United States Patent

[11] 3,587,103

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[73] Assignee The Garrett Corporation
LosAngeles, Calif.
Continuation of application Ser. No. 628,899, Apr. 6, 1967, now abandoned.

[54] STOWABLE RADIO ANTENNA
7 Claims, 8 Drawing Figs.

[52] U.S. Cl. 343/709, 343/900
[51] Int. Cl. H01q 1/34
[50] Field of Search 343/709, 900

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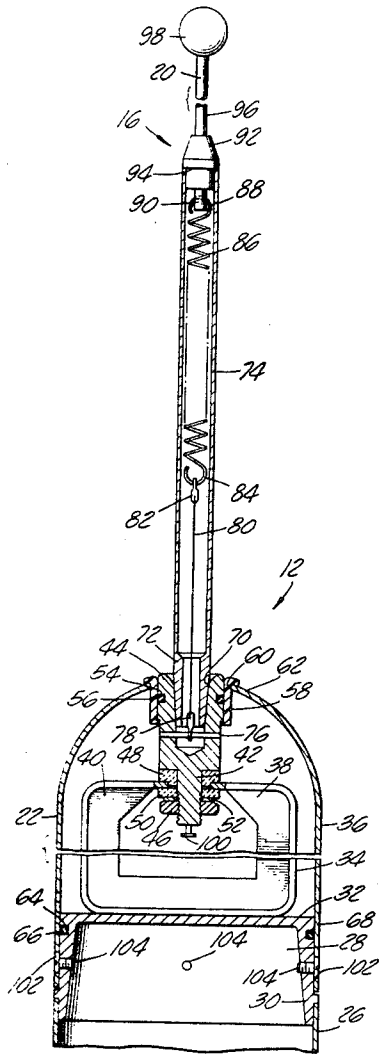
ABSTRACT: A tubular sleeve at the base end of an antenna encloses a tension spring, an end of which is secured to a wall having a socket member arranged to receive a plug member on the base end of the antenna. The spring erects the antenna from the wall with the plug in the socket. Alternatively, the socket may be disposed on the end of the antenna and the plug on the wall.



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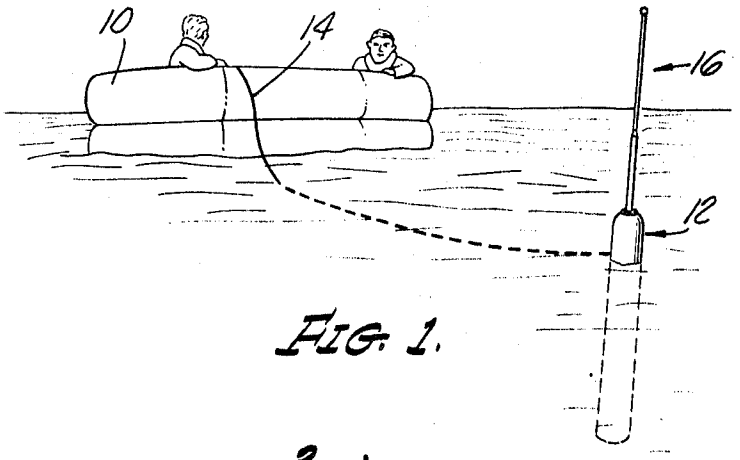

FIG. 1.

