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A. F. FEYLING

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BUOY APPARATUS

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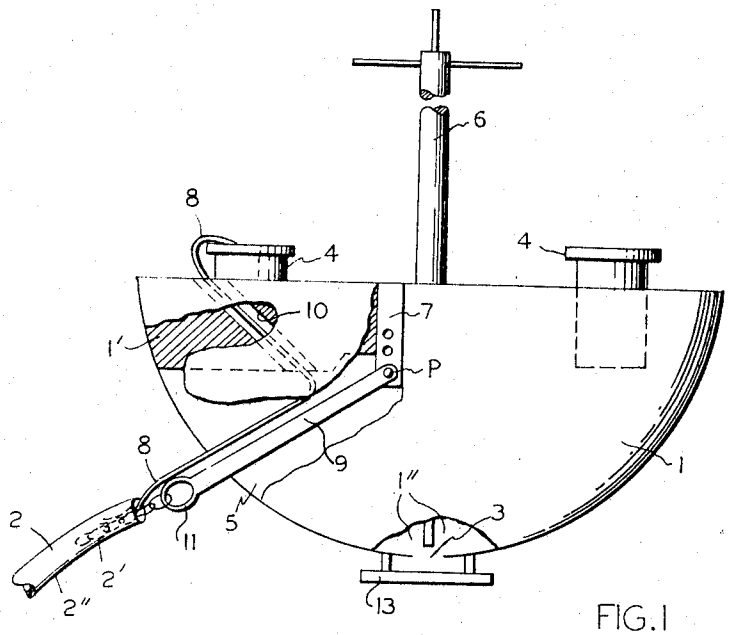

FIG. 1

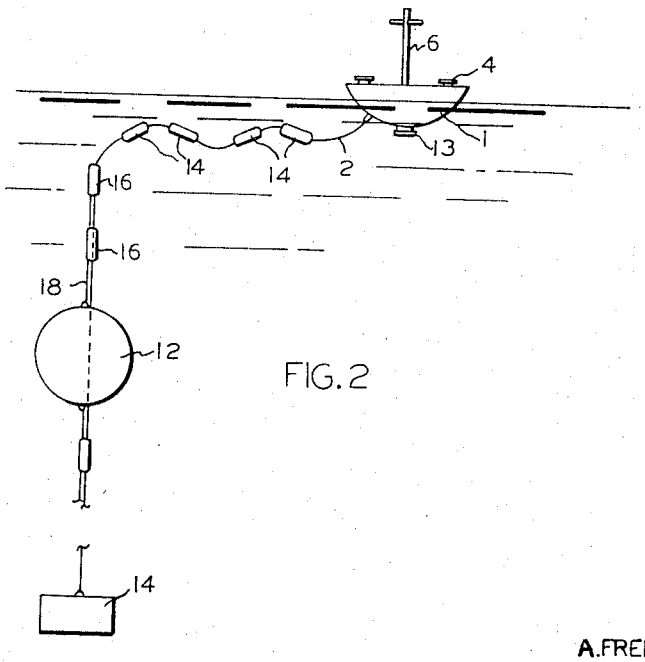

FIG. 2

INVENTOR
A.FRED FEYLING

BY Reines and Reines

ATTORNEYS

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BUOY APPARATUS

Anders Fred Feyling, Cambridge, Mass., assignor, by mesne assignments, to EG & G International, Inc., Bedford, Mass., a corporation of Delaware

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ABSTRACT OF THE DISCLOSURE

Hemispherical buoy with an upper buoyant section, a compartmentalized lower free-flooding stabilizing section, and a counterweight below a flooding opening. A slot in the lower section contains a mooring bar pivoted at one end to the buoy substantially at its center of gravity and connected at the other end to a mooring line comprising a chain and an electrical conductor bound thereto by a surrounding sheath.

The present invention relates to buoy apparatus and is more particularly, though not exclusively, concerned with telemetering systems in which electrical signals are detected or produced underwater and are fed to a surface buoy for recording and/or transmitting, as by radio, to distant stations.

In prior apparatus of this character, and other buoy systems, the underwater moored surface buoy is subject to various instabilities caused by wind, waves, subsurface currents and tides that may come from widely different directions and in many combinations. Such instability not only makes radio transmission unreliable, but, in addition, subjects the mooring line to kinking and fouling, and exerts undue strain upon any subsurface buoy from which anchored instruments and other apparatus depend.

An object of the present invention, accordingly, is to provide a new and improved buoy apparatus that overcomes these disadvantages and others; and, to the contrary, is, in summary, substantially mechanically omnidirectional so that, when moored, it has a high degree of stability and low drag even with opposing combinations of wind, waves, tide and subsurface currents.

A further object is to provide a novel buoy system in which kinking, fouling and straining of the mooring is substantially eliminated.

An additional object is to provide a substantially strain-free mooring cable with electrical conductors that features high strength with no tendency to kinking and damage from strain, abrasion or fish bites.

Other objects will be explained hereinafter and are delineated in the appended claims.

The invention will now be described with reference to the accompanying drawing.

FIG. 1 is a side elevation of a preferred embodiment, with sections partly broken away to show details of construction; and

FIG. 2 is a view of a complete moored buoy system embodying the invention.

Referring to FIG. 1, a closed buoy **1** is constructed, as of fiberglass or the like, in the form of substantially a downwardly convex hemisphere, the upper portion **1'** of which comprises compartments of buoyant foam plastic or the like. The lower portion is divided into substantially quadrant compartments **1''** that are free-flooding through a bottom aperture **3** to provide ballast stabilization for the buoy. A slot **5** is formed in the left-hand quadrant, as shown in FIG. 1, communicating with a conduit **7** within which a prferably planar mooring bar **9** may be pivoted at its inner end, as at one of the points P. The

bar **9** extends along the slot **5** and externally beyond the outer buoy skin, terminating in a mooring ring **11**. Depending from the bottom of the buoy at the opening **3** is a counterweight ballast **13** for adding self-righting stability, the water freely flooding into and out of the stabilizing compartments **1''** between the counterweight **13** and the bottom of the buoy.

By selecting or adjusting that pivot point P along the conduit **7** that corresponds to the center of gravity of the buoy (i.e. the point about which the buoy pivots in pitch and roll), it has been found that the mooring bar **9** will compensatorily pivot upward and downward in response to different directions of pull by a mooring line **2** connected to the mooring ring **11**, such that the buoy is unaffected by such change. This construction, indeed, effectively decouples the effects of the direction of pulling (ranging from towing of the buoy with the cable **2** substantially horizontal, to downward pulling) from the buoy.

The hemispherical-shape compartmentalization, and self-righting construction, together with this mooring-direction decoupling, moreover, reduces the effect of conflicting moments of waves, wind, cable, etc. and keeps the buoy in a stable and upright position.

A 5½ foot diameter 350-pound, 33-inch tall fiberglass buoy of this character, having a 300-pound ballast **13**, 1,600 pounds of ballast water in compartments **1''** and a net buoyancy when loaded with 300 pounds of instruments of 700 pounds, has been found to be remarkably stable even in storm conditions, having a natural roll and pitch period of only 1½ seconds with a 15° movement from vertical when moored as shown in FIG. 1. The center of gravity in this case was at a point about 21 inches upward from the bottom and 3 inches off the center line.

The electrical or other instruments are stored in watertight wells **4** loaded from the top and extending into the foam region **1'**, and the buoy may carry on its top a radio transmitting antenna **6** or any other signaling, sensing or related apparatus. Electrical connection to these instruments is effected by insulation-covered conductors **8** that extend through a conduit **10** in the buoy, into the slot **5** and along the mooring bar **9** (where the conductors **8** are bent upward but restrained), further extending along the mooring line **2** to an underwater buoy **12** and to the instruments or other apparatus (not shown) depending therefrom and anchored at **14**.

