United States Patent

[11] 3,590,406

[72] Inventors George S. Lockwood, Jr.
Carmel Valley;
Klemme M. Jones, San Pedro, both of,
Calif.

[21] Appl. No. 731,156
[22] Filed May 22, 1968
[45] Patented July 6, 1971

[73] Assignee Global Marine Inc.
Los Angeles, Calif.

[54] LONG SPAR BUOY
5 Claims, 4 Drawing Figs.

[52] U.S. Cl. 9/8, 73/170
[51] Int. Cl. B63b 21/52
[50] Field of Search 9/8, 8.3; 73/170; 325/114, 116, 118

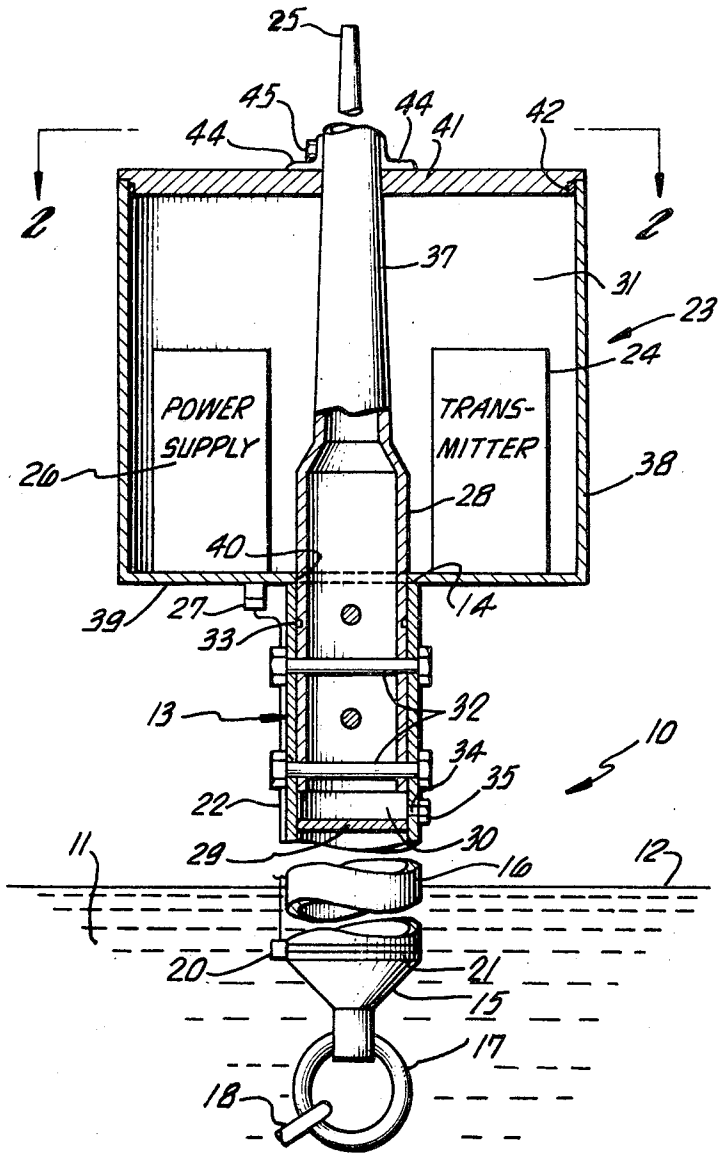
[56] References Cited

UNITED STATES PATENTS

1,974,832	9/1934	Peterson	9/8.3
3,390,408	7/1968	Lockwood et al.	9/8
3,405,558	10/1968	Koot	9/8
157,785	12/1874	Brown	9/8
2,397,844	4/1946	Dewhurst	9/8
2,910,834	11/1959	Knapp	9/8
3,092,852	6/1963	Devereux	9/8

Primary Examiner—Milton Buchler
Assistant Examiner—Steven W. Weinrieb
Attorney—Christie, Parker & Hale

ABSTRACT: An oceanographic long spar buoy including a plurality of elongated tubular members connected to each other in an end-to-end relationship to define a body of the buoy. A weatherproof data handling instrumentation container is demountably secured to an upper unsubmerged end of the body. The instrumentation container houses equipment which is coupled to instrument transducers mounted at selected locations along the buoy. The container is removable as a unit from the buoy for ease of servicing or repair of the contents thereof.



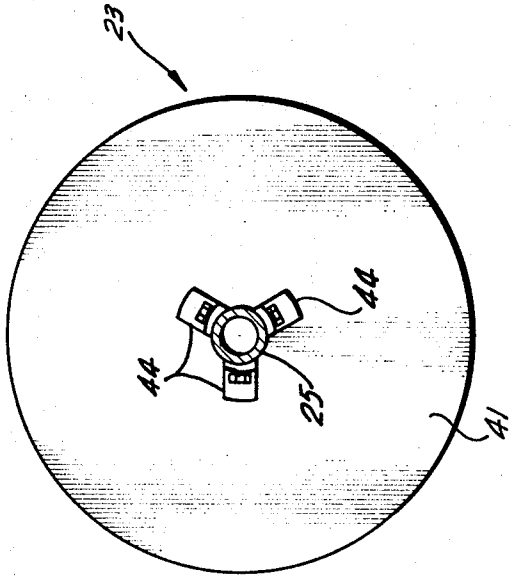
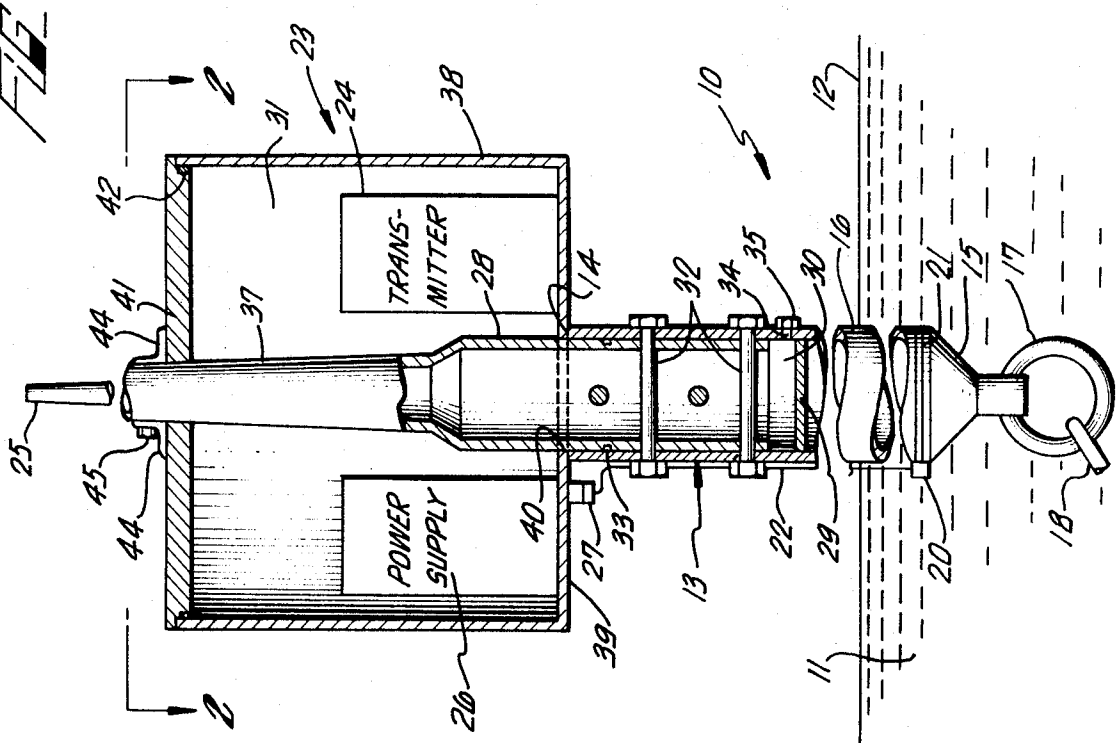


FIG 2

FIG 1



INVENTORS
GEORGE S. LOCKWOOD, JR.
KLEMMIE M JONES
BY
Christie, Parker & Hale
ATTORNEYS

