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B. V. DEL RE' ETAL

3,139,945

PNEUMATIC CORER

Filed July 11, 1963

2 Sheets-Sheet 1

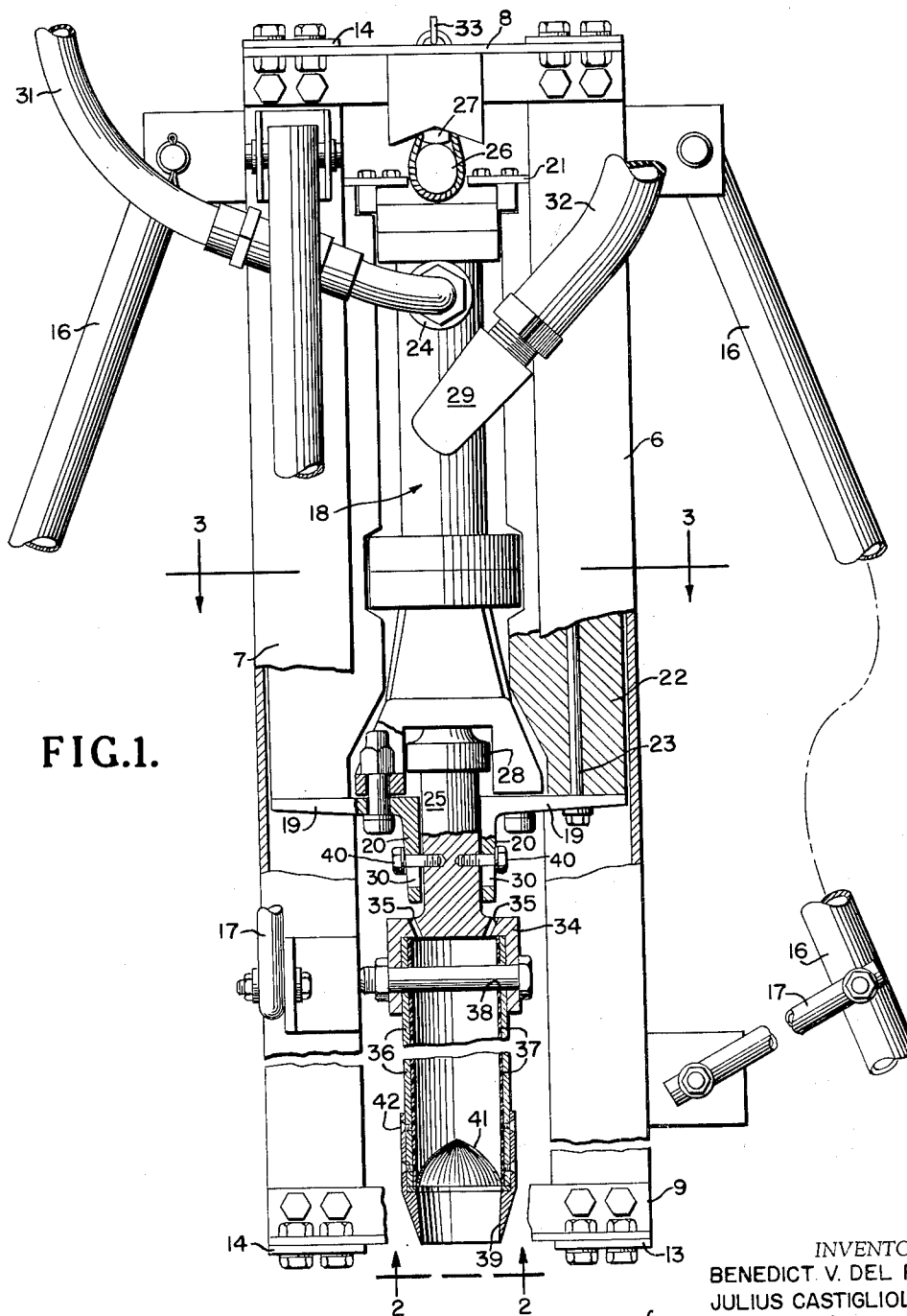


FIG. 1.

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2 Sheets-Sheet 2

FIG. 3.

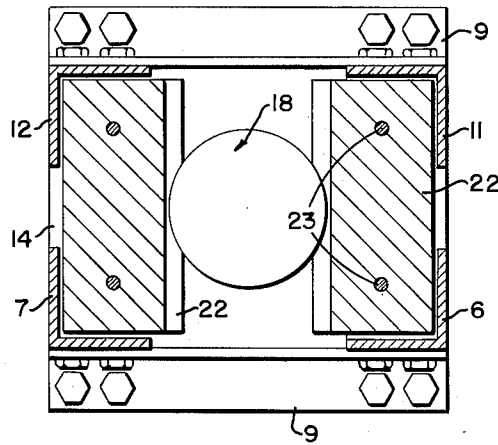
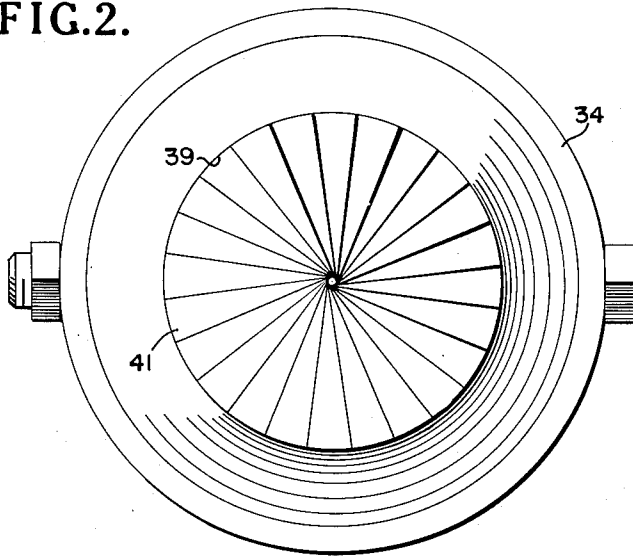


FIG. 2.



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## PNEUMATIC CORER

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5 Claims. (Cl. 175—6)

(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention relates to an underwater earth sampling device, and more particularly to a ship controlled pneumatically driven sampler tube and cutting head for cutting, collecting, retaining and subsequently retrieving a relatively undisturbed and substantially perpendicular sample of the earth's surface including portions of mud, sand, coral and gravel.

The prior art devices have generally been of two distinct types, one being a large oil rig which is heavy, bulky, expensive and required ships specially modified to carry the rig. The other type has generally been the weighted tube which is dropped over the side of a ship and through the force of its own weight is driven into the earth. This type has generally been unsuccessful in earth containing any coral, shell, gravel or sand since the limited force available, in the presence of this material, would prevent the penetration of the earth's surface to obtain the desired sample.

The purpose of this invention is to provide a portable sampler which is able to obtain an undisturbed sample of the earth's surface even in the presence of sand, shell, gravel and coral, hereafter referred to as sediment. The ship carrying the pneumatic corer needs no special alterations or modifications as most ships generally have a crane and a source of compressed air. The pneumatic corer is lowered into the water from the side of the ship and allowed to descend to the earth's surface under the body of water. At that position the legs support a frame having a pneumatic hammer, which, under the action of the compressed air from the ship drives a cutter into the earth's surface through the sediment and collects within a tube the undisturbed sample of the earth. A core catcher at the end of the tube retains the sample within the tube and the ship by means of its crane retrieves the corer and sample for subsequent analysis work.

An object of the present invention is to provide an apparatus for cutting a perpendicular core sample of sediment of the earth's surface storing the sample in a relatively undisturbed state, and subsequently retrieving the sample for further analysis.

Another object of the present invention is to provide a pneumatic hammer for forcibly cutting the sediment.

Still another object is to provide a core barrel and a core retaining means for maintaining the sample in a relatively undisturbed condition.

Another object is to eliminate undue oscillatory motion of the core sample.

Other objects and features of the invention will become apparent to those skilled in the art as the disclosure is made in the following detailed description of an illustrative embodiment of the invention as shown in the accompanying sheets of drawings in which:

FIG. 1 illustrates a plan view, partially in section, of an illustrative embodiment of the assembled invention;

FIG. 2 illustrates an end view taken along the lines 2—2 of FIG. 1 of the core barrel, core catcher and the core cutter; and

FIG. 3 illustrates a section along the lines 3—3 of

FIG. 1 showing the guide frame, the weight and air hammer.

Referring to FIG. 1 there is shown a frame constructed, illustratively, of angle irons 6 and 7 held rigidly in position by spacing bars 8 and 9 at the top and bottom, respectively. Another pair of angle irons 11 and 12, shown in FIG. 3, are held in position by a pair of spacing bars 13 and 14. These elements constitute a rigid frame which is supported in an upright position on the earth's surface under a body of water by a plurality of legs 16 which are held in position by braces 17. Illustratively a quadrupod is utilized in the present embodiment, but any number greater than two may be utilized for maintaining the frame in a stable upright position.

In a slidable arrangement within the frame of angle irons is an air hammer or motor generally shown at 18, held in spaced relationship to the frame by suitable brackets 19 at the lower portion and brackets 21 at the upper portion. Sandwiched between the brackets 19 and 21 are a plurality of weights 22 of any suitable dense material such as lead. The weights 22 are maintained in position by a bolt 23.

The air hammer 18 is of the commercial type of paving breaker with sheeting driver and having a reversible, slug-type piston and tappets with a renewable seat. The various well known parts of the hammer shown are the compressed air inlet 24, the handle 26 with the actuating arm 27 and the reciprocating hammer 28. Various modifications have been performed on the hammer to adapt it for its present purpose, such as attaching a waterproof exhaust 29 and attaching the brackets 19. The actuating handle 27 is maintained in the normally active or working position by a suitable clip (not shown). The air hammer 18 has various connections with the ship (not shown) on the surface of the water including the noncollapsible intake hose 31 for carrying compressed air from the ship to the air hammer inlet port 24. A second noncollapsible hose 32 is connected to the exhaust 29 for carrying the expended compressed air to the surface for discharge at atmospheric pressure. A suitable sling 33 is attached to the handle 26 and leads to the ship for raising and lowering the entire assembly.

Lower brackets 19 are provided with a pair of lugs 20 which extend downwardly a short distance therefrom. An anvil 34 is provided for receiving the energy imparted by reciprocating hammer 28, the anvil having a portion 25 extending between the lugs 20. Anvil 34 is connected to lugs 20 by means of a connection which permits limited relative motion between the anvil and the lugs. For this purpose, lugs 20 are slotted as shown at 30 and guide elements which may take the form of bolts 40 extend through slots 30 and into threaded bores in anvil portion 25. The anvil transmits the received energy to a metallic tube 36 which is illustratively made of aluminum but can suitably be made of any other material having sufficient strength not to collapse under the blows of the air hammer 18. The holes 35 in anvil 34 permit the escapement of water upon the insertion of the sample in the tube 36. Contained within the metallic tube 36 is a plastic tube 37 made of any material suitable for holding a core sample. A bolt passing through hole 38 connects the metallic and plastic tube to the anvil 34. On the lower end of the metallic tube 36 is attached a cylindrical core cutting member 39 having an inside diameter slightly smaller than the internal diameter of the plastic tube 37. The core cutter is formed of any suitable metal capable of cutting through the sediment and has a tapered side wall leading to a pointed cutting edge on the extreme bottom edge thereof. At the lower extremity of the plastic tube 37 is a core catcher 41 which has a plurality of fingers extending longitudinally along the axis of the plastic tube 37 and

are tapered toward the center thereof in the approximate shape of a cone. These fingers are forced open upon insertion of the core, and close upon the core to retain it within the plastic tube after cessation of the coring operation. The core cutter 39 is mounted on the metallic tube 36 by means of a plurality of screws 42.

FIG. 2 illustrates an end view of the core catcher fingers 41 extending from the walls of the plastic tube to the center of the tube. The fingers when in the normally closed position completely close the end of the tube to prevent the loss of the core sample if it be of sand or fine gravel.

Referring to FIG. 3, taken along section lines 3—3 of FIG. 1, there is shown in section the four angle irons 6, 7, 11 and 12 connected together by spacing bars 9, 13 and 14 which maintain the frame in a fixed position. Shown in block diagram form is the air hammer 18 held in position within the frame by the weights 22 which are secured to the bracket 19, FIG. 1, by the bolts 23. The weights 22 are of sufficient magnitude to provide the necessary force to prevent the vibration along the longitudinal axis of the air hammer and the metallic tube. The limited relative motion between the hammer and the anvil afforded by slots 30 and bolts 40 also aids in isolating the vibrations of the hammer and eliminating undesired oscillation of core tube 36. This prevents the undue disturbance of the sample obtained within the plastic tube 37, since it is highly desirable to obtain the sample in the original condition so that an accurate analysis of the sample may be made.

In operation the entire pneumatic corer assembly is carried aboard ship to the location where a sample of the earth is to be obtained. With the intake and exhaust hoses 31 and 32 respectively connected to both the appropriate equipment aboard ship and to the air hammer and compressed air applied to the intake hose, the crane of the ship lowers the entire pneumatic corer assembly over the side of the ship by the sling 33. Upon reaching the bottom of the body of water the frame settles itself upon the bottom supported by the legs 16 and the pneumatic corer is now in position to commence obtaining the desired sample whereupon a piston within the air motor 18 reciprocates the hammer 28 and drives the cutting head of the core cutter 39 into the earth's surface to cut a cylindrical sample which is collected within the plastic tube 37. When the desired sample is within the tube 37 the entire assembly is raised from the earth and brought to the ship again by means of the sling 33. The core and the plastic tube 37 may then be removed from the metallic tube 36 for subsequent analysis and utilization. Upon the insertion of another plastic tube 37 within the metallic tube 36, the pneumatic corer is again ready for operation. The corer has been successfully operated and has obtained samples containing coral rock at depths of 100 feet of water and with a three inch diameter core being taken up to five feet long. The device, however, is not limited to these dimensions and depths, but the present limiting factor appears to be the water pressure in the greater depths. However, it is anticipated that the device is operable up to depths of several hundred feet without a radical change in the structure. Thus, the pneumatic corer provides a completely portable and reliable means of obtaining a relatively undisturbed sample of the earth taken perpendicularly to the surface of the earth.

It should be understood, of course, that the foregoing disclosure relates only to an illustrative embodiment of the invention and that numerous modifications or operations may be made therein without departing from the spirit and the scope of the invention as set forth in the appended claims.

What is claimed is:

1. An apparatus for obtaining relatively undisturbed core samples of underwater sediments, comprising:  
an elongated rectangular skeletal frame adapted to be

lowered from a surface craft to the sediments to be cored,

support means on said frame for holding the same upright on the surface of the sediments,

an air motor, having a casing and a hammer reciprocable therein, means attached to the casing of said air motor and slidably engaging said frame for supporting said air motor for longitudinal sliding movement in said frame,

heavy weight means attached to the casing of said motor,

a coring tube having a core cutter at one end, and means at the other end of said coring tube for loosely supporting the same on the casing of said air motor and for receiving the blows of the hammer thereof, whereby only a negligible amount of vibration is transmitted to said coring tube and to the sediments being cored.

2. An apparatus as set forth in claim 1, wherein said means for loosely supporting said coring tube comprises: a pair of depending lugs attached to said casing, each of said lugs having an elongated slot therein, an anvil attached to said coring tube for receiving the blows delivered by said hammer, said anvil having a portion extending between said lugs, and a pair of guide elements secured to said anvil portion and extending radially therefrom through said slots, whereby said anvil has freedom for limited reciprocable movement with respect to said lugs.

3. A pneumatic corer for obtaining a relatively undisturbed core sample taken substantially perpendicular to the earth's surface comprising in combination,

a frame comprising a hollow metallic skeleton for positioning and guiding the pneumatic corer, said frame having a plurality of support means for maintaining the frame substantially perpendicular to the earth's surface,

an air motor, having means thereon which is in slidable engagement with and guided by said frame, for producing a series of reciprocating hammer blows,

at least one weight means attached to said air motor for minimizing vertical oscillatory motion of said air motor,

said air motor and said weight means being contained completely within the skeleton,

a metallic tube having means on one end thereof for loosely attaching the same to said air motor for transmitting therethrough the blows of said air motor and for receiving the core sample,

and a core cutter connected to the other end of said metallic tube for receiving the force of the blows of said air motor and for utilizing this force of the blows in cutting a core sample from the earth's surface.

4. A pneumatic corer as set forth in claim 3, wherein said means for loosely attaching said metallic tube to said air motor comprises:

a pair of depending lugs attached to said air motor, each of said lugs having an elongated slot therein,

an anvil attached to said metallic tube and having a portion thereof extending between said lugs, and

a pair of guide elements secured to said anvil portion and extending radially therefrom through said slots, whereby said anvil has freedom for limited reciprocable movement with respect to said lugs.

5. An apparatus for obtaining relatively undisturbed core samples of underwater sediments comprising:

an elongated rectangular skeletal frame consisting of four elongated angle irons, spacing means attached to said angle irons for rigidly positioning them with respect to each other to define the four corners of the frame, the adjacent edges of the angle irons being spaced from each other,

a plurality of legs attached to said frame for supporting said frame in an upright position on the earth's surface,

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an air motor slidably mounted within said frame, said  
 air motor having a casing and a reciprocable ham-  
 mer therein,  
 bracket means fixedly attached to the upper and lower  
 end of said air motor casing, respectively, said bracket 5  
 means being of rectangular configuration and fitting  
 closely within said frame for guiding said air motor  
 in said frame,  
 heavy weight means attached to the casing of said air  
 motor to increase the inertia and thereby minimize 10  
 oscillation thereof,  
 the lower of said bracket means having a pair of de-  
 pending lugs thereon, each of said lugs having an  
 elongated slot therein,  
 an anvil for receiving the blows delivered by said ham- 15  
 mer, said anvil having a portion extending between  
 said lugs, said anvil being supported from said lugs  
 and guided therein for limited reciprocable move-  
 ment by elements extending through the slots in said  
 lugs, 20  
 said anvil having an enlarged hollow cylindrical lower  
 end portion,  
 a metallic core tube secured in the enlarged lower end  
 portion of said anvil, said core tube having a plastic  
 liner on the internal surface thereof, 25  
 a core cutter supported on the lower end of said core  
 tube,  
 a core retainer within the lower end of said core tube,

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a manipulating line attached to the upper end of said  
 frame for lowering the apparatus,  
 a noncollapsible supply hose extending from said air  
 motor,  
 and a noncollapsible exhaust hose extending from said  
 air motor to the atmosphere,  
 whereby the apparatus is lowered to a rest position on  
 the surface of the undisturbed sediments, the motor  
 is operated by supplying compressed air thereto and  
 the core tube is thereby driven into the sediments,  
 the weights and the slotted connection between the  
 hammer and anvil assuring that the core tube will  
 proceed with a negligible amount of vibration to thus  
 maintain the core sample in its relatively undisturbed  
 state.

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