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[54] LOW PROFILE ANTENNA MOUNTED ON A WATERCRAFT

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[51] **Int. Cl.** **H01q 1/34**

[58] **Field of Search** 343/709, 710, 792, 830, 846, 343/873, 721, 822

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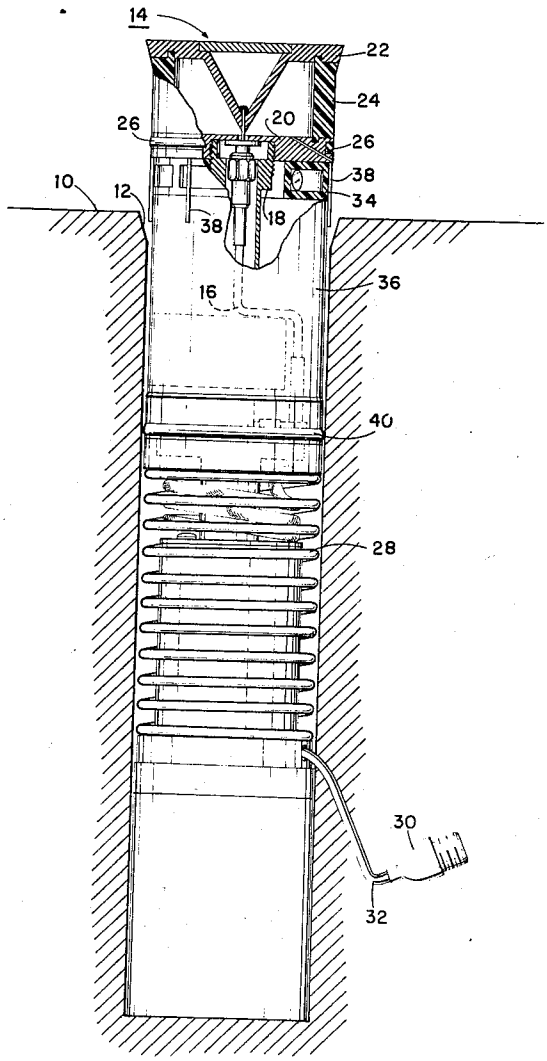
Primary Examiner—Eli Lieberman

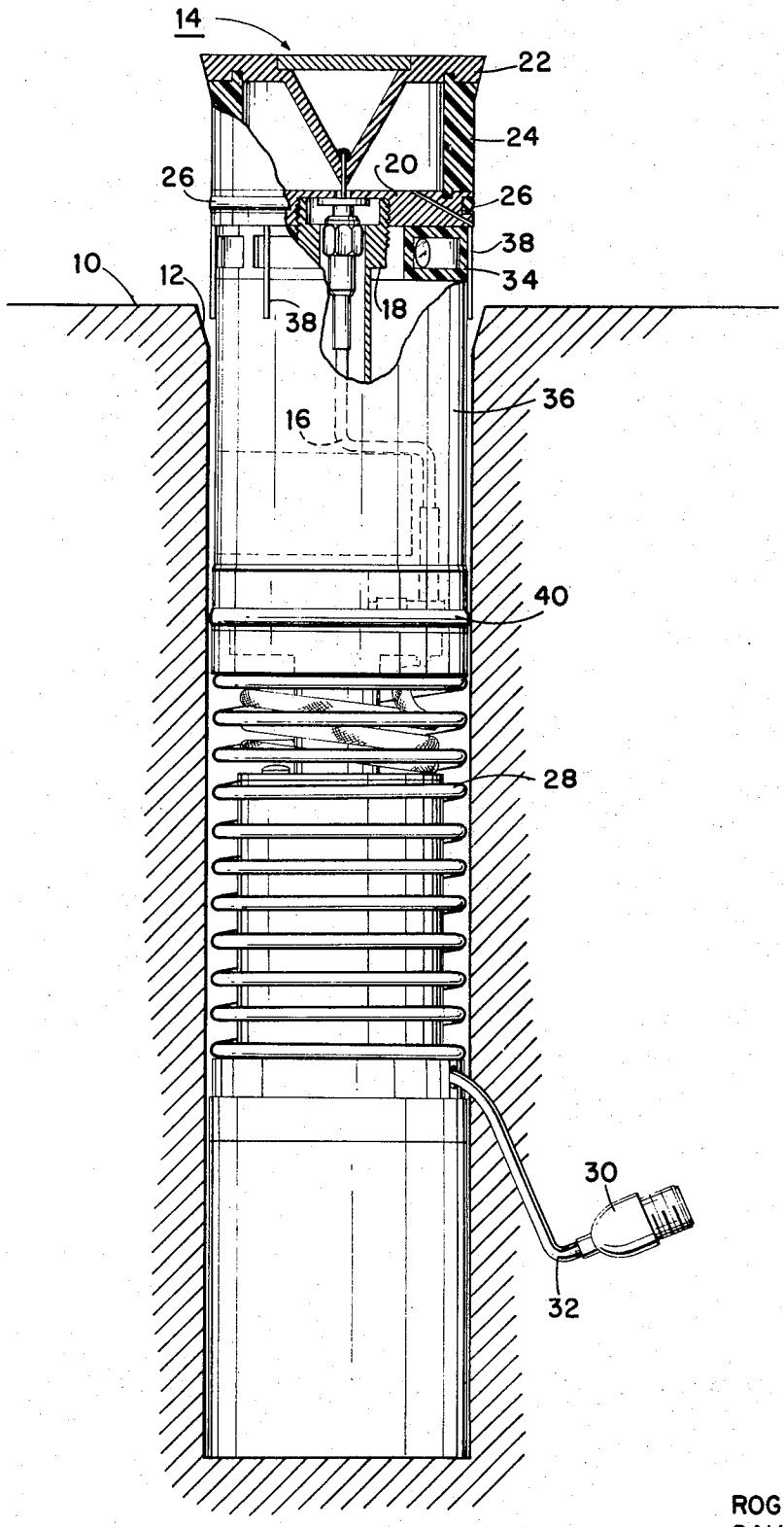
Attorney—Robert C. Smith and Plante, Hartz, Smith and Thompson