FIG 4

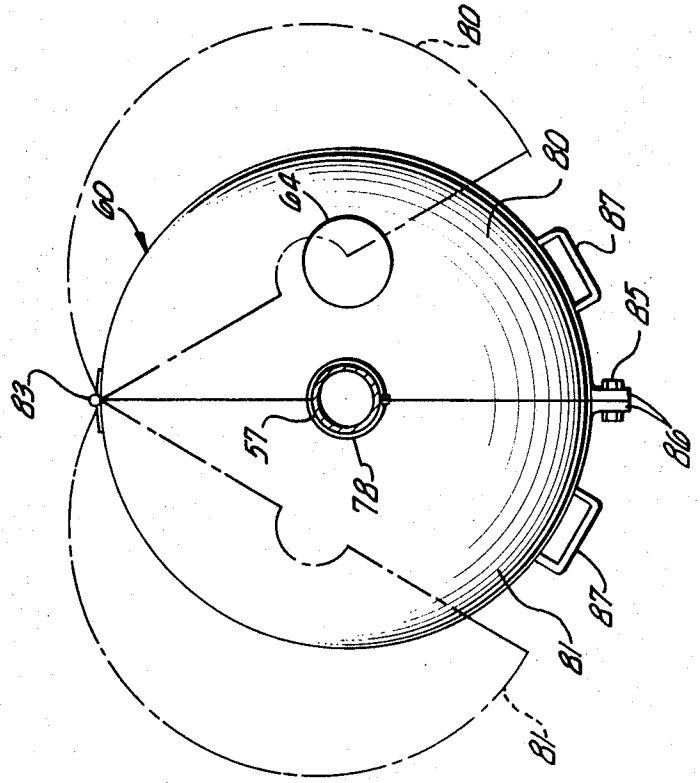
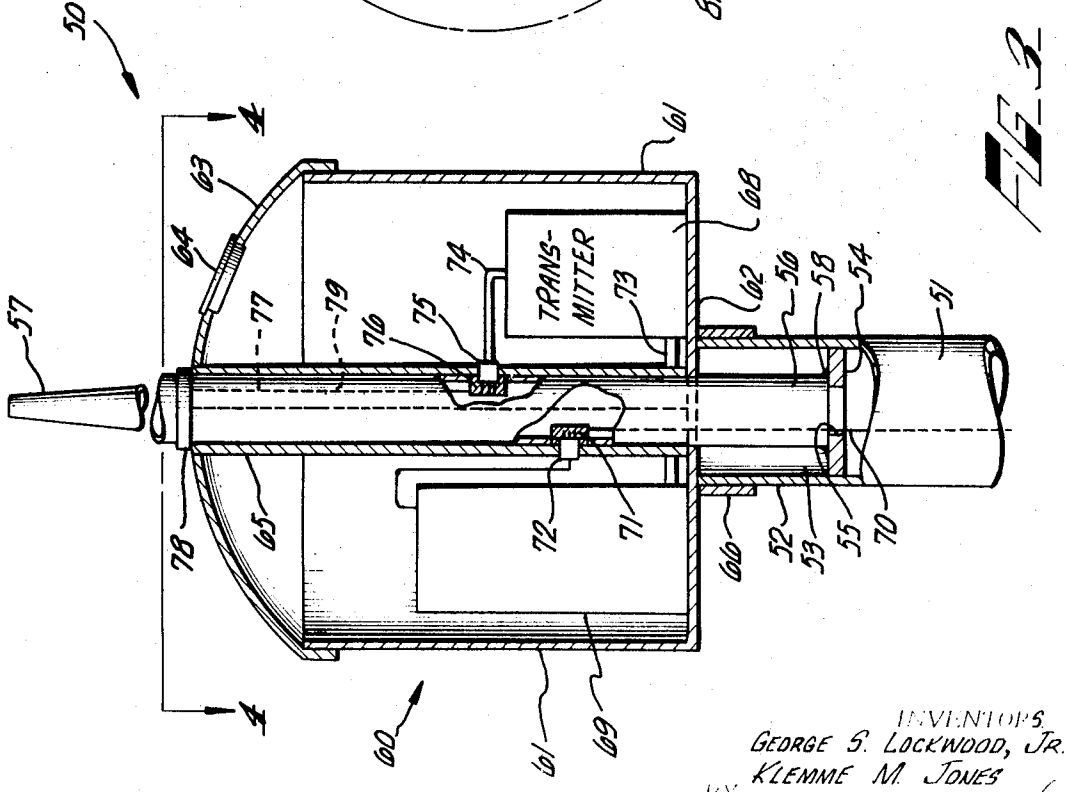


FIG 3



INVENTORS
GEORGE S. LOCKWOOD, JR.
KLEMME M. JONES
BY
Chantle, Parker & Hale
ATTORNEYS.

