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Kovar

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[54] **DOUBLE RIDGED WAVE GUIDE FEED FOR SIGNAL ANTENNA**

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[52] **U.S. Cl.** **343/772,** 343/895

[51] **Int. Cl.** **H01q 1/36**

[58] **Field of Search** 343/862, 863, 895, 343/772, 865

[56] **References Cited**

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[57] **ABSTRACT**

A microwave antenna system comprising a balanced two-arm spiral antenna or pyramidal antenna is directly fed at its center pole by a double ridged wave guide.

8 Claims, 5 Drawing Figures

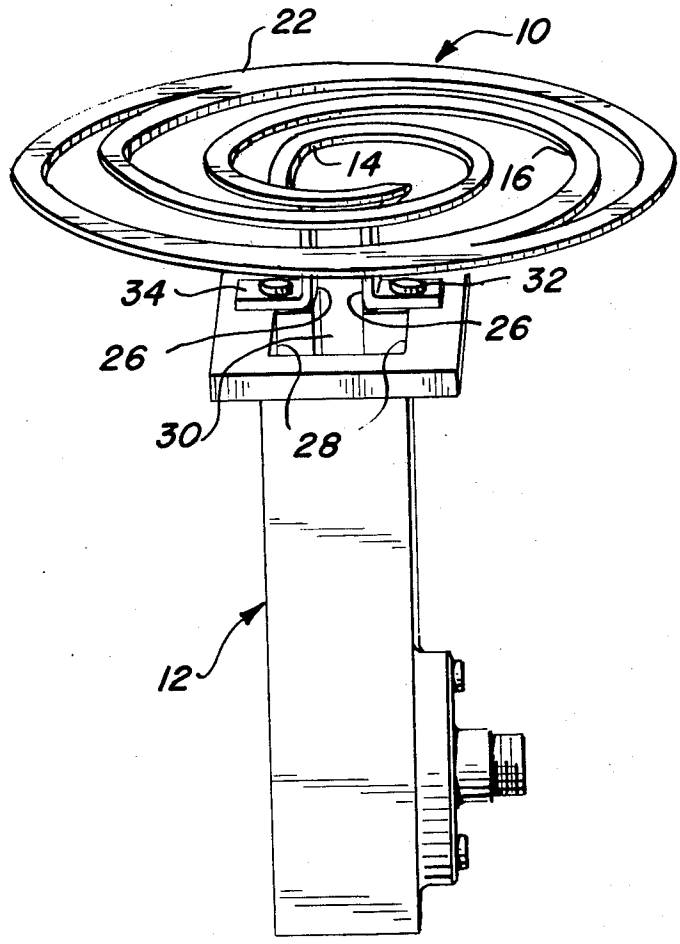


FIG. 1

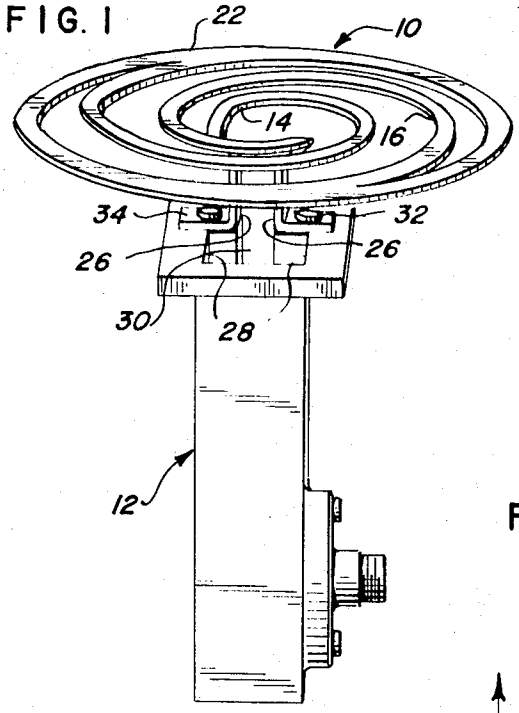


FIG. 3

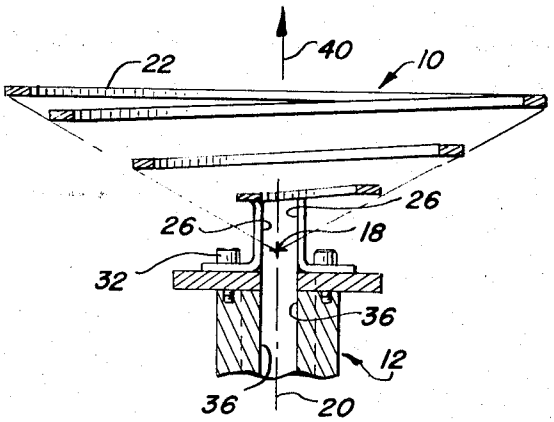


FIG. 2

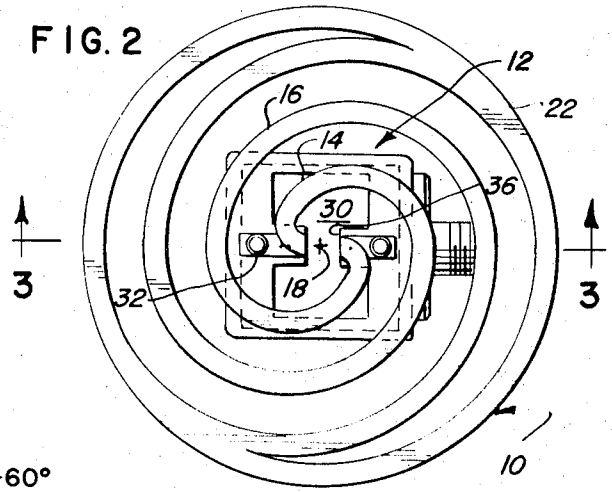


FIG. 5

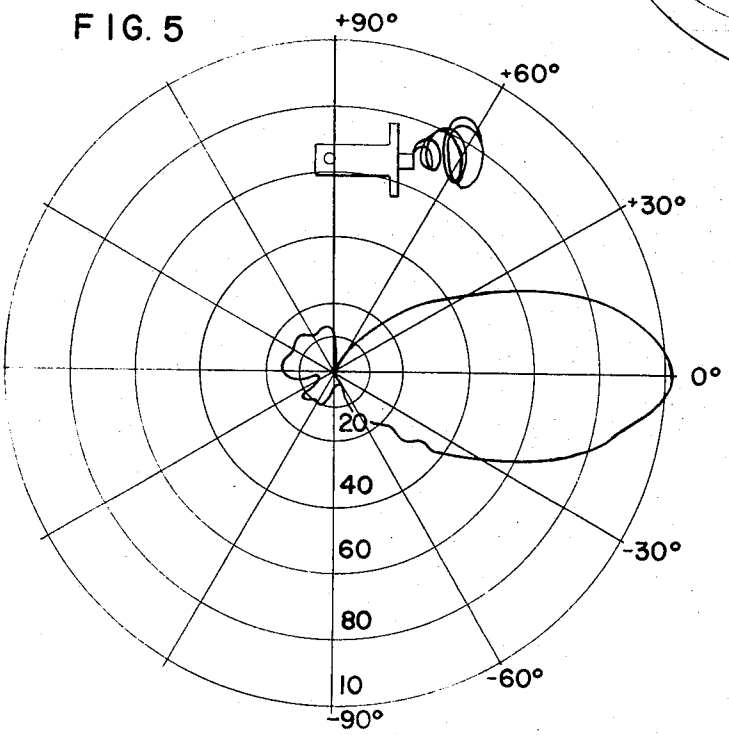
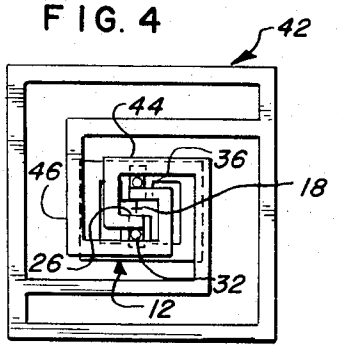


FIG. 4



DOUBLE RIDGED WAVE GUIDE FEED FOR SIGNAL ANTENNA

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention generally relates to a microwave antenna system and in particular to an antenna system providing direct coupling between a wave guide and a balanced antenna.

2. Description of the Prior Art

Typically, heretofore, balanced, long-periodic spiral, conical or pyramidal antennas have been fed by either a balanced line carried along the axis of the antenna, a coaxial cable and balun, or a coaxial cable carried along the axis of the antenna and soldered in contact with one of the arms of the antenna. The balanced line feed is often only suitable where a balanced signal is directly available and presents no advantage where special means have to be provided to convert an unbalanced signal to a balanced signal to feed the antenna. Antenna systems using a coaxial cable feed are limited by the inability of the coaxial cable to handle high power levels. Also, typically, such coaxial cable fed antennas require a bowl-shaped reflector which further limits the bandwidth of the system.

Where wave guides have been used to feed a two-arm, conical, spiral antenna or other balanced, log-periodic antennas, a transformer to coaxial and/or balun feed have been utilized. These feed methods all suffer from the power handling and bandwidth limitations imposed by the coaxial cable, transformer or balun.

SUMMARY OF THE INVENTION

The antenna system of the present invention overcomes the disadvantages of the prior antenna systems noted above in a unique, novel and simple manner. A two-arm balanced antenna, as a log-periodic flat or conical spiral antenna is directly connected with a double ridged wave guide. The feed points of the antenna comprise a portion at the end of each antenna arm nearest the antenna apex or pole, directly coupled to the ridges of the wave guide at its open end with a surface thereof substantially coplanar with the inner surface of the wave guide ridge to which it is coupled. Direct coupling of the antenna to the wave guide without use of any intermediate converter is, of course, much simpler than any of the feed connections noted above. The antenna arms extend into free space, i.e., only the media in which the antenna system is located is interposed between the arms of the antenna and the open end of the wave guide. The power handling capabilities and bandwidth of the antenna system are therefore only limited by the power handling capability and bandwidth of the antenna and the wave guide. Thus, the antenna system of the present invention provides a wave guide fed,balanced,log-periodic antenna having much greater power handling and bandwidth capabilities than has heretofore been achieved.

This feed configuration when utilized to feed a conical or pyramidal antenna, results in the radiation being transmitted in a direction from the apex toward the base of the antenna rather than from the base toward the apex, as results from all other known feed configurations for these types of antennas. Thus, the antenna may be mounted with its apex adjacent the wave guide opening and its base spaced axially therefrom without having the radiation being degraded by the wave guide feed in its path as would otherwise occur if one of the prior noted feed configurations were used. Thus, this feature of the radiation being directed from the apex toward the base enables a much simpler antenna mounting configuration than previously allowed.

A principal feature of the antenna system is that the antenna and wave guide are directly coupled together which eliminates the expense and power and bandwidth limitations imposed by the intermediate coupling and converting devices required by previous systems.

Another feature of the antenna system is the provision of a means for directly feeding, from a wave guide, a balanced,log-periodic antenna.

A further feature is that the direct feed when used to feed a conical or pyramidal antenna, results in the radiation being directed from the apex toward the base of the antenna.

BRIEF DESCRIPTION OF THE DRAWINGS

Further features and advantages will be made more apparent in the following detailed description taken in conjunction with the following drawings, in which:

FIG. **1** is a perspective view of an embodiment of an antenna system embodying the invention with a flat spiral antenna directly coupled to the open end of a double ridged wave guide;

FIG. **2** is a top view of an embodiment of the antenna system with a conical spiral antenna directly coupled to the open end of a double ridged wave guide;

FIG. **3** is a section taken along line **3—3** of FIG. **2**;

FIG. **4** is a top view of an embodiment of the antenna system with a two-arm pyramidal, log-periodic antenna directly coupled with a double ridged wave guide; and

FIG. **5** is a polar plot of a typical radiation characteristic of an embodiment of the antenna system as illustrated in FIG. **3**, showing that the microwave energy is substantially transmitted in a direction from the apex toward the base of the antenna.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIGS. **1–3** of the drawings, preferred embodiments of the antenna system are shown in which a two-arm, spiral antenna generally designated by reference numeral **10** is directly coupled to a double ridge wave guide generally designated by reference numeral **12.** Antenna **10** has two arms, arms **14** and **16,** which are spiraled outwardly in free space from around a common pole **18** located along the center axis **20** of wave guide **12** and merge together to form a base **22.** However, it should be noted that the merging of the two arms is not necessary for proper operation of the antenna. Of course, in the flat or planar antenna illustrated in FIG. **1,** base **22** and pole **18** lie in substantially the same plane, whereas in the conical antenna as shown in FIG. **3,** base **22** is axially spaced from pole **18.** In either event, the feed points of the antenna system comprise portion **26** at the end of each antenna arm nearest pole **18** mounted substantially parallel with axis **20** of wave guide **12.**

The feed points are directly coupled to wave guide **12** respectively adjacent opposite sides **28** of wave guide opening **30** by means of bolts **32** securing bends **34** to the open end of wave guide **12.** More specifically, feed points **26** are coupled to ridges **36** extending inwardly toward each other from opposite sides **28.** Of particular

importance is that the feed points **26**, when the antenna is mounted to wave guide **12**, comprise a portion of each antenna arm having a surface substantially coplanar with the inner surface of the opposite sides **28** to which it is coupled. In particular, when the antenna is fed by a double ridged wave guide as illustrated in FIGS. **1–3**, the inner surface of the opposite sides **28**, to which the feed portions are coplanar with, comprise the inner surfaces of ridges **36**. The feed portion **26** may be considered as forming an extension of the wave guide ridge to which it is connected.

