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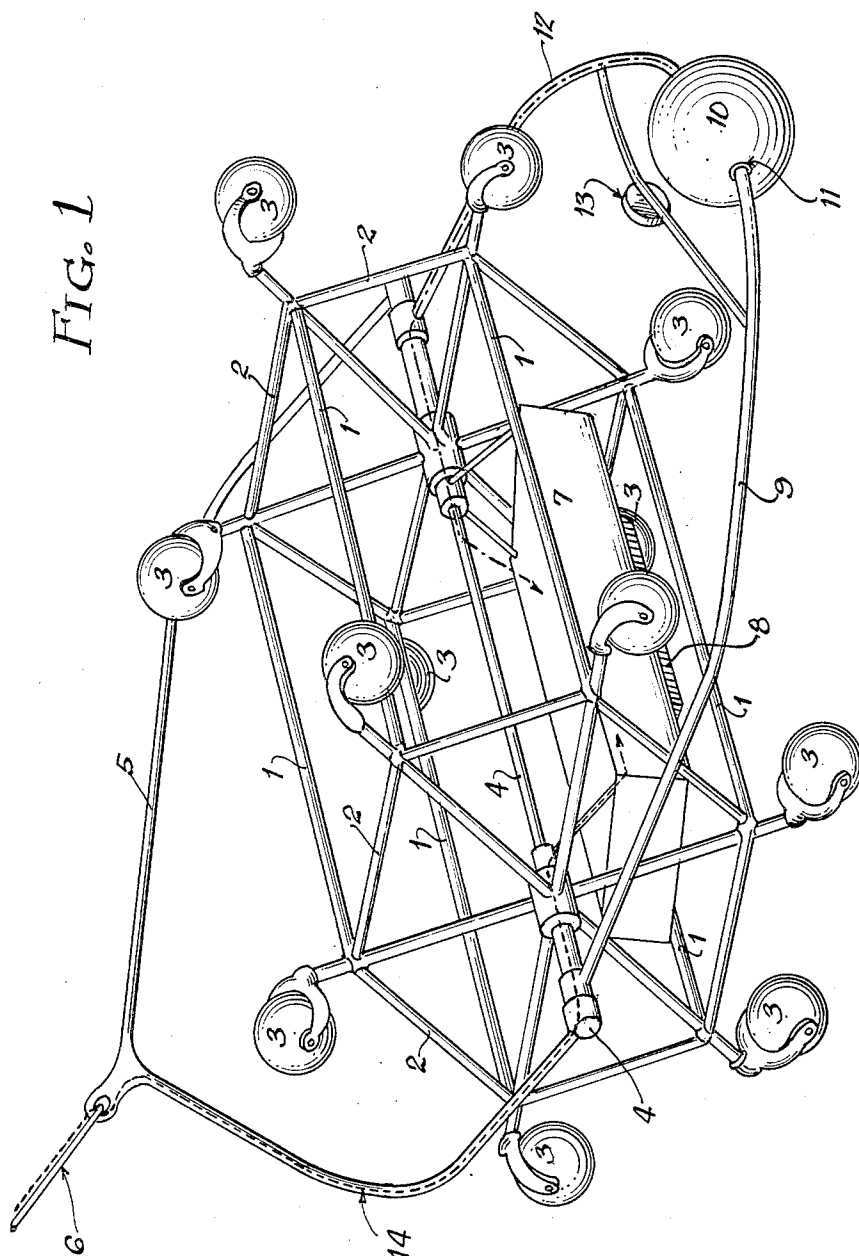
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OCEANOGRAPHIC SAMPLING

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2 Sheets-Sheet 1

FIG. 1



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OCEANOGRAPHIC SAMPLING

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The present invention is related to oceanographic sounding and concerns, more particularly, an apparatus for the recovery of marine samples thus facilitating exploring and investigating the bottom of oceans and seas.

It is well known that recent explorations have permitted recovery of heretofore unknown and quite unusual microorganism specimens from the bottom of oceans and seas, for investigation purposes, which specimens are able to live only under very high pressures of the order of about several hundred atmospheres.

However, the known methods using sounders or reversing bottles offer the major drawback that the sampling is effected sporadically and without having previously explored, located or selected the preferable ground on which is should be effected and consequently such methods are empirical and relatively uncertain.

The applicant has developed an apparatus for use in continuous oceanographic sounding which permits exploration and systematic location of the preferred zones of the medium to be sampled as well as permitting the actual sampling. There are preferable zones at the bottom of oceans and seas, where the density of microbial and/or isotopic elements is higher and the character thereof more diversified. Such zones have been found to be particularly located on the bottom of natural deeps or trenches of the submarine ground.

The present invention has for its object the provision of an apparatus for use in oceanographic sounding which consists substantially of means for exploring, locating, sampling and recovering the products which are on the ocean floor, the apparatus employing a technique which includes measuring the variations of the density of the medium containing the said products.

The other objects of the invention will be disclosed in the course of the following description. The accompanying drawings provide illustrations of the inventive subject matter as follows:

FIGURE 1 is a perspective view of the oceanographic sounding device;

FIGURE 2 is a schematic illustration of a sampling mechanism employed in this device;

FIGURE 3 is a schematic illustration of a diving controller mechanism; and

FIGURE 4 is a schematic illustration of the diving controller of FIGURE 3 shown in the position taken when the sounder is on the ocean floor.

The applicant has found, on the one hand, that it is possible to systematically sound the ocean bottoms by taking advantage of the density variations of the medium. It is known that the density of the ocean and sea water generally becomes practically the same in any part of the world, irrespective of the longitude and the latitude, at points below several hundred meters deep. In addition, the salt concentration remains substantially constant and of the order of about 3.5% by weight. Moreover, from about one thousand meters depth, the most complete quietness prevails; and any plant life, even at the microscopical stage, does not exist below three hundred meters. Lastly, the temperature remains practically unvariable below two hundred meters.

The applicant has established, on the other hand, that by relative measurement of the density of the medium,

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one can detect the presence of zones having a modified density, that is, a density varying from the accepted standard for a given depth. Such variations can occur due to the existence of such phenomena as proliferation of microbes and isotopic elements, and suspensions of inorganic and organic substances, and more or less significant increases in the deuterium oxide (heavy water) content of water, etc.

The applicant has further established that it is possible to immediately effect "in situ" such a relative measurement of density by directly applying the float densimetric method through immersion of an apparatus, the main component of which permits exploration, location, sampling, and recovery of samples from the ocean medium. The apparatus may comprise a float of a type which will normally place itself on a flotation balance with its environment. Thus, the float may be placed on a flotation balance with a 3.5% by weight salt water solution and any variation of the density of said medium brings about, ipso facto, an unbalancing of said float.

According to a preferred but not limiting embodiment of the invention, said float consists substantially of a sphere of a few centimeters diameter, for example of the order of about 10 to 30 centimeters, filled with a liquid having a density close to that normally prevailing in the deep sea waters. For example, with water the salt concentration of which is of the order of about 3.5% by weight, the wall of said sphere is made out of a thin membrane of any material such as, for instance, metal, rubber, plastic, glass fiber, etc. Such a float offers the important advantage of being, ipso facto, integral with the aqueous medium prevailing, in the exploration zones, irrespective of what the conditions of temperature, pressure and compressibility may be. The parameters, other than density, which are liable to vary, owing to the presence of foreign elements within the medium, will be found to be practically neutralized, because balanced with such a float.

The present invention is more specifically directed to a sounder adapted to:

(1) Signal its arrival and its making contact with the ground on the bottom of the ocean or sea;

(2) Signal its forward progress on the submarine ground;

(3) Signal any unwillfully created acceleration in said forward progress, due, for instance, to the presence of a slope soliciting said sounder;

(4) Signal any unwillfully created stopping in said forward progress, due to the presence, for example, of hindrances, such as wrecks, etc.;

(5) Signal any unwillfully created loss of contact with the ground, due, for instance, to a sudden discontinuity in the bottom surface;

(6) Signal the arrival in a zone having a density different from the standard density of the medium and which is one of the sought for densities;

(7) Achieving any sampling or picking up in said zone.

The applicant has developed according to a preferred but not limiting embodiment of the present invention, an apparatus of the "sounder" type permitting exploration, location, sampling, and recovery in said zones by applying "in situ" the float densimetric method.

Essentially, such a "sounder" consists substantially of a carriage comprising the various apparatuses including orientation, signalling, sampling and recovery means capable of achieving the different functions hereabove set forth. The carriage, controlled by operators or navigators, moves on the submarine bottom. It may be towed by any known engine, including a boat by means of any rope connected with said boat over a winch. It stays permanently in communication with the operators

or navigators who are informed, at any time, of its behavior and its position of immersion through an electric connection. The various reactions of the sounder are signalled to the operators or navigators by electric wave trains of different shapes, similar, for instance, to those used in the Morse system, and transmitted by the various apparatuses and components.

The sounder consists substantially of a carriage, forming a cage (FIGURE 1) comprising six rods 1, for instance, solid or tubular metallic rods, parallel to each other and placed according to the six edges of an hexagonal cross sectional volume. The rods 1 are linked together at the ends by means of two frames 2, of a hexagonal shape. The frames 2 each include three diagonal bars and each of said diagonals is equipped with a ball stand 3, constituted by a metallic sphere designed to pivot about any direction. Said carriage is thus liable to move in all directions and under all ocean floor surface conditions.

The thus formed cage freely pivots about its axis 4, as does the driving fork 5, which may be connected with a boat through the rope 6, the latter consisting of any known material, such as metal, rubber, plastic material and/or glass fiber.

On being submerged, the sounder adapts itself to the contour of the ocean floor and is adapted to be moved forwardly, controlled from the surface, while it freely obeys any side influences induced by the presence of slopes. It will thus spontaneously proceed toward the lowest portions, seeking any depression liable to contain the various density phenomena which were quoted hereinabove.

Said sounder may have any other shape for instance that of a sphere, the only condition being that it be able to move freely and easily in all directions under the mere influence of any undulation of the land constituting the submarine ground, for instance of any slanting portion.

Inside the cage a tray 7 is attached to the carriage axis by gimbals mountings. The various apparatuses described are located on this tray. The tray, forming a platform, is maintained horizontally in the course of the sounder motion by means of a ballast 8, comprising, for instance, an electric power source and among others, secondary cells, feeding the various apparatuses and/or means which equip the sounder.

A second fork 9, the branches of which are integral with the axis 4, as a ball or wheel 10, pivoting about an axis 11 located thereon. The ball 10 is adapted to roll along the ground and carries along in its rotation a flexible drive shaft 12 connected with a component of the sounder. The operation of this portion of the apparatus will be hereinafter explained.

13 represents an apparatus which will also be described hereinafter. 14 illustrates the electric cable connecting the various apparatuses of the sounder with the controlling ones at the surface and according to a preferred but non limiting embodiment of the invention and owing to the fact that in such working conditions, economy of electrical material and simplification are of primary importance, said cable consists substantially of one pair of electric conductors only or even of one single wire, running along or integral with the rope or controlling cable of the sounder.

Means meeting the requirements, hereinabove set forth as 6 and 7 and comprising the float-sphere 15 (FIG. 2) will be described in detail. This float is the primary means for carrying out the process, according to the invention, and is the main component of the sounder therefor.

In practice, under the effect of the density variations of the medium in which the float of this invention moves, it meets both of the above basic requirements, i.e., it points out the sought for zones and, it insures the standard density of said medium and which pertains to the sought for zones and, on the other hand, it ensures any sampling

or picking up of the constituents of said zone. Effectively, when the sounder enters a zone the density of which is higher than the standard density, the float 15 rises up. This motion induces the reversal of the two integral components 17 and 18 by a rotation about the axis 16 and simple and immediate transmission of information by these components.

The numeral 17 represents a mercury tube which, on being reversed, closes the electric circuit 19—20. Then a continuous signal is transmitted to the operators or navigators which may be heard, seen or automatically recorded and which informs them of the presence of a zone of higher density. They can then immediately stop the sounder so that it will not be moved out of this zone.

18 represents a necked down mercury apparatus generally known as a "time glass" which, on being reversed and after a few seconds, for instance of the order of one minute, closes an electric circuit 21—22. This closing delay is necessary to allow complete introduction of the sounder into the lowest point of said zone and to neutralize any momentary phenomenon, which although not a density variation of the medium is nevertheless able to create a motion of said float sufficient to close the circuit 19—20. This could be done by a shock produced by some unevenness of the submarine ground. The closing of said circuit 21—22, induces the operation of sampling or picking up of the constituents of said zone.

Said sampling or picking up is achieved according to the invention in any way including the manner shown in FIGURE 2. This sampling takes place responsive to the closing of circuit 21—22 which in turn induces the closing of a solenoid 23—24. The electromagnet 25 then starts the operation of said sampling. The sampling may consist of a recovery of the constituents of said zone by closing a vessel which may have a capacity of the order of one liter for instance, such as is represented on FIGURE 2, at 26. Then the sounder is brought up and recovered for analyzing said sample. Any other sampling system, according to the invention, may also be achieved and as a non-limiting example such system may include routine sample taking with suction bottles, each bottle being directly recovered afterwards by automatic dropping from said sounder. On the other hand, picking up of the zone constituents by pumping through a duct which may double as a trawling rope and which takes, for instance, a flat shape, before sampling. Another alternative may comprise a combination of these systems.

Means for working the control of the sounder and meeting the requirements, hereinabove set forth as 1, 2, 3, 4 and 5, are afterwards described. They comprise a forwarding control system of the tachometer type and a driving controller.

The tachometer, shown on FIGURES 1 and 2, comprises a ball 10 which may be toothed, which turns about its axis 11 in the course of the forward movement of the sounder on the submarine bottoms. This rotation actuates the flexible cable 12, which is connected by passing through axis 4, to the axis of the cam type disc 27 having a circumference of the spiraloid type. A metallic rod 28, fitted in the guide 29, is retained substantially perpendicular to the axis of the disc 27 and is resiliently maintained against the surface of the disc by the action of a spring 30. The other end of the rod 28 is movably secured on a lever 31 which is integral with a mercury tube 32. This mercury tube is normally maintained in a horizontal position.

Turning of the wheel 10 causes rotation of the disc 27 through the flexible drive 12 and a spring 30 is thereby gradually compressed and then briskly released during each cycle of rotation. At the end of a revolution of the wheel 10 and due to the sudden action of the spring 30, the mercury contained in tube 32 is thrown towards the opposite end of the tube through a centrifugal force effect. This shuts the electric circuit 33—34 for a fraction of a

second thus transmitting a wave flux which may be heard, seen or recorded by the operators or navigators. Consequently, the signal corresponding to the forward movement of the sounder on the submarine ground will be of the distinct and regular type. The occurrence of this signal corresponds to contact of the submerged sounder with the ground, and the frequency of the pulses will give information concerning its behaviour during forward movement. If the signal stops, this condition will correspond to damage or blocking of the sounder or to a loss of contact with the ground. It must be noted in this respect that the operation of the cam means 27 and the switch 32 provides bridging of the contacts 33 and 34 at only one slight interval of rotation of the ball 10. Therefore, the possibility of the carriage stopping while the contacts are bridged is minimized.

The diving controller shown at 13 on FIGURE 1 and on FIGURES 3 and 4 comprises a simple mercury contact of a special shape, such as a disc, and is composed of glass or any thick, non conducting substance. At the heart of the disc is provided a void space of a spherical cup shape at the bottom of which two electrodes 35 and 36 are provided substantially flush with the surface and at a little distance from one another, of the order of about a few millimeters. Contained in the cup is a mercury drop capable of closing an electrical circuit between said electrodes. Said controller is placed upon the sounder in such a way that, in the course of its going down and as long as it does not touch the soil, said circuit will be alternately closed as the controller passes to the horizontal position and opened, irregularly, due to the swinging movement of the equipment as it proceeds through the water. The operators can hear, see or record such signals thus transmitted and as soon as the sounder has contacted the ground, said controller will assume a non horizontal position and, consequently, its circuit will remain open. At this time the forwarding control system of the tachometer type heretofore set forth begins working.

I claim:

1. Apparatus for the recovery of marine samples having a density greater than normal density and located near the bottom of a body of water, comprising submersible means including a float having a density substantially corresponding to said normal density, electrical conductors operatively connected to said float, means for bridging said conductors when said float is raised in response to an increase in density, sampling means for holding said marine samples, electro-responsive means included in a circuit with said conductors, said electro-responsive means being operatively associated with said sampling means and being adapted to close said sampling means to retain a marine sample therein whenever said electro-responsive means is energized due to completion of said circuit.

2. Apparatus for the recovery of marine samples having a density greater than normal density and located near the bottom of a body of water, comprising a submersible carriage and means to pull said carriage from the surface of the water while it is submerged, said carriage including a device responsive to increases in density, sampling means adapted to retain a sample of said water and adapted to be recovered with the retained sample, means operatively connected to said device and to said sampling means adapted to close said sampling means for retaining said samples when said device operates in response to an increase in density, rotatable supporting means on the underside of said carriage adapted to contact the floor of the body of water, and flexible drive

means having one end connected to one of said rotatable means and the other end connected to signal transmitting means whereby rotation of said one rotatable means operates said flexible drive means to transmit signals.

3. Apparatus for the recovery of marine samples having a density greater than normal density and located near the bottom of a body of water, comprising a submersible carriage and means to pull said carriage from the surface while it is submerged, said carriage including a device responsive to increases in density, sampling means adapted to retain a sample of said water and adapted to be recovered with the retained sample, means operatively connected to said device and to said sampling means adapted to close said sampling means for retaining samples when said device operates in response to an increase in density, rotatable supporting means located on the underside of said carriage adapted to contact the floor of the body of water, a flexible drive shaft having one end connected to one of said rotatable means and the other end connected to signal transmitting means whereby operation of said rotatable means causes said drive shaft to operate said transmitting means, and diving controller means located on said carriage, said controller means including second signal transmitting means, said second means being inoperative when said carriage is positioned on said floor and being operative to intermittently transmit signals when said carriage moves to other positions, whereby an irregular signal is transmitted by said controller as said carriage is swung irregularly when lowered to said floor.

4. The apparatus according to claim 2 wherein said device comprises a float having a density substantially corresponding to said normal density, and the means operatively connected thereto comprising electrical contacts and means for bridging said contacts when said float responds to said increased density, and wherein said sampling means is a container having a solenoid operatively connected thereto, said solenoid being included in the circuit including said bridging means and said contacts, and being adapted to actuate said sampling means when said contacts are bridged.

5. The apparatus according to claim 4 wherein said device further comprises time delay means secured to said carriage and interposed in said circuit, said time delay means including second electrical contacts and means for bridging said second contacts a given interval of time after bridging of said first contacts, whereby said sampling means is actuated only after bridging of said second contacts.

6. The apparatus according to claim 5 wherein said first and second contacts are each adapted to transmit a signal to the operator of the apparatus when bridged by said bridging means.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,069,905

December 25, 1962

Ladislav Erdely

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 31, after "various" insert -- modified --; same column, lines 73 to 75, strike out "points out the sought for zones and, it insures the standard density of said medium and which pertains to the sought for zones and, on the other hand, it ensures any sampling", and insert instead -- points out the presence of zones having a density different from the standard density of said medium and which pertain to the sought for zones and, it insures any sampling --.

Signed and sealed this 23rd day of July 1963.

(SEAL)
Attest:

ERNEST W. SWIDER
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