LONG SPAR BUOY

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to long spar buoys and, more particularly, to long spar buoys adapted for use in oceanographic research.

2. State of the Prior Art

Oceanographic data is required for military purposes, such as for improving or predicting sonar performance, as well as for commercial purposes as, for example, locating undersea mining and farming areas or for predicting optimum shipping routes. Ideally, an oceanographic instrument platform should be relatively motionless even in severe seas; also, the platform should be rugged, low in cost, and economical to maintain.

Long spar buoys have been proposed for use as instrument platforms in oceanographic research projects. Such buoys are preferably fabricated of a number of lengths of oil well casing pipe and are of substantially constant diameter over their length. A long spar buoy may have a length of several thousand feet, if desired. Such buoys exhibit very little heaving even in extremely high seas and are potentially less costly to construct, install and maintain than more conventional surface buoys.

Previously proposed long spar buoys may include an instrument container permanently secured to the upper end of the buoy above the water surface. Instrument transducers, transmitters and power batteries are housed in the container and coupled to additional transducers disposed along the length of the buoy and with an antenna projecting above the buoy for transmitting information gathered by the transducers to telemetering and data processing installations located remote from the buoy. If the devices in the container become damaged or require replacement, either the entire buoy must be retrieved for repair or a service vessel must be dispatched to the buoy for servicing of the buoy at the buoy site. Substantial difficulties are likely to be encountered in repairing the buoy at its installation site because of wind and wave action acting both on the buoy and the service vessel while service personnel are present on the buoy. Repair of the previously proposed spar buoys, therefore, is a costly and time consuming procedure regardless of whether the buoy is serviced at its site of installation or remote from such site.

SUMMARY OF THE INVENTION

This invention provides a long spar buoy for use in oceanographic instrumentation and research and in which a data handling device, such as a recorder or a transmitter, and a power source for the data handling device are contained within a housing releasably yet securely mounted to the upper end of the buoy. Should the power source require replacement, or should the data handling device require replacement or repair, the housing can be removed readily from the buoy for replacement by a spare housing containing an operative power source and data handling device. Such repairs as are required to the contents of the original housing may be performed at a shore-based location or aboard a specially equipped service vessel; in either event, repairs are made under improved working conditions without risk to life and limb. Also, the buoy is not removed from service for extended periods while repairs are made.

Generally speaking, this invention provides a long spar buoy for use in oceanographic instrumentation and research programs. The buoy has a positively buoyant tubular body having a length many times greater than its average transverse dimension. The body is adapted to float vertically in a body of water with its upper end disposed above the water surface. At least one instrument transducer is located at a selected location along the length of the body and produces signals in response to variations in a selected phenomenon in the ocean, the transducer being sensitive to such phenomenon. A data handling device and a power source for the device, as well as for the transducer, if necessary, are provided. The data handling device and the power source are disposed within a housing which is removably yet securely mounted to the upper end of the buoy body.

DESCRIPTION OF THE DRAWINGS

The above-mentioned and other features of this invention are more fully set forth in the following detailed description of presently preferred embodiments of the invention, which description is presented with reference to the accompanying drawings, wherein:

FIG. 1 is a fragmentary elevation view, in section, of a long spar buoy in accord with the present invention;

FIG. 2 is a view taken along lines 2–2 of FIG. 1;

FIG. 3 is a fragmentary cross-sectional elevation view of another embodiment of the invention; and

FIG. 4 is a view taken along lines 4–4 of FIG. 3 showing the opened instrument container in phantom lines.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A long spar buoy **10**, see FIG. 1, floats in a body of water **11** having surface **12**. The body has an elongate body **13** having upper and lower ends **14** and **15**, respectively. The body is defined by a plurality of elongate tubular elements **16** secured together in end-to-end relation. The body has a length which is many times greater than its average transverse dimension. For example, the body may have a diameter in the range of from about 10 inches or so to about 30 inches or so and a length of from about 100 feet to several thousand feet. Preferably the body of buoy **10** is defined by a plurality of lengths of piping such as oil well casing. If desired, the body may be divided into sections interconnected, pursuant to the disclosures of commonly owned copending application Ser. No. 548,610 filed May 9, 1966, by moment-free connectors (not shown) such as universal joints, or lengths of wire rope or chain.

