United States Patent

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[73] Assignee The United States of America as represented by the Secretary of the Navy

[54] **FLEXIBLE BOUYANT CABLE ANTENNA**
4 Claims, 4 Drawing Figs.

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[51] Int. Cl. H01q 1/34
[50] Field of Search 343/709, 710, 790, 873, 900, 908

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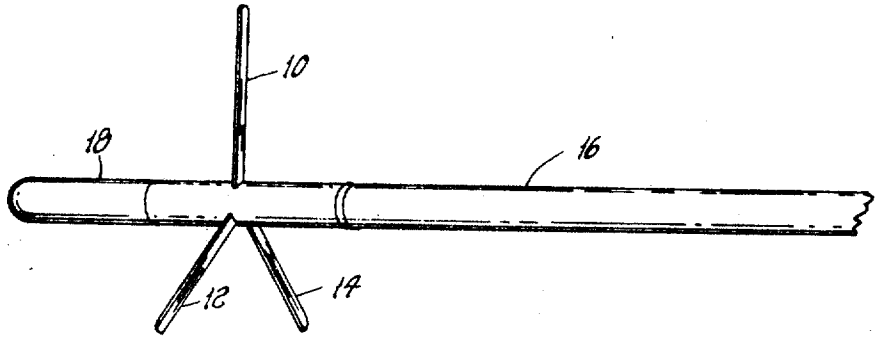
ABSTRACT: A spoke-wheel foldable, buoyant antenna comprising three-spokes separated by 120°, the spokes being held on a threaded rod between spacers and the assembly being tightened by a nut. The central conductor of a coaxial cable having a dielectric sheath, a conductive braiding sheath and a buoyant outer sheath is bared and soldered to the connecting means. A short length of cable is similarly added to the connecting means at its other end as a stabilizing tail. Thermoplastic water-resistant material is then molded over the exposed parts to form a sheath having substantially the same diameter as the cable and tail. Thermoplastic water-impermeable, insulative material is then molded around each spoke and a portion of the braiding is left outside the cable to make electrical contact with the sea water environment. The spokes are made of spring-steel tape so that they can be folded down over the cable or the tail.



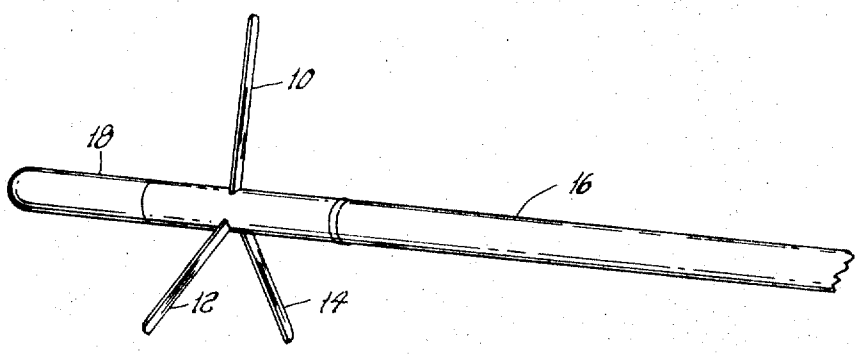


Fig. 1

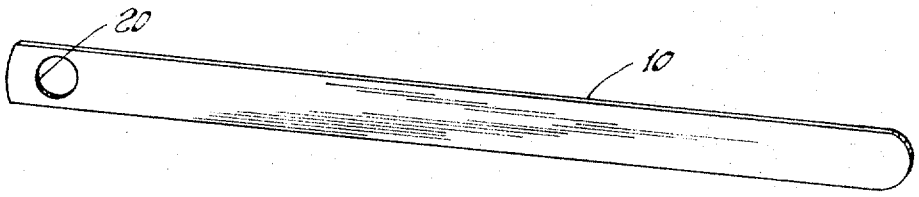


Fig. 2

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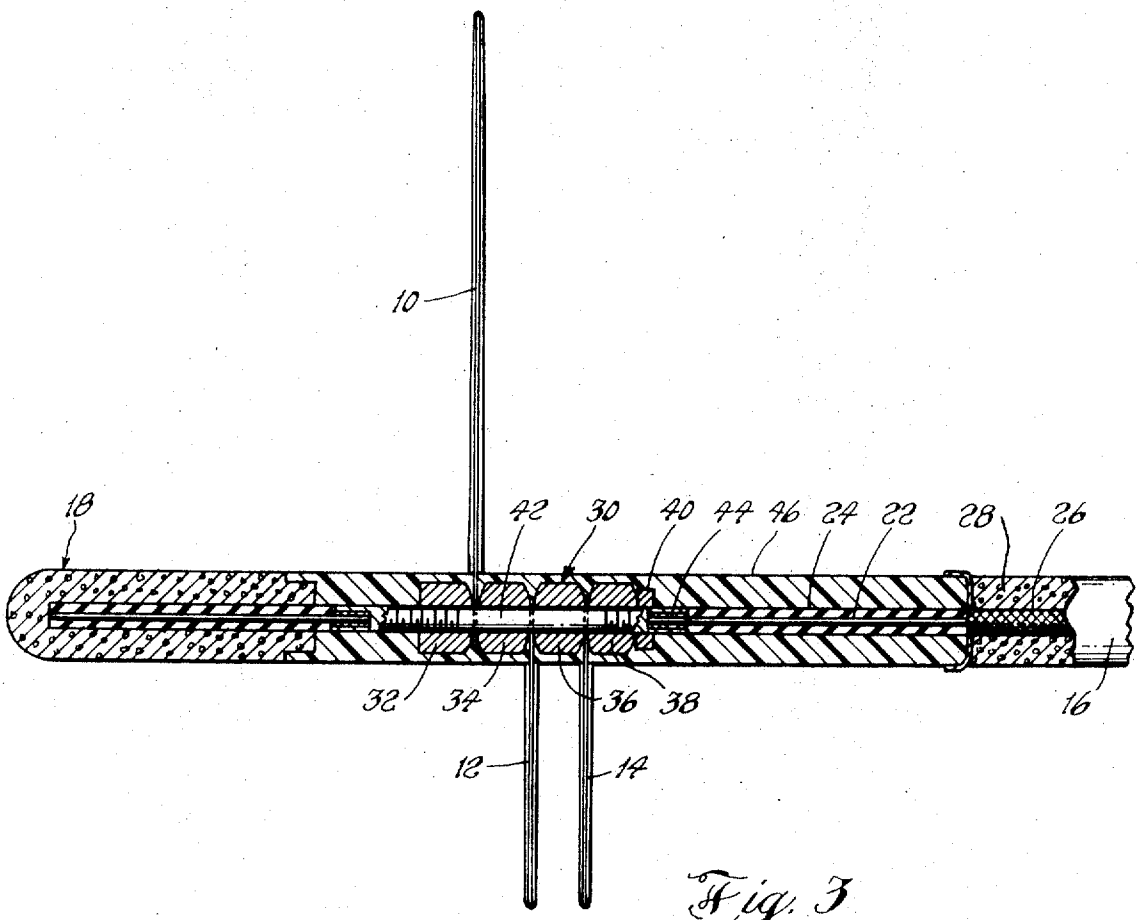

Fig. 3

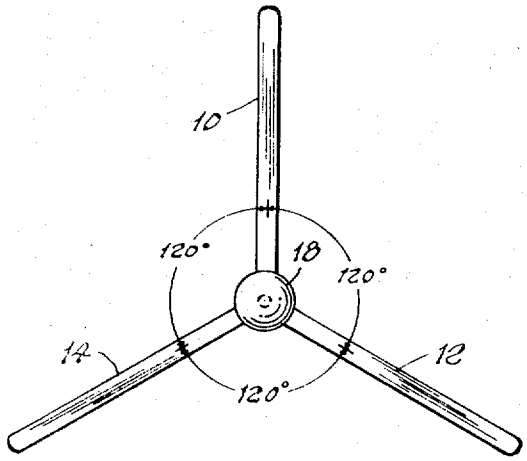

Fig. 4

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FLEXIBLE BOUYANT CABLE ANTENNA

This invention relates to buoyant cable antennas and especially to buoyant cable antennas with foldable radiation elements.

Two-way radio communication between a submarine operating below periscope depth and aircraft, surface ships, shore stations and other submarines requires an antenna located at the sea surface and linked to terminal equipment in the submarine. It is desirable that the antenna and its connecting cable be releasable from within the submarine, that the cable and antenna be buoyant, and that the cable and antenna be retrievable into the submarine. Up to now, effective vertically polarized submarine antennas have not been releasable from within, and retrievable into the submarine.

An object of this invention is to provide a buoyant antenna which is releasable from within, and retrievable into, a submarine.

Another object is to provide a buoyant antenna having vertical polarization characteristics.

A further object is to provide a buoyant antenna whose gain characteristics are little affected by any rotation of the antenna while being towed.

These objects and advantages are provided by fabricating the poles, or elements, of the antenna from flexible conductive material so that they fold backward and forward along the buoyant connecting cable without damage. The poles are made thin relative to the diameter of the cable so that when the poles are folded, the diameter of the cable plus the folded poles is no greater, or only slightly greater than the diameter of the cable alone, thus allowing release and retrieval through submarine ports just slightly larger than the cable diameter and also permitting the use of conventional submarine cable-reeling equipment.

Other objects, advantages and novel features of the invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings wherein:

FIG. 1 is an isometric view of a three-element buoyant-cable antenna;

FIG. 2 is an illustration of a pole, or element of the antenna;

FIG. 3 is a cross-sectional illustration of the antenna and cable showing the constructional details; and

FIG. 4 is a sketch showing an end view of the antenna.

FIG. 1 shows a three-pole, buoyant cable antenna. The antenna has three poles **10**, **12** and **14** spaced 120° apart. A buoyant coaxial cable **16**, shown broken away, connects the antenna poles to the submarine. A relatively short trailing tail **18** of buoyant cable provides the antenna poles with some stability while they are being towed on the sea surface.

The poles **10**, **12** and **14** can be made of any flexible conductive material and should be thin relative to the diameter of the coaxial cable **16**. A good choice is to fabricate the elements as shown in FIG. **2** from a length of flexible spring-steel tape with a hole **20** near one end.

Constructional details for one embodiment of the invention are shown in FIG. **3**. Here the connecting cable **16** is of the coaxial type having a center conductor **22**, a dielectric sheath **24**, a sheath of conductive braiding **26** and a sheath of buoyant insulating material **28** such as foamed polyethylene.

The buoyant sheath **28** is cut away at one end of the cable **16** to expose the center conductor **22** and the insulating sheath **24**. At the far end, the insulating sheath **24** is cut away to expose about one-half inch of the center conductor **22**.

Connecting means **30** lies between the connecting cable **16** and the trailing tail **18** and comprises, in this embodiment, a group of four spacers **32**, **34**, **36** and **38**, a nut **40** and a central rod **42** threaded at both ends.

The rod **42** extends through the holes in the antenna poles and each pole is tightly held between a different pair of spacers so that, in an end view (see FIG. **4**), the three antenna poles are each separated by 120°. The whole assembly **30** is held together by a locking nut **40**.

If desired, the tripole antenna assembly may be formed without the spacers by soldering the ends of the poles to the rod at the proper angles.

The rod **42** has a hole **44** bored in one end and the bare end of the center conductor **22** is fitted into this end and soldered thereto.

The antenna poles are each covered by the sheath of heat-shrinkable, electrically insulative tubing, such as polyvinyl chloride tubing, and the tubing is heated to fit it tightly around the element.

The trailing tail **18** is fitted against the connecting means and fastened thereto, one method being to bore a hole into the associated end of the rod **42**, fit the center conductor into the hole and solder the conductor to the rod.

The connecting means **30** is now wrapped with water-impervious, insulative, thermoplastic material, such as polyethylene tape and heated in a mold until the tape fuses together to form an insulative sheath **46**.

The end of the braiding **26** is flattened down over the insulative sheath **46** so that the braiding **26** is exposed to the sea water.

When the antenna is within the submarine, the poles fold down flatly against the cable. As the antenna is pushed out of the submarine, the poles extend resiliently until they attain the attitude shown in FIGS. **1**, **3** and **4**.

When towed on the surface, usually one pole is vertical. However, even if the poles are rotated in position, the gain of the antenna remains fairly constant, ranging from a relative power gain of −9.5 db. with one pole up to −15.8 db. with two poles up.

Obviously, many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

We claim:

1. An antenna assembly comprising, in combination:

at least three antenna poles, each being fabricated from thin, resilient, electrically conductive material;

a buoyant, water-impermeable, coaxial cable having a central conductor, a dielectric sheath surrounding said central conductor, a sheath of conductive braiding, and a sheath of buoyant insulation;

an antenna tail comprising a length of cable having a central core of stiff material and a sheath of buoyant, water-impermeable material;

connecting means; and

thermoplastic, insulative, water-impermeable material,

said antenna poles being held firmly at one end by said connecting means to form a spaced pattern,

the buoyant insulation being cut back to expose the central conductors of said coaxial cable and said antenna tail and each said central conductor being conductively fastened to opposite points of said connecting means so that the coaxial cable, connecting means and tail effectively form a single length of cable,

said thermoplastic material being formed into a sheath around said connecting means and the exposed parts of said central conductors to make water-impermeable contact with the sheaths of buoyant insulation around said cable and said tail,

a portion of said conductive braiding being brought outside said cable to make contact with the ambient environment,

said antenna poles being insulated against electrical contact with the ambient environment.

2. An antenna assembly as in claim **1**, wherein said antenna poles form equal angles with each other.

3. An antenna assembly as in claim **2**,

said thermoplastic sheath having roughly the same outer diameter as said cable and tail.

4. An antenna assembly as in claim 2,

the insulation of said antenna poles being formed by an insulative sheath of thermoplastic material around each said pole.