[57] **ABSTRACT**

An omnidirectional, ultra high frequency transmitting antenna is disclosed having an unusually low profile and being of unusually rugged physical construction. A cylindrical monopole is attached to the outside conductor of a coaxial cable, and the center conductor is fastened to the apex of a conical dipole, with mechanical spacing and support between the dipoles being supplied by means of a ring of low loss dielectric material which provides dielectric loading for the antenna. With the dielectric loading, the height of the antenna can be made appreciably less than in the case of a conventional dipole antenna. A light flasher is incorporated into the cylindrical monopole as an aid in visually locating the antenna and associated equipment.

12 Claims, 1 Drawing Figure





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LOW PROFILE ANTENNA MOUNTED ON A WATERCRAFT

BACKGROUND OF THE INVENTION

Various types of manned and unmanned vehicles, buoys, transponders, etc., have been used, and others are currently in use or being planned for ocean research work. Except for devices considered expendable, it is necessary to provide some means for locating and recovering the devices when they have completed their mission. Aircraft and other devices are frequently lost and searched for over both land and water. Various types of radio transmitters have been used to aid in searching, all of which require some form of antenna. One type which has been used is a simple vertical whip antenna which may be carried in a folded or collapsed condition until the device or vehicle surfaces and which is then extended for transmitting. For some applications this type of antenna has been found to be unsatisfactory because it takes up too much space, even as folded or collapsed, or because when extended it raises the center of gravity such that the device or vehicle may roll or capsize, resulting in failure to transmit by dipping the antenna in the water. Other types of antennas have often been found to be larger than desired, either occupying space desired for other functions or imposing a penalty in the form of additional frontal area, or drag in the water. Often the performance of the antenna has been severely limited because its design preferably requires a ground plane of substantial size, and the required area is not available on the device or vehicle.

SUMMARY OF THE INVENTION

The antenna design which is disclosed herein provides omnidirectional performance equal to much larger antennas of conventional design and yet avoids the problems enumerated above. Since it is of limited size, it requires only a small amount of space in the vehicle or device in which it is installed and yet is designed to remain flush with the vehicle's surface until deployed. When the antenna is deployed it extends only a limited distance out of the surface of the vehicle and thus does not produce or contribute substantially to a moment tending to roll or capsize the vehicle. This result is accomplished through the use of a cylindrical monopole combined with a contiguous top-loaded conical monopole and a low-loss type of dielectric loading arrangement. The surface of the vehicle adjacent the cylindrical monopole becomes an effective ground plane. The entire assembly is very rugged physically and may be combined with a light flasher to assist in locating the vehicle.

DESCRIPTION OF THE DRAWING

The single FIGURE shows an antenna embodying our invention in its deployed state.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, the surface of the waterborne vehicle or device is shown at numeral **10**. Formed in the surface of the vehicle is a bore **12** which would normally be cylindrical for receiving the transmitting beacon package **14**. The beacon unit **14** includes transmitting equipment (not shown in detail) terminating in a coaxial cable **16** which is connected through a conventional electrical connector to a circular plate member **20** forming part of a cylindrical dipole structure. The center conductor of coaxial lead **16** is soldered to the apex of a conical member **22** forming part of a conical dipole. An annular member **24** of a low-loss dielectric material (such as polytetrafluorethylene)is positioned between members **20** and **22** to provide dielectric loading as well as mechanical support for the member **22**. An O-ring seal **26** is shown located in the outside edge of member **20** which may be used to prevent sea water, rain or moisture from other sources from entering the bore **12** when the beacon assembly is in its retracted position. As retracted, the surface of member **22** is flush with surface **10**. The beacon assembly **14** may be held in its retracted position against the force of a spring **28** through any suitable means, such as a detent with a solenoid-operated plunger or other suitable mechanism. When the plunger, etc. is removed, as by energizing of the aforementioned solenoid, the spring **28** will force the assembly **14** into the position shown. Electrical power is supplied from the vehicle **10** through a connector **30** and a wire **32** to the transmitter within assembly **14**. This power is also supplied to an annular flasher bulb **34** which is positioned between plate **20** and a collar member **36** which cooperate with a series of conductor wires **38** to complete the cylindrical dipole structure. The light **34** then flashes through windows formed between the conducting members **38**. It will be observed that plate **20** is drilled to permit conductor **38** to be extended to the upper surface of member **20** where it is soldered or otherwise fastened to a nickel-plated layer in order to provide assurance that there is no significant voltage drop between the upper surface of member **20** and the surface of member **36**. All of the members **38** are connected to the plated surface of plate **20** as shown.

