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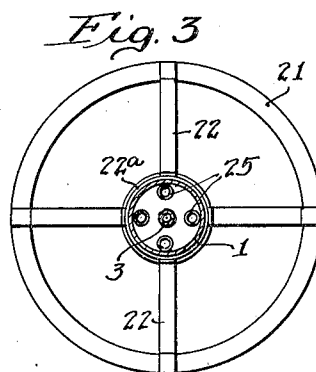
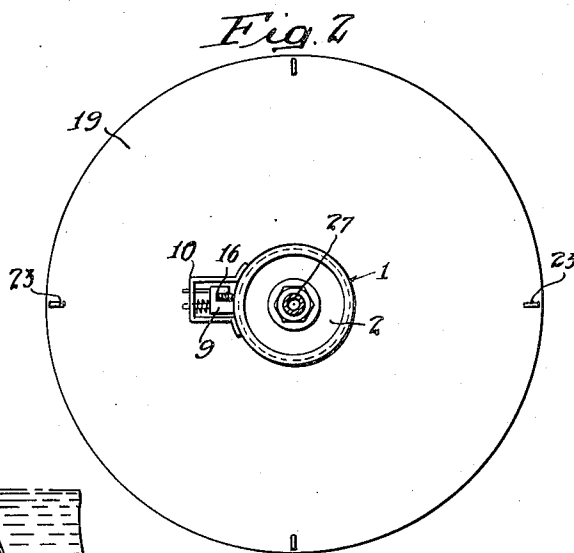
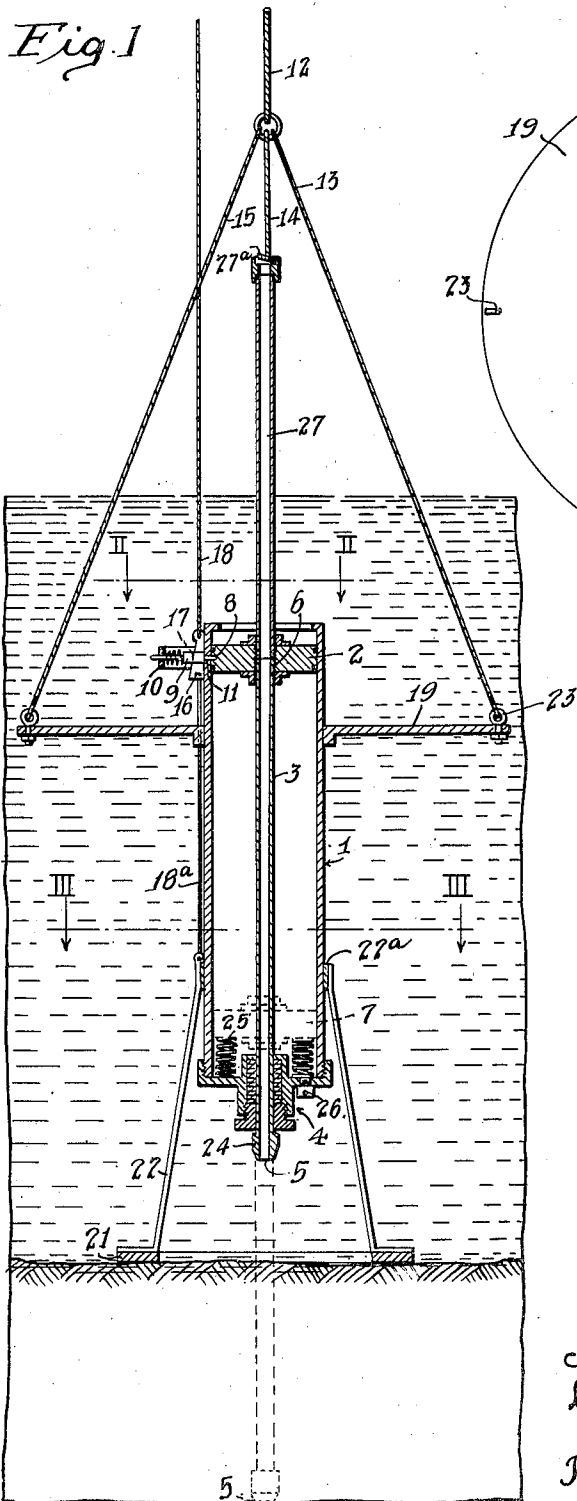
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2,176,477

METHOD OF AND APPARATUS FOR TAKING EARTH CORES

Filed Jan. 11, 1937

2 Sheets-Sheet 1



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Fig. 4

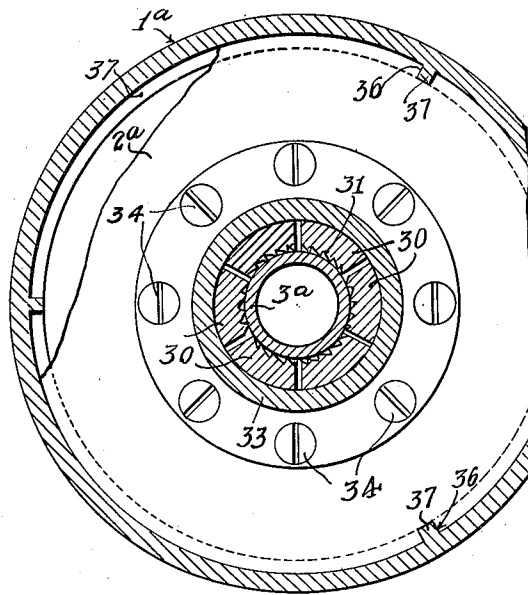
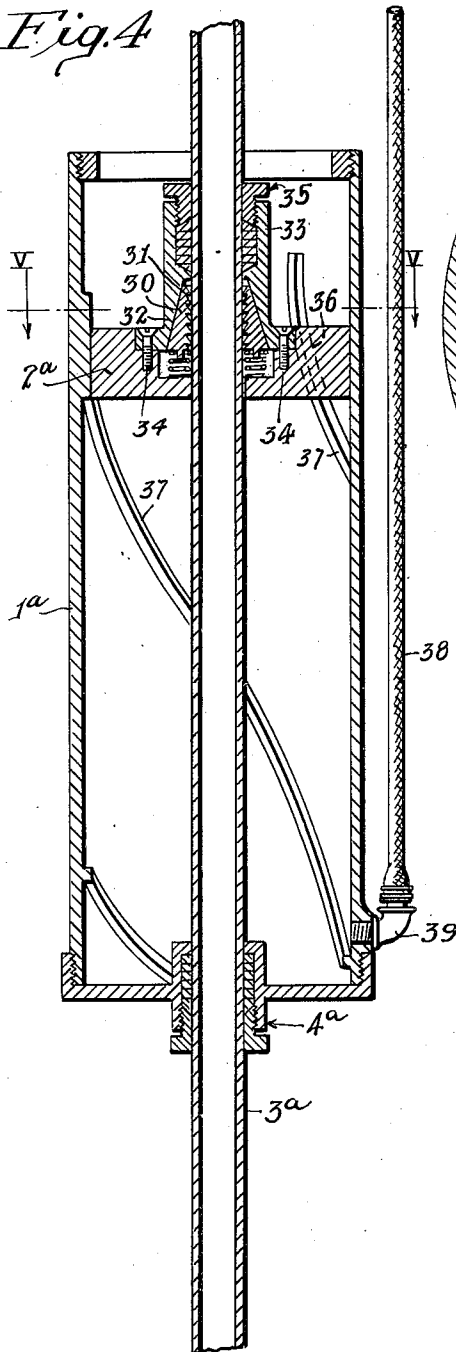


Fig. 5

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UNITED STATES PATENT OFFICE

2,176,477

METHOD OF AND APPARATUS FOR TAKING
EARTH CORESFrederick M. Varney, West Los Angeles, and
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Application January 11, 1937, Serial No. 119,978

17 Claims. (Cl. 255—1)

Our invention relates to a method of and apparatus for taking earth cores, and has particular reference to the art of drilling and removing cores in making geological surveys.

In geological surveys, either for academic geological study or for industrial geological study, one of the important sources of information consists in removing from the earth an elongated core of earth in which core the character and depth of various strata are retained in the position in which such strata occur in the earth.

An important source of information for the geologist, both for the purpose of academic or industrial geological study, is represented by the sedimentary deposits on the floor of the ocean, cores taken from the ocean floor permitting the study of the sedimentary deposits and of the biological and chemical changes that are taking place in the zone of sediment below the surface of the sea bottom.

From a study of the cores taken from the ocean bottom or from deep bores, such as oil wells, lithologic, stratigraphic, biologic, faunal and historic information may be obtained.

Various devices have been employed for removing earth cores from land locations, such as oil wells, but heretofore no satisfactory method or apparatus has been devised for taking cores from the ocean bottom in rough water locations, or in deep water locations.

With particular reference to the taking of underwater cores, various instruments have been devised which depend for their operation upon one or another of the following principles:

1. A freely falling dart or tube is allowed to drop on the end of a cable which must be paid out with sufficient rapidity so as not to check the free fall of the dart so that the dart, when it arrives at the bottom of the body of water, will have sufficient force to penetrate into the floor of the ocean, lake or river bottom; or

2. A structure which can be rigidly mounted or secured relative to the bottom of the body of water is employed somewhat as the derrick of an oil well, and from which casing and boring tools may be operated to produce bores similar to those employed in oil well drilling; or

3. Core-taking instruments are lowered upon a cable until they arrive at the bottom and then an explosive charge is used to drive a coring instrument into the bottom.

The first of these devices is impractical due to the resistance of the water to the free fall of the device, and there is little or no penetrative force when the instrument reaches the bottom,

and when lowering such device an excess of cable must be paid out to avoid restraining the fall of the instrument and such excess cable frequently becomes snarled and breakage occurs.

The second form of apparatus can be successfully employed only in comparatively still and shallow bodies of water and at great expense, while the third form of the device is so dangerous as to render its use substantially prohibitive.

It is, therefore, an object of our invention to provide a method of and an apparatus for taking cores from the ocean bottom by employing a safe, simple and light weight instrument which may be lowered at the end of a cable to the floor of a body of water and then be positively actuated to take the core.

Another object of the invention is to provide a coring instrument which may be used to take underwater cores in which water pressure above the floor of the body of water is used as the motive power employed to take the core.

Another object of the invention is to provide an instrument of the character set forth wherein the instrument may be lowered to the floor of a body of water upon a cable or similar support and wherein, after the instrument is so located, power is applied to the instrument to drive a coring device into the earth and remove a core therefrom.

Another object of the invention is to provide an instrument of the character set forth, wherein a core tube is adapted to be driven into the earth by hydrostatic pressure or by the hydrodynamic force created by the influx of a large quantity of water above the core tube.

Another object of the invention is to provide a coring instrument, wherein a core tube is surrounded by a cylinder and in which the core tube is projected from the cylinder by a piston which is forced through the cylinder by hydrostatic pressure.

Other objects and advantages will be apparent from a study of the following specifications, read in connection with the accompanying drawings, wherein

Fig. 1 is a vertical sectional view, taken through an instrument constructed in accordance with our invention; the modification of the device shown therein being one adapted for removing cores from underwater locations;

Fig. 2 is a sectional view, taken along line II—II of Fig. 1;

Fig. 3 is a sectional view, taken along line III—III of Fig. 1;

Fig. 4 is a detail, vertical sectional view of a

modified form of an instrument constructed in accordance with our invention, wherein a core tube may be driven through the cylinder in a series of steps; and

5 Fig. 5 is a detail sectional view taken along line V—V of Fig. 4.

As will be more fully pointed out hereinafter, our instrument is adapted to taking cores either from land or water locations, but for purposes of simplicity and clarity in describing our method and apparatus, we have illustrated, in Figs. 1, 2 and 3, an embodiment of the instrument adapted to take cores from underwater locations, such as the floor or bed of the ocean, lakes, or similar bodies of water.

The instrument itself comprises essentially a cylinder 1 in which is slidably mounted a piston 2 connected either permanently or releasably with a core tube 3. The lower end of the cylinder 1 is preferably provided with a suitable packing gland 4, through which the core tube 3 may slide, but which will substantially prevent any leakage of water or other liquid to the interior of the cylinder from the bottom end thereof.

While the dimensions of the cylinder 1 and the core tube 3 may vary within relatively wide limits, depending upon the particular conditions under which our instrument is to be used, it is desirable that the core tube 3 be of such length as to allow it to take cores of a length ranging from 6 to 30 or more feet. In the embodiment illustrated in Figs. 1, 2 and 3, it may be presumed that the cylinder 1 is approximately 30 feet in length and that the core tube 3 is slightly in excess of 30 feet in length from its lowermost end 5 to its connection at 6 with the piston 2 so that when the piston is in its raised or uppermost position, relative to the cylinder 1, approximately 30 feet of core tube will lie within the cylinder 1.

Hence when the piston 2 is allowed to move down through the cylinder 1 to its lowermost position, (illustrated in dotted lines at 7), approximately 30 feet of core tube 3 will be projected from the lower end of the cylinder 1.

When taking underwater cores, the hydrostatic head of water above the floor or bed of the ocean, lake, or river represents a source of tremendous power which may be readily employed for the purpose of driving the core tube into the earth, and we employ this force by allowing the head of water to bear upon the upper surface of the piston 2 and control the same by any suitable means, such as by mechanically locking the piston 2 in its uppermost position by means of a lock 8 which, in the form illustrated herein, assumes the shape of a lock-pin projecting from a block 9 slidably mounted in a bracket 10 upon one side of the cylinder 1 near the upper end thereof, the pin 8 being received in a suitable slot 11 in the side wall of the piston tube. With the piston drawn upwardly in the cylinder and locking the cylinder in place by means of the lock-pin 8, the entire instrument may be lowered from a boat or other structure upon the surface of the water as by means of a suitable tackle, which may include a cable 12 which is in turn connected by means of cables 13, 14 and 15 to the cylinder 1 in such manner as to hold the cylinder in a substantially vertical position, while it is being lowered or raised, by the cable 12. When the instrument, lowered by the cable 12, arrives at the bottom or floor of the body of water the lock-pin 8 may be withdrawn and the pressure of the water above the piston 2 will then

force the piston 2 downwardly in the cylinder and drive the core tube 3 into the floor of the body of water and take a core therefrom. The rushing water drives the piston and core tube downwardly not only by the static pressure of the water above the piston but also the rushing water produces an additional force due to the hydrodynamic forces or kinetic forces of the relatively large body of water in motion as it passes into and down through the cylinder.

When the piston is to be so moved, the lock-pin 8 may be withdrawn by any suitable mechanical means, illustrated herein as comprising a wedge member 16 which passes through a slot 17 in the block 9 of such shape and dimensions that when the wedge member 16 is drawn upwardly by a trigger member 18 the pin 8 will be retracted and allow the piston to fall freely through the cylinder 1.

The recoiling force resulting when the core tube 3 is driven from the cylinder 1 may be absorbed by the water surrounding the instrument. The inertia of the instrument and the friction of the water upon the cylinder acts as a retarding or recoil absorbing force, but by providing a plate or shelf 19 in the form of a substantially circular disc secured to the cylinder 1 and extending radially therefrom so that a considerable area is provided to engage the water, the effect of the water to retard recoil may be increased.

It is preferable that the cores taken should be along a vertical line irrespective of the angle of the surface of the ocean floor and the instrument may be so controlled that when the core tube is driven into the floor its longitudinal axis will be disposed in the vertical. The "plumb-bob" effect of the instrument suspended from the cable 12 will have this effect and it may be enhanced by the flange 19 or by attaching one or more floats to the cable 12. Or, if desired, the lower end of the cylinder may be provided with a shoe which may act as a support holding the cylinder perpendicular to the surface of the ocean floor. Such shoe may comprise an annular ring 21 from which rise legs 22 to a ring 22a surrounding the cylinder 1, the shoe acting as a foot-piece engaging the floor and assisting in guiding the cylinder in the desired vertical or perpendicular disposition.

Also, the shoe may act as an automatic trip to release the latch 8 at the instant the instrument reaches the floor by making the ring 22a slidable along the cylinder and extending a rod 18a to the wedge 16. By allowing the shoe to extend down below the lower end of the core tube 3 the shoe will contact the floor before the core tube reaches the floor and will slide upwardly to release the latch prior to the time the core tube engages the floor. The momentum gained by the core tube, piston and superincumbent water before the core tube encounters the floor will increase the penetrative effect of the core tube.

With the invention thus far described, it will be apparent that the cylinder with its piston held in raised position may be lowered as slowly as is desired, the instrument being held substantially upright by the cables 13, 14 and 15 attached to the plate or disc 19, as indicated at 23; namely, at the points disposed laterally about the cylinder 1, so that the normal effect of gravity will hold the cylinder upright. The instrument will come to rest upon the floor of the body of water without its rest position being disturbed by any movement of the boat or other structure

from which the cable 12 is lowered, thus adapting our instrument for use in rough water at any desired depth. Moreover, our instrument, when it arrives at the ocean bottom, will rest thereon in a vertical or upright position relative to the floor of the ocean or other body of water. Then by a simple trigger arrangement, the piston 2 may be released and the full hydrostatic head of water above the instrument will effect the driving of the core tube 3 into the ocean, lake or river bottom.

If desired, a bit or other cutting instrument 24, may be mounted upon the lower end of the core tube 3 to assist in the penetration of the core tube into the strata forming the bottom.

As will be appreciated, the enormous force of the head of water will drive the core tube 3 into the bottom with almost explosive force, the force being determined by the depth of the water, by the relative diameters of the piston and core tube, and by the "reach" of the shoe.

Prior to the lowering of the instrument, the piston 2 is cocked or located in its uppermost position relative to the cylinder 1 and the space within the cylinder is therefore occupied by air at atmospheric pressure or a vacuum may be drawn therein. The piston 2 in this position acts as a stopper for the upper end of the cylinder 1, so that as the instrument is lowered the hydrostatic head of the water above it will be acting to move the piston down through the cylinder against only the atmospheric pressure within the cylinder. When the piston is allowed to move down in the cylinder it will therefore compress the air within the cylinder which will act to check or cushion the movement of the piston at the lower end of its stroke, though we prefer to provide springs or similar braking means 25 to bring the piston to rest at the end of its stroke without damage to the lower end of the cylinder. If desired, a check valve 26 may be provided at the lower end of the cylinder 1 by which air compressed within the cylinder 1 may pass out of the cylinder without permitting the entrance of the water into the cylinder 1.

We prefer to provide a section of tubing 27 above the piston 2 in communication with the core tube 3 to permit the escape of water from the interior of the core tube as the core passes into the tube 3, a check valve 27a being provided to prevent the core from sucking out. The tube 27 should be of such length as to always dispose its upper end above the stream of water rushing into the cylinder.

In Figs. 4 and 5 we have illustrated a modified form of our invention by which a rotational movement may be produced upon the core tube 3 as it is moved down through the cylinder and thus facilitate the penetration of the core tube into the ocean or river bottom, and also we have illustrated in Figs. 4 and 5 a modification whereby a relatively short cylinder may be employed for the taking of relatively long cores, as by permitting the core tube to be driven through the cylinder in a series of steps rather than in a single motion.

In Figs. 4 and 5 we have illustrated a cylinder 1a which may be constructed as hereinbefore described for the cylinder 1, having upon its lower end a suitable stuffing box 4a through which a core tube 3a may pass. The cylinder 1a is preferably open at its top and has a piston 2a mounted for reciprocation therein.

In this form of the device, however, the core tube 3a, instead of being connected rigidly to the

piston, has the piston provided with a gripping mechanism by which the piston may be releasably engaged with the core tube 3a. This releasable mechanism is illustrated as comprising a plurality of slips 30 similar to those employed in oil well packers, elevators, and other tools, the slips 30 being provided with a plurality of outstanding teeth 31 adapted to engage and grip the outer surface of the core tube 3a whenever the slips are moved toward the bottom of the cylinder. The slips 30 are preferably wedge shape in cross section and are adapted for limited reciprocation within a tapered bore 32 in a head member 33 secured to the piston 2a as by means of screws or bolts 34. The head 33 is preferably provided with a stuffing box 35 which permits the piston 2a to slide relative to the core tube 3a but which will prevent the passage of liquid between the piston 2a and the core tube 3a.

In this form of the device the piston 2a may slide upwardly along the core tube 3a but whenever the piston 2a descends the slips 30 will be drawn into gripping relation with the core tube 3a and the core tube and piston will then move downwardly as a unit. The piston 2a may then be again elevated which will release the grip of the slips 30, allowing the piston to ascend without raising the core tube 3a, and a second descent of the piston 2a may be accomplished to further drive the core tube 2a toward the cylinder 1a.

By repeatedly raising and lowering the piston 2a an extremely long length of core tube 3a may be moved in a series of successive steps into the floor of the ocean or other body of water to take a core of great length.

In order to produce a rotation of the core tube 3a the piston 2a may be provided with a plurality of slots 36 which engage upon a series of splines 37 helically disposed about the interior of the cylinder 1a so that as the piston descends the entire piston and core tube will be given a twist or rotation, assisting in the penetration of the core tube into the formation. The teeth 31 of the slips 30 may be shaped as shown in Figs. 4 and 5 so that their angular disposition relative to the core tube 3a is such that they will grip not only in a vertical direction but also in a lateral direction in order to transmit the twisting force from the piston to the core tube 3a.

The repeated reciprocation of the piston 2a may be accomplished in any suitable manner, though for underwater work a preferred method of operating the piston might include an air tube 38 by which compressed air or other fluid may be pumped into the cylinder 1a beneath the piston 2a. The hose or air pipe 38 is illustrated as connecting to a suitable fitting 39 which communicates with the interior of the cylinder 1a and through which air or other fluid may be passed into the cylinder 1a, it being understood that the diameter of the air or fluid tube 38 must be such as to allow the escape of such fluid as the piston descends without materially retarding the movement of the piston under the effect of the hydrostatic pressure of the water above the piston.

While we have illustrated our core taking instrument as adapted particularly for underwater work, it will be apparent that the same principles of operation may be employed for the taking of cores in land earth cores, such as oil well cores, and reduce the labor required under present methods.

For example, our instrument may be lowered into a well bore upon the end of a cable and

operated either by fluid pressure supplied above the piston or by the hydrostatic head of water or liquid which may be within the bore, without the necessity of connecting up and disconnecting a string of drill tubing, as is required for most core instruments now employed in this industry. In other words, our instruments does not require the assembly, stand-by-stand, of drill tubing to support the instrument and lower it into the well nor the removal of such drill tubing as the instrument is drawn from the well after taking the core.

Other applications of our device will be apparent to those skilled in the art of taking cores from a review of the foregoing description.

It will therefore be observed that we have provided an instrument for taking cores for any desired purpose, which is relatively simple in its construction and which does not require rigid connection between the instrument and the surface of the land or water from which the instrument is to be manipulated, and that we have devised a method of taking cores which is simple and unique.

While we have shown the core tube as passing directly into the cylinder, it will be apparent that the piston may be secured to or engage a rod or tube which operates within the cylinder but upon the lower end of which the actual core taking tube may be secured.

While we have shown and described the preferred embodiment of our invention, we do not desire to be limited to any of the details of construction shown herein, except as defined in the appended claims.

We claim:

1. In a device for taking earth cores in underwater locations, an elongated cylinder, a core tube slidable through the bottom of said cylinder, a piston on said core tube, means for holding said piston near the top of said cylinder, and mechanical means for releasing said holding means to allow hydrostatic pressure above said piston to drive said piston and core tube downwardly relative to said cylinder.

2. In a device for taking earth cores, an elongated cylinder, an elongated core tube slidable through the bottom of said cylinder, the bottom of said cylinder being closed to the passage of water between said cylinder and said core tube, a piston on said core tube operable within said cylinder from a position near the top thereof to a position near the bottom thereof, means for holding said piston in elevated position in said cylinder, means for admitting water to said cylinder above said piston, and means for releasing said piston holding means to allow pressure of water above said cylinder to drive said core tube downwardly relative to said cylinder.

3. In a device for taking earth cores from underwater locations, an elongated core tube, an elongated cylinder surrounding said core tube and having a closed bottom through which one end of said core tube projects, said tube being slidably mounted in said bottom for movement therethrough, a piston operable in said cylinder and engaging said core tube in spaced relation to the end thereof, the other end of said cylinder being open to receive the effect of hydrostatic pressure upon said piston, means for holding said piston near the open end of said cylinder, whereby when said instrument is lowered beneath the surface of a body of water the hydrostatic pressure of the water above said piston will tend to drive said piston downwardly in said

cylinder, and means for releasing said piston to permit said hydrostatic head of water to drive said piston downwardly in said cylinder to drive said core tube downwardly relative to said cylinder.

4. In a device for taking earth cores from underwater locations, an elongated core tube, an elongated cylinder surrounding said core tube and having a closed bottom through which one end of said core tube projects for movement therethrough, a piston operable in said cylinder and engaging said core tube in spaced relation to the end thereof, the other end of said cylinder being open to receive the effect of hydrostatic pressure upon said piston, means for holding said piston near the open end of said cylinder, whereby when said instrument is lowered beneath the surface of a body of water the hydrostatic pressure of the water above said piston will tend to drive said piston downwardly in said cylinder, means for releasing said piston to permit said hydrostatic head of water to drive said piston downwardly in said cylinder to drive said core tube downwardly relative to said cylinder, and means on said cylinder providing a water engaging surface to resist the reactive forces produced by hydrostatic pressure upward against the bottom of the cylinder, effective when the piston moves downwardly in said cylinder.

5. In a device for taking earth cores from underwater locations, an elongated core tube, an elongated cylinder surrounding said core tube and having a closed bottom through which one end of said core tube projects, said tube being slidably mounted in said bottom for movement therethrough, a piston operable in said cylinder and engaging said core tube in spaced relation to the end thereof, the other end of said cylinder being open to receive the effect of hydrostatic pressure upon said piston, means for holding said piston near the open end of said cylinder, whereby when said instrument is lowered beneath the surface of a body of water the hydrostatic pressure of the water above said piston will tend to drive said piston downwardly in said cylinder, means for releasing said piston to permit said hydrostatic head of water to drive said piston downwardly in said cylinder to drive said core tube downwardly relative to said cylinder, and a base on said cylinder near the bottom end thereof to engage the surface of the floor of the body of water to hold said cylinder substantially perpendicular to said bottom.

6. In a device for taking earth cores from underwater locations, an elongated cylinder, an elongated core tube operable through said cylinder, means at one end of said cylinder for slidably engaging said core tube and substantially closing the space between said cylinder and said core tube against the passage of liquid therebetween, a piston on said core tube movable through said cylinder operable by the hydrostatic pressure of the fluid in which the cylinder is immersed, and means operable by said hydrostatic pressure for rotating said core tube with respect to said cylinder as said tube is moved through said cylinder by said piston.

7. In a device for taking earth cores from underwater locations, an elongated cylinder, an elongated core tube operable through said cylinder, means at one end of said cylinder for slidably engaging said core tube and substantially closing the space between said cylinder and said core tube against the passage of liquid therebetween, a piston on said core tube movable

through said cylinder operable by the hydrostatic pressure of the fluid in which the cylinder is immersed, and means operable by said hydrostatic pressure for rotating said piston and said core tube with respect to said cylinder as said piston moves down through said cylinder.

8. In a device for taking earth cores from underwater locations, an elongated cylinder, an elongated core tube operable through said cylinder, means at one end of said cylinder for slidably engaging said core tube and substantially closing the space between said cylinder and said core tube against the passage of liquid therebetween, a piston on said core tube movable through said cylinder, means operable by the hydrostatic pressure of the fluid in which said cylinder is immersed to force said core tube into the earth, and releasable means for connecting said piston with said core tube to drive said tube downwardly with said piston but permitting upward movement of said piston in said cylinder without raising said core tube relative to said cylinder.

9. In a device for taking earth cores from underwater locations, a core tube, a cylinder and piston associated with said core tube to drive said core tube under the influence of the pressure of water above said piston when said cylinder and piston are submerged, means for lowering said piston, cylinder and core tube toward the floor of a body of water, and means engaging the floor prior to contact therewith of the core tube to hold the core tube spaced from the floor until said piston is actuated.

10. In a device for taking earth cores from underwater locations, a core tube, a cylinder and piston associated with said core tube to drive said core tube under the influence of the pressure of water above said piston when said cylinder and piston are submerged, