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[54] **OCEANOLOGICAL AND METEOROLOGICAL STATION**

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[58] **Field of Search** .... 73/170 A; 9/8 P

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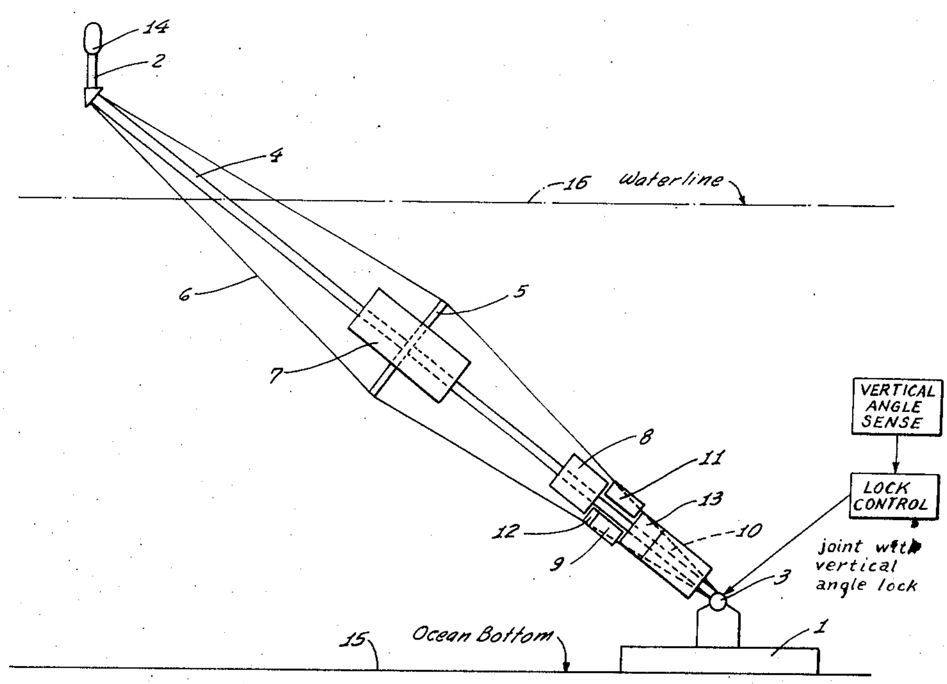
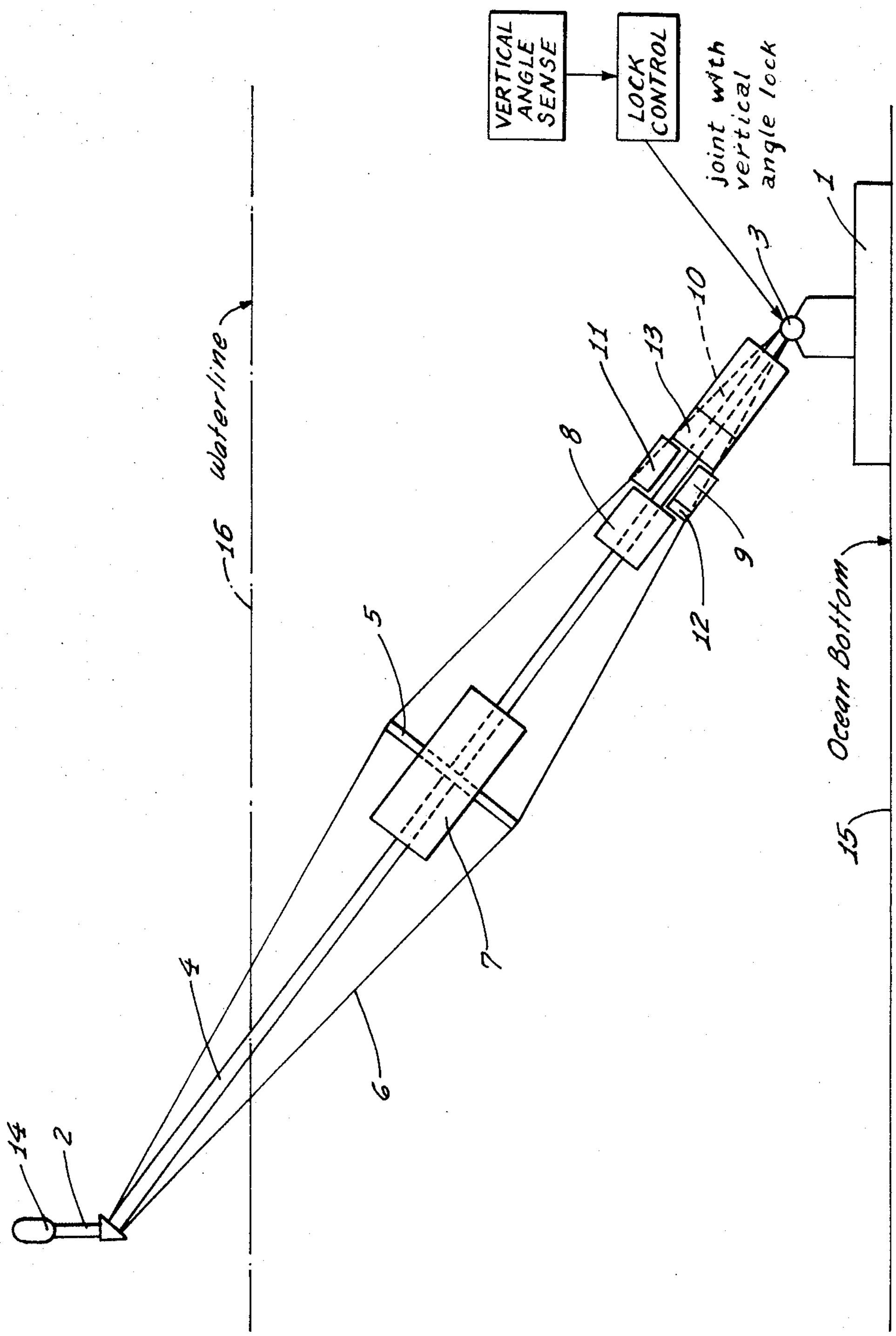
[57] **ABSTRACT**

Equipment establishing a station for providing for oceanological and meteorological measurements in the continental shelf region and in similar, shallow parts of the ocean, and having a base anchoring the station to the bottom of the ocean, a mast pivotally linked to the base for up and down pivoting as well as for turning on a vertical axis; and variable buoyancy is provided at the mast above the point of pivoting. Instrumentation, including sensing means for taking oceanological and meteorological readings as well as a radio receiver transmitter and a controller are disposed on top of the mast.

5 Claims, 1 Drawing Figure





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OCEANOLOGICAL AND METEOROLOGICAL STATION

The present invention relates to apparatus and equipment for providing for oceanological and meteorological measurements, particularly in the continental shelf region and other shallow waters.

Floatation and buoyancy devices equipped with suitable sensor systems are usually employed for oceanological and meterological measurements. Oceanological data are acquired when the device is submerged whereby basically there is no limit to the depth that can be probed. The device surfaces by buoyancy control for taking meteorological measurements. These controlled buoyancy devices dive or surface and take the necessary readings in response to programmed controllers, whereby individual control sequences are usually triggered by remote control, e.g., through radio signals.

The known buoyancy devices, however, do not operate quite satisfactorily in shallow waters near coastal regions where there are strong currents and, possibly, high waves of short wave length. The device in accordance with the invention is particularly destined for operation under these unfavorable conditions, and is to be preferably in the continental shelf region and similar, relatively shallow parts of the ocean.

In accordance with the preferred embodiment of the invention, it is suggested to provide the following combination of elements. (a) There is to be an anchoring device for establishing a base and stationary support on the bottom of the sea; (b) a mast is linked to the anchoring device, and provided for rotation about a vertical axis as well as for up and down pivoting; (c) a buoyancy device is connected to the mast for providing controlled buoyancy, so as to pivot the mast up and down; (d) oceanological and meteorological instrumentation, probes, sensors etc. are to be provided and mounted to the mast, preferably, they are mounted on top of the mast, a controller is provided for operation of the measuring equipment as well as for controlling operation of the buoyancy device. The controller may be part of the instrumentation at the top of the mast, though power components of the controller will be disposed below, near the power supply at the bottom of the arrangement.

The buoyancy device is preferably a container or tank that can be flooded or blown on command from the controller. The container may be open at the bottom, and the top thereof connects to a pressure conduit leading up from a compressed air tank which is disposed near the lower end of the mast or at the base. Alternatively, the buoyancy device may be a closed container with discharge control valve, but also connected to such a compressed air tank. Still alternatively, the buoyancy device may be a closed container with flooding valve and water pump.

The buoyancy container may have any configuration. Therefore, the mast itself may at least in part be of hollow construction, so that the enclosed volume is available for buoyancy development. Alternatively, a sliding weight is disposed in the mast for buoyancy control.

A goniometer, protractor or the like should be disposed between mast and anchor, or a pressure gauge should be provided at the tip of the mast so as to determine and to detect the vertical angle of the mast, i.e., the height of the tip above the ocean bottom. In either case, a fastening and arresting device for the pivotal displacement of the mast is controlled by the respective height detecting instrument, so as to maintain the instrument pack temporarily in a particular level, particularly when the instrumentation is submerged, for example, for taking oceanological data readings over a long period of time.

The mast, as pivoting on a vertical axis, is capable of assuming always the most favorable position relative to ocean currents, wind or tide changes etc., to offer least resistance to the powerful forces of the ocean. Power supply for this meterological and oceanological station may be provided in the anchoring device or in the lower portion of the mast, to provide little inhibition for buoyancy.

While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention, it is believed that the invention, the objects and features of the invention and further objects, features and advantages thereof will be better understood from the following description taken in connection with the accompanying drawings in which:

The FIGURE shows somewhat schematically an example of the preferred embodiment of the present invention.

Turning now to the detailed description of the drawing, reference numerals **15** and **16** respectively denote ocean bottom and surface in the particular location of installing the novel equipment and station. An anchoring device **1** has been lowered to the bottom **15** and firmly secured thereat, though its own weight may suffice for anchoring the station.

A mast is linked to anchoring base **1** by means of a universal joint **3**, so that the mast may turn on a vertical axis to assume least resistance to ocean currents. The mast is also capable of pivoting up and down in any direction, possibly following vertical ocean current variations. The mast is comprised of a central pipe **4**, trussing elements **5** and bracing wires **6**. Instrumentation **2** is provided at the tip of the mast, containing probes etc. for taking meteorological and oceanological data readings. On top of the instrument housing is a radio transmitter and receiver **14**. A controller is responsive to a radio command signals and is likewise disposed in the instrument housing.

A container or buoyancy controlled tank **7** is disposed in the central portion of the mast; the tank can be flooded or blown on command for buoyancy control. Tank **7** does not have to be in the middle of the mast, but should always be far enough submerged to be as little as possible influenced by waves in the ocean surface. On the other hand, the leverage for mast pivoting by buoyancy is better, the higher the position of the tank.

The various possibilities of buoyancy control have been outlined above. The interior of container or tank **7** communicates with pipe **4**, preferably via command controlled valves. The lower end of pipe **4** communicates with a compressed air tank **8** so that selectively tank **7** can be blown or flooded. In the illustrated position tank **7** is presumed to have been blown so that the top of the mast with instrumentation **2** and radio antenna **14** is above the water line **16**.

Near the low point of the mast, i.e., as close to the pivot as possible, there is disposed the (rather heavy) power supply equipment, including a compressor **9**, accumulator battery **11**, a battery charger **12**, a motor **13**, such as a diesel engine, for driving compressor and charger **11**, and a fuel tank **10** for the engine. These elements are subject to control in response to command and control signals from the controller in instrumentation set **2**.

The device as described operates as follows: In the illustrated position, instrumentation **2** takes meteorologic readings. The radio equipment **14** communicates with a shore station, an offshore station, a ship etc.; in particular, the radio equipment may broadcast coded data, e.g., while the command controller runs the instrumentation through a programmed data reading and acquisition cycle as is usual for telemetry. Alternatively, the transmitter may broadcast data at a high rate, the data having been acquired previously and stored.

After completion, either automatically or on command received via the radio link, the controller issues command signals for tank **7** to be flooded, in that, for example, a remote controlled valve discharges air from the tank. Accordingly, the mast, particularly the tip, will dive. Now, oceanological data are read, particularly, for example, during diving. The data are stored in suitable facilities that are part of the instrumentation. After a pre-programmed period (or after the storage facility is filled to capacity), the tank **7** is blown. In the particular example as illustrated, it is presumed that tank **7** is blown by admitting air from container **8** to the tank. After the mast tip has surfaced, the transmitter of radio equipment **14** will transmit the data from the data storage facility. Data may have been acquired also (or only) during re-surfacing.

As can be seen from the drawing, the pipe **4** leads up to the tip of the mast. Therefore, in the illustrated position, the upper end of the pipe is aboe the surface. That top may be closed by a valve, which can be opened. Now, engine **13** and compressor **9** are turned on, and air is sucked into the pipe to replenish the supply in compressed air tank **8**. Air needed for combustion in the engine is likewise received through pipe **4**. Concurrently, the charger **12** may recharge the batteries. The generator included in the charger may directly supply electrical energy to the equipment as long as the top of the mast is above the surface.

Instrumentation for measuring the angle of the mast relative to the vertical may be included in instrumentation **2**, or placed anywhere on the mast, to determine the relative height of the instruments above the bottom of the sea, and whether the equipment is above or below the surface. Alternatively, the instrumentation may include particular pressure gauge for determining the position of the mast tip relative to the surface level **16**. The position data, thus, provided is indicative in either case of the height position of the instrument pack **2**. The height determining data may be fed to the command controller as part of the input thereof, for programmed overall operation control.

It can readily be seen that upon sustaining a particular state of filling in tank **7**, the instrumentation set **2** can be maintained in a particular submerged position, so as to take oceanological readings in a particular level over an extended period of time. For this, it may be advisable to include controlled locking means, e.g., in the universal joint **3** for arresting the position of the mast, but only as to the vertical angle. The locking means will respond to the height measuring equipment. The preprogrammed control will unlock the mast when the data have been read (or when the data storage facility is filled to capacity) and the tank will be blown. After surfacing the acquired data are transmitted, and the station may wait thereafter for receiving a command, e.g., to take meteorological readings or to begin a new oceanological measuring cycle etc.

Various other possibilities for buoyancy control have already been mentioned. As there are times in which the power equipment in effect communicates with the surface (via pipe **4** as well as via the radio link and the radio equipment) there is little basic restriction as to the type of power supply that can be used. In lieu of batteries fuel cells can be used. In lieu of a diesel engine, there may be an electric motor to drive all of the equipment (of course, a recharger will not be needed in that case). As stated, the power pack may be in the anchored base, so as to completely relieve the mast pivoting operation from any weight of these parts. However, the compressor and the compressed air tank are preferably on the lower end of the mast, so that the lower pipe end can communicate directly with these elements, obviating the need for articulated conduit means. As the compressor is on the mast, the engine better be also on the mast to simplify construction of the driving train. However, a large fuel supply and/or a large battery may well be placed on or in the base **1**. The weight distribution may vary in the individual cases, and will depend on trade off between construction costs for buoyancy control and for the power supply and its connections.

The invention is not limited to the embodiments described above but all changes and modifications thereof not constituting departures from the spirit and scope of the invention are intended to be included.

I claim:

1. Equipment establishing a station for providing for oceanlogical and meteorological measurements in the continental shelf region and similar shallow parts of the ocean, comprising in combination:

first means for anchoring to the bottom of the ocean, to establish stationary support;

a mast pivotally linked to the first means for up and down pivoting as well as for turning on a vertical axis;

means for detecting the angular position of the mast tip relative to anchored bottom, i.e., the height of the tip above the anchoring means on the ocean bottom;

second means for providing variable buoyancy and connected to the mast above the point of pivoting;

instrumentation on the mast including sensing means for taking oceanological and meteorological readings; and

means under control of the detecting means for arresting and locking the up/down pivotal position of the mast in selectible and controlled positions wherein the instrumentation has particular vertical positions above or below the sea level, the ability of turning on the vertical axis remaining during said position arresting and locking.

2. Apparatus as in claim **1**, there being a radio receiving and transmitting equipment disposed on the tip of the mast.

3. Equipment as in claim **1**, the second means including a buoyancy control tank and means for selectively flooding and blowing the tank, there being means for controlling the flooding and blowing of the tank.

4. Equipment as in claim 3, there being a compressed air tank near the lower end of the mast, the mast including a pipe connecting the comprised air tank to the buoyancy controlled tank.

5. Equipment as in claim 4, including a compressor for repressurizing the compressed air tank, the pipe leading up to the tip of the mast so that air can be sucked there through by the compressor when the mast tip is above the water surface.

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