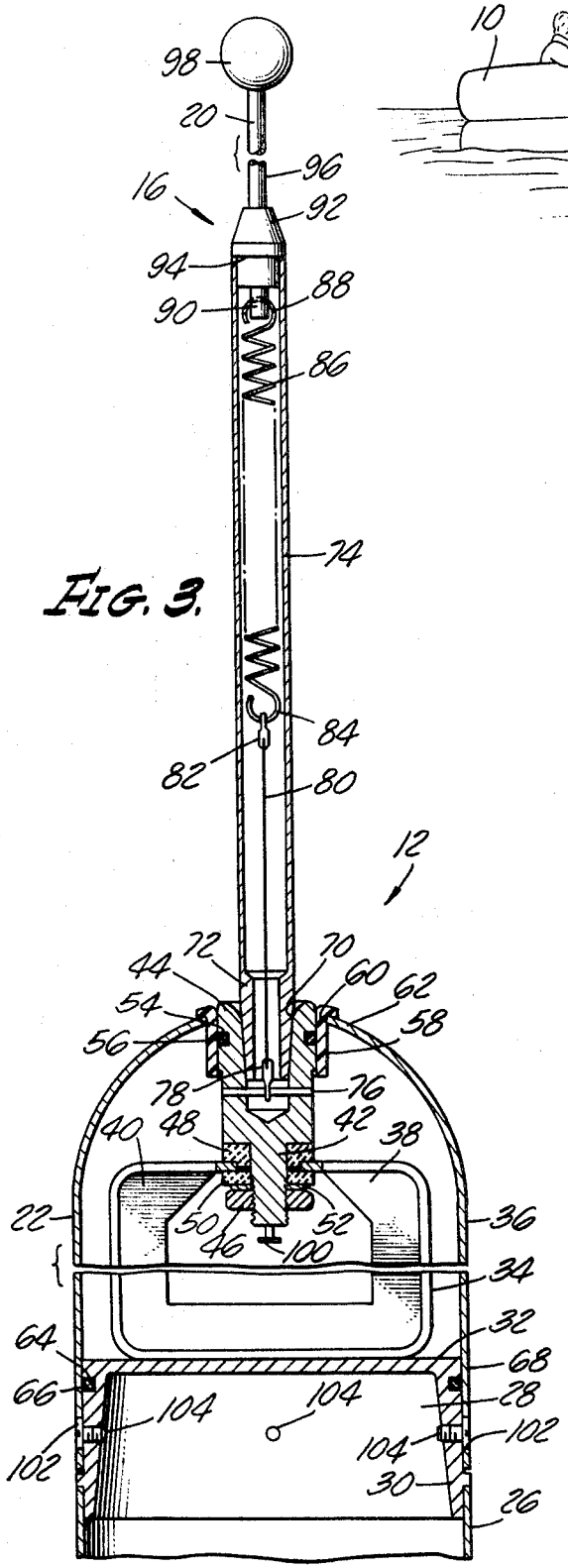

FIG. 3.

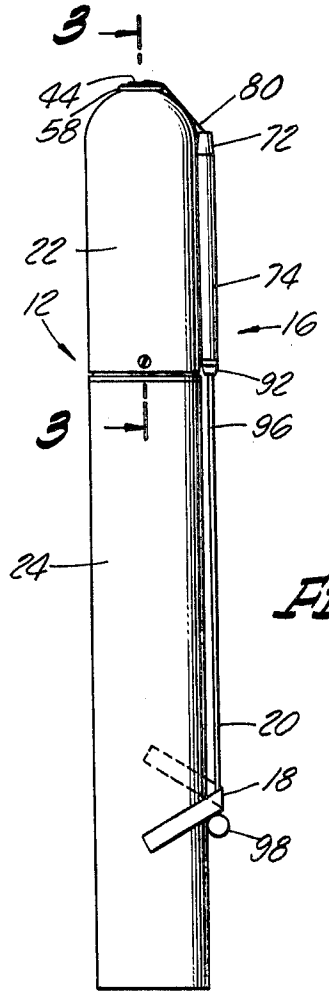

FIG. 2.