When the antenna system incorporates a conical spiral antenna, the apex of the cone is situated coincidental with pole **18**, and base **22** is axially spaced from open end **30** and pole **18**, as illustrated in FIG. **3**. When a conical spiral antenna, or a pyramidal log-periodic antenna as will be discussed below is directly fed at its apex, the microwave energy is transmitted substantially in a direction from apex or pole **18** toward base **22** as indicated by arrow **40** of FIG. **3** in the polar graph of FIG. **5**. In all other previous antenna systems where a conical antenna was fed at its apex, the radiation was transmitted in a direction opposite to that indicated by arrow **40**, i.e., in a direction from base **22** toward apex **18**. Thus, to avoid the feeding device from interfering with the radiation pattern of the antenna, it has to be carried along the axis of the antenna within the cone.

The antenna system of this invention is, of course, not limited to a double ridged wave guide feeding only spiral conical antennas but encompasses the direct feeding by a double ridged wave guide of any balanced antenna mounted to the wave guide and having two arms extending outwardly from and around a common pole with a feed portion at the end of each arm adjacent to the pole respectively coplanar with or forming an extension of each of the ridges. Thus, as seen in FIG. **4**, a four-sided pyramidal, log-periodic antenna **42** having two arms, arms **44** and **46**, extending outwardly from and around a common pole **18** in a log-periodic fashion is directly coupled to wave guide **12** with a portion **26** of each arm respectively forming an extension of one of the wave guide ridges **36**. The two arms are considered as extending outwardly from pole **18** in a logarithmic periodic fashion in that the length and spacing between arms progressively increases with the logarithm of the distance of the arm segment from pole **18**. The rectangular antenna shown in FIG. **4** may be flat or planar like the antenna shown in FIG. **1** or may be pyramidal in shape, analogous to the conical shape of the spiral antenna illustrated in FIG. **3**, and is mounted to wave guide **12** in a similar manner as that of the conical antenna. Further, although only a four-sided antenna is depicted, an antenna having any number of sides greater than three could be directly mounted to and fed by wave guide **12** in a manner analogous to that shown in FIGS. **1–4**. Also, the pyramidal antenna when directly fed by the wave guide as shown in FIG. **4** would have a radiation pattern similar to that depicted in FIG. **5**.

I claim:

1. A microwave antenna system comprising: a rectangular wave guide having an open end with opposed inner surfaces on ridges at the open end on two opposite sides thereof; a balanced antenna mounted to the wave guide having two arms extending in free space with only the medium in which the antenna system is located being interposed between the arms of the antenna and the open end of the wave guide, said antenna arms extending outwardly from, and around, a common pole with a feed portion at the end of each arm adjacent the pole forming a substantially linear extension of a respective one of the opposed inner surfaces beyond the open end of the wave guide and, said feed portions providing substantial support for the antenna adjacent its pole.

2. The antenna system of claim **1** wherein the arms extend outwardly from, and around, the common pole in a logarithmic periodic fashion.

3. The antenna system of claim **2** wherein said arms are spiraled outwardly from said pole.

4. The antenna system of claim **2** wherein said antenna has a conical shape with an apex coincident with said pole and a base axially spaced from the wave guide, the radiation pattern for said conical antenna extending from its apex toward its base.

5. The antenna system of claim **2** wherein said antenna has a pyramidal shape with an apex coincident with said pole and a base axially spaced from the wave guide, the radiation pattern for said conical antenna extending from its apex toward its base.

6. The antenna system of claim **1** wherein the feed portions at the ends of the antenna arms nearest the pole are directly mounted to the wave guide open end adjacent the ridges.

7. The antenna system of claim **1** wherein the ridges terminate substantially flush with the open end of the wave guide.

8. The antenna system of claim **1** in which the feed portions provide the principal support for the antenna.

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