World's Leading Manufacturer Of Fibreglass Whip Antennas

Valcom

SPECIALISTS FOR HIGH FREQUENCY

35 Ft Broadband HF Antenna VBBA 2-30 MHz

PN: VD-97-00061-1

THE VALCOM MODEL VBBA 2-30 IS A 35 FOOT, BROADBAND HF TACTICAL WHIP ANTENNA INTENDED FOR USE IN HIGH POWER ELECTRONIC COUNTER MEASURE (ECM) SYSTEMS. THE VBBA 2-30 OPERATES IN THE 2 MHz TO 30 MHz RANGE.

THE VBBA 2-30 EXHIBITS A NOMINAL INPUT IMPEDANCE OF 50 OHMS OVER THE HF FREQUENCY BAND OF 2 MHz TO 30 MHz PROVIDING A MAXIMUM VSWR OF 2:1 ALL WITHOUT THE USE OF AN EXTERNAL TUNER. LIGHTNING PROTECTION IS PROVIDED BY A DC STATIC SHORT AT THE INPUT OF THE ANTENNA.

BY USING A COMPATIBLE, THIRD-PARTY MULTI-COUPLER OR POWER COMBINER UNIT, MULTIPLE TRANSMITTERS CAN BE DIRECTLY CONNECTED TO THE VBBA 2-30, PROVIDING THE PEAK POWER RATING IS NOT EXCEEDED AT ANY TIME.

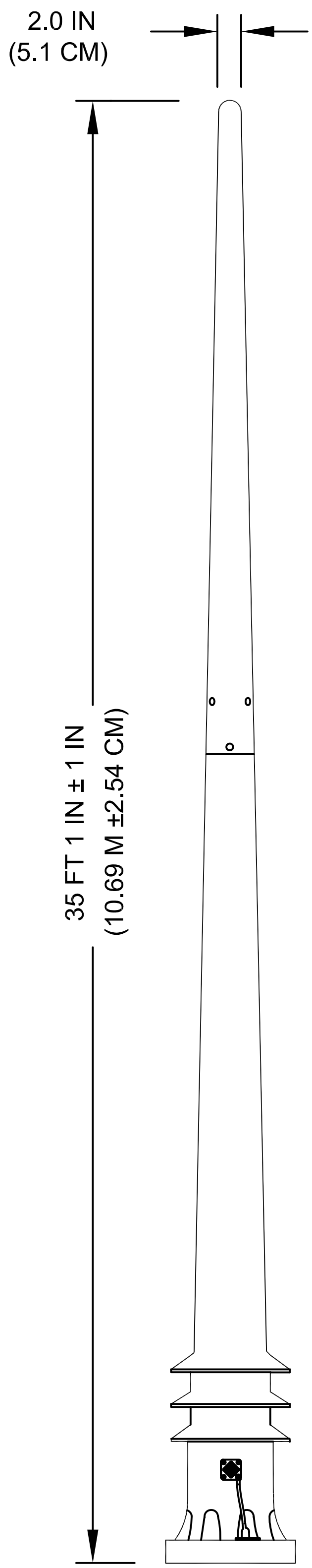
THE VBBA 2-30 IS A SELF-SUPPORTING WHIP ANTENNA CONSISTING OF AN ALUMINUM RADIATING ELEMENT AND AN INTEGRAL FIBREGLASS MOUNTING BASE AND INSULATOR. THE MOUNTING BASE UTILIZES THE SAME MOUNTING PATTERN THAT IS CURRENTLY USED BY THE AS-3772B/U TUNABLE HF SHIPBOARD ANTENNA.

FEATURES:

- MINIMUM MAINTENANCE
- HIGH RELIABILITY
- SHIPBOARD APPLICATIONS
- BROADBAND
- WEATHERPROOF

U.S. PATENTS: 5357261, 7242367 & 7555827

QUICK REFERENCE DATA
VBBA2-30



ELECTRICAL CHARACTERISTICS

FREQUENCY RANGE	2-30 MHz
POLARIZATION	VERTICAL
POWER RATING	3KW CW, 5KW PEP
AZIMUTH COVERAGE	OMNIDIRECTIONAL ±3 dB
VSWR	LESS THAN 2.0:1
INPUT CONNECTION	7/8 EIA FLANGE (NOTE 2)

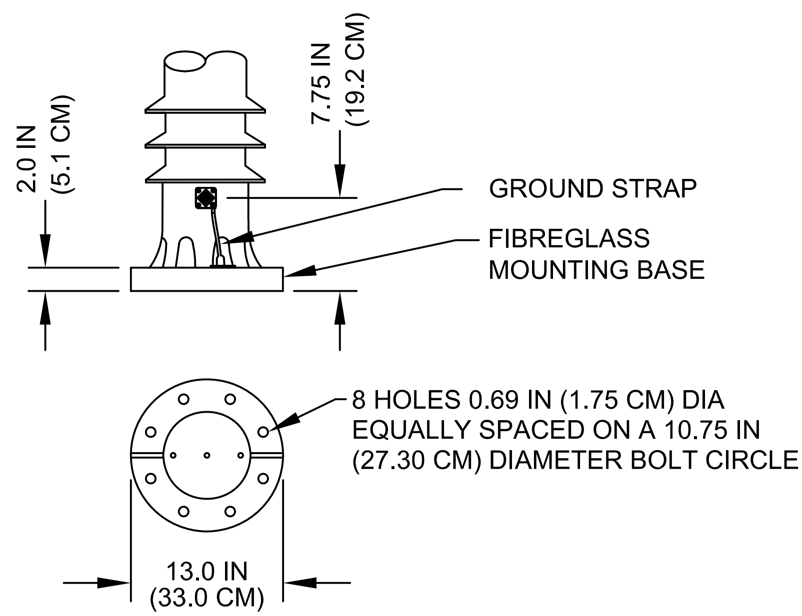
MECHANICAL CHARACTERISITICS

ANTENNA OVERALL LENGTH	35 FT 1 IN ± 1 IN (10.69 M ± 2.54 CM)
ANTENNA WEIGHT	250 LBS (118 KG)
RADIATING ELEMENT	ALUMINUM
INTEGRAL BASE/INSULATOR	EPOXY FIBREGLASS
FINISH	HAZE GRAY SILICONE ALKYD ENAMEL PER TT-E-490, COLOUR 26270 PER FED-STD-595

ENVIRONMENTAL CHARACTERISITICS

TEMPERATURE	-50°C TO 65°C (-60°F TO 150°F)
RELATIVE HUMIDITY	0-100%
VIBRATION	MIL-STD-167-1 TYPE 1
WIND VELOCITY	140 MPH (224 KPH)
ICE LOADING	4.5 LBS/SQ FT (22 KG/SQ M)
SHOCK	MIL-S-901 GRADE A

NOTES:
1. DO NOT USE LEAD BASE PAINT TO TOUCH-UP OR REPAINT ANTENNA.
2. CONTACT FACTORY FOR OTHER AVAILABLE OPTIONS.



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US005357261A

United States Patent [19]
Brandigampola

[11] **Patent Number: 5,357,261**
[45] **Date of Patent: Oct. 18, 1994**

[54] ANTENNA FOR MATCHED TRANSMISSION SYSTEM

[76] Inventor: **Don E. Brandigampola,** 131 Dimson Ave., Guelph, Ontario, Canada, N1G 3C5

[21] Appl. No.: **27,647**

[22] Filed: **Mar. 8, 1993**

[51] **Int. Cl.**[5] **H01Q 9/30;** H01Q 1/32

[52] **U.S. Cl.** **343/900;** 343/715; 343/888

[58] **Field of Search** .... 343/900, 715, DIG. 1, 343/895, 904, 906, 878, 884, 888; H01Q 9/30, 1/32

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,725,944 4/1973 Valeriote, Jr. 343/900
4,300,140 11/1981 Brandigampola 343/900
4,500,888 2/1985 Brandigampola 343/900

FOREIGN PATENT DOCUMENTS

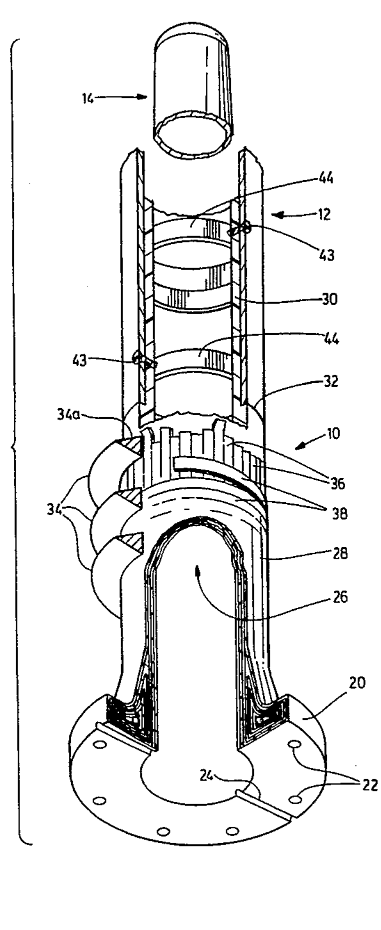
748318 4/1956 United Kingdom 343/DIG. 1

Primary Examiner—Donald Hajec
Assistant Examiner—Hoanganh Le

[57] **ABSTRACT**

A free standing antenna for use in associations with high-stress environments subjecting the antenna to extremes of flexing stress and temperature stress and chemical stress, the antenna having a mounting base portion which can be secured to a base adjacent to the high-stress environment, the base member being formed of glass fibre reinforced resin materials containing fibres extending in a longitudinal direction, along the axis of the base, and further fibres running in a generally annular fashion in planes generally transverse to the axis, and the base member further defining a fastening flange, a plurality of fastening holes formed in the flange, a generally tapering neck portion extending upwardly from the fastening flange, and a generally cylindrical junction head extending upwardly from the neck, the head and the neck being located along a common central axis, and an antenna column secured to the cylindrical head, the column being formed of hollow tubular metal defining outer and inner wall surfaces, and progressively tapering from a larger end to a smaller end, and a cylindrical junction portion at the wide end which makes a snug fit over the generally cylindrical head portion of the base, at least three electrical connections secured to the column portion adjacent the base, at spaced apart points therealong, to which electrical connections may be made by radio equipment, a generally dome shaped cap secured to the smaller end of the column portion, and, a damping weight secured within the interior of the column spaced below the cap.

6 Claims, 3 Drawing Sheets



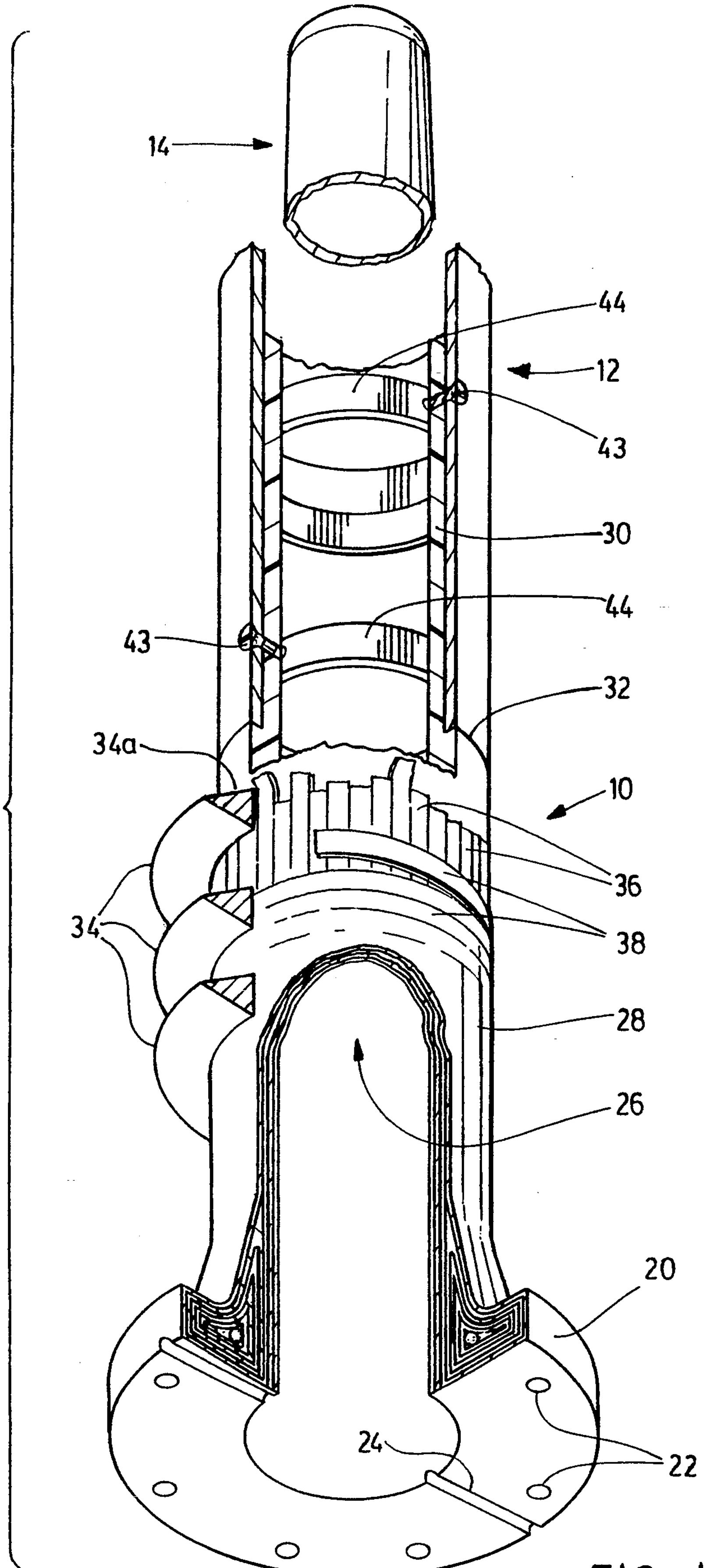
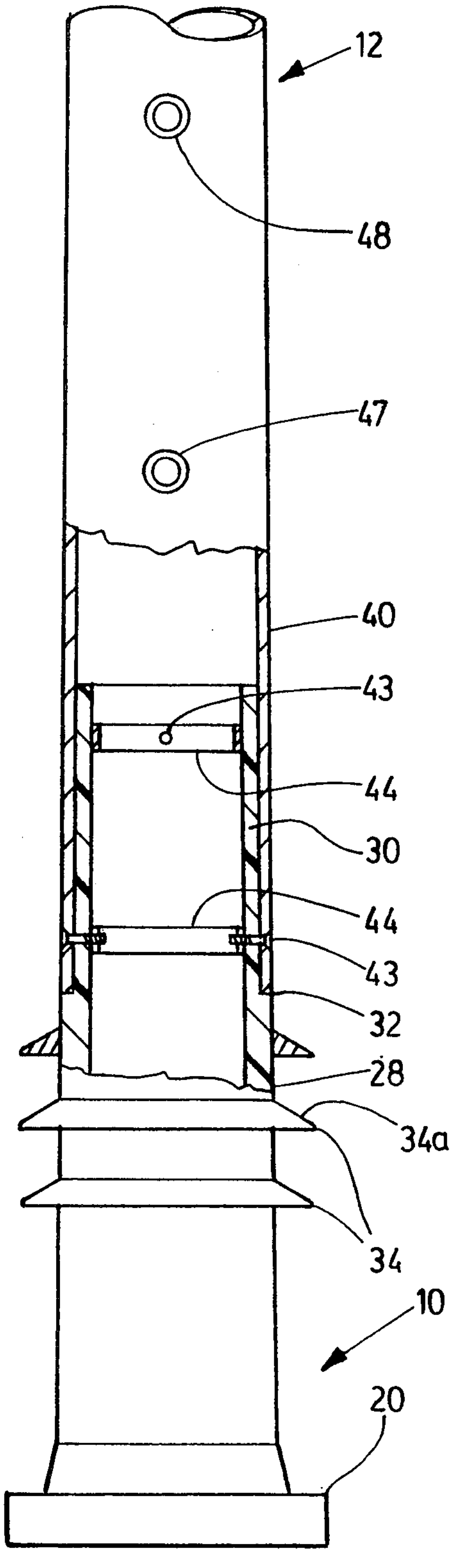


FIG. 1



12
48
47
40
43
44
30
44
43
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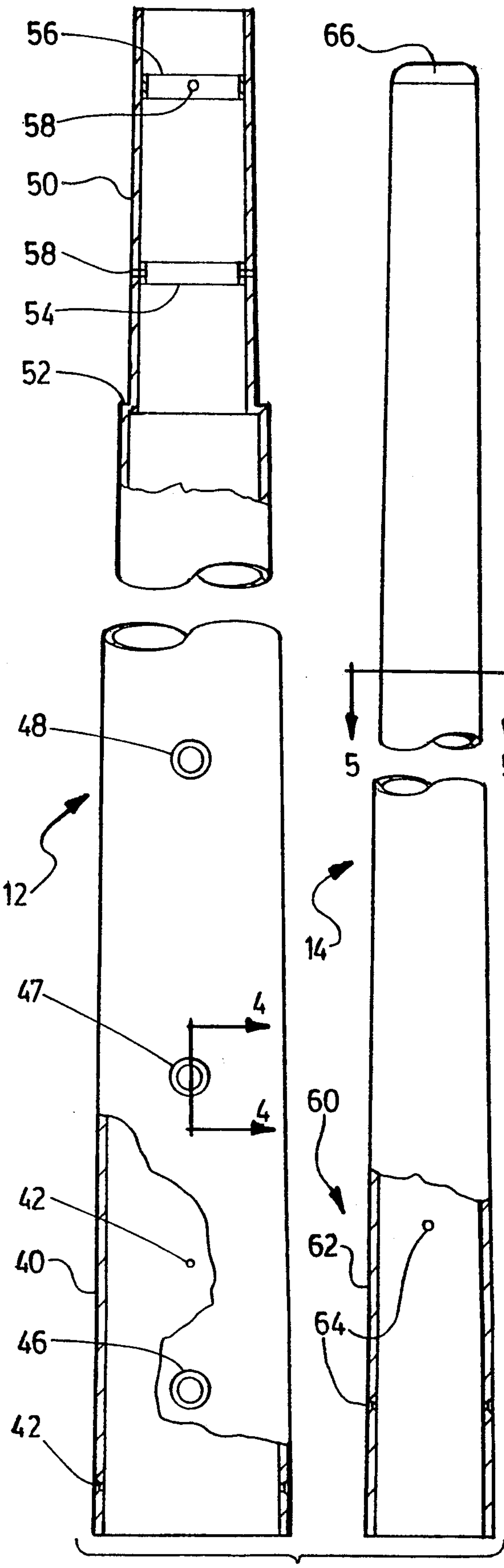
28
34a
34
10
20

FIG. 2



56
58
50
58
54
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12
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4
4
42
40
46
42
5
5
14
60
62
64

FIG. 3

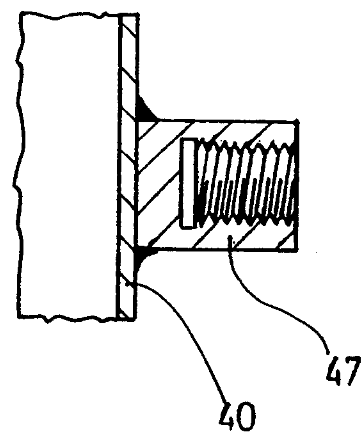

FIG. 4

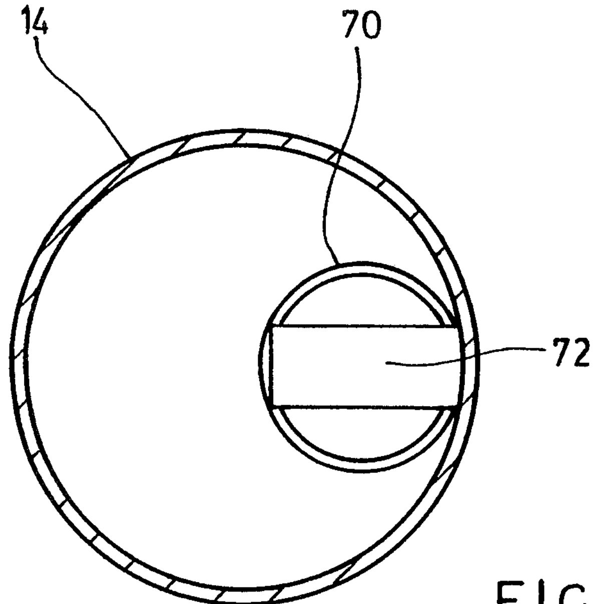

FIG. 5

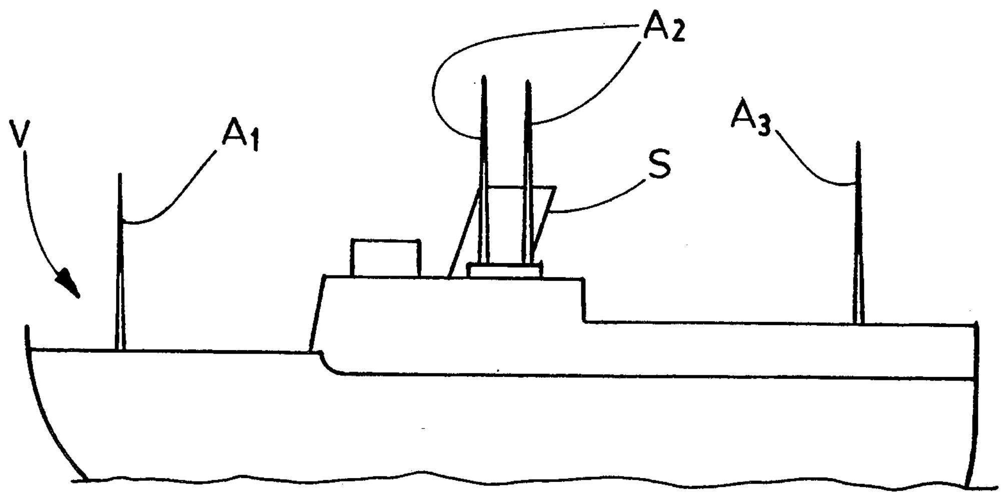

FIG. 6

ANTENNA FOR MATCHED TRANSMISSION SYSTEM

FIELD OF THE INVENTION

The invention relates to antennas for use in radio transmission and receiving systems, and in particular, to matched antennas for such radio transmission systems which are used on marine vessels.

BACKGROUND OF THE INVENTION

In the radio transmission art, it is well known that the effective length of the antenna must be "matched" to the transmission wave length. This is understood to mean that for a given wave length of radio transmission, the antenna must have an optimum length. Thus, in some transmission systems, it is the practice to vary the length of the antenna in order to match it to the transmission.

However, in the great majority of radio transmission systems, this is not practical. What is in effect done is that an antenna of a predetermined average length is provided, and an electronic matching circuit is provided between the transmitter and the antenna, so that, the apparent length of the antenna can be matched to the wave length actually being transmitted. Again, this is relatively well known.

For the purposes of this explanation the term "radio transmission system" is deemed to include either the radio transmitter, or receiver, or both. Matched antennas are often required for both for transmitting and receiving.

In the marine radio transmission art, one of the complicating factors is that it is highly desirable to provide what are known as "whip" antennas. A whip antenna is defined as an antenna which is fastened only at its base, and is essentially free-standing, without the intervention of any supports such as guy wires or the like.

In order to withstand the motion of a marine vessel at sea, particularly during high winds and rough weather, such whip antennas must have a certain degree of flexibility, so as to permit them to withstand the extreme motion of the vessel itself.

Some particularly effective forms of whip antenna design are described in U.S. Pat. Nos. 3,725,944, 4,300,140, and 4,500,888, all of which have been assigned to Valcom Ltd.

These whip antennas are constructed of fibreglass, and the longer versions of such antennas are constructed in sections which can be put together, somewhat in the manner of a fishing rod. Conductors are located within the body of the antenna carrying the radio signal up or down the length of the antenna.

Such whip antennas, made in accordance with these patents and have proved to be highly effective in use, and are widely used for marine purposes, particularly by military and naval vessels in various countries of the world.

However, due to the increasing crowding of the air waves by an increasing volume of radio signals, and also to a certain extent due to the requirements of security, it is desirable to provide for a radio transmission system on a marine vessel which will operate over a relatively wide band width. Desirably, such a radio transmission system may be capable of operating over band widths of from two megahertz to thirty megahertz. At present, it is not possible in this wide frequency range to provide a single antenna which can be matched to all of the transmissions over this wide band width. In the past, when somewhat narrower band widths may have been satisfactory, it was the practice to provide two pairs of whip antennas on a vessel. One pair would be mounted towards the bow, and the other pair of antennas mounted towards the stern of the vessel, in a typical case. By a suitable selection of the lengths of the antennas in the two pairs, it was possible to provide a reasonable degree of matching over the then acceptable band width for transmission and/or reception.

Alternatively one pair might be used for transmitting, and the other pair for receiving.

However, increasingly greater band widths are now required for transmissions, and greater and greater demands are made on the transmission systems, both for greater range and also for clarity of transmission, and for security.

It is also desirable to be able to switch bands relatively quickly, and this band switching may take place even within the space of a single message transmission.

When two pairs of antennas were regarded as satisfactory, it was the practice to provide one pair of shorter antennas and one pair of longer antennas. The antennas in their respective pairs acted as dipoles, so that they could be matched to handle a reasonable range of band widths of transmission or reception, within the limitations of their own lengths.

However, as mentioned above, due to the increasingly strict demands being made upon such radio transmission systems, it is no longer adequate to provide simply two pairs of whip antennas for any one radio system.

Requirements now call for the provision of three separate pairs of whip antennas. Each pair of antennas must be securely and substantially permanently attached at its location, i.e. to the vessel, and, bearing in mind the complexity and amount of other equipment which is also carried on such vessels, it has become increasingly difficult to find suitable locations for positioning the three pairs of antennas, particularly on smaller vessels. While there is relatively little problem in locating one pair of antennas near the bow, and another pair towards the stern, it is generally necessary to mount the third pair of antennas more or less amidships to the vessel.

The antennas must be mounted so that the two antennas in any one pair are no more than about ten feet apart from one another, in order to achieve the desired dipole effect.

While this does not present any serious problems, with the antennas mounted towards the bow and towards the stern, it does present problems with regard to the pair of antennas which are now required to be mounted amidships. Usually, the vessel will have one or more smoke stacks, emitting fumes or exhaust from the engines, and usually the smoke stack will also be located amidships. The fumes or exhaust as they leave the smoke stack may well be at a temperature in the region of six hundred or more degrees Fahrenheit and contain harmful chemicals. If antennas made of glass fibre reinforced resin materials are placed in close juxtaposition to the smoke stack, they will be unable to withstand these high temperatures and chemical emissions and the resin material will soon be degraded.

An additional, although not so serious a problem, was presented by the degree of flexibility incorporated in antennas made of glass fibre reinforced resins. Antennas made of such material were capable of relatively extreme degrees of deflection in high winds or during violent motion of the vessel in rough water. Depending upon where the antennas were placed, and how close to the smoke stack the antennas were located, it was conceivable that during extreme weather the antennas might contact the smoke stack and be damaged.

Accordingly, it is desirable to provide antennas which are both resistant to chemical emissions and to much higher temperature gases than are antennas made of glass fibre reinforced material, and which are also possessed of a higher degree of stiffness, making them more resistant to bending during extreme weather conditions. Antennas having such improved physical properties can then be mounted immediately alongside the smoke stack of a vessel, without fear of damage due to chemicals or to high temperature gases, and without fear that they will interfere with the smoke stack during extreme weather.

BRIEF SUMMARY OF THE INVENTION

With the view therefore to overcoming the various conflicting problems described above, the invention comprises a free standing antenna for use in association with high-stress environments, said environments subjecting said antenna to extremes of stress including flexing stress and temperature stress, and said antenna comprising a mounting base member adapted to be secured to a base adjacent to said high-stress environment, said base member being formed of glass fibre reinforced resin materials containing fibres extending in a longitudinal direction, along the axis of said base, and further fibres running in a generally annular fashion in planes generally transverse to said axis, and said base member further defining a fastening flange, a plurality of fastening holes formed in said fastening flange, a generally tapering neck portion extending upwardly from said fastening flange, and a generally cylindrical junction head extending upwardly from said neck portion, said head and said neck portion being located along a common central axis, and an antenna column portion secured to said cylindrical head, said antenna column portion being formed of hollow tubular metal defining outer and inner wall surfaces, and progressively tapering from a larger end to a smaller end, and a cylindrical junction portion at said wide end adapted to make a snug fit over said generally cylindrical head of said base member, three electrical connections means secured to said column portion adjacent said base, at spaced apart points therealong, whereby electrical connections may be made thereto by radio equipment, a generally dome shaped cap secured to said smaller end of said column portion, and, damping weight means secured within said column portion adjacent to but spaced from said cap, said damping means being secured within the interior of said hollow metal tube.

The invention further comprises such an antenna, wherein said column portion comprises at least two separate first and second column portions, each of said column portions defining larger lower ends and smaller upper ends, and said first column portion at said smaller end defining a generally cylindrical column junction section, and said second column portion defining, at said larger end, a generally cylindrical column junction sleeve adapted to make a snug fit over said column junction section, and, reinforcing ring means secured inside said column junction section at spaced apart intervals, and fastening opening means formed in said column junction sleeve in registration with said reinforcing rings, whereby fastenings may be passed therethrough and secured into said reinforcing rings, thereby joining said first and second column portions together.

The invention further comprises such an antenna and including an axial opening in said base extending therealong from the top of said junction head portion, to said flange, and, drain conduit means formed in the underside of said flange, whereby liquid within said base or said column may drain downwardly and outwardly therefrom.

The invention further comprises such an antenna and including reinforcement ring means in said cylindrical head, and fastening openings therethrough, whereby fastenings can be passed from said cylindrical junction portion at said wide end of said antenna column portion, and said cylindrical head of said base member, and through said reinforcement ring means.

The invention further comprises such an antenna and including at least two collar members formed on the exterior or said base member, axially spaced therealong, on said neck portion, below said generally cylindrical junction head.

The various features of novelty which characterize the invention are pointed out with more particularity in the claims annexed to and forming a part of this disclosure. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which there are illustrated and described preferred embodiments of the invention.

IN THE DRAWINGS

FIG. **1** is a perspective illustration of an antenna in accordance with the invention, shown partially cut away;

FIG. **2** is a partial section along the line **2—2** of FIG. **1** illustrating the base;

FIG. **3** is an elevation of one antenna, exploded and partially cut away, and illustrating the details of both of the column portions;

FIG. **4** is a section along line **4—4** of FIG. **3** illustrating a connector in detail;

FIG. **5** is a section along **5—5** of FIG. **2** of the upper end of the second column portion, illustrating the damping device; and

FIG. **6** is a side elevation of a typical marine craft, illustrating three pairs of antennas erected thereon.

DESCRIPTION OF A SPECIFIC EMBODIMENT

Referring first of all to FIG. **6**, it will be seen that the invention in this particular embodiment is illustrated in the form of an antenna for use on a marine vessel. The circumstances in the environment of a marine vessel have already been described above. It is sufficient to say that antennas on marine vessels are subject to extremes of environmental stress both at physical stress due to the violent motion of the vessel, and also chemical and temperature stress, due to the emissions from the smoke stack of the engine of the vessel.

It will be observed that on the vessel indicated generally as V, there are three pairs of antennas indicated respectively as **A1**, **A2**, and **A3**, mounted respectively in pairs at or adjacent to the bow, amidships, and towards the stern of the vessel, respectively.

All six of the antennas are of course subjected to the same extremes of physical stress during rough weather.

However, the center pair of antennas A2 located amidships are located closely alongside the smokestack S of the vessel V.

It is not possible to locate the antennas far enough apart so that they will be distanced from the smokestack to avoid the emissions from the smokestack. In the first place the emissions from the smokestack are liable to blow in any direction depending upon the wind and/or direction of movement of the vessel. In the second place, the respective pairs of antennas A1, A2, and A3 are required to function in pairs as "dipoles", for reasons which will be apparent to those skilled in the art, and which require no special description. In order to function in this way, it is desirable that the antenna pairs be mounted adjacent to one another, preferably no more than ten feet apart.

It will also be observed that the pairs of antennas A1, A2, and A3 are of varying lengths. In this way, it is possible for the radio transmission/reception unit on the vessel V to select for its transmission either the antennas A1, or A2, or A3, depending upon the particular transmission wave length being transmitted (or received) at the moment, for example, and for other reasons understood in the art.

In this way, it is possible for the radio transmission (or reception) to be switched rapidly from one pair of antennas to the other and back again, and so on. Antenna matching units (not shown) are adjustable in known manner, so as to tune the selected pair of antennas, so as to be as closely as possible matched to the wavelength of the transmission being emitted (or received) at that particular moment by the radio transmission/reception unit.

In this way, it is possible for the radio transmission/-transmission on a vessel to be switched at relatively short time intervals from one wave length to another and back again and so on throughout a single transmission. Alternatively, if for some reason it is desirable to transmit at a particular frequency, then that of course can also be performed by the transmission unit. Typically shorter wavelengths will be used for communications from vessel to vessel which are adjacent to one another, and longer wave lengths will be used for transmission to vessels which are further apart, or for transmission to/or from, for example, a land based station, and back again.

These remarks are essentially generalities, and these factors are well understood to persons skilled in the art, and are included here merely for the sake of illustrating the way in which the invention is used.

It will thus be seen that at least in the case of the antennas A2, for being placed closely just opposed either on one side of the smokestack (or on either side), they are not only subjected to the physical stress of the movement of the vessel, but they are also subjected to the severe heating and chemical stress caused by the hot emissions from the closely adjacent smoke stack.

The antennas in accordance with the invention are therefore designed and specified to function effectively under these extreme conditions of stress, without degradation, and without flexing into contact with the smoke stacks.

The antennas according to the invention are illustrated more specifically in association with FIGS. 1 to 5. Before describing these figures, it will be understood that depending upon the length of the antenna required they may be made either as a single length, or in two lengths, or in some cases three or more separate lengths, connected together to form a single extended antenna. For the purposes of this invention, and for simplicity in explanation, FIGS. 1 through 5 illustrate an antenna constructed in two lengths. It will however be appreciated that the invention is not solely limited thereto but comprehends both a single length, and three or more lengths of antenna, as the case may require.

In FIG. 1, the antenna will thus be seen to comprise three components, namely a base indicated as **10**, a lower first antenna column portion **12** and an upper second antenna column portion **14**.

As illustrated in FIG. 2, the base comprises a flange **20**, having a plurality of bolt holes **22** formed therein by means of which it may be secured to a mounting position for example on the deck of a vessel or the like. In addition, on the underside of the flange **20**, there are drainage passageways **24**, extending thereacross, communicating with the central interior axial opening **26**.

The base **12** also comprises a generally tapering neck portion **28** extending upwardly from the flange, and a generally cylindrical head junction portion **30** extending upwardly from the neck **28**.

A shoulder **32** is formed at the junction between the head and the neck.

As generally illustrated, the entire base is fabricated of glass fibre reinforced material. The reinforcing fibres are indicated as **36** and **38**. The fibres **36** extend more or less longitudinally along a vertical axis, from flange **20** up into the junction head **30**. Generally annular fibres **38** extend around the base intersecting the longitudinal fibres. Preferably in fact the entire structure is formed on a rotatable mandrel (not shown) so that the longitudinal fibres may be arranged in position, after which a plurality of the annular fibres may be wound therearound, and then a further quantity of longitudinal fibres arranged, and so on, thereby building up a matrix of longitudinal and annular fibres, the annular fibres being located more or less in planes which are normal to the longitudinal fibres. It will be understood that this is not precisely the case since the annular fibres are wound on so that they will in fact form a spiral configuration, but the analogy is close enough for the purposes of this explanation.

It will be noted that the generally longitudinal fibres **36** extend downwardly into the flange **20**, and wrap around thereunder to form a continuous structure.

In addition, a plurality, in this case three, collars **34**—**34** are formed on the exterior of the neck portion **28**, and define upwardly frusto-conical surfaces **34A** which function to shed moisture outwardly.

It will thus be seen that the base provides a secure, and electrically insulated means of mounting an antenna, and at the same time, being of hollow construction, with interior drainage, will not result in the accumulation of any moisture that may enter, which might otherwise over a period of time, eventually cause deterioration.

As mentioned above, the particular antenna illustrated in this embodiment comprises the lower antenna section **12** and the upper antenna section **14**. However as mentioned a two section antenna is described here purely for the sake of illustration and without limitation.

Thus in this particular embodiment, the lower antenna section **12** will be seen to comprise a continuous progressively tapering metal tube, drawn from high strength aluminum metal, continuously tapering from its lower end to its upper end.

At its lower end, it is of generally cylindrical shape, indicated as 40, and is adapted to make a snug fit over the head portion 30 of the base 10.

Suitable openings 42 are formed through the cylindrical portion, to receive fastenings 43, which are then received in the head 30 of the base 10.

In order to reinforce the head 30, a pair of reinforcement rings 44—44 are located embedded within the inner surface of the head 30, and are provided with suitable openings registering with openings 42, so that fastenings 43 passing from the cylindrical lower end 40 of the lower antenna column 12, may pass through the head portion and be received through the reinforcement ring, and fastened in any suitable manner such as by washers and nuts.

A plurality, in this case three electrical connection fixtures 46, 47 and 48 are secured to the exterior of the lower end 40 of the lower antenna portion 12. Such electrical connection devices comprise threaded sleeves or sockets (FIG. 4), adapted to receive threaded fastening devices such as bolts, (not shown). In this case as mentioned, there are three such separate electrical connection devices spaced one above the other along the length of the lower section 12 of the antenna.

At the upper end of the lower section 20, a reduced diameter cylindrical connection sleeve 50 is provided, defining a shoulder 52 where the transition occurs from the tapering configuration to the sleeve 50.

Within the sleeve 50 there are located a pair of reinforcement rings 54-56 preferably formed for example of aluminum. Fastening openings 58 are formed through the sleeve, and through the reinforcing ring, and are suitably threaded to receive threaded fastening devices such as bolts.

The upper column portion 14 of the antenna also comprises a continuously tapering tubular member formed of high strength aluminum material tapering progressively from its lower to its upper end. At its lower end 60, a cylindrical connection portion 62 is formed, which is adapted to make a snug fit over the connection sleeve 50 of the lower portion 12 of the antenna. Openings 64 are formed through the cylindrical portion 62 and register with openings 58 in the connection sleeve 50, whereby fastenings such as bolts (not shown) may be passed therethrough.

At the upper end of the upper section 14, a generally dome shaped cap 66 is secured, to make the antenna as far as possible weatherproof.

As mentioned, during extreme weather conditions, the antennas will be subject to relatively violent stresses, and will be flexed to and fro. In certain conditions, depending upon the frequency of roll, or pitch of the vessel, or on other conditions, the flexing of the antennas may reach a resonant frequency, at which time further flexing may cause damage.

In order therefore to damp out such resonations, and to as far as possible eliminate resonant frequency vibration, a damping device illustrated generally in FIG. 5 is incorporated in the upper end of the upper antenna section 14. Such damping device comprises a generally cylindrical housing 70, secured by bracket 72 to the interior of the upper end of the upper portion 14 of the antenna, the central axis of the housing 70 being offset with respect to the central axis of the upper portion 14 of the antenna.

By suitably adjusting the weight of the housing 70, it effectively damps out resonant vibrations of the entire antenna.

The mode of operation and usage of the antenna in accordance with the invention is self evident from the foregoing description.

As explained, it is particularly designed for use on marine vessels, but is of general application to many different location where a free standing whip antenna is required to be mounted.

As explained above, while the antenna is described as having two sections, it may have a single section or it may be in three or more sections or portions, joined together in essentially the same way as shown in connection with FIGS. 1 through 5.

The base effectively insulates the entire antenna, and the provision of the plurality of electrical connections on the metallic antenna itself permits electrical connections to be made at suitable points, so that while the antenna itself may be energized, the antenna is insulated from the vessel or other substrate on which the base is mounted.

The foregoing is a description of a preferred embodiment of the invention which is given here by way of example only. The invention is not to be taken as limited to any of the specific features as described, but comprehends all such variations thereof as come within the scope of the appended claims.

What is claimed is:

1. A free standing antenna for use in association with high-stress environments for radiating or receiving radio wave transmissions, said environments subjecting said antenna to extremes of stress including flexing stress and temperature stress, and said antenna comprising;

an insulating, non-radiating mounting base member adapted to be secured adjacent to said high-stress environment , said base member being formed of glass fibre reinforced resin materials containing fibres extending in a longitudinal direction, along an axis of said base, and further fibres running in a generally annular fashion in planes generally transverse to said axis, and said base member further defining a fastening flange, and a plurality of fastening holes formed in said fastening flange;

an insulating non-radiating generally tapering neck portion formed of glass fibre reinforced resin extending upwardly from said fastening flange;

an insulating non-radiating generally cylindrical junction head formed of glass fibre reinforced resin and extending integrally upwardly from said tapering neck portion, said head and said neck portion being integral with said base member and located along a common central axis;

a metallic antenna column secured to said cylindrical head, said column being formed of hollow tubular metal defining outer and inner wall surfaces, and progressively tapering from a larger end to a smaller end;

a metallic cylindrical antenna junction at said larger end of said antenna column adapted to make a snug fit over said glass fibre reinforced resin cylindrical junction head of said base member;

at least three metallic electrical connection means secured to said metallic antenna column adjacent said larger end at spaced apart points along said column for attachment of electrical connections thereto from radio equipment;

a generally dome shaped cap secured to said smaller end of said column, and, a hollow cylindrical damping housing secured within said column adjacent to but spaced below said cap, said damping housing being located offset relative to the central axis of said antenna column.

2. A free standing antenna, as claimed in claim **1**, wherein said column comprises at least two separate first and second column portions, each of said column portions defining respective larger lower ends and smaller upper ends, and said first column portion at its said smaller end defining a generally cylindrical column junction head, and said second column portion defining, at its said larger end, a generally cylindrical column junction sleeve adapted to make a snug fit over said column junction head, and, reinforcing ring means secured inside said column junction head at spaced apart intervals, and fastening opening means formed in said column junction sleeve in registration with said reinforcing rings, whereby fastenings may be passed therethrough and secured into said reinforcing rings, thereby joining said column two portions together.

3. A free standing antenna, as claimed in claim **1**, and including an axial opening in said base member extending therealong from the top of said junction head, to said flange, and, drain conduit means formed in the underside of said flange, whereby liquid within said base member or said column may drain downwardly and outwardly therefrom.

4. A free standing antenna as claimed in claim **1** and including reinforcement ring means in said cylindrical head and fastening openings therethrough, whereby fastenings can be passed from said cylindrical junction at said larger end of said antenna column, and said cylindrical head of said base member, and through said reinforcement ring means.

5. A free standing antenna as claimed in claim **4** and wherein said reinforcing ring means comprises first and second reinforcing rings spaced apart from one another axially along the length of said cylindrical head, each of said reinforcing rings having fastening openings therethrough, and registering fastening openings in said cylindrical head, whereby fastenings can be passed therethrough.

6. A free standing antenna as claimed in claim **1** and including at least two collar members formed on the exterior of said base member, axially spaced therealong, on said neck portion, below said generally cylindrical

* * * * *

US007242367B2

(12) **United States Patent**
Pozzobom et al.

(10) **Patent No.: US 7,242,367 B2**
(45) **Date of Patent: Jul. 10, 2007**

(54) **CODED ANTENNA**

(75) Inventors: **Frank Pozzobom**, Guelph (CA); **Paul R. MacPherson**, Vancouver (CA)

(73) Assignee: **Valcom Manufacturing Group Inc.**, Guelph, Ontario (CA)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/900,178**

(22) Filed: **Jul. 28, 2004**

(65) **Prior Publication Data**

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(51) **Int. Cl.**
H01Q 9/30 (2006.01)
H01Q 1/36 (2006.01)

(52) **U.S. Cl.** **343/900**; 343/895; 343/906

(58) **Field of Classification Search** 343/900, 343/906, 702, 895
See application file for complete search history.

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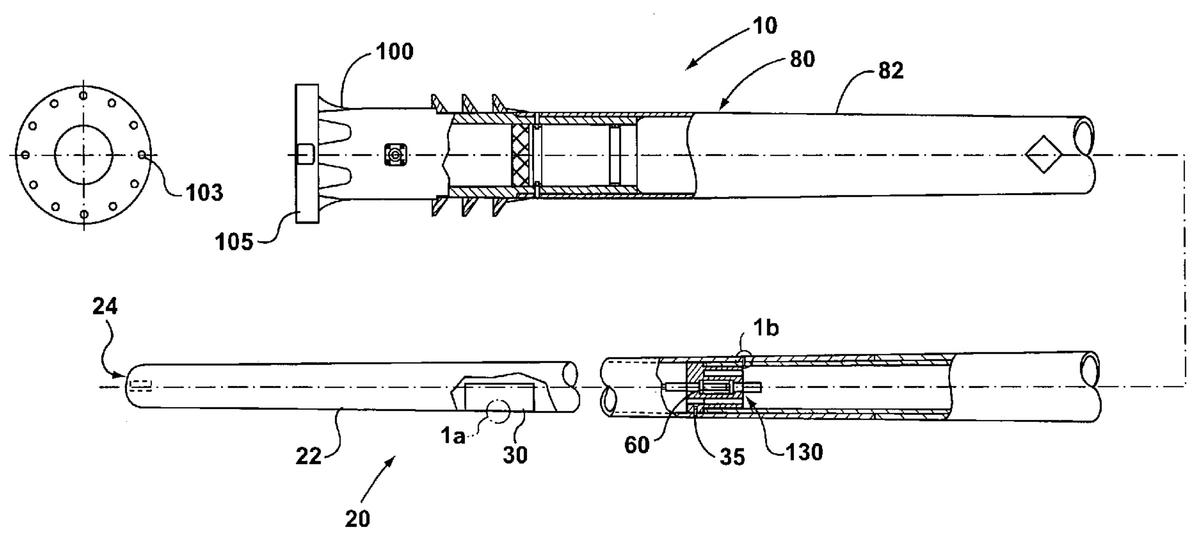
Primary Examiner—Trinh Vo Dinh
(74) *Attorney, Agent, or Firm*—Eugene J.A. Gierczak

(57) **ABSTRACT**

A free standing antenna extending longitudinally to present a base and a free end, comprising a helical conductor disposed over an insulated metallic tube.

19 Claims, 6 Drawing Sheets



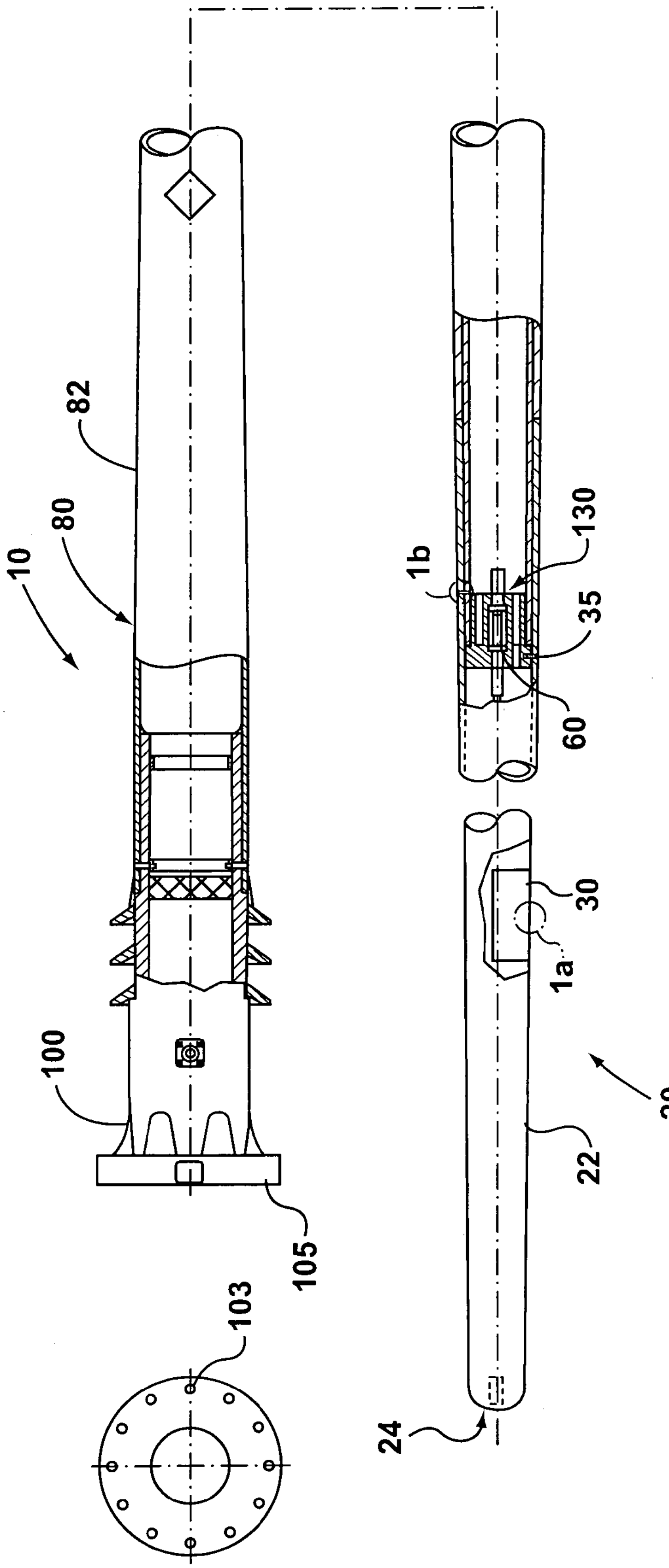


FIG. 1

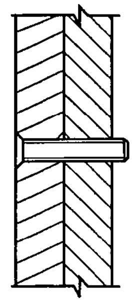


FIG. 1b

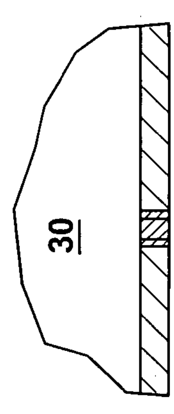


FIG. 1a

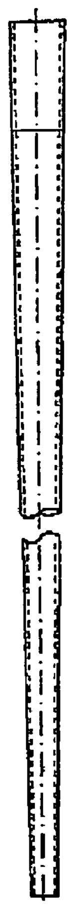


FIG. 2

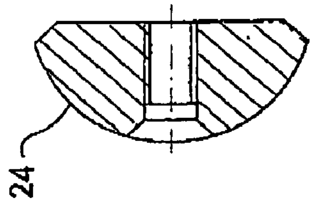


FIG. 3b

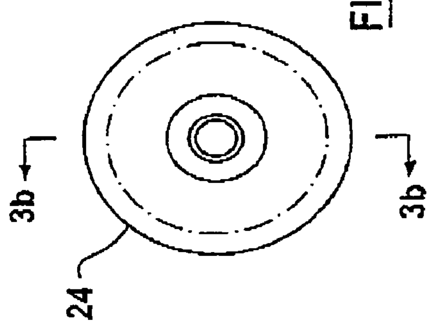


FIG. 3a

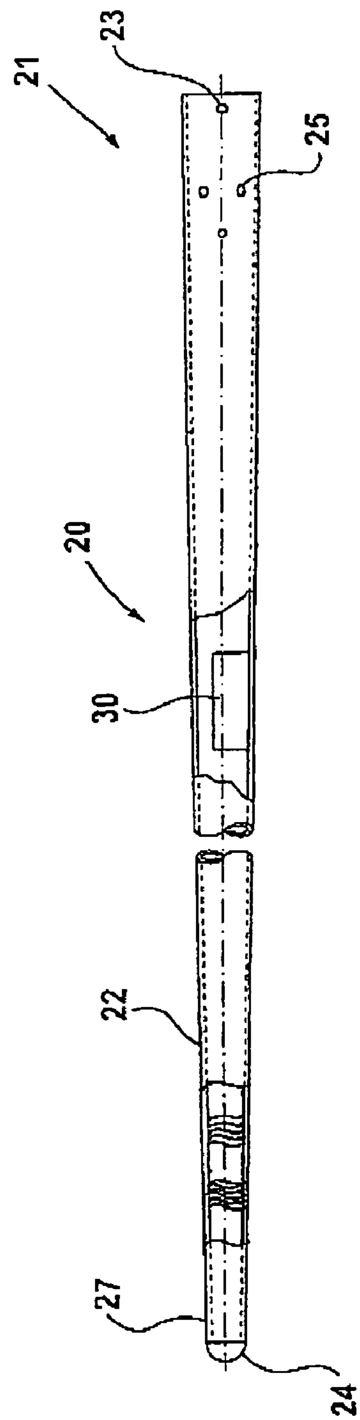


FIG. 4

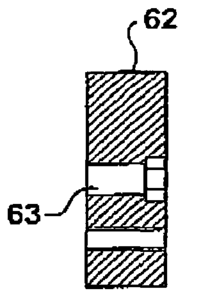


FIG. 5b

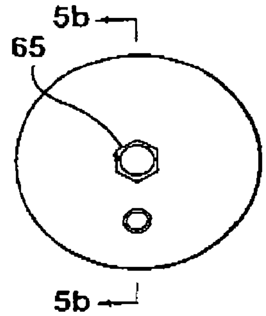


FIG. 5a

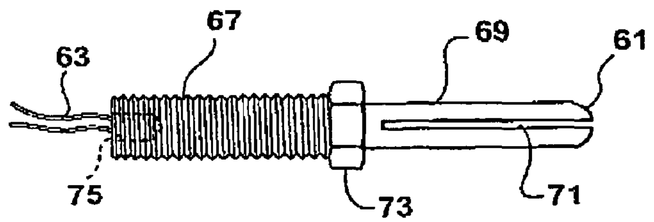


FIG. 6a

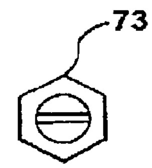


FIG. 6b

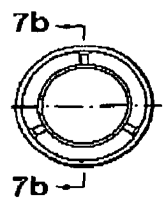


FIG. 7a

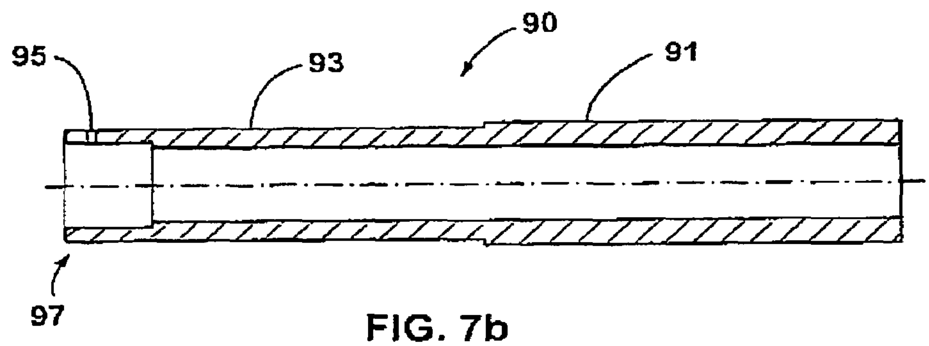


FIG. 7b

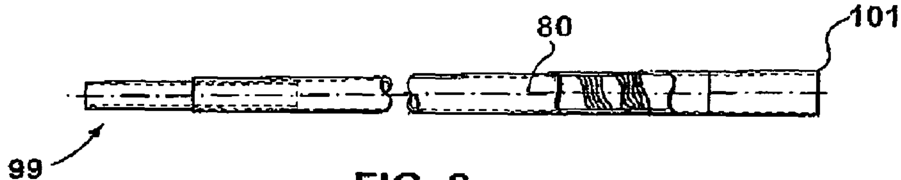


FIG. 8

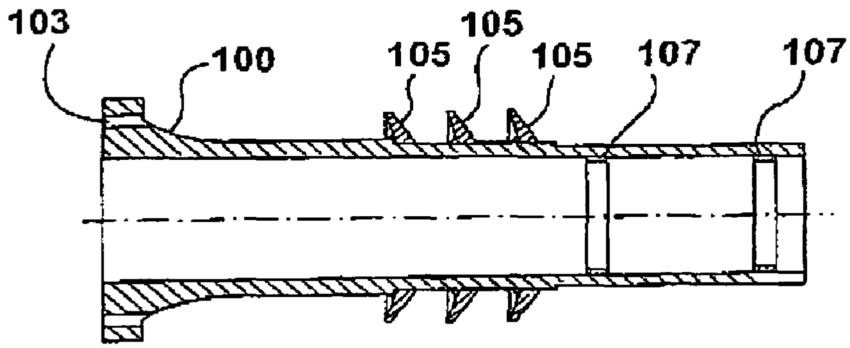


FIG. 9

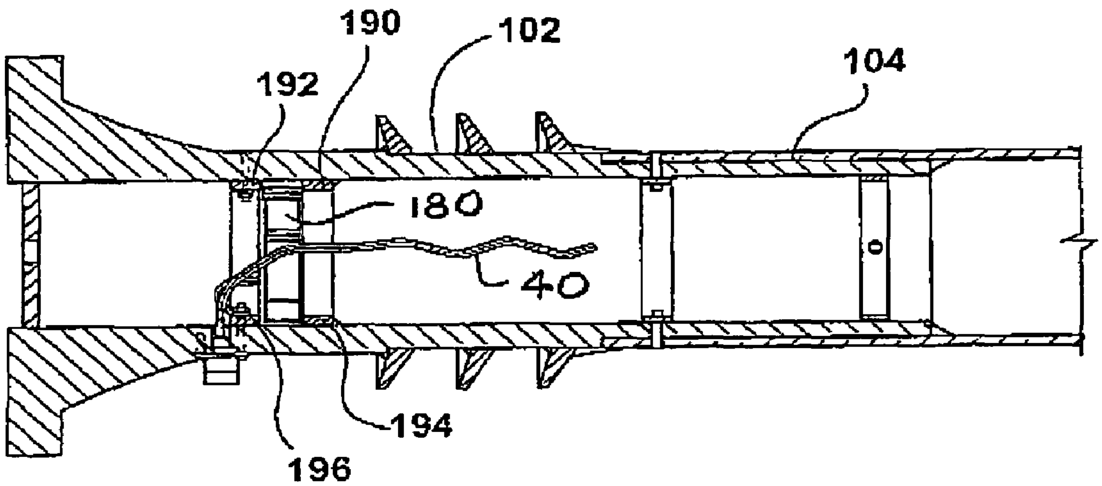


FIG. 10

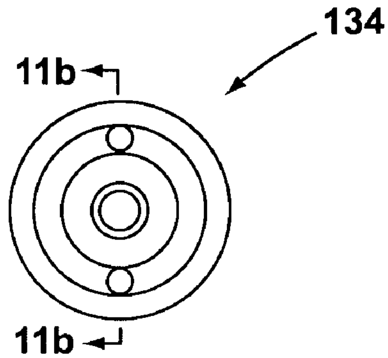


FIG. 11a

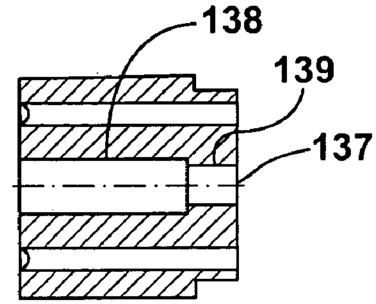


FIG. 11b

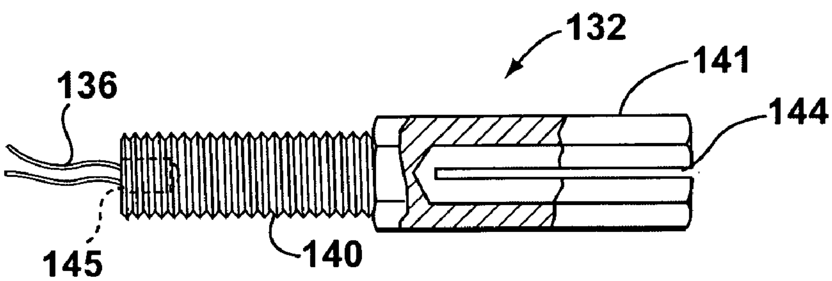


FIG. 12a

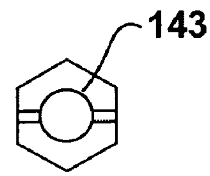


FIG. 12b

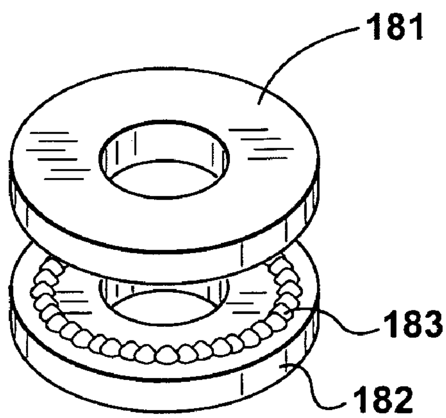


FIG. 14a

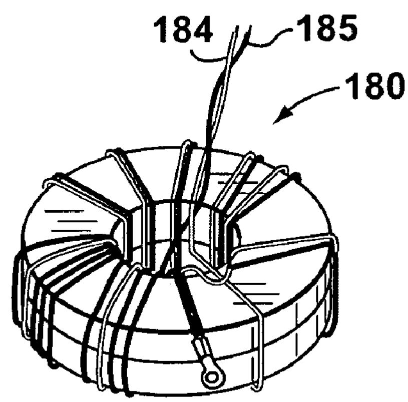


FIG. 14b

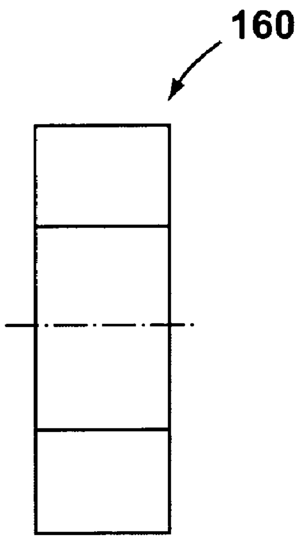


FIG. 13a

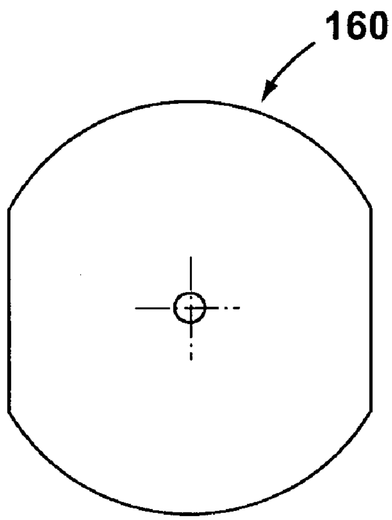


FIG. 13b

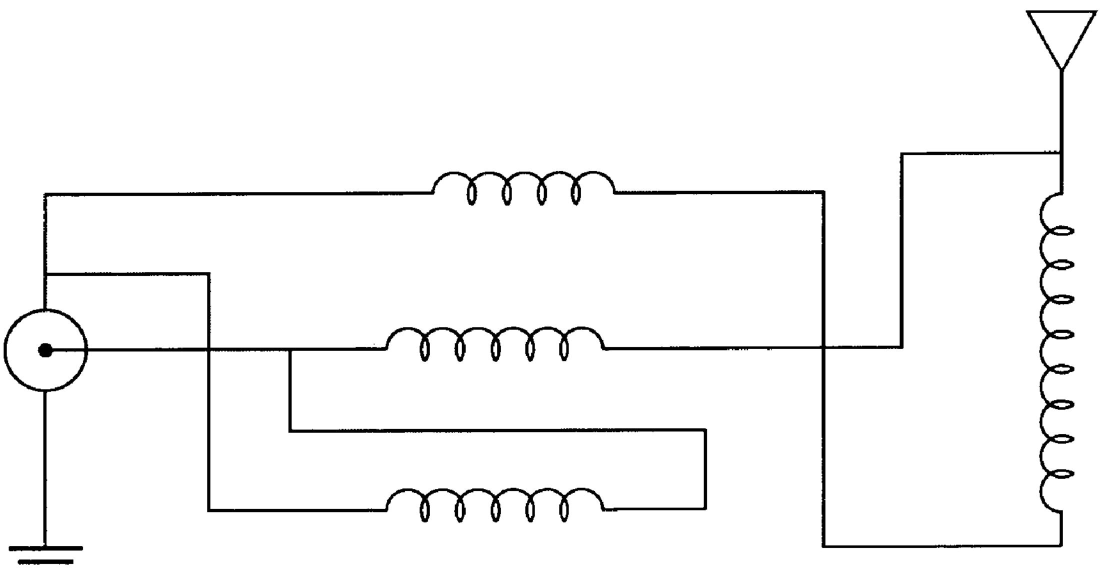


FIG. 14c

CODED ANTENNA

FIELD OF INVENTION

This invention relates to a free standing antenna and particularly to a whip antenna comprising inductive coils having a plurality of a selected number of turns disposed over an insulated aluminium tube and the method therein. The invention also relates to an antenna having plasma coating.

BACKGROUND OF THE INVENTION

Free standing or whip antennas generally comprise of an upstanding tapered length presenting a base at the bottom end thereof and a free end at the upper end. Such base antennas are used to receive and transmit signals and may be located on land or a ship.

Various attempts have heretofore been made in the prior art in order to strengthen the whip antennas that can be subjected to severe weather conditions in terms of wind or snow blowing.

For example U.S. Pat. No. 3,725,944 illustrates an antenna constructed exclusively of fibreglass with the sole exception of the electrical conductors, couplings, and upper and lower ends, which may incorporate fibreglass or some other materials.

Also U.S. Pat. No. 4,500,888 teaches a free standing antenna formed with an elongated tubular body portion having one or more sections and an enlarged base portion at its lower end for mounting thereof, and the body portion having a plurality of layers of reinforcing filaments some of the layers being bundles of longitudinal filament rovings running lengthwise, and other of the layers being generally circumferential windings of filament rovings, the layers being bonded together by resin material; electrically conducted materials embedded in the tubular structure and running from end to end, an annual electrically conductive collar connected to the conductive elements adjacent the lower end of the structure, a female threaded socket connected to the collar, and extending through a wall of the tubular structure for connection from the exterior, at least one layer of the woven reinforcing filament cloth material extending up the interior of the tubular structure adjacent the lower end, and overlying the interior of the collar, and, resin bonding the layer of woven cloth material to the interior of the tubular structure, and to the interior of the collar.

Furthermore U.S. Pat. No. 5,357,261 illustrates a whip antenna having a base member being formed of glass fibres reinforced resin materials.

Other arrangements of free standing antennas are shown in U.S. Pat. No. 4,914,450 which shows a flat ribbon-like conductor which is wound around a fibre glass rod.

U.S. Pat. No. 4,214,247 relates to a turnable fibreglass whip antenna comprising an elongated fibreglass core having a conductive wire coiled a round the core and serving as the antenna. The upper most extremity of the wire is tightly coiled around an axial bore within the fibreglass. A metal insert, fixed within the fibreglass bore is in threaded engagement with a setscrew accessible from the top of the antenna.

Furthermore, U.S. Pat. No. 4,161,737 shows a stepped, tapered helical antenna having tightly wound loading coils between each of the different helical sections, and the loading coils are wound in a stepped, tapered mathematical progression.

Furthermore, some prior art whip antennas need to be operated in pairs aboard a ship or on land in order to extend

the operation frequency range required in operation as shown in Canadian Patent No. 2,114,661.

It is an object of this invention to provide an improved free standing antenna which is easier to manufacture than shown in the prior art.

It is a further object of this invention to provide an antenna to be operated substantially instantaneously within a selected frequency band.

It is an aspect of this invention to provide a freestanding antenna extending longitudinally to present a base and a free end, comprising a helical conductor disposed over an insulated metallic tube.

It is another aspect of this invention to provide a whip antenna comprising inductive coils having a plurality of selected number of turns disposed over an insulated aluminium tube.

Yet another aspect of this invention relates to a method of producing a whip antenna comprising: tapering a length of aluminium tube, applying a high velocity plasma coating, having a nickel based alloy powder, applying a winding a ribbon conductor with a plurality with a selected number of turns along said tube, and applying a layer of polymer coating.

These and other objects and features of the invention shall now be described in relation to the follow drawings:

DRAWINGS

FIGS. **1**, **1**(*a*) and **1**(*b*) are exploded schematic views of the whip antenna.

FIG. **2** is a side elevational view of the upper tube.

FIGS. **3***a* and **3***b* are top and sectional views of the corona ball.

FIG. **4** is a side elevational view of the upper section assembly.

FIG. **5***a* is a top plan view of the upper plug insulator.

FIG. **5***b* is a cross sectional view taken along the line A—A of FIG. **5***a*.

FIG. **6***a* is a side elevational view of the male contact.

FIG. **6***b* is an end view of FIG. **6***a*.

FIG. **7***a* is an end view of the joint sleeve.

FIG. **7***b* is a cross sectional view taken along the line A—A of FIG. **7***a*.

FIG. **8** is a side elevational view of the lower taped aluminium tube.

FIG. **9** is a cross sectional view of the base insulator.

FIG. **10** is a partial view showing the base insulator connected to the lower tapered tube.

FIG. **11***a* shows the lower plug contact insulator.

FIG. **11***b* is a cross section taken along the line A—A of FIG. **11***a*.

FIG. **12***a* is a partial cross sectional view of the lower female contact.

FIG. **12***b* is an end view of FIG. **12***a*.

FIGS. **13***a* and **13***b* are side and top plan views of the spacer plate.

FIG. **14***a* is a partial assembly drawing of the transformer.

FIG. **14***b* is a perspective view of the transformer.

FIG. **14***c* is a schematic view of the transformer.

DETAILED DESCRIPTION OF THE INVENTION

Like parts will be given like numbers throughout the figures. The drawings are not necessarily to scale.

FIG. **1** is an exploded schematic view of the invention showing the whip antenna **10** comprising an upper section

20 and a lower section **80**. The upper section assembly **20** generally consists of a tapered aluminium tube **22**, corona ball **24**, vibration damper **30**, internal wiring **40** and an insulated plug style contact **60**.

Although the invention is described in relation to an aluminium tube any suitable material such as metal, could be utilized. The aluminium tube **20** is cut to a desired length and tapered using a spinning method and heat treated in order to impart the desired strength and flexing characteristics. The outside surface of the aluminium tube **22** is rotary sanded to a desired smoothness. As shown in FIG. **4** any number of holes can be drilled through the bottom end **21** of the aluminium tube **22**. As shown four holes **23** are drilled and countersunk equally spaced around the circumference of the tube **21**. A further four holes **25** are drilled and countersunk equally spaced around the circumference of the tube **22** and off set from the first four holes by 45 degrees.

The corona ball **24** may be machined from a round a luminium bar stock as shown in FIG. **3***b* and then welded to the top of the tapered tube **27** all the way around and ground flush. A vibration damper **30** is connected to the inside of the aluminium tube **22** as shown in FIG. **4** and filled with lead shot. The vibration damper is disposed off center from the inside of the hollow tube **22** so as to discourage the generation of a periodic vibration of the antenna which could otherwise be generated as a standard wave due to the influence of weather conditions, such as the wind or rocking action of a ship.

The upper plug contact **60** is comprised of three components: the male contact **61**, an insulator **62** and internal wiring **63**.

The insulator **62** may be produced by a variety of methods including machining the insulator **62** from a round nylon bar so as to produce a counter sunk bore **63** having a hexagonal recess **65**. The male contact **61** may also be produced by a variety of methods including machining the male contact **61** from a hexagonal brass bar to the configuration show in FIGS. **6***a* and **6***b*. In particular the male contact **61** has a threaded portion **67** and a generally rounded cylindrical section **69** with a slot **71** running there through. The male contact **61** fits into the insulator **62** as shown in FIG. **1** and fastened thereto by a nut (not shown); More specifically the hexagonal raised portion **73** of the male connector **61** fits into the recess **65**. Two wires **63** are stripped and soldered into the solder cup **75** of the male contact **61** using for example high temperature solder. Although the invention has been described in relation to a nylon insulator **62** and brass male contact **61** any variety of suitable materials such as insulating material or metallic material may be used.

The upper plug contact assembly **60** may then be inserted into the upper tube **22** as shown in FIG. **1**. One such assembly for example can consist of drilling three holes **35** countersunk into the tube **22** equally spaced around the circumference of the tube near the bottom **21**. Furthermore two more holes can be drilled into the tube **22** equally spaced around the circumference above the previous three holes **35**. The wires **63** can then be fed through the two holes while the upper plug contact assembly **60** is inserted into the tube until it is centered under the three countersunk holes. The insulator **62** can then be drilled and taped using the three countersunk holes as a guide and the whole assembly **60** screwed into place using these three taped holes. The loose ends of the wires **63** can then be stripped and inserted through copper button contacts, then soldered. The button contacts are fastened into the two holes drilled into the tube.

The lower section assembly **80** consists of a tapered metallic tube such as aluminium **82** joint sleeve **90**, fibre glass base insulator assembly **100**, internal wiring **110** and an lower insulated plug style contact **130**.

The tapered aluminium tube **82** can be produced by a variety of methods including cutting an aluminium tube to length and tapering it using a spinning method and heat treating same to desired specifications of strength and flexibility. The outside surface of the tube **82** is rotary sanded using a selected grit sandpaper.

The joint sleeve **90** as shown in FIGS. **7***a* and **7***b* and can be manufactured in a variety of ways. One such manufacture includes machining a round aluminium tube stock to produce a tube having a first section **91** having a first diameter and having a second section **93** with a second diameter where the second diameter **93** is smaller than the first diameter **91**. A plurality of holes, for example three holes **95**, can be drilled and countersunk into the sleeve **90** equally spaced around the circumference near the top **97** of the sleeve **90**. The sleeve **90** may then be inserted into the top **99** of the lower tube **80** so that a portion of the sleeve **90** extends out the top of the tube as shown in FIG. **1**.

The joint sleeve **90** may then be fastened to the tube **80** such as for example welding. A number of holes, for example eight, can be drill through the exposed part of the sleeve **90** using the upper section assembly as a guide for locating the holes. The holes may then be taped for threaded inserts.

The base insulator **100** can be manufactured by a variety of ways, and in one embodiment is manufactured by winding fibreglass roving soaked with an epoxy resin over a mandrel in a manner well known by persons skilled in the art. The fibreglass may be wound both longitudinally and circumferentially for strength. A mould may be clamped over the bottom of the base to form the flange and hole pattern for mounting, then placed in an oven until the resin cures.

After the resin cures, the base insulator **100** is machined and sanded down to a selected standard. Two step down diameters **102** and **104** are machined, one for the drip shield rings **105** and the other for the lower end **101** of lower tube **80**, respectively.

In one embodiment the surfaces of the base insulator which will be exposed after final assembly, to the elements, are covered with an epoxy resin soaked, thin fibreglass cloth to create a smooth outer surface.

A drill jig (not shown) can be used to drill a selected number of holes **103** into the base flange **105**. A flat and mounting hole pattern to accommodate a panel-mount LC-type connector may also be drilled and machined at this time.

A plurality of drip shield rings **105** can be manufactured in a variety of ways including utilizing resin soaked fibreglass wound over a mandrel, and clamping a mould over it as the rings **105** are cured in an oven. The drip rings may then be dimensioned so as to be concentrically mounted over step down diameter **102** and glued thereon with a suitable adhesive such as high strength epoxy glue. Spacer rings (not shown) may be installed between each drip shield **105** to separate them from each other.

A number of reinforcement rings **107** are shown in FIG. **9**. The reinforcement rings **107** can be comprised of a variety of materials including metal in the embodiment shown comprised of aluminium. The rings **107** may be inserted into the base insulator **100** and glued in place using high strength epoxy glue.

The base insulator subassembly may then be slid inside the bottom **101** of lower tube **80**. A number of holes may then be drilled so that they run through the wall of the tube

80, the wall of the step down **104** of the base insulator **100** and into the lower reinforcement ring **107**. A number of other holes may be drilled and countersunk and tapped equally spaced around the circumference of the tube. In one embodiment these holes are rotated 90 degrees and drilled into the upper reinforcement ring **107**.

The lower plug contact assembly **130** comprising three components namely the female contact **132**, lower plug contact insulator **134** and internal wiring **136**. As described above the contact **130** can be machined from nylon bar stock to present a bore **137** having a first diameter **138** and a second diameter **139**. The second diameter **139** is smaller than the first diameter **138**.

The female contact **132** may be machined from a metal bar stock such as for example brass to produce a first threaded portion **140** and a second portion **141** having a hexagonal cross section with a blind hole **143** as shown in FIGS. **12***a* and **12***b*. A slot **144** is presented by the hexagonal cross section **141**. The female contact **132** fits within the insulator **134** with the threaded portion **140** registering within the second diameter **139**. Female contact **132** is fastened onto the insulator **134** with a nut (not shown). Two wires **136** are stripped and soldered into the solder cup **145** of the female contact **132** using high temperature solder.

The lower contact assembly **130** may then be inserted into the lower tube **80**. In one embodiment two holes may be drilled into the tube equally spaced around the circumference near the top **99**. The wires **136** are fed through the two holes while the lower contact assembly **130** is inserted into the tube **80** until it stops centered under the three countersunk holes of the sleeve. The insulator **134** may be drilled and tapped using the three countersunk holes as a guide and the whole assembly is screwed into place using these three tapped holes. The loose ends of the wires **136** are stripped and inserted through copper button contacts then solders using high temperature solder. The button contacts are fastened into the two holes drilled into the tube **80**.

Two additional holes may be drilled into the lower section, one near the bottom of the base **80** and the other spaced above and in line with the first. Two wires may be cut and inserted through the holes running toward the bottom of the antenna. The loose ends of the wires (outside of the lower section) are stripped and inserted through copper button contacts then soldered using high temperature solder. The button contacts are fastened into the two holes drilled into the tube **80**.

A spacer **160** comprised of polyethylene foam as shown in FIG. **13** is inserted inside the base insulator **100** to just below the bottom of the reinforcement ring. The spacer **160** is inserted so that the two loose wires are pinned within the inner wall of the lower section and the outside surface of the spacer. Silicone adhesive is used to secure the wires and spacer against movement.

Winding and Plasma Flame Coating

Generally speaking the antenna **10** and namely the upper and lower aluminium tubes **20** and **80** are cleaned then subjected to plasma coating and then coated with a polymer prior to the application of a helical ribbon conductor with a plurality of selected number of turns along said antenna.

More specifically the upper section assembly **20** is sanded to remove any irregularities. The button contacts are masked with teflon tape and the upper section **20** is degreased and blasted with aluminium oxide grit.

Following blasting a high velocity plasma coating is applied by preheating the section to 150 degrees Fahrenheit and applying an alloy nickel based powder. In one embodiment the plasma coating occurs within one hour after grit blasting by using argon (pressure 150 PSI, flow 38 SLM) and hydrogen (pressure 50 PSI, flow 2 SLM). In one embodiment a Metco (trademark) 480 NS alloy nickel based powder is sprayed to apply a metal ceramic coating with no particles protruding more than 2 millimeters above the general surface using Metco 9M series spray system. However, other plasma sprays may be utilized.

Within 2 hours of the plasma spraying the upper section **20** is then coated with a polymer coating, taped, coated a gain and diamond ground to a smooth finish. In one embodiment the section is coated with Metal Tee 7100 coating using a roller. The taping may comprise of teflon tape for example Ultra Temp 90 tape 0.032 thick. The button contacts are then exposed, the whole section primed with for example Rustoleum G93 Xylene and the button contacts masked over again. Another polymer coating is applied to the section and the button contacts exposed again.

Thereafter a ribbon conductor which, in one example comprises of 0.120×0.010 inches is wound around the upper section **20** from bottom to top, with one full tern over top of both button contacts. The windings are selected so as to impart a desired frequency response. For example the windings can start with 10 turns per foot for the first 12 inches and increase by 4 turns per foot every 12 inches up to a total length of 16 feet. More specifically the first 12 inches can be wound at a rate of 10 turns per foot, the next 12 inches wound at a rate of 14 turns per foot, while the next 12 inches are wound at a rate of 18 turns per foot, all the way to the last 12 inches which are wound at a rate of 17 turns per foot. The ribbon conductor is then soldered to both electrical buttons using high temperature solder.

The whole section is coated with another layer of polymer coating by applying Metal Tech 7100 polymer coating with a minimum thickness of 15 mil, before wrapping a layer of fibreglass reinforcing mesh around the upper section **20** with a final polymer coating on top of the whole process. After a forty hour cure time the surface of the section is sanded smooth and the edges are ground down. The eight holes drilled into the bottom of the section **20** are re-drilled and re-countersunk to remove the plasma flame and polymer coating layers.

With respect to the lower section **80**, the base insulators **100** as well as the upper portion of the joint sleeve **90** are masked off as they do not get coated. The remaining portion of the lower section **80** is then sanded down to remove any irregularities. The button contacts are masked with teflon tape and the section is then degreased and blasted with aluminium oxide grit.

Following the blasting a high velocity plasma coating is applied to the section by preheating it to 150 degrees Fahrenheit and applying the plasma spray as described above. Within two hours of the plasma coating the section is then coated with Metal Tech 7100 polymer coating, taped, coated again and diamond ground to a smooth finish. The button contacts are then exposed, the section primed with Rustoleum G93 Xylene and the button contacts are masked over again. One more polymer coating is applied to the section and the button contacts are exposed again.

Again a ribbon conductor is selectively wound around the section from bottom to top. By way of example starting with one full turn over top of the bottom or lower button contact, a ribbon conductor (0.125×0.005 inches) is wound around the section from bottom to top. Again by way of example only the windings can start with 35 turns per foot for the first 12 inches with the 35 turn over top of the section button contact. The winds can decrease by 2 turns per foot every 12 inches after this, up to a total length of 16 feet. For example the first 12 inches are wound at a rate of 35 turns per foot, the next 12 inches are wound at a rate of 33 turns per foot, the next 12 inches are wound at a rate of 31 turns per foot, all the way to the last 12 inches which are wound at a rate of 5 turns per foot. The last turn is wound over top of the two button contacts installed at the top of the lower section. The ribbon conductor is then soldered to all four of the electrical buttons using high temperature solder.

The whole section is coated with another layer of polymer coating before wrapping a layer of fibreglass reinforcing mesh around the section with a final polymer coating over top of the whole process. After a 48 hour cure time, the surface of the section is sanded smooth and the edges are ground down. The eight holes drilled into the bottom of the lower section **80** are re-drilled and re-countersunk to remove the plasma flame and polymer coating layers.

Final Assembly

Two antenna sections **20** and **80** are joined together by sliding the upper section **20** over the joint sleeve **90**. The complete antenna is raised onto a ground plain outside to complete the tuning of the matching transformer **180**.

The matching transformer **180** is wound using a tri-filar winding of eight turns around two ferrite tororids **181** and **182**, stacked and glued together as shown in FIG. **14***a* by using an adhesive **183**. The output terminals **184** and **185** of the transformer **180** are connected to the two internal wires of the lower section. The input of the transformer **180** can be connected to a Network Analyser in order to measure the antenna's Voltage Standing Wave Ratio (VSWR). The windings on the transformer can be adjusted as with a silicone adhesive to prevent them from moving.

Two toroid support rings **190** and **192** as shown in FIG. **10** can be manufactured by a variety of means including winding resin soaked fibreglass strands around a mandrel. One support ring **190** is installed into the base insulator **100** by gluing it with high strength epoxy glue. A silicone rubber gasket **194** is placed next to the support ring **192** before the transformer is inserted. A second rubber gasket **196** is placed next to the transformer followed by the second support ring **192**.

Using one of the upper mounting holes of the LC-connector (drilled when the base insulator was first machined) found on the side wall of the base insulator, a hole is drilled through the support ring below. A nut and bolt can be used to fasten the connector, and the support ring to the base insulator.

The invention described above comprises of a vertical radiating element tapering from the integral fibreglass base to the free end. The radiating element comprises the selective windings of inductive coils over the tapered insulated aluminium tube as described. The design of the radiating element, along with its integrated matching transformer allows the antenna to be operated substantially instantaneously at any frequency within its operating frequency band. For example the frequency band can comprise of 2 MHz to 30 MHz. The antenna as described exhibits VSWR of less than 3 to 1 across the entire operating frequency band without the need of a separate tuning device.

The antenna exhibits vertical polarization and omni-directional radiation in the azimuth plane. The LC-type connector found on the side of the antenna **10** just below the drip shield allows the antenna to be directly coupled to the transmitting or receiving equipment. Up to 5 kW of transmitting power can be applied to the antenna **10**.

The fibreglass base of the antenna provides high voltage isolation between the radiating element and ground. Drip shields installed at the top of the base insulator **100** prevent high voltage spark over and corona fields from occurring between the radiating elements and ground in wet environments such as on board ships or raining weather.

Since the antenna is substantially a true broadband device, no additional tuner or coupler is necessary for operation thereby permitting replacement of other antenna systems having 2 separate whip antennas and couplers.

Furthermore since the male and female connectors were slotted they can accommodate good frictional fit and flexibility there between to maximize electrical contact.

Moreover the antenna described therein exhibits superior heat dissipating characteristics so as to substantially minimize tracking of heat seeking missiles.

The foregoing is a description of the preferred embodiments of the invention which is given here by way of example only. The invention is not to be taken as limited to any of the specific features as described, but comprehends all such variations thereof as come within the scope of the appended claims.

We claim:

1. A free standing antenna extending longitudinally to present a base and a free end, comprising a metallic tube, a metallic plasma layer disposed on said metallic tube, a polymer layer disposed on said metallic plasma layer, a helical conductor ribbon disposed on said polymer layer.

2. The free standing antenna as claimed in claim **1** wherein said metallic tube comprising a tapered aluminum tube.

3. The free standing antenna as claimed in claim **2** including a fiberglass base insulator disposed at the base of said free standing antenna.

4. The free standing antenna as claimed in claim **3**, wherein said helical conductor includes at least two different selected number of turns per unit length along said antenna.

5. The free standing antenna as claimed in claim **4**, wherein said plasma coating comprise an alloy nickel based ceramic.

6. The free standing antenna as claimed in claim **5** including another polymer layer disposed on said helical conductor ribbon.

7. The free standing antenna as claimed in claim **6**, including a fiberglass reinforcing mesh disposed on said another polymer layer.

8. The free standing antenna as claimed in claim **7**, further including a matching transformer.

9. The free standing antenna as claimed in claim **7**, wherein said helical conductor has a plurality of selected number of turns along said longitudinal length.

10. The free standing antenna as claimed in claim **9**, wherein said antenna includes an upper section and a lower section.

11. A radio frequency whip antenna comprising an upper and lower aluminum tube, each said tube having a metallic plasma layer disposed over said aluminum tube and a polymer layer disposed over said metallic plasma layer, and inductive coils having a plurality of different selected number of turns disposed over said polymer layer of said upper and lower aluminum tube.

12. A whip antenna as claimed in claim **11**, including the fiberglass base insulator disposed at a base of said lower tube.

13. A whip antenna as claimed in claim **12** wherein said coil comprises a conductive ribbon.

14. A whip antenna as claimed in claim **13**, wherein said metal plasma-coating includes a nickel based alloy ceramic.

15. A whip antenna as claimed in claim **14**, including a transformer disposed in a fiberglass base insulator.

16. A whip antenna extending longitudinally from a base to a free end comprising;

(a) an aluminum tube tapering form said base to said free end;

(b) a nickel ceramic plasma coating disposed on said aluminum tube;

(c) a polymer coating disposed on said nickel ceramic plasma coating;

(d) a conductor disposed over said polymer coating with varying number of turns of conductor along the length of antenna;

(e) another polymer coating over said conductor;

(f) fibreglass reinforced mesh disposed over said another polymer coating.

17. A whip antenna as claimed in claim **16** wherein said conductor comprises a ribbon conductor.

18. A whip antenna as claimed in claim **17** wherein said number of turns is selected from a range of 35 to 12 turns per foot.

19. A whip antenna as claimed in claim **18** including a transformer.

* * * * *

US007555827B2

(12) United States Patent
Pozzobon et al.

(10) **Patent No.: US 7,555,827 B2**
(45) **Date of Patent: Jul. 7, 2009**

(54) **MANUFACTURING CODED ANTENNA**

(76) Inventors: **Frank Pozzobon**, 302 Maltby Road East, Guelph, Ontario (CA) N1L 1G4; **Paul R. MacPherson**, 1010 Duchess Avenue, British Columbia, Ontario (CA) V7T 1G9

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **11/774,057**

(22) Filed: **Jul. 6, 2007**

(65) **Prior Publication Data**

US 2008/0010810 A1 Jan. 17, 2008

Related U.S. Application Data

(62) Division of application No. 10/900,178, filed on Jul. 28, 2004, now Pat. No. 7,242,367.

(51) **Int. Cl.**
H01P 11/00 (2006.01)

(52) **U.S. Cl.** **29/600**; 29/606; 343/900

(58) **Field of Classification Search** 29/825, 29/831, 600, 601; 333/162; 343/900, 906, 343/702, 895; 445/29, 49
See application file for complete search history.

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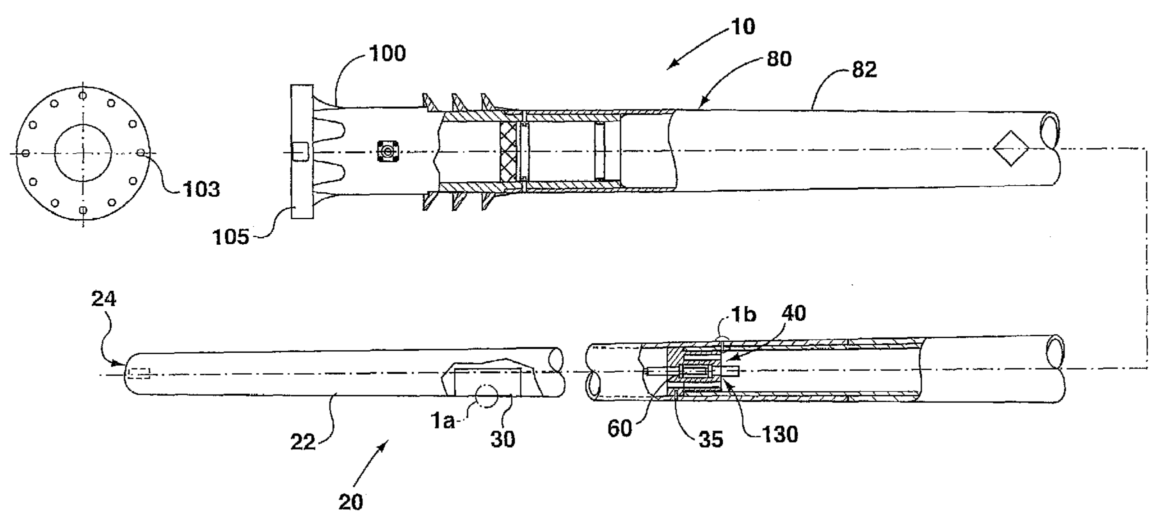
Primary Examiner—Minh Trinh

(57) **ABSTRACT**

A method of producing a whip antenna by tapering a length of aluminium tube and applying high velocity plasma to the aluminium tube. A ribbon conductor is also wound with a plurality of selected number of turns along the aluminium tube. A polymer coating is also applied to the antenna.

10 Claims, 6 Drawing Sheets



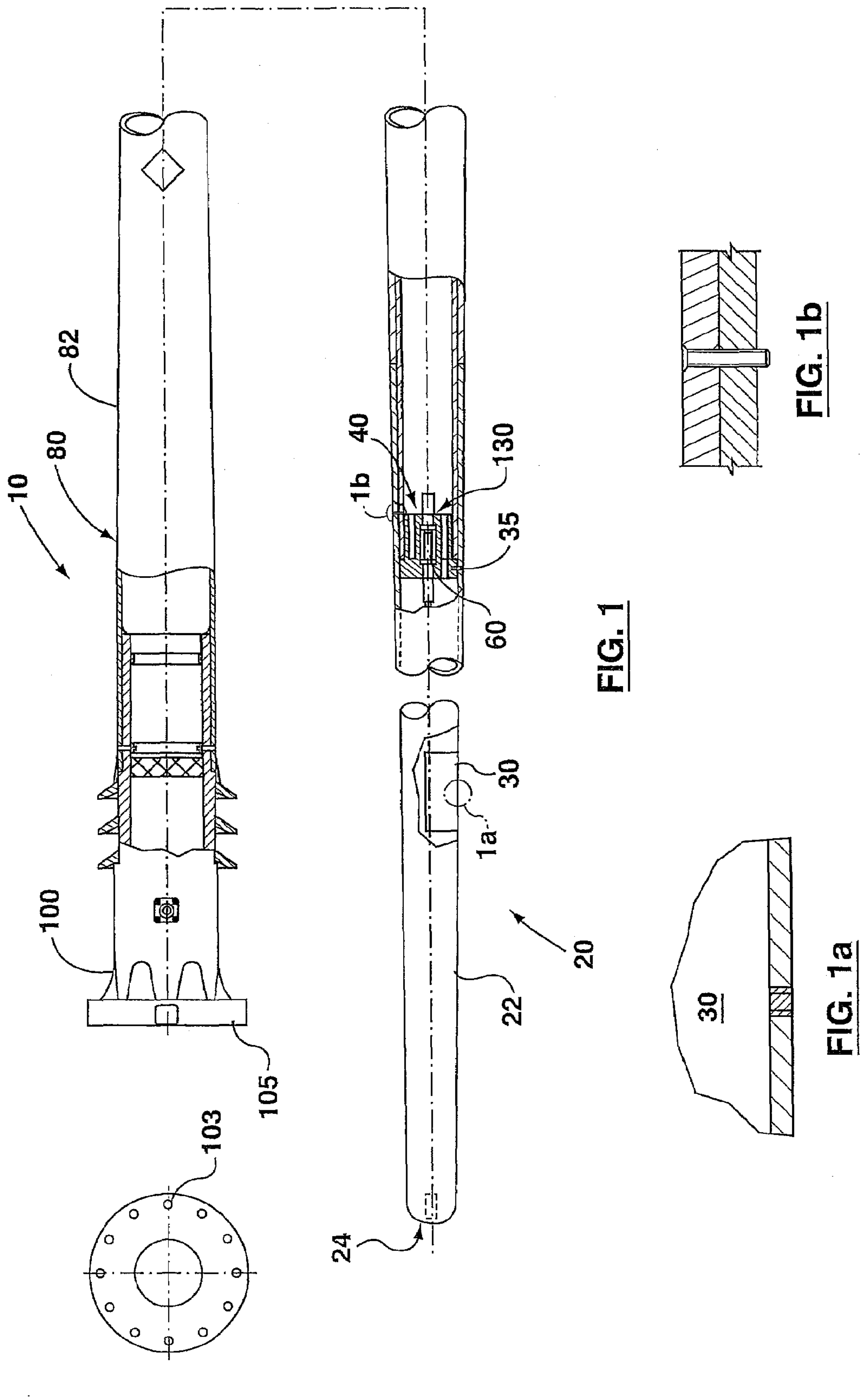


FIG. 1

FIG. 1a

FIG. 1b

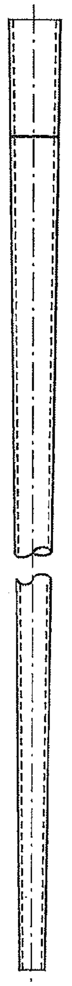


FIG. 2

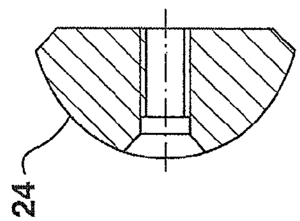


FIG. 3b

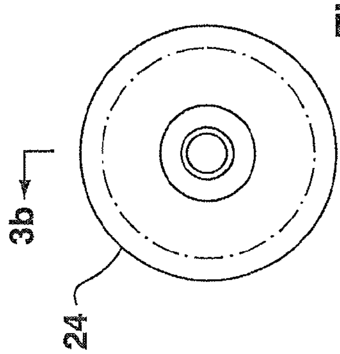


FIG. 3a

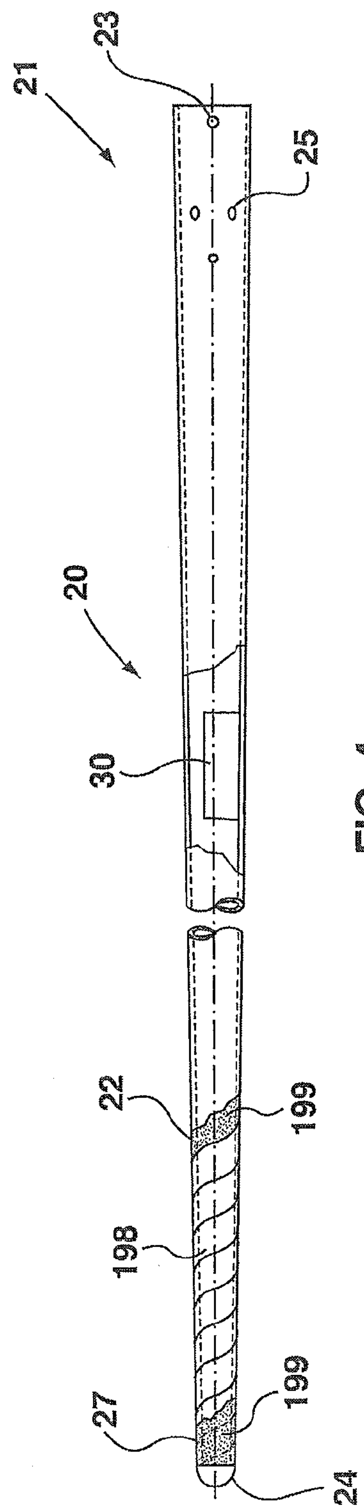


FIG. 4

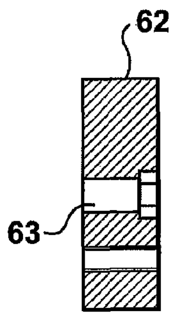


FIG. 5b

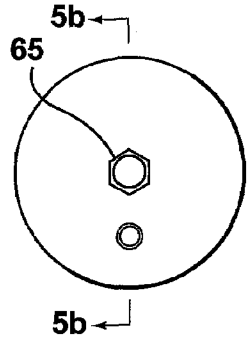


FIG. 5a

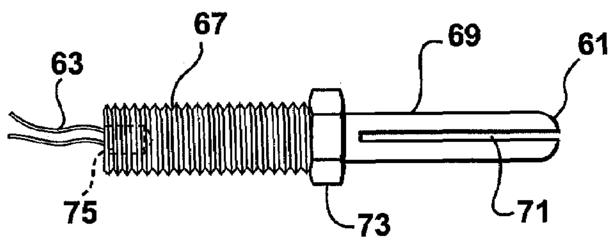


FIG. 6a

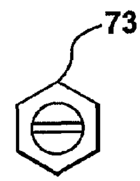


FIG. 6b

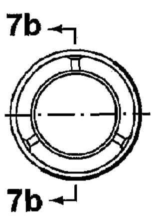


FIG. 7a

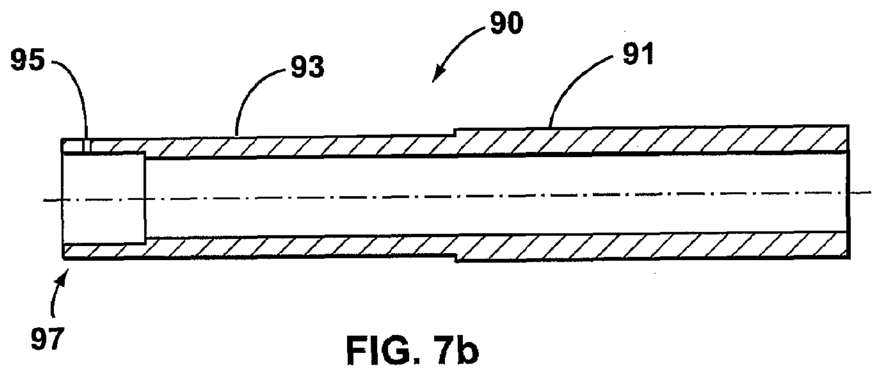


FIG. 7b

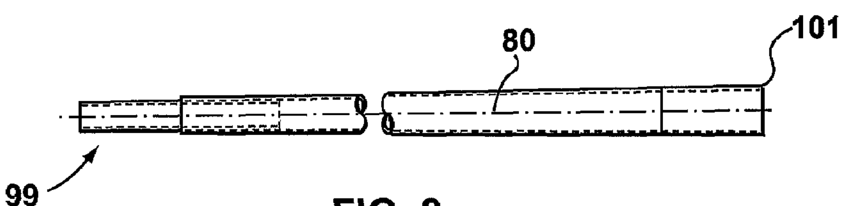


FIG. 8

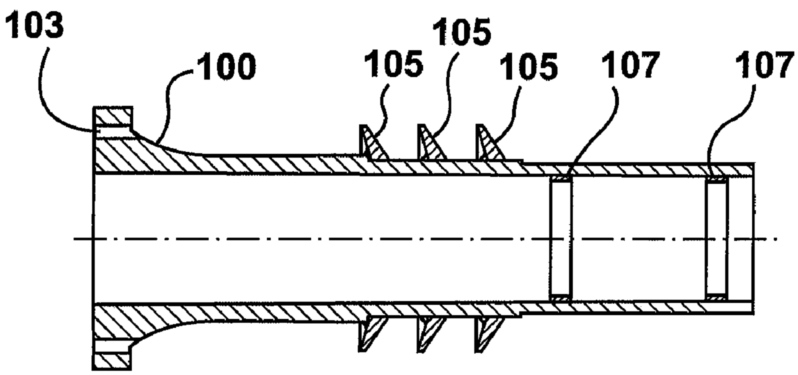


FIG. 9

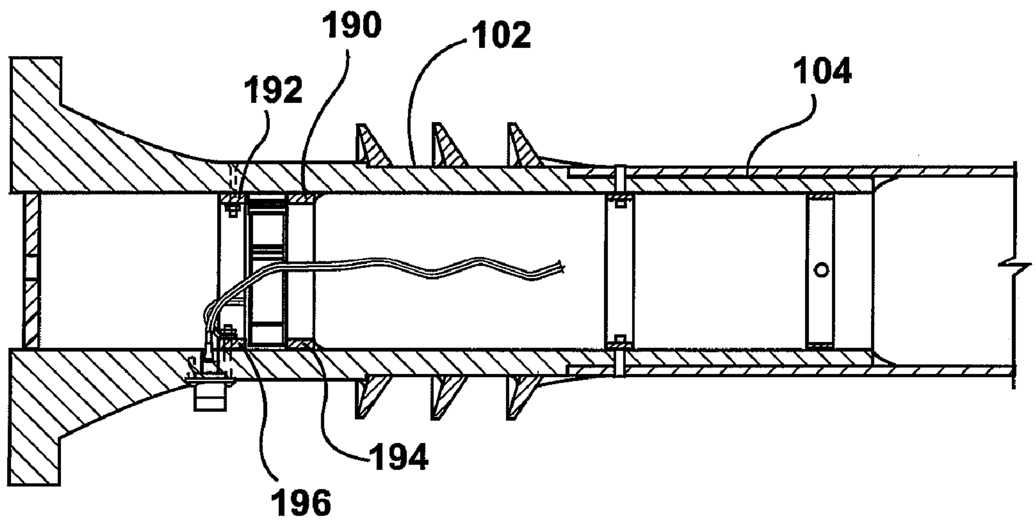


FIG. 10

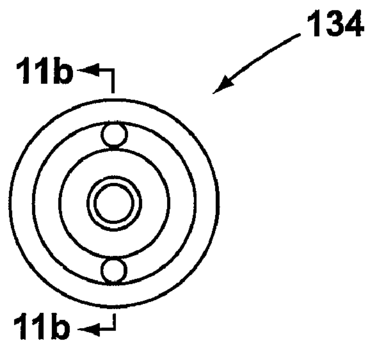


FIG. 11a

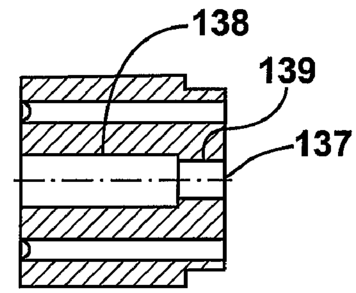


FIG. 11b

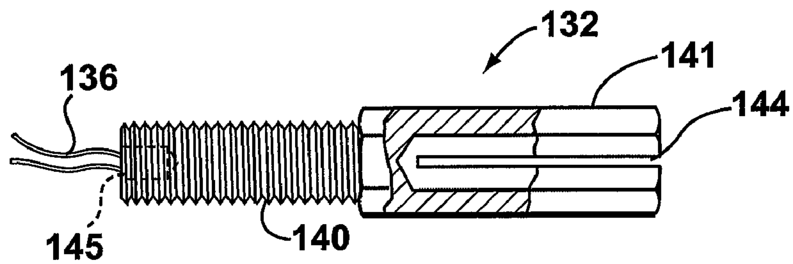


FIG. 12a

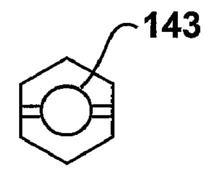


FIG. 12b

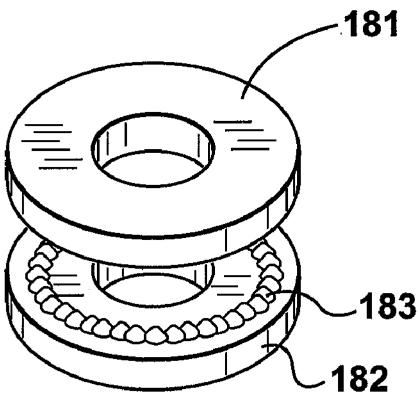


FIG. 14a

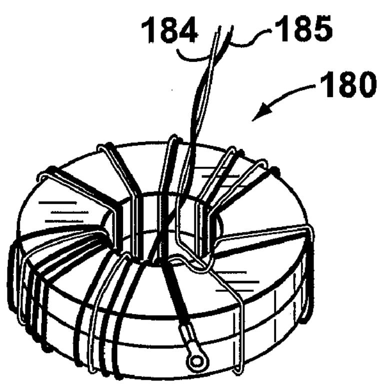


FIG. 14b

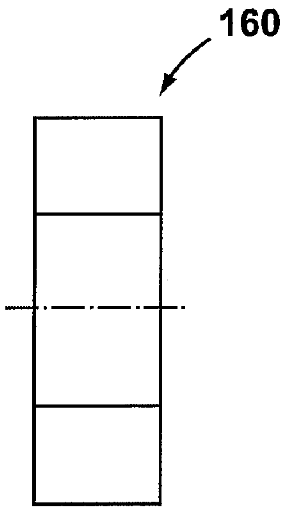


FIG. 13a

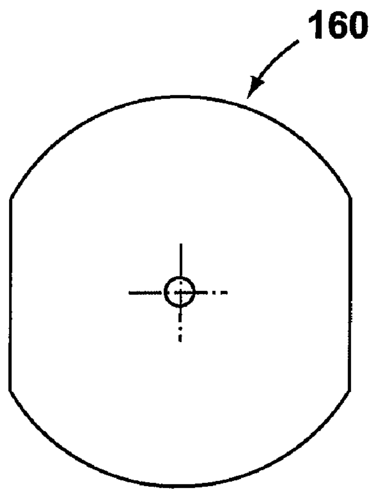


FIG. 13b

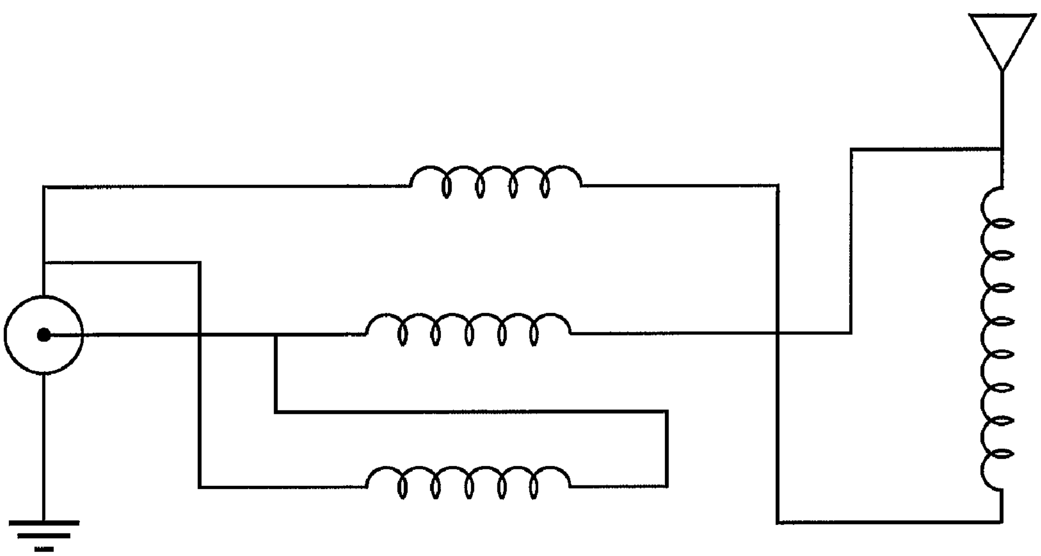


FIG. 14c

MANUFACTURING CODED ANTENNA

This application is a divisional of U.S. patent application Ser. No. 10/900,178 filed on Jul. 28, 2004.

FIELD OF INVENTION

This invention relates to a method for producing a whip antenna.

BACKGROUND OF THE INVENTION

Free standing or whip antennae generally comprise of an upstanding tapered length presenting a base at the bottom end thereof and a free end at the upper end. Such base antennas are used to receive and transmit signals and may be located on land or a ship.

Various attempts have heretofore been made in the prior art in order to strengthen the whip antennas that can be subjected to severe weather conditions in terms of wind or snow blowing.

For example U.S. Pat. No. 3,725,944 illustrates an antenna constructed exclusively of fibreglass with the sole exception of the electrical conductors, couplings, and upper and lower ends, which may incorporate fibreglass or some other materials.

Also U.S. Pat. No. 4,500,888 teaches a free standing antenna formed with an elongated tubular body portion having one or more sections and an enlarged base portion at its lower end for mounting thereof, and the body portion having a plurality of layers of reinforcing filaments some of the layers being bundles of longitudinal filament rovings running lengthwise, and other of the layers being generally circumferential windings of filament rovings, the layers being bonded together by resin material; electrically conducted materials embedded in the tubular structure and running from end to end, an annual electrically conductive collar connected to the conductive elements adjacent the lower end of the structure, a female threaded socket connected to the collar, and extending through a wall of the tubular structure for connection from the exterior, at least one layer of the woven reinforcing filament cloth material extending up the interior of the tubular structure adjacent the lower end, and overlying the interior of the collar, and, resin bonding the layer of woven cloth material to the interior of the tubular structure, and to the interior of the collar.

Furthermore U.S. Pat. No. 5,357,261 illustrates a whip antenna having a base member being formed of glass fibres reinforced resin materials.

Other arrangements of free standing antennas are shown in U.S. Pat. No. 4,914,450 which shows a flat ribbon-like conductor which is wound around a fibre glass rod.

U.S. Pat. No. 4,214,247 relates to a turnable fibreglass whip antenna comprising an elongated fibreglass core having a conductive wire coiled around the core and serving as the antenna. The upper most extremity of the wire is tightly coiled around an axial bore within the fibreglass. A metal insert, fixed within the fibreglass bore is in threaded engagement with a setscrew accessible from the top of the antenna.

Furthermore, U.S. Pat. No. 4,161,737 shows a stepped, tapered helical antenna having tightly wound loading coils between each of the different helical sections, and the loading coils are wound in a stepped, tapered mathematical progression.

Furthermore, some prior art whip antennas need to be operated in pairs aboard a ship or on land in order to extend

the operation frequency range required in operation as shown in Canadian Patent No. 2, 114, 661.

It is an object of this invention relates to a method of producing a whip antenna comprising: tapering a length of aluminium tube, applying a high velocity plasma coating, having a nickel based alloy powder, applying a winding a ribbon conductor with a plurality with a selected number of turns along said tube, and applying a layer of polymer coating.

The features of the invention shall now be described in relation to the follow drawings:

DRAWINGS

FIGS. **1**, **1**(*a*) and **1**(*b*) are exploded schematic views of the whip antenna.

FIG. **2** is a side elevational view of the upper tube.

FIGS. **3***a* and **3***b* are top and sectional views of the corona ball.

FIG. **4** is a side elevational view of the upper section assembly.

FIG. **5***a* is a top plan view of the upper plug insulator.

FIG. **5***b* is a cross sectional view taken along the line A-A of FIG. **5***a*.

FIG. **6***a* is a side elevational view of the male contact.

FIG. **6***b* is an end view of FIG. **6***a*.

FIG. **7***a* is an end view of the joint sleeve.

FIG. **7***b* is a cross sectional view taken along the line A-A of FIG. **7***a*.

FIG. **8** is a side elevational view of the lower taped aluminium tube.

FIG. **9** is a cross sectional view of the base insulator.

FIG. **10** is a partial view showing the base insulator connected to the lower tapered tube.

FIG. **11***a* shows the lower plug contact insulator.

FIG. **11***b* is a cross section taken along the line A-A of FIG. **11***a*.

FIG. **12***a* is a partial cross sectional view of the lower female contact.

FIG. **12***b* is an end view of FIG. **12***a*.

FIGS. **13***a* and **13***b* are side and top plan views of the spacer plate.

FIG. **14***a* is a partial assembly drawing of the transformer.

FIG. **14***b* is a perspective view of the transformer.

FIG. **14***c* is a schematic view of the transformer.

DETAILED DESCRIPTION OF THE INVENTION

Like parts will be given like numbers throughout the figures. The drawings are not necessarily to scale.

FIG. **1** is an exploded schematic view of the invention showing the whip antenna **10** comprising an upper section **20** and a lower section **80**. The upper section assembly **20** generally consists of a tapered aluminium tube **22**, corona ball **24**, vibration damper **30**, internal wiring **40** and an insulated plug style contact **60**.

Although the invention is described in relation to an aluminium tube any suitable material such as metal, could be utilized. The aluminium tube **20** is cut to a desired length and tapered using a spinning method and heat treated in order to impart the desired strength and flexing characteristics. The outside surface of the aluminium tube **22** is rotary sanded to a desired smoothness. As shown in FIG. **4** any number of holes can be drilled through the bottom end **21** of the aluminium tube **22**. As shown four holes **23** are drilled and countersunk equally spaced around the circumference of the tube **21**. A further four holes **25** are drilled and countersunk equally spaced around the circumference of the tube **22** and off set from the first four holes by 45 degrees.

The corona ball **24** may be machined from a round aluminium bar stock as shown in FIG. **3***b* and then welded to the top of the tapered tube **27** all the way around and ground flush. A vibration damper **30** is connected to the inside of the aluminium tube **22** as shown in FIG. **4** and filled with lead shot. The vibration damper is disposed off center from the inside of the hollow tube **22** so as to discourage the generation of a periodic vibration of the antenna which could otherwise be generated as a standard wave due to the influence of weather conditions, such as the wind or rocking action of a ship.

The upper plug contact **60** is comprised of three components: the male contact **61**, an insulator **62** and internal wiring **63**.

The insulator **62** may be produced by a variety of methods including machining the insulator **62** from a round nylon bar so as to produce a counter sunk bore **63** having a hexagonal recess **65**. The male contact **61** may also be produced by a variety of methods including machining the male contact **61** from a hexagonal brass bar to the configuration show in FIGS. **6***a* and **6***b*. In particular the male contact **61** has a threaded portion **67** and a generally rounded cylindrical section **69** with a slot **71** running there through. The male contact **61** fits into the insulator **62** as shown in FIG. **1** and fastened thereto by a nut (not shown). More specifically the hexagonal raised portion **73** of the male connector **61** fits into the recess **65**. Two wires **63** are stripped and soldered into the solder cup **75** of the male contact **61** using for example high temperature solder. Although the invention has been described in relation to a nylon insulator **62** and brass male contact **61** any variety of suitable materials such as insulating material or metallic material may be used.

The upper plug contact assembly **60** may then be inserted into the upper tube **22** as shown in FIG. **1**. One such assembly for example can consist of drilling three holes **35** countersunk into the tube **22** equally spaced around the circumference of the tube near the bottom **21**. Furthermore two more holes can be drilled into the tube **22** equally spaced around the circumference above the previous three holes **35**. The wires **63** can then be fed through the two holes while the upper plug contact assembly **60** is inserted into the tube until it is centered under the three countersunk holes. The insulator **62** can then be drilled and taped using the three countersunk holes as a guide and the whole assembly **60** screwed into place using these three taped holes. The loose ends of the wires **63** can then be stripped and inserted through copper button contacts, then soldered. The button contacts are fastened into the two holes drilled into the tube.

The lower section assembly **80** consists of a tapered metallic tube such as aluminium **82** joint sleeve **90**, fibre glass base insulator assembly **100**, internal wiring **110** and an lower insulated plug style contact **130**.

The tapered aluminium tube **82** can be produced by a variety of methods including cutting an aluminium tube to length and tapering it using a spinning method and heat treating same to desired specifications of strength and flexibility. The outside surface of the tube **82** is rotary sanded using a selected grit sandpaper.

The joint sleeve **90** as shown in FIGS. **7***a* and **7***b* and can be manufactured in a variety of ways. One such manufacture includes machining a round aluminium tube stock to produce a tube having a first section **91** having a first diameter and having a second section **93** with a second diameter where the second diameter **93** is smaller than the first diameter **91**. A plurality of holes, for example three holes **95**, can be drilled and countersunk into the sleeve **90** equally spaced around the circumference near the top **97** of the sleeve **90**. The sleeve **90** may then be inserted into the top **99** of the lower tube **80** so that a portion of the sleeve **90** extends out the top of the tube as shown in FIG. **1**.

The joint sleeve **90** may then be fastened to the tube **80** such as for example welding. A number of holes, for example eight, can be drill through the exposed part of the sleeve **90** using the upper section assembly as a guide for locating the holes. The holes may then be taped for threaded inserts.

The base insulator **100** can be manufactured by a variety of ways, and in one embodiment is manufactured by winding fibreglass roving soaked with an epoxy resin over a mandrel in a manner well known by persons skilled fin the art. The fibreglass may be wound both longitudinally and circumferentially for strength. A mould may be clamped over the bottom of the base to form the flange and hole pattern for mounting, then placed in an oven until the resin cures.

After the resin cures, the base insulator **100** is machined and sanded down to a selected standard. Two step down diameters **102** and **104** are machined, one for the drip shield rings **105** and the other for the lower end **101** of lower tube **80**, respectively.

In one embodiment the surfaces of the base insulator which will be exposed after final assembly, to the elements, are covered with an epoxy resin soaked, thin fibreglass cloth to create a smooth outer surface.

A drill jig (not shown) can be used to drill a selected number of holes **103** into the base flange **105**. A flat and mounting hole pattern to accommodate a panel-mount LC-type connector may also be drilled and machined at this time.

A plurality of drip shield rings **105** can be manufactured in a variety of ways including utilizing resin soaked fibreglass wound over a mandrel, and clamping a mould over it as the rings **105** are cured in an oven. The drip rings may then be dimensioned so as to be concentrically mounted over step down diameter **102** and glued thereon with a suitable adhesive such as high strength epoxy glue. Spacer rings (not shown) may be installed between each drip shield **105** to separate them from each other.

A number of reinforcement rings **107** are shown in FIG. **9**. The reinforcement rings **107** can be comprised of a variety of materials including metal in the embodiment shown comprised of aluminium. The rings **107** may be inserted into the base insulator **100** and glued in place using high strength epoxy glue.

The base insulator subassembly may then be slid inside the bottom **101** of lower tube **80**. A number of holes may then be drilled so that they run through the wall of the tube **80**, the wall of the step down **104** of the base insulator **100** and into the lower reinforcement ring **107**. A number of other holes may be drilled and countersunk and tapped equally spaced around the circumference of the tube. In one embodiment these holes are rotated 90 degrees and drilled into the upper reinforcement ring **107**.

The lower plug contact assembly **130** comprising three components namely the female contact **132**, lower plug contact insulator **134** and internal wiring **136**. As described above the contact **130** can be machined from nylon bar stock to present a bore **137** having a first diameter **138** and a second diameter **139**. The second diameter **139** is smaller than the first diameter **138**.

The female contact **132** may be machined from a metal bar stock such as for example brass to produce a first threaded portion **140** and a second portion **141** having a hexagonal cross section with a blind hole **143** as shown in FIGS. **12***a* and **12***b*. A slot **144** is presented by the hexagonal cross section **141**. The female contact **132** fits within the insulator **134** with the threaded portion **140** registering within the second diameter **139**. Female contact **132** is fastened onto the insulator **134** with a nut (not shown). Two wires **136** are stripped and soldered into the solder cup **145** of the female contact **132** using high temperature solder.

The lower contact assembly **130** may then be inserted into the lower tube **80**. In one embodiment two holes may be drilled into the tube equally spaced around the circumference near the top **99**. The wires **136** are fed through the two holes while the lower contact assembly **130** is inserted into the tube **80** until it stops centered under the three countersunk holes of the sleeve. The insulator **134** may be drilled and tapped using the three countersunk holes as a guide and the whole assembly is screwed into place using these three tapped holes. The loose ends of the wires **136** are stripped and inserted through copper button contacts then solders using high temperature solder. The button contacts are fastened into the two holes drilled into the tube **80**.

Two additional holes may be; drilled into the lower section, one near the bottom of the base **80** and the other spaced above and in line with the first. Two wires may be cut and inserted through the holes running toward the bottom of the antenna. The loose ends of the wires (outside of the lower section) are stripped and inserted through copper button contacts then soldered using high temperature solder. The button contacts are fastened into the two holes drilled into the tube **80**.

A spacer **160** comprised of polyethylene foam as shown in FIG. **13** is inserted inside the base insulator **100** to just below the bottom of the reinforcement ring. The spacer **160** is inserted so that the two loose wires are pinned within the inner wall of the lower section and the outside surface of the spacer. Silicone adhesive is used to secure the wires and spacer against movement.

Winding and Plasma Flame Coating

Generally speaking the antenna **10** and namely the upper and lower aluminium tubes **20** and **80** are cleaned then subjected to plasma coating and then coated with a polymer **199** prior to the application of a helical ribbon conductor **198** with a plurality of selected number of turns along said antenna.

More specifically the upper section assembly **20** is sanded to remove any irregularities. The button contacts are masked with teflon tape and the upper section **20** is degreased and blasted with aluminium oxide grit.

Following blasting a high velocity plasma coating is applied by preheating the section to 150 degrees Fahrenheit and applying an alloy nickel based powder. In one embodiment the plasma coating occurs within one hour after grit blasting by using argon (pressure 150 PSI, flow 38 SLM) and hydrogen (pressure 50 PSI, flow 2 SLM). In one embodiment a Metco (trademark) 480 NS alloy nickel based powder is sprayed to apply a metal ceramic coating with no particles protruding more than 2 millimeters above the general surface using Metco 9M series spray system. However, other plasma sprays may be utilized.

Within 2 hours of the plasma spraying the upper section **20** is then coated with a polymer coating **199**, taped, coated again and diamond ground to a smooth finish. In one embodiment the section is coated with Metal Tee 7100 coating using a roller. The taping may comprise of teflon tape for example Ultra Temp 90 tape 0.032 thick. The button contacts are then exposed, the whole section primed with for example Rustoleum G93 Xylene and the button contacts masked over again. Another polymer coating is applied to the section and the button contacts exposed again.

Thereafter a ribbon conductor **198** which, in one example comprises of 0.120.times.0.010 inches is wound around the upper section **20** from bottom to top, with one full tern over top of both button contacts. The windings are selected so as to impart a desired frequency response. For example the windings can start with 10 turns per foot for the first 12 inches and increase by 4turns per foot every 12 inches up to a total length of 16 feet. More specifically the first 12 inches can be-wound at a rate of 10 turns per foot, the next 12 inches wound at a rate of 14 turns per foot, while the next 12 inches are wound at a rate of 18 turns per foot, all the way to the last 12 inches which are wound at a rate of 17 turns per foot. The ribbon conductor **198** is then soldered to both electrical buttons using high temperature solder.

The whole section is coated with another layer of polymer coating **199** by applying Metal Tech 7100 polymer coating with a minimum thickness of 15 mil, before wrapping a layer of fibreglass reinforcing mesh around the upper section **20** with a final polymer coating on top of the whole process. After a forty hour cure time the surface of the section is sanded smooth and the edges are ground down. The eight holes drilled into the bottom of the section **20** are re-drilled and re-countersunk to remove the plasma flame and polymer coating layers.

With respect to the lower section **80**, the base insulators **100** as well as the upper portion of the joint sleeve **90** are masked off as they do not get coated. The remaining portion of the lower section **80** is then sanded down to remove any irregularities. The button contacts are masked with teflon tape and the section is then degreased and blasted with aluminium oxide grit.

Following the blasting a high velocity plasma coating is applied to the section by preheating it to 150 degrees Fahrenheit and applying the plasma spray as described above. Within two hours of the plasma coating the section is then coated with Metal Tech 7100 polymer coating, taped, coated again and diamond ground to a smooth finish. The button contacts are then exposed, the section primed with Rustoleum G93 Xylene and the button contacts are masked over again. One more polymer coating **199** is applied to the section and the button contacts are exposed again.

Again a ribbon conductor **198** is selectively wound around the section from bottom to top. By way of example starting with one full turn over top of the bottom or lower button contact, a ribbon conductor **198** (0.125.times.0.005 inches) is wound around the section from bottom to top. Again by way of example only the windings can start with 35 turns per foot for the first 12 inches with the 35 turn over top of the section button contact. The winds can decrease by 2 turns per foot every 12 inches after this, up to a total length of 16 feet. For example the first 12 inches are wound at a rate of 35 turns per foot, the next 12 inches are wound at a rate of 33turns per foot, the next 12 inches are wound at a rate of 31 turns per foot, all the way to the last 12 inches which are wound at a rate of 5 turns per foot. The last turn is wound over top of the two button contacts installed at the top of the lower section. The ribbon conductor **198** is then soldered to all four of the electrical buttons using high temperature solder.

The whole section is coated with another layer of polymer coating **199** before wrapping a layer of fibreglass reinforcing mesh around the section with a final polymer coating **199** over top of the whole process. After a 48 hour cure time, the surface of the section is sanded smooth and the edges are ground down. The eight holes drilled into the bottom of the lower section **80** are re-drilled and re-countersunk to remove the plasma flame and polymer coating layers.

Final Assembly

Two antenna sections **20** and **80** are joined together by sliding the upper section **20** over the joint sleeve **90**. The complete antenna is raised onto a ground plain outside to complete the tuning of the matching transformer **180**.

The matching transformer **180** is wound using a tri-filar winding of eight turns around two ferrite tororids **181** and **182**, stacked and glued together as shown in FIG. **14***a* by using an adhesive **183**. The output terminals **184** and **185** of the transformer **180** are connected to the two internal wires of the lower section. The input of the transformer **180** can be connected to a Network Analyser in order to measure the antenna's Voltage Standing Wave Ratio (VSWR). The windings on the transformer can be adjusted as with a silicone adhesive to prevent them from moving.

Two toroid support rings **190** and **192** as shown in FIG. **10** can be manufactured by a variety of means including winding resin soaked fibreglass strands around a mandrel. One support ring **190** is installed into the base insulator **100** by gluing it with high strength epoxy glue. A silicone rubber gasket **194** is placed next to the support ring **192** before the transformer is inserted. A second rubber gasket **196** is placed next to the transformer followed by the second support ring **192**.

Using one of the upper mounting holes of the LC-connector (drilled when the base insulator was first machined) found on the side wall of the base insulator, a hole is drilled through the support ring below. A nut and bolt can be used to fasten the connector, and the support ring to the base insulator.

The invention described above comprises of a vertical radiating element tapering from the integral fibreglass base to the free end. The radiating element comprises the selective windings of inductive coils over the tapered insulated aluminium tube as described. The design of the radiating element, along with its integrated matching transformer allows the antenna to be operated substantially instantaneously at any frequency within its operating frequency band. For example the frequency band can comprise of 2 MHz to 30 MHz. The antenna as described exhibits VSWR of less than 3 to 1 across the entire operating frequency band without the need of a separate tuning device.

The antenna exhibits vertical polarization and omni-directional radiation in the azimuth plane. The LC-type connector found on the side of the antenna **10** just below the drip shield allows the antenna to be directly coupled to the transmitting or receiving equipment. Up to 5 kW of transmitting power can be applied to the antenna **10**.

The fibreglass base of the antenna provides high voltage isolation between the radiating element and ground. Drip shields installed at the top of the base insulator **100** prevent high voltage spark over and corona fields from occurring between the radiating elements and ground in wet environments such as on board ships or raining weather.

Since the antenna is substantially a true broadband device, no additional tuner or coupler is necessary for operation thereby permitting replacement of other antenna systems having 2 separate whip antennas and couplers.

Furthermore since the male and female connectors were slotted they can accommodate good frictional fit and flexibility there between to maximize electrical contact.

Moreover the antenna described therein exhibits superior heat dissipating characteristics so as to substantially minimize tracking of heat seeking missiles.

The foregoing is a description of the preferred embodiments of the invention which is given here by way of example only. The invention is not to be taken as limited to any of the specific features as described, but comprehends all such variations thereof as come within the scope of the appended claims.

We claim:

1. A method for producing a whip antenna comprising:

(a) tapering a length of aluminum tube,

(b) applying a metallic plasma coating, having a nickel based alloy powder, on said tube,

(c) applying a layer of polymer coating on said metallic plasma coating,

(d) winding a ribbon conductor with a plurality of selected number of turns on said polymer coating,

(e) further wrapping a layer of fibreglass reinforcing mesh and another coat of polymer coating, thereby forming an antenna.

2. The method as claimed in claim **1**, wherein said aluminum tube comprises two sections, and the sections are connected to each other.

3. The method as claimed in claim **2**, wherein one section includes an insulating base and inserting a transformer therein.

4. The method as claimed in claim **3**, wherein the insulating base is disposed at a lower section of said aluminum tube.

5. The method as claimed in claim **4**, wherein the ribbon conductor is wound along the aluminum tube at least two different selected number of turns per unit length along said tube.

6. The method as claimed in claim **4**, including the step of cleaning said aluminum tube with aluminum oxide grit prior to plasma coating.

7. The method as claimed in claim **6**, wherein another coat of polymer coating is disposed on the ribbon conductor.

8. The method as claimed in claim **1** wherein the plasma coating is nickel ceramic plastic coating.

9. The method as claimed in claim **1** wherein the number of turns of ribbon can vary along with length of the whip antenna.

10. The method as claimed in claim **1** wherein the antenna operates between a frequency band between 2 MHz and 30 MHz.

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