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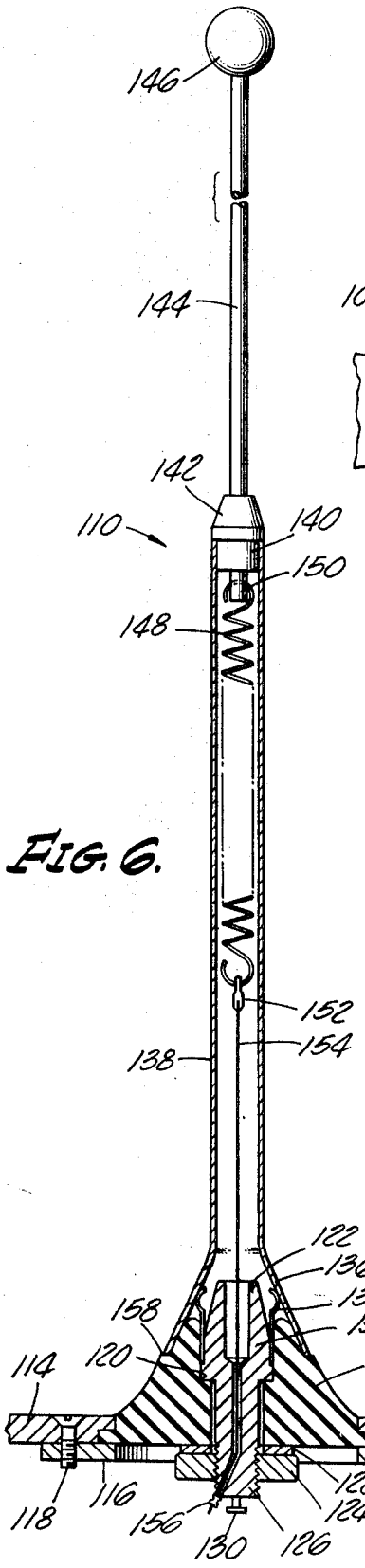
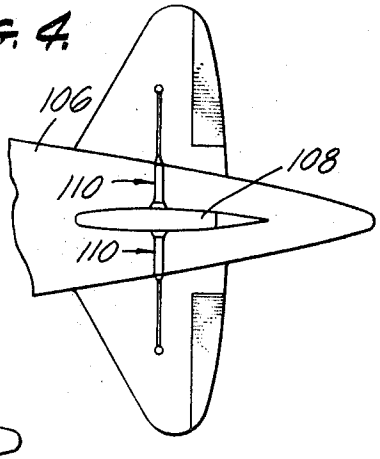


FIG. 6.

FIG. 4.



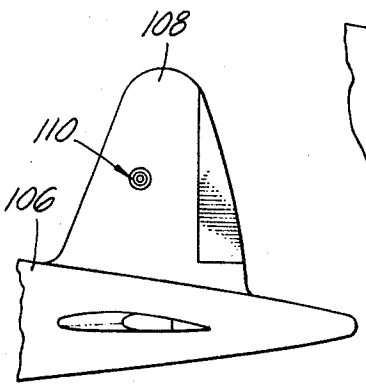


FIG. 5.

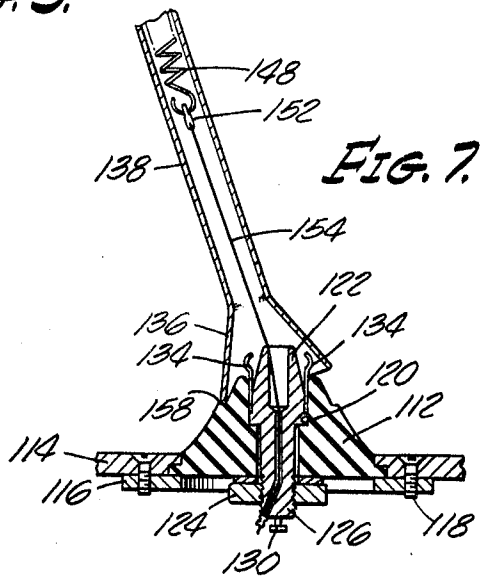


FIG. 7.

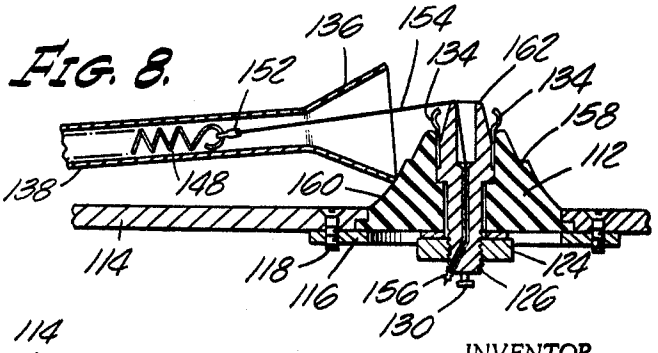


FIG. 8.

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STOWABLE RADIO ANTENNA

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of my copending application entitled "Radio Antenna Apparatus," Ser. No. 628,899, filed Apr. 6, 1967, now abandoned.

BACKGROUND OF THE INVENTION

The antenna requirement of a portable or transportable radio set presents peculiar problems by reason of the antenna's very configuration and its physical relationship to the radio set. Thus, the antenna for such sets is usually comprised of a relatively long, thin radiator rod which, in the operation of the set, is required to be erected vertically from a supporting structure or wall comprising the enclosure for the radio set. Particular types of radio sets compound the problems. In the case of a marker beacon radio, for example, the set must necessarily be as compact as possible for transport in a stowed condition, and a permanently erected antenna is not compatible with such a situation.

Another example of a situation where the antenna presents critical problems is that of an aircraft having an onboard radio transmitter to function with a distress signal in the event of a crash of the aircraft. As is known, many such crashes occur in remote and mountainous or wooded sections. In such a case, a permanently erected antenna is very apt to snap off if merely brushed by the limb of a tree. Here, too, a permanently erected antenna is not compatible with this type situation.

The present invention is concerned with apparatus forming a part of the antenna and the wall of the enclosure for the radio set whereby the antenna may be moved between erected and nonerected positions with respect to the enclosure wall, the movement from nonerected to erected position being automatic and positive, as required under the particular circumstances of the time, by means of a tension spring enclosed within a tubular sleeve at the base of the antenna. It is an object of the present invention to provide such an arrangement of apparatus which surmounts the shortcomings of the prior art.

Marker beacon radio sets of the prior art, for example, have only partially solved the problem of movement of the antenna between erected and nonerected positions. In one known case, the antenna has its base end pivotally arranged with the enclosure wall by means of a hingelike structure and having a coiled spring associated therewith to effect erection of the antenna. This has been proven to be highly unsatisfactory from both mechanical and electrical considerations. From the mechanical standpoint, this known arrangement is cumbersome, complex and expensive to manufacture and assemble. It is even more unsatisfactory from the electrical standpoint in that it presents difficult problems of radiofrequency transmission line impedance mismatch, resulting in unpredictable standing waves which degrade performance. Since marker beacon radio sets have a relatively low power output, e.g. of the order of 350 milliwatts average power, it is apparent that even a slight impedance mismatch may degrade the radiation output seriously.

SUMMARY

The objects of the invention are accomplished by providing a mechanical and electrical arrangement of plug and socket members associated with the antenna radiator and the enclosure wall of the radio set. A tension spring disposed in a tubular sleeve forming one end of the antenna radiator serves to move the antenna from nonerected to erected positions and cause the plug member to be engaged by the socket member so as to provide a firmly and substantially fixed mechanical erection, and at the same time to close the transmission line circuit from the radio to the antenna with little or no electrical impedance mismatch. Preferably, the plug is disposed on the base end of the antenna in the case of a marker beacon radio set, and the socket member is disposed on the enclosure wall with insulator means between the socket and the wall. It is apparent, of course, that the plug and socket members could be disposed in reverse positions, as will be disclosed in the alternate embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

The two embodiments of the invention illustrated in the drawings are by way of disclosing the invention and not with the intention of limiting the invention to such embodiments, as will be apparent to those skilled in the art. In the drawings:

FIG. 1 illustrates the invention incorporated in a marker beacon radio set and the practical use of the latter in facilitating a typical sea rescue operation;

FIG. 2 is a side elevation view of a marker beacon radio set, showing the antenna in stowed or nonerected position;

FIG. 3 is an enlarged cross section view of a portion of the radio set, taken on the line 3–3 of FIG. 2, with the antenna radiator in erected position;

FIG. 4 is a top plan view of the tail portion of an airplane showing the installation of a pair of antennas of the invention disposed on the vertical tail fin;

FIG. 5 is a side elevation view of the tail portion of the airplane shown in FIG. 4;

FIG. 6 is an enlarged cross section view of the antenna shown in FIGS. 4 and 5;

FIG. 7 is a cross section view of a portion of the antenna of FIG. 6, showing the antenna displaced slightly from erected position; and

FIG. 8 is a view similar to FIG. 7 showing the antenna grossly displaced from erected position.