With the beacon assembly **14** in its deployed state, as shown, sea water will enter the bore **12** and surround member **36** and will extend into bore **12** at least to the level of an O-ring seal **40**. The sea water provides a conducting path between the member **36** and the surface **10** of the vehicle, thus providing an arrangement whereby a substantial part of the surface of the vehicle acts as a ground plane for the antenna structure. Other conductors such as resilient fingers may extend between members **36** and **10** where the transmitter is operated in air.

Those skilled in the art will recognize that certain dimensions and proportions of the parts above affect both the center frequency and the band width of the transmitted signal. With a diameter and deployed height of about 2 inches, the center frequency will be in the region of 1 GHz. The height may be further reduced where the flasher bulb **34** is not included. The antenna is a fairly narrow band device, as shown, with band widths in the range of 10 to 20 percent of the center frequency. The diameter of the base of the conical portion of member **22**, as well as the angle of its sides, will affect band width. The thickness of the dielectric material in the walls of member **24** will also affect band width. Impedance matching between the coaxial line and the antenna may be effected by controlling the distance the center conductor extends between the plated surface of the cylindrical monopole member **20** and the apex of the conical portion of member **22**. Of course, minor variations from a circular cross-section would be expected to produce similar electrical results but with some irregularities in the pattern, depending on the magnitude of such variations, and where reference is made to "cylindrical" or "circular" members, it is intended that such minor variations be included.

We claim:

1. An antenna structure for connection to a coaxial signal carrying conductor comprising

a cylindrical monopole section of electrical conducting material,

a circular plate closing one end of said cylindrical monopole section and a coaxial line termination device attached to said plate, with the outside or shield conductor connected to said plate and with the center conductor insulated from said plate,

a conical monopole member connected at its apex to said center conductor, said conical monopole including a radially extending flange,

a loading ring of dielectric material fixed between said flange and the outer edge of said plate,

and ground plane means adjacent said cylindrical monopole section.

2. An antenna structure as set forth in claim **1** wherein the distance along said center conductor between said plate and said apex is selected to provide an impedance match between said coaxial line and said antenna.

3. An antenna structure as set forth in claim 1 wherein said antenna is deployed on a water-borne device, a water-filled gap is located between said cylindrical monopole section and said ground plane means, and said ground plane means includes a substantial portion of the surface of said device.

4. An antenna structure as set forth in claim 3 wherein O-ring sealing means are carried on the side walls of said cylindrical monopole section.

5. An antenna structure as set forth in claim 1 wherein the thickness of said loading ring is a substantial proportion of its height.

6. An antenna structure as set forth in claim 1 wherein said circular plate has a plating layer on its side nearest said apex and conductors are soldered between said plating layer and the side walls of said cylindrical monopole section.

7. An antenna structure as set forth in claim 6 wherein illumination means is incorporated into the side wall of said cylindrical monopole section.

8. An antenna structure as set forth in claim 7 wherein said illuminated means includes a light-transmitting housing positioned adjacent said plate and an annular bulb in said housing.

9. For use with a water-borne vehicle, an antenna structure adapted to be carried within said vehicle and connected to a coaxial feed cable, said antenna having a surface flush with the surface of said vehicle when not deployed and which is urged out of the said surface when deployed, said antenna when deployed comprising:

a cylindrical monopole section of electrically conducting material connected to the outside conductor of said coaxial feed cable including a circular plate,

a conical monopole section axially aligned with said cylindrical monopole section connected at its apex to said center conductor including a radially extending flange, said flange including the said flush surface, said center conductor extending between the surface of said circular plate and said apex for a length selected to provide an impedance match between said coaxial feed cable and said antenna,

a loading ring of low loss dielectric material fixed between said flange and the outer edge of said plate,

and ground plane means for said antenna including at least a portion of the surface of said vehicle and a water-loaded slot between said surface and said cylindrical monopole section.

10. An antenna structure as set forth in claim 9 wherein said antenna, when deployed, extends out of the surface of said vehicle a distance approximately equal to its diameter.

11. An antenna structure as set forth in claim 10 wherein said circular plate has a plating layer on its side nearest said apex and conductors are soldered between said plating layer and the side walls of said cylindrical monopole.

12. An antenna structure as set forth in claim 10 wherein illumination means is incorporated into the side wall of said cylindrical monopole section.

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