Body **13** is constructed, either by reason of internal ballasting or by distribution of the weight of its own structure, to be positively buoyant and to float in a vertical attitude with its upper end **14** disposed a selected distance above water surface **12**.

A ring **17** is secured to the lower end of the buoy body to enable connection of the buoy to a mooring chain **18** for anchoring of the buoy at a selected location in body of water **11**, which body of water may be an ocean in which oceanographic research effort is to be conducted.

The high slenderness ratio (ratio of length to diameter) of buoy **10** results in the provision of a buoy which has extremely useful properties and which is well suited for use in oceanographic research and instrumentation. Buoy **10** moves only slightly, if at all, vertically in response to the movement of waves past the buoy. Also, the buoy does not pitch or roll appreciably in response to wind or wave action, but instead provides a stable platform in the ocean. Where the buoy has great length, it extends through regions affected by surface currents and tends to resist movement by currents. Since the buoy has little surface exposed above the water surface, it is essentially insensitive to movement by wind effects.

At least one instrument transducer **20** is mounted to the buoy body, as by strapping **21**; preferably a plurality of transducers, of the same or different types, are mounted to the body at selected locations along the length of the body. The transducer is sensitive to a selected phenomenon in the ocean around it, such as temperature, salinity, light, or current velocity, for example, and produces output signals as the phenomenon varies in magnitude. The transducer output signals are conducted from the transducer along the buoy body via a cable **22** to a housing **23** which is releasably mounted to the upper end of the buoy body above water surface **12**. Within the housing is located a data handling device, such as transmitter **24** which is provided for transmitting data gathered by transducer **20** to a remote shore-based or ship-based data receiving and processing station; the transmitter is

coupled to an antenna 25 which extends upwardly from the housing along the axis of the buoy body. If desired, however, the data handling device could be a recorder or the like in which data acquired by the transducer is stored for periodic collection by appropriate personnel on a service vessel or the like; if the data handling device is a recorder, the antenna of buoy 10 may be omitted. A power supply 26 is also disposed in housing 23 for powering the data handling device and the transducer in the event that the transducer is such as to require external energization.

Cable 22 is connected to housing 23 by a separable connector 27 one part of which is mounted to the housing structure.

As shown in FIG. 1, upper end 14 of buoy body 13 is open. A closure plate 29 is sealed across the interior of the body a selected distance below the open end of the body to define a watertight, upwardly open recess 30 which functions as a step for the butt 28 of antenna 25. The butt of the antenna is cylindrical in shape and extends from just above closure plate 29 to within a chamber 31 defined by housing 23. The antenna butt is secured releasably to the buoy body by a plurality of cross bolts 32 which extend through the buoy body and the antenna butt as shown. A watertight seal is provided between the antenna and the body by an O-ring 33 or the like engaged between the outer circumference of the antenna butt and the interior of body 13. Should any moisture accumulate in recess 30, such moisture may be drained through an opening 34 through the buoy body just above the closure plate, the opening normally being sealed by a closure plug 35.

Above its butt, antenna 25 is tapered as shown at 37 in FIG. 1.

Housing 23 is a basically cylindrical structure having a cylindrical vertical wall member 38 and a circular floor 39. A central opening 40 is provided through the floor and is sized to make a tight fit with the outer surface of the antenna butt. The housing floor is supported upon the upper end of buoy body 13. The upper surface of the housing is defined by a circular closure plate 41 which carries a peripheral gasket 42 for sealing cooperation with the upper extent of the housing wall member. The housing closure plate has a central aperture 43 through it sized to mate snugly with the taper of the antenna when the closure plate is seated on the housing wall cylinder. A plurality of bolting dogs 44 are secured to the closure plate around aperture 43 so that the closure plate may be secured into closure relation to chamber 37 by bolts 45 engaged in the mast.