Referring to FIG. 1 there is shown an inflated raft 10 with a number of occupants. The figure is illustrative of a situation wherein an aircraft, for example, having encountered trouble in an overwater flight has ditched, and the onboard inflatable raft, after being ejected or cast free from the aircraft, has inflated, the passengers of the aircraft thereafter boarding the raft in known manner. Also shown in the figure is a marker beacon radio set 12, to which a tether line 14 is secured, the other end of the tether being secured inside the raft to prevent the radio set from drifting away from the immediate area.

The radio set 12 may, for example, be stowed with the raft 10 in a designated compartment of the aircraft, both the raft and radio set being ejected simultaneously in the emergency in known manner. In the alternative, the radio set may be removably secured to a bracket in the pilot's compartment of the aircraft, for example, to be snatched by the pilot and carried with him when he leaves the craft in the emergency. Whether stowed with the raft, or bracketed, it is desirable that the radio set have its antenna radiator nonerected until such time as it is put into use.

Referring to FIG. 2, the radio set 12 is shown with its antenna radiator 16 in nonerected position, and retained thusly alongside the set 12 by means of a water-soluble link such as the water-soluble tape 18 which is cemented or otherwise bonded to the set 12 adjacent the tip end 20 of the antenna 16. The set 12 comprises upper and lower container portions 22 and 24, respectively, joined by means to be described. Portions 22 and 24 form a generally cylindrical assembly which is relatively long compared to its diameter. This configuration is efficacious and preferred in that it permits the enclosure of a battery or other type of power supply (not shown) in the lower portion 24 and the radio transmitter proper in the upper portion 22. Conveniently, the lower portion 24 may be open at the bottom end to permit access of water to the battery if the latter is the type which is energized by the addition of water thereto. The arrangement assures that the center of mass of the set 12 is toward the lower end whereby the assembly will be partially buoyant with a substantial part of the upper portion 22 displaced above the waterline. When the set 12 enters the water, the tape 18 is loosened or dissolved and permits the antenna 16 to be erected, as will be described hereinafter.

As illustrated in FIG. 3 the upper end 26 of the lower portion 24 has disposed across the open end thereof a cup 28. The lower end of the skirt 30 of the cup is seated in the upper end 26 and secured thereto as by cementing or brazing. It is apparent, of course, that the container portion 24 and the cup 28 could be fabricated as an integral unit by casting, for example. The flat face 32 of the cup 28 has secured thereto one end of a substantially U-shaped angle bracket 34 which extends upwardly within the wall 36 of the upper portion 22 of the set 12. The bracket 34 is adapted to have secured thereto the base of the circuit board of a radio transmitter (not shown), and the upper inwardly disposed ends 38, 40 are arranged to have secured thereto the reduced threaded end portion 42 of the socket 44 by means of the nut 46. A shouldered insulating washer 48 and a flat insulating washer 50 disposed on the reduced end portion 42 of the socket 44 serve to electrically insulate the socket from the bracket ends 38 and 40. A thin metal washer 52 is interposed between the nut 46 and the flat insulating washer 50.

The socket 44, which is provided with a peripheral groove 54 adapted to receive an O-ring seal 56, is slidably received within an insulator bushing 58 which is disposed within an opening 60 in the end 62 of the wall 36. As shown, the end 62 is hemispherical but could be sloping in configuration, and the bushing 58 is secured therewithin by cementing, for example, to prevent entry of water through the opening 60 between the bushing 58 and the wall 36. The O-ring seal serves the same purpose as between the socket 44 and the insulator bushing 58. Likewise, it will be observed that the cup 28 is provided with a peripheral groove 64 arranged to receive an O-ring seal 66 to prevent the entry of water between the cup 28 and the lower end 68 of the wall 36.

The socket 44 is provided with a tapered bore 70 adapted to slidably receive a similarly tapered plug end 72 of the tubular sleeve 74 of the antenna radiator 16. Preferably, plug end 72 is of somewhat thickened section, as compared with the rest of the sleeve 74, to constitute a plug member which is resistant to bending, compression and torsion stresses incident to the antenna erecting procedure detailed below. The socket 44 is also bored transversely to have secured therewithin a roll pin 76 which is adapted to engage a ferrule 78 on an end of a lanyard 80, the ferrule 82 on the other end of which is engaged on one end 84 of a tension spring 86 disposed within the sleeve 74. Preferably, the lanyard 80 is comprised of woven wire braid having an eyelet formed on each of the ends 78 and 82 which are adapted to overlie the roll pin 76 and the end 84 of the spring, respectively.

The other end 88 of the spring 86 is secured to the reduced portion 90 of the plug 92 which is secured partially on the upper end of the sleeve 74, as shown, by means of the shoulder 94 of the plug 92 which bears against the end of the sleeve. Extending from the outer end of the plug 92 is the radiation rod 96 which is provided with a small plastic ball 98 on the end 20 thereof. The ball is for the protection of personnel and the raft fabric when the antenna 16 is erected.

It is readily apparent that with this arrangement of parts, the socket 44 and the radio transmitter (not shown) may be assembled and secured on the bracket 34 with the antenna erected from the socket after which the output terminal (not shown) of the radio transmitter may be coupled to the terminal 100 on the reduced portion 42 of the socket 44. Thereafter, the enclosure wall 36 may be disposed down over the antenna 16 with the insulator bushing 58 slidably disposed over the socket 44 and the lower end 68 of the wall disposed over the skirt 30 of the cup 28. For retention thereat, the lower end 68 of the wall 36 is provided with a plurality of openings 102 which are slightly larger than the heads of the screws 104 threadably received in the skirt 30 of the cup 28.

The tension spring 86 may, for example, have a spring rate of the order of 15 to 20 pounds per inch, and, when the parts are assembled as shown in FIG. 3, maintains a preferable tension of say about 10 pounds to keep the antenna 16 firmly erected with the tapered plug end 72 thereof securely fixed in the tapered base 70 of the socket 44. This nominal tension on the antenna when erected is sufficient to maintain it in that condition with a good electrical path from the terminal 100 through the faying surfaces of the tapered bore and plug end, respectively, of the socket and antenna.

As noted, FIG. 3 shows the radio set 12 with its antenna radiator 16 erected. Displacement of the antenna from erected to nonerected positions for stowage, as shown in FIG. 2, is accomplished easily by grasping the upper portion 22 of the radio set 12 in one hand and the tubular sleeve portion 74 of the antenna 16 in the other hand and withdrawing the plug end 72 from the socket 44 with a slight twisting motion of the hands. The antenna is withdrawn sufficiently far enough, thereby stretching the spring 86, to enable it to be laid alongside the upper and lower portions 22 and 24 as shown in FIG. 2, after which the tape 18 may be applied to secure the antenna in the stowed position. This provides a radio set package which is easily stowed in the selected location.

The novelty of the embodiment of the invention shown in FIGS. 2 and 3 is manifest at once when the radio set 12 enters the water to perform its included function. Immediately upon loosening of the water-soluble tape 18, the tension of the spring 86 exerted through the lanyard 80 on the antenna causes the latter to move upwardly with the plug end 72 moving along the hemispherical curve of the end wall portion 62. This causes the antenna to whip outwardly and arcuately until its longitudinal axis coincides with the longitudinal axis of the upper portion 22 of the radio set 12, whereupon the plug end 72 of the antenna is forced into the socket 44 by the continuing tension of the spring 86. The resulting mechanical and electrical coupling of the plug and socket is complete and secure, and the radio set is able to send its signals on the frequencies appropriate to its application without further attention.

It should be noted that upon the occasion of response to the signals and rescue or imminent rescue operations by a search aircraft homing on the signals, the radio set may be quickly and easily disabled against further transmission by the simple expedient of displacement of the antenna from erected to nonerected positions by one of the survivors, substantially as described above. In this event, the retention of the antenna 16 alongside the radio set 12 may be conveniently effected by wrapping the tether cord 14 therearound and tying it.

Turning now to the second embodiment of the invention illustrated in FIGS. 4—8, there is disclosed an antenna arrangement which differs from that of FIGS. 1—3 principally in that a reversal of the plug and socket members is preferable, as will be described. FIG. 4 shows the bare outline of the tail portion 106 of an aircraft fuselage having a vertical tail fin 108, on either side of which is disposed a pair of identical antennae 110. FIG. 5 shows a side elevation view of the tail structure with one of the antennas erected from the skin surface of the fin.

The preferred structure and arrangement of the parts of the antenna 110 is illustrated in FIG. 6, wherein the antenna comprises an insulator base 112 secured to the skin or wall 114 of the aircraft (not shown) by means of an annular ring 116 held in place by screws 118. The insulator base 112 defines a stepped bore 120 within which the plug element 122 is secured by a nut 124 threaded on the lower portion 126 of the element 122. A washer 128 is interposed between the base 112 and the nut 124. A terminal 130 is provided on the lower end of the portion 126 of the element 122, to which the transmission line of the radio set in the aircraft may be coupled.

Disposed between the upper portion 132 of the element 122 and the contiguous surface of the bore in the base 112 are a pair of leaf springs 134 which are thereby pressed into intimate contact with the element 122. The springs 134 function to establish an electrical path from the terminal 130 through the member 132 to the radiator of the antenna 110 by way of contact with the interior surface of the outwardly flared portion 136 at the lower end of the tubular sleeve member 138. Disposed within the upper end of the sleeve 138 is the reduced

portion 140 of a plug 142 from which extends the radiation rod 144 which may be provided with a small plastic or metal ball 146 on its distal end. A tension spring 148 disposed within the sleeve 138 has its upper end engaged by the further reduced portion 150 of the plug 142, and its lower end engaged by the ferrule 152 on the upper end of the lanyard 154. The lower end of the lanyard extends through a central bore in plug element 122 and has secured thereto a clip 156 to retain the spring 148 in tension via the lanyard 154.

As shown in FIGS. 6, 7 and 8, the insulating member 112 is of interrupted, generally frustoconical configuration defining a step 158 intermediate the top and bottom ends of the member. With the radiator in erected position the step 158 provides a footing for the entire lower edge of the flared portion 136 of the sleeve member 138 and the tension spring 148 tends to hold the radiator in the erected position. In that position, the antenna is available for radiation of the output signal supplied to it at the terminal 130 from the antenna output terminal of a radio transmitter carried within the fuselage 106 of the aircraft.

It is now obvious from FIGS. 6, 7 and 8 that the flared portion 136 of the antenna radiator constitutes the socket member, and the plug member is comprised of the insulator 112, the plug element 122 and the leaf springs 134.

The antenna of this embodiment has important use in connection with the emission of a distress signal in the event of an aircraft crash. As often happens, such a crash may occur in remote areas of dense brush or heavy woods. In such a case, if the brush or undergrowth is contacted by impact of the antenna radiator thereagainst, the usual antenna structure of the prior art snaps off or is bent in such a manner as to make it nearly useless after the contact ceases by further movement of the aircraft through the brush. In some cases the contact impact could be great enough to bend the antenna into contact with the aircraft skin, and thus constitute a net-zero impedance short circuit seen by the radio transmitter which would short circuit the output to the other of a pair of antennas such as shown in FIG. 4.

In any event, even a light contact with brush constitutes a pathway to ground for the radiation from the antenna and causes standing waves in the transmission line, thereby degrading the output to a companion antenna.

The antenna radiator of the present embodiment is enabled to "rock" on the footing 158 and at the same time to cause an interruption of the electrical path from the radio transmitter to the radiator by separation of the plug and socket members. This is illustrated in FIG. 7 wherein the force of an assumed contact between the antenna radiator and a tree branch, for example, (not shown) has caused the radiator to rock on the step 158. Simultaneously with the rocking displacement the interior surface of the flared portion 136 of the tube sleeve 138 moves away from contact with the leaf springs 134 and interrupts the electrical integrity of the transmission line. Upon removal of the displacing force, the tension spring 148 causes the radiator to rock back to erected position and to reinstate the electrical integrity through the leaf springs 134 and the flared portion 136.

If, instead of merely rocking the radiator on the step 158, the external applied force is of such intensity that the flared portion 136 is removed completely off the step 158, the radiator will then reerect itself when the external force is removed. This is illustrated in FIG. 8 wherein the radiator has been completely disengaged from the base 112 to the extent that the radiator lies alongside the wall 114. It is at once apparent that such a displacement would cause additional extension of the tension spring 148. Upon removal of the displacing force, the spring causes the radiator to move back toward the base 112 until the edge of the flared portion 136 contacts the lower surface 160 of the base 112. The point of contact becomes a fulcrum about which the radiator rotates toward an erect position by the spring force.

Since the point of contact may be below the step 158, it is apparent that the inner surface of the flared radiator portion 136 will be brought into contact with the upper rounded end 162 of the plug element 122 and will slide therealong until the lower end of the flared portion seats on the step 158. Thereafter, the radiator whips to an erect position, thereby restoring the electrical integrity between the inner surface of the flared portion 136 and the leaf springs 134.

We claim:

1. Apparatus for erecting and maintaining erect a radio antenna radiator comprising:

container means having an exterior wall, including an elongated sidewall portion and an end wall portion, said end wall means portion having an opening therein,

a socket member positioned in said opening and having a tapered bore therein, the larger end of said bore being accessible from the exterior of said end wall portion,

an antenna radiator including a tubular sleeve having a plug member at one end thereof,

spring means in said sleeve, said socket member having attachment means in said bore spaced from said larger end, flexible extension means connecting said attachment means with said spring means, said extension means extending through said plug member, and

holding means for temporarily holding said antenna radiator against said sidewall portion substantially parallel with the longitudinal axis of said sidewall portion and spaced from said socket member bore, said holding means including a water-soluble adhesive bonding said antenna radiator against said sidewall portion, whereby said holding means releases said antenna radiator when exposed to water and said radiator whips over said end wall and said plug member is pulled into said tapered bore by said extension means and said spring means.

2. The apparatus according to claim 1 wherein said end wall is substantially hemispherical and said flexible extension means has a length greater than the radius of said hemispherical portion, whereby said antenna radiator is wholly supported on said sidewall portion.

3. The apparatus according to claim 2 wherein said water responsive holding means includes a tape overlapping said antenna radiator at a distance spaced from said plug member, said adhesive being on said tape and bonding said radiator to said sidewall portion whereby said extension means and said tape cooperate to maintain said antenna radiator against said sidewall portion.

4. The apparatus according to claim 1 wherein said attachment means includes a pin extending transversely of said tapered bore, and said extension means includes a lanyard connected at one end with said pin and at the opposite end with said spring means in said sleeve.

5. Radio antenna package comprising:

a body having a cylindrical wall and an end wall,

a socket member having a tapered bore therein, means mounting said member in said end wall,

an antenna radiator including a tubular sleeve having a plug member at one end thereof, said sleeve extending axially along said cylindrical wall on the outside of said cylindrical wall with a portion of said end wall being between said bore and said one end of said sleeve,

spring means in said sleeve, a lanyard, means attaching one end of said lanyard in said bore, said lanyard extending through said plug member and being attached to said spring means, said lanyard having a bend over a portion of said socket member and a bend over said plug member, said spring means continuously applying tension in said lanyard, and

means for temporarily holding said sleeve on said cylindrical wall, said holding means being released upon exposure to water, whereby the bends in the lanyard cooperate with the holding means to overcome the force of the spring means, but when exposed to water, the antenna radiator swings over the end wall and is pulled into the bore by the lanyard.

6. The apparatus according to claim 5 wherein said holding means includes a water-soluble tape spaced longitudinally of said sleeve from said plug member, said tape overlapping said radiator and being bonded to the surface of said cylindrical wall.

7. The apparatus according to claim 6 wherein the central axis of said bore is substantially parallel to the central axis of said plug member, with the sum of said lanyard bends being greater than 90°.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,587,103 Dated June 22, 1971

Inventor(s) George Smith Lawrie

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

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Should read -

-- Inventor George Smith Lawrie,
Don Mills, Ontario, Canada --

Signed and sealed this 21st day of March 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

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