It has been found that wear, kinking and fouling of the moring line and electrical conductors can be remarkably obviated by constituting the mooring line of a chain **2'** (which inherently has high strength and resists kinking, etc.) and binding the coextensive insulation-covered electrical conductors **8** to the chain as by a tightly fitting rubber or other plastic jacket or sheath **2''**. The chain will absorb substantially all the mooring strain and not the electrical cables. Further to obviate sagging and reveling, and to prevent the mooring line **2** from sinking and fouling on a subsurface buoy **12**, plastic floats are preferably attached, as at **14**, to cause the mooring line **2** to assume a catenary configuration, as illustarted in FIG. 2. To reduce strain at the subsurface buoy **12**, a plurality of apertured plastic or other floats **16** may be chain-connected to the buoy **12** as at **18**, and the mooring line **2** (with its bound chain **2** and electrical conductors **8**) passed thorugh other apertures inthe floats **16**, being thus maintained almost vertically, with strain and shock taken up by slippage and buoyancy of the floats **16**. The line **2** may continue through the subsurface buoy **12** to the apparatus depended below.

While there has been described what is presently considered the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes

and modifications may be made therein without departing from the inventive concept contained therein, and it is, therefore, aimed to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A substantially stabilized closed surface buoy of substantially hemispherical contour having, in combination, an upper buoyant section, a lower free-flooding stabilizing section and a slot extending into a lower quadrant thereof and containing mooring bar means pivoted at one end to the buoy at a point within the said slot corresponding substantially to the center of gravity of the buoy, the other end of the mooring bar means extending externally to the buoy and having means for connecting the same to a mooring line, said buoy having counterweight means depended from the bottom thereof, said stabilizing section comprising substantialy quadrant compartments having a flooding opening at the base between the same and the counterweight means.

2. A substantially stabilized closed surface buoy of substantially hemispherical contour having, in combination, an upper buoyant section, a lower free-flooding stabilizing section and a slot extending into a lower quadrant thereof and containing mooring bar means pivoted at one end to the buoy at a point within the said slot corresponding substantially to the center of gravity of the buoy, the other end of the mooring bar means extending externally to the buoy and having means for connecting the same to a mooring line, said buoy having instrument well means extending from the top thereof into the said upper section thereof, and conduit means for receiving electrical conductor means extending from the instrument well means through said slot and along the mooring line.

3. A substantially stabilized closed surface buoy of substantially hemispherical downwardly convex contour having, in combination, an upper buoyant section, a lower free-flooding stabilizing section of said convex contour with a flooding opening therein and a slot extending into a lower quadrant thereof, said slot containing mooring mar means pivoted at one end to the buoy at a point within the said slot corresponding substantially to the center of gravity of the buoy, the other end of the mooring bar means extending externally to the buoy and having means for connecting the same to a mooring line.

4. A buoy as claimed in claim 3, and in which means is provided for adjusting the said point of pivot in accordance with variations in loading of the buoy.

5. A buoy as claimed in claim 2 and in which the said upper section comprises foam plastic.

6. A buoy as claimed in claim 2 in which radio transmitting means is carried by the top of the buoy for transmitting information corresponding to the signals carried by the electrical conductor means to said instrument well means.

7. A buoy as claimed in claim 2 and in which the mooring line comprises a chain intimately bound to the electrical conductors means extending therealong.

8. A buoy as claimed in claim 7 and in which the bound mooring line and electrical conductor means are provided with float means for holding the same underwater in catenary-like fashion.

9. A buoy as claimed in claim 8 and in which the bound mooring line and electrical conductor means are passed through apertured float means separately chain-connected to a sub-surface buoy from which depends apparatus electrically connected to the conductor means and moored to anchor means.

References Cited

UNITED STATES PATENTS

2,079,689	5/1968	Gorton	174—69 X
15,845	10/1856	Ellis	9—8
2,397,957	4/1946	Freeman	244—130 X
2,891,501	6/1959	Rather	114—235
3,086,491	4/1963	Rather et al.	114—235
3,295,489	1/1967	Bossa	9—8 X

FOREIGN PATENTS

410,293	5/1934	Great Britain.
421,660	12/1934	Great Britain.
889,245	2/1962	Great Britain.

TRYGVE M. BLIX, *Primary Examiner.*

U.S. Cl. X.R.

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