FM Antenna Guide, The MacMillan Company, New York, copyright 1951, page 206 relied on. (Copy in Group 250–5.)

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