Should the power supply or the transmitter located within housing 23 require servicing or replacement, access can be had thereto merely by removing the housing closure plate over antenna 25. If the repair operation cannot conveniently be performed in a few minutes by personnel working within the housing, the entire housing may be removed from the buoy over the antenna and be replaced by a spare housing containing an operational power supply and transmitter. Substitution of one housing for another can be accomplished without involving attention to transducer 20 in view of connector 27 which would have duplicate female components thereof, for example, mounted to the original housing and to the substitute housing.

Should the antenna become damaged, a new antenna may be inserted in its place in short order in view of the antenna-buoy body connection described above.

Another oceanographic instrumentation long spar buoy 50, shown in part in FIGS. 3 and 4, has an elongate tubular body 51 similar to body 13 of buoy 10. Body 51 has an open upper end 52 which defines the rim of an upwardly open recess 53 closed at its lower end by a closure plate 54 having a central opening 55 therethrough. A cylindrical butt 56 of an antenna 57 is stepped in recess 53. Butt 56 has a diameter less than the diameter of recess 53 but greater than the diameter of opening 55 and is aligned coaxially of the buoy body. The lower end of the antenna is welded, as at 58, to the closure plate about the opening.

A housing 60 is removably mounted to the upper end of the buoy body around antenna 57. The housing has cylindrical walls 61, a flat floor 62 and a domed roof 63 fitted with an access hatch 64. An antenna support sleeve 65, open at its opposite ends to the exterior of the housing, extends axially of the housing concentric to the antenna and provides lateral stability to the antenna when the housing is in place on the buoy body. An additional support sleeve 66 extends downwardly of the housing along the exterior of the buoy body. As shown in FIG. 3, the housing is supported on the upper end of the body.

The housing includes a transmitter 68 and a power supply 69 for the transmitter and for such instrument transducers (not shown) located along the buoy as may require external energization. Each transducer is connected via a conductor cable 70 to the power supply. Each cable 70 is lead up the interior of the buoy, through opening 55 in closure plate 54, and through the interior of the antenna to a suitable connector receptacle 71 built into the mast. Each receptacle 71 cooperates with a corresponding plug 72 mounted to support sleeve 65 and coupled to the power supply. The power supply and the transmitter are interconnected by a cable 73. The output of the transmitter is applied to the antenna via a cable 74 which terminates in a plug 75 mounted to support sleeve 65. Plug 75, in turn, engages a receptacle 76 in the antenna at the end of a conductor 77.

A watertight closure is provided between the upper end of sleeve 65 and the antenna by a seal assembly 78. The seal assembly may be structured to prevent movement of the housing along the antenna if such feature is desired.

As shown in FIG. 4, housing 60 is preferably provided as a clamshell-like assembly. That is, the housing is, in effect, divided by a diametral and vertical parting plane 79 (see FIG. 3) into two sections 80 and 81 which are hinged together by a vertical axis hinge 83 along mating edges of the housing parts. Sleeves 65 and 66 and seal assembly 78, therefore, are provided in mating parts. The housing parts are secured in closure relation to each other around the antenna by bolts 85 which cooperate with bolting flanges 86 carried by the housing parts opposite from the hinge. Handles 87 are mounted to each housing part to facilitate movement of the parts relative to each other.

Routine servicing of the equipment in housing 60 may be performed without removal of the housing from the buoy body; servicing personnel may enter the housing for this purpose via hatch 64. Should major repair or replacement of the equipment in the housing be required, the housing is removed from the buoy body by a suitable service vessel and a duplicate housing containing operative equipment is installed in place of the removed housing. The housing is removed by removing bolts 85 and by releasing seal assembly 78. Housing parts 80 and 81 are then moved apart from each other on hinge 83 so that plugs 72 and 75 disconnect from receptacles 71 and 76 in the antenna. The substitute housing then may be installed by reversing this procedure, care being taken that the connecting plugs and receptacles are properly aligned before the housing parts are closed relative to each other.

A long spar buoy according to this invention maintains all the advantages of previously described long spar buoys, but it has additional advantages not possessed by such prior buoys. The present buoy is well suited for use in oceanographic research and instrumentation projects of a short term or continuing nature.

We claim:

1. A long spar buoy comprising an elongate positively buoyant body having a submerged length many times greater than the average transverse submerged dimension thereof and adapted to float substantially vertically in a body of water with its upper end disposed above the water surface, at least one instrument transducer mounted to the body at a selected location therealong for producing output signals indicative of a selected physical phenomenon to which the transducer is sensitive, an antenna extending substantially coaxially upward from the buoy body, a data handling device to which the trans-

ducer output signals are applied, the data handling device including a transmitter and means for releasably coupling the transmitter to the antenna, a source of power for at least the data handling device, a housing for the power source and the data handling device and through which the antenna extends, and means for securely yet releasably mounting the housing to the buoy body at the upper end thereof above the load waterline of the buoy body for removal of the housing from the buoy body with the power source and data handling device therein independently of the antenna, said releasable mounting means including sleeve means carried by said housing for releasable mating engagement about said antenna, and a floor for said housing arranged in cooperating with said sleeve means for support by said buoy body when said sleeve means is mated to said antenna.

2. A long spar buoy comprising:

a. an elongate positively buoyant body having a submerged length many times greater than the average transverse submerged dimension thereof and adapted to float substantially vertically in a body of water with its upper end disposed above the water surface;

b. at least one instrument transducer mounted to the body at a selected location therealong for producing output signals indicative of a selected physical phenomenon to which the transducer is sensitive;

c. a transmitting device to which the transducer output signals are applied;

d. a source of power for the transmitting device;

e. a housing for the power source and the transmitting device, the housing comprising a pair of parts arranged to mate in closure relation to each other, and releasable means for securing the housing parts in closure relation to each other;

f. a transmission antenna mounted to the buoy body and extending axially thereof through the housing, the housing parts being arranged to mate in closure relation about the antenna; and

g. means for securely yet releasably mounting the housing to the buoy body at the upper end thereof above the load waterline of the buoy body such that the housing, with the power source and transmitting device therein, is removable from the buoy body independently of the antenna.

3. The buoy of claim 2, further including:

a. conductor means for coupling the transducer to the transmitting device, the conductor means extending internally of the buoy body; and

b. separable connector means in the conductor means enabling removal of the housing from the buoy body independently of the transducer, the connector means including male and female components, one of which is mounted to the housing and the other of which is mounted to the buoy body.

4. The buoy of claim 3, in which the housing further includes:

a. a dome-shaped roof; and

b. an access hatch defined in the roof for allowing access into the housing.

5. A long spar buoy comprising an elongate positively buoyant body having a submerged length many times greater than the average transverse submerged dimension thereof and adapted to float substantially vertically in a body of water with its upper end disposed above the water surface; at least one instrument transducer mounted to the body at a selected location therealong for producing output signals indicative of a selected physical phenomenon to which the transducer is sensitive; a data handling device to which the transducer output signals are applied, the data handling device including a radio transmitter and a transmission antenna mounted to the buoy body and extending substantially coaxially upward from the buoy body, a source of power for at least the data handling device; a housing for the power source and the data handling device and through which the transmission antenna extends, the housing including a pair of parts arranged to mate in closure relation to each other about the antenna, hinge means interconnecting the housing parts with each other, and releasable means for securing the housing parts in closure relation to each other; and means for securely yet releasably mounting the housing to the buoy body at the upper end thereof above the load waterline of the buoy body for removal of the housing from the buoy body with the power source and data handling device therein independently of the antenna.

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,590,406 Dated July 6, 1971

Inventor(s) George S. Lockwood, Jr. and Klemme M. Jones

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

Column 4, line 64, after "nature.", insert:

--The buoy need not be removed from its place of installation in the event repair is required to the data handling equipment aboard the buoy. Moreover, repairs to defective data handling equipment can be performed in safety under optimum working conditions at locations remote from the buoy site. These advantages are obtained without removing the buoy from service any longer than is necessary to substitute one equipment housing for another.

--The present invention has been described with reference to presently preferred embodiments of the invention. The above-described embodiments are not the only forms which structure of this invention may assume. Accordingly, the foregoing description should not be regarded as a definitive catalog of all the details and arrangements within the scope and spirit of the invention as defined in the following claims.--

Signed and sealed this 21st day of March 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents