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3,155,174

FUEL POWERED SEDIMENT CORER

Filed April 12, 1961

2 Sheets-Sheet 1

FIG. 1

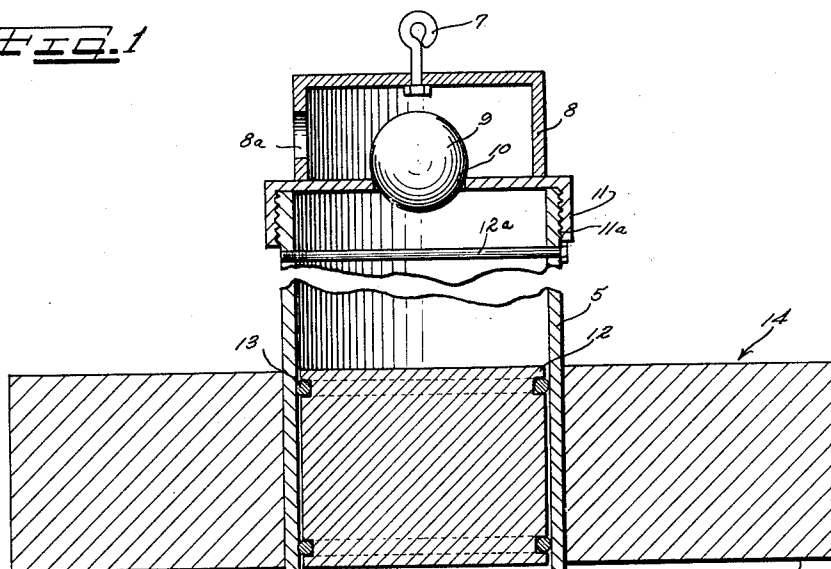
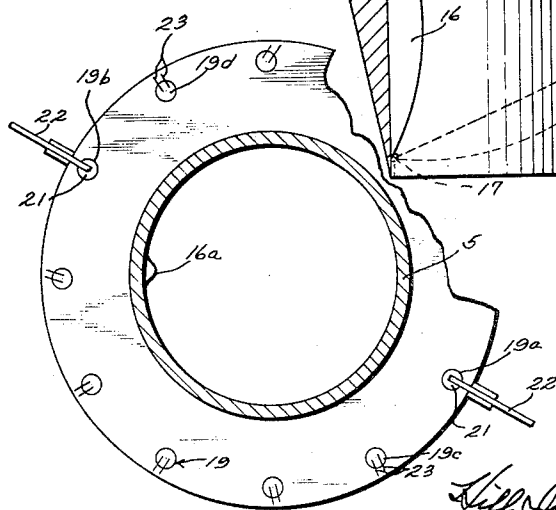


FIG. 2



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FIG. 3

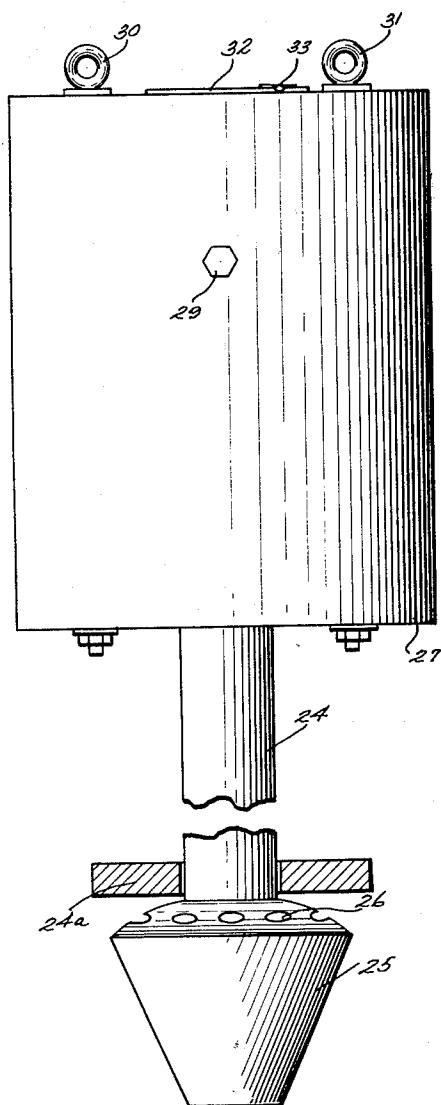
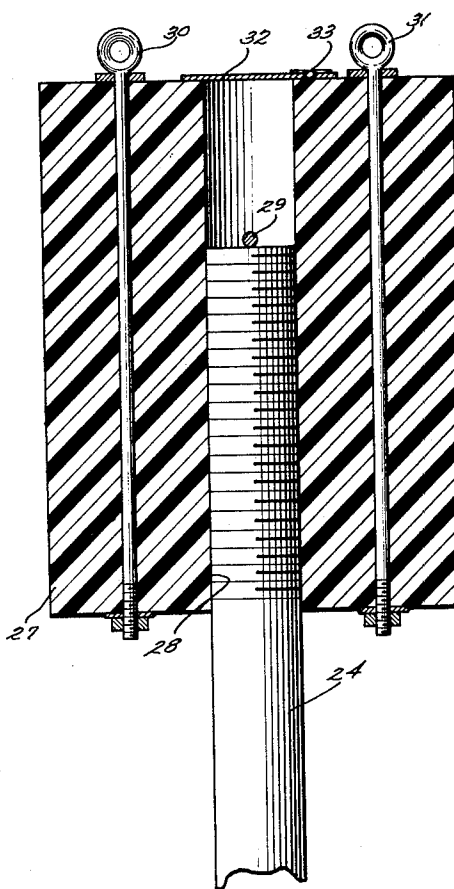


FIG. 4



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FUEL POWERED SEDIMENT CORER

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The present invention relates to an improved mechanism for obtaining core samples of oceanic deposits.

It is known that the deposits which carpet the floor of the ocean differ in different places and it is desirable and necessary to obtain samples of the deposits for scientific and other purposes. Various devices have been attached to the leads which are used by sailors for determining the ocean depth intended to catch and hold the material when soft enough to be penetrated. These devices include snappers or spring jaws for biting a portion of the ocean bottom. A collector formed of a plain cylindrical tube is commonly used and the tube is driven into the bottom of the sea by the weight of a sounding lead with the tube being drawn to the surface for obtaining the core sample. Sediment cores presently in use are of the "gravity" or "gravity piston" type both employing heavy weights attached to the cores. Devices heretofore used have had disadvantages and these disadvantages in a large number of instances are related to the conditions under which samples must be obtained and to the nature of the materials which must be gathered and to the wide variation in the characteristics of the materials. The nature of the materials in the ocean bottom varies widely and the materials have been classified into types of clays, muds, oozes, sands, gravels, etc. These materials vary with the location where the samples are taken or whether taken as deep sea deposits (between 100 fathoms or 200 metres), shallow water deposits (in less than 100 fathoms) and littoral deposits (between high and low water marks). The materials can also be classified as pelagic deposits (formed in deep water remote from land or terrigenous deposits (formed in deep or shallow water close to land). With the variations in materials are variations in factors that directly affect the operation of a corer, such as the consistency of the sample and the rigidity of the ocean floor.

It is accordingly an object of the invention to provide an improved corer which is dynamically stable and is assured of vertical entry into the ocean bottom, and which avoids features heretofore necessary that often caused non-vertical entry of a mechanism for obtaining core samples.

Another object of the invention is to provide an improved core sampling device which is pulled vertically into the material at the ocean bottom rather than being pushed and which avoids a requirement of lead plates at the top of the core such as has been necessary with certain types of coring mechanisms.

A still further object of the invention is to provide a coring mechanism for obtaining oceanic samples which is extremely light and is therefore more easily handled at sea.

A further object of the invention is to provide an oceanic core sampling mechanism which is capable of greater depth penetration than models heretofore available.

Other objects and advantages will become more apparent with the teaching of the principles of the invention in connection with the disclosure of the preferred embodiment in the specification, claims and drawings, in which:

FIGURE 1 is a vertical sectional view of a mechanism for obtaining oceanic deposit samples constructed in accordance with the principles of the present invention;

FIGURE 2 is a horizontal sectional view taken substantially along line II-II of FIGURE 1;

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FIGURE 3 is a side elevational view of another form of mechanism for obtaining oceanic deposit samples shown with a length of the vertical tube removed for convenience of illustration and with other elements omitted from the showing; and

FIGURE 4 is a vertical sectional view taken through the center of the mechanism of FIGURE 3.

As shown on the drawings:

The mechanism for obtaining samples of oceanic deposits, as shown in FIGURES 1 and 2, includes an elongated vertical hollow cylindrical tube 5 formed of a non-magnetic material and preferably formed of a rigid plastic. At the lower end of the tube is a head 6 which points downwardly and has a central circular opening 6a through which the oceanic core sample moves when the tube is driven vertically downwardly into the ocean floor. At the top of the tube is suitably connected an eye bolt 7 which provides a means for attaching a line for lowering the device to the ocean floor and retrieving it after a sample has been gathered within the tube.

At the top of the tube 5 is a cage 8 having suitable openings 8a for the escape of sea water as it flows past a ball check valve 9 through a port 10. The ball 9 is held within the cage 8 and rises as the tube 5 is being driven into the ocean floor for gathering a sample, to permit the escape of sea water from the inside of the tube 5. When the tube is raised on a line attached to the eye bolt 7, the ball 9 seats against the sides of the port 10 helping retain the sample within the tube 5.

The cage 8 is suitably secured to the top of a cap 11 which has an outer annular flange with internal threads for threading the top of the tube. The lower edge 11a of the cap provides a shoulder which prevents an annular magnet 14 from slipping upwardly off the top of the tube 5, as will later become clear. Thus the tube 5, the head 6, and the cage 8 provide a barrel means with an inner chamber for receiving the sample through the bottom opening 6a and holding the sample within the barrel means.

Within the hollow cylindrical tube is a cylindrically shaped iron piston 12 which is mounted for free sliding movement. The piston may have seals 13 which engage the inner surface of the tube 5. The piston functions to ride on top of a sample core that is forced up into the tube to hold it compact and to maintain its stratified composition if such is the nature of the sample taken. The piston holds the sample with the various layers as they are obtained from the ocean floor and also prevents portions of the sample from washing out upwardly through the ball check valve 9. A pin or bolt 12a extends across the tube 5 to limit the upward travel of the piston 12.

The piston 12 is maintained at the level of the ocean floor preventing it from pressing down into the sample, and holding it at the base of the tube when the tube is being lowered to the ocean floor. For this purpose the annular "doughnut" magnet 14 surrounds the tube 5 and is vertically slidable thereon. As the tube is lowered to the ocean floor, the lower surface 15 of the magnet 14 rests on the ocean floor and maintains it at that level. As the tube sinks into the ocean floor the piston 12 is maintained at the level of the annular magnet 14 by the magnetic lines of force.

At the base of the tube 5, carried by the head 6, is a valve 16 which permits the sample to pass up into the tube as the tube is being forcibly thrust down into the ocean floor, and which closes to prevent the escape of the sample when the tube is raised. This prevents the loss of any samples and also prevents ocean water from washing the sample out from the interior of the tube as the tube is being raised. The valve 16 is formed from a section cut from a cylindrical liner shell 16b held in the

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lower end of the head. The valve 16 is pivoted at its base end at the side of the opening 6a on a hinge 17 and lies flush with the rest of the liner 16b in the solid line open position of FIGURE 1. The upper end is curved out slightly at 16a so that the material inside the tube will force the valve to close when the tube is lifted, and the valve will close in the dotted line position of FIGURE 1. As will be appreciated by those skilled in the art, other valve constructions may be employed at the base of the tube.

The tube is uniquely thrust vertically downwardly into the ocean floor by explosive charges 20. These are carried in chambers 19 in the head at the base of the tube. The head 6 is suitably rigidly secured to the tube so as to draw the tube downwardly with it when it is forced downwardly into the ocean bottom. For improved penetration the sides 18 of the head are tapered to a narrow edge at the base of the head. This also provides area for the chambers 19 which hold the explosive.

The chambers may take various shapes and a single chamber may be provided. The chamber will have one or more upwardly facing ejection openings through which the gases are ejected when the explosive within the chambers 19 is fired for thrusting the head 6 and its tube 5 downwardly into the materials at the ocean bottom.

The invention contemplates the provision of a plurality of chambers arranged around the head each provided with an ejection opening. This makes it possible to fire sequential charges of explosive for succeeding thrusts of the head down into the ocean bottom. As shown in FIGURE 2, for example, the head is shown with a plurality of chambers with individual chambers being shown at 19a, 19b, 19c and 19d having charges of explosive 20 therein with the explosive being in the form of solid fuel. The solid fuel is preferably of a monopropellant type wherein the fuel and oxidizer are combined, ignited by suitable means such as a firing cap 21.

For balanced downward thrust, opposed chambers may be fired simultaneously and 19a and 19b may be fired at the same time. Two other diametrically opposed chambers may be fired next such as 19c and 19d, and the remaining opposed chambers may be fired in pairs at a later time or all charges may be fired simultaneously.

For firing the first chambers, or for firing a single charge, a device is provided for automatic firing when the mechanism engages the ocean floor. Tripping levers 22 are shown pivoted at the side of the head with their inner ends positioned for striking the firing caps 21 and their outer ends positioned for engaging the ocean floor to pivot them inwardly. For firing the additional successive charges, delay devices may be provided or the additional charges may be fired electrically such as by providing wires 23 leading to the surface and operated from a location such as the supporting ship where the tube is supported on a line attached to the eye bolt 7.

As a brief summary of operation, the mechanism is supported on a line secured to the eye bolt 7 and lowered to the ocean floor whereupon the lower end of the tube enters the relatively soft material on the ocean bottom and the material pushes upwardly on the outer ends of the tripping levers 22 to ignite the solid propellant 20 in the chambers 19 to thrust the head 6 down into the oceanic deposits and forcing a core up past the valve 16 into the tube 5. The annular magnet 14 holds the iron piston at the level of the ocean floor as it rests thereon, and sea water escapes from the tube above the piston through the check valve 9.

In the form shown in FIGURES 3 and 4, an elongated vertical core receiving tube 24 is provided which is made of a suitable plastic such as polyethylene or polyvinyl chloride. This tube or barrel is lightweight and permits control of the piston inside by the annular doughnut magnet 24a which is slidably mounted on the tube 24. The tube is lightweight and can be made of plastic in long lengths on the order of up to 200 feet.

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At the base of the tube 24 is connected a metal head 25 with sloping sides having a construction substantially the same as the head of FIGURES 1 and 2. The devices for firing the chambers such as the levers 22 and wires 23 of FIGURE 2 are not shown in FIGURE 3.

At the upper end of the tube is threaded a cylindrical plastic block 27 formed of solid polyethylene. The plastic block 27 lends stability to the corer and causes it to remain upright inasmuch as polyethylene has a specific gravity of substantially 0.9. The tube 24 and block 27 thus float upwardly, and the heavy head 25 at the lower end contributes toward dynamic stability.

The block 27 is internally threaded at 28 for attachment of the tube 24. A rod 29 extends laterally through the block across the top of the tube to provide a stop for the piston (not shown) when the piston reaches the uppermost limit of its travel and a full sample has been taken. The block 27 is vertically bored to receive two eye bolts 30 and 31 for securing the cable to suspend the coring mechanism from a ship.

The block is provided with a flap type valve 32 hinged at one side on the block and this functions the same as the ball check valve of the mechanism of FIGURES 1 and 2. A lightly loaded torsion spring 33 may be provided so that the flap check valve 32 closes when the corer is raised after having been filled with a sample.

In the embodiment of FIGURES 1 and 2 or the embodiment of FIGURES 3 and 4 the inside dimension of the head 6 or 25 is the same as the inside dimension of the tube 5 or 24 so that the sediment sample fills the tube or barrel in an undisturbed state. This, contacting with the magnetically supported piston 12, maintains the sediment in its stratified form as it appears on the ocean floor and disturbance of the stratification is maintained at a minimum.

In presently used gravity and gravity piston type of corers, heavy weights are attached to the corer to drive it down into the ocean floor. Certain corers presently used also employ a piston in conjunction with the weights wherein the piston is held in position by a cable inside the corer tube. With this construction precise and reliable positioning of the piston is impossible. Because of the weights and because the corer barrels are made of steel, their weight is substantial and they are unmanageable in rough weather and cannot be used except from vessels of substantial size such as over 75 feet in length. Weight requirements for depth penetration of greater than 60 feet become enormous (over 1,000 pounds).

The present corer eliminates the weight requirements and because the corer is pulled into the sediment (rather than driven or pushed) much deeper sediment samples may be obtained. Further, dynamic stability is achieved with the avoidance of the required weights at the top end. Because of the stability the present corer will penetrate the bottom at an angle perpendicular to the bottom avoiding penetration at angles with corers heretofore used. The lightweight tube or barrel and the floating upper end contribute toward stability and insure perpendicular penetration.

Thus it will be seen that I have provided an improved core sampling device for obtaining samples of oceanic deposits, which meets the objectives and advantages above set forth.

The coring mechanism is designed to be dynamically oriented toward the vertical and the solid fuel propulsion draws the tube behind it vertically down into the sediment on the ocean floor.

The drawings and specification present a detailed disclosure of the preferred embodiments of the invention, and it is to be understood that the invention is not limited to the specific forms disclosed, but covers all modifications, changes and alternative constructions and methods falling within the scope of the principles taught by the invention.

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I claim as my invention:

1. A coring mechanism for obtaining samples of oceanic deposits comprising an elongated hollow tube formed of a rigid plastic, means on the upper end of the tube for attaching a line for lowering the tube to the ocean floor and for raising the tube with a sample, a piston slidably mounted in the tube formed of a magnetically attractable material, an annular magnetic ring slidably mounted on the tube for relative vertical movement and for resting on the ocean bottom while the tube is sunk into the ocean bottom for magnetically holding the piston at the level of the ocean bottom surface, a self-closing check valve at the upper end of the tube permitting the escape of sea water as the piston rises relatively to the tube, a penetrating head mounted at the base of the tube having an annular downwardly extending inwardly tapering outer surface for penetrating the ocean floor, a self-opening and closing hinged valve at the base of the head for being opened by the material of the ocean floor as the tube is sunk into the floor and being closed as the tube is raised and the material tends to leave the tube, a plurality of explosive chambers in said head for containing individual explosive charges, and individual upwardly facing discharge openings in each of the chambers so that the individual explosive charges in separate chambers can be fired at successive times for individual vertical thrust to force the tube into the ocean floor.

2. A coring device for obtaining samples of oceanic deposits comprising an elongated core sample barrel having an upper portion formed of material having a specific gravity less than sea water, and having a head at the lower portion of the barrel having a specific gravity greater than sea water, said barrel having an overall specific gravity greater than sea water so that it will sink in sea water, means for attaching a line at the top of the tube, means defining a propellant chamber at the lower end of the barrel exposed upwardly to the ambient sea water for ejecting an explosive propellant and drawing the barrel head downwardly into the ocean bottom, and means to fire the propellant.

3. A corer for obtaining underwater deposits from the bottom of a body of water comprising an elongated hollow core sample tube, means on the tube for attaching a line for lowering the tube to the floor of a body of water and for raising the tube with a sample, a penetrating head mounted at the base of the tube having an annular outer surface tapering upwardly in an outward direction for penetrating said floor, means defining an explosive chamber in said head, an upwardly facing discharge port opening from said chamber exposed to ambient water so that firing an explosive charge in the chamber generates a downward thrust due to reaction with the water for driving the head into the material at the bottom of a body of water, and means for firing a

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charge in the chamber at the bottom of the body of water.

4. A coring mechanism for obtaining underwater deposits comprising an elongated hollow tube of non-magnetic material, means at the upper end of the tube for supporting the tube from a line for lowering to the bottom of a body of water and retrieving a deposit core sample, a piston member slidably mounted in the tube, an outer member mounted exteriorly of the tube for relative vertical movement and for resting on the bottom of a body of water while the tube is sunk into said bottom, one of said members being formed of magnetic material and the other of said members being a magnet for magnetically holding the piston at the level of the surface of said bottom, means for sinking the tube into said bottom, and means permitting the piston to move upwardly without trapping water in the upper portion of the tube.

5. A coring mechanism for obtaining underwater deposits comprising an elongated hollow tube of non-magnetic material, means at the upper end of the tube for connecting a line for lowering the tube to the bottom of a body of water and retrieving a deposit core sample, a piston slidably mounted in the tube formed of a magnetic material, an annular magnet ring slidably mounted on the tube for relative vertical movement and for resting on said bottom while the tube is sunk into said bottom for magnetically holding the piston at the level of the surface of the bottom, means for sinking the tube into the bottom, and means permitting the piston to move upwardly in the tube without trapping water in the upper portion of the tube.

6. A coring mechanism for obtaining underwater deposits comprising an elongated hollow tube formed of a rigid plastic, means on the upper end of said tube to lower the tube on a line to the bottom of a body of water and retrieve a deposit core sample, a piston slidably mounted in the tube formed of a magnetic material, a magnet member mounted exteriorly of the tube for relative vertical movement by resting on said bottom while the tube is sunk into the material of said bottom for magnetically holding the piston at the level of said bottom, means for sinking the tube into said bottom, and means permitting the piston to move upwardly without trapping water in the upper portion of the tube.

References Cited in the file of this patent

UNITED STATES PATENTS

1,661,091	Riabouchinski	Feb. 28, 1928
2,227,198	Piggot	Dec. 31, 1940
2,264,449	Mounce	Dec. 2, 1941
2,405,127	Beach	Aug. 6, 1946
2,798,378	Del Raso et al.	July 9, 1957
3,078,931	Moore	Feb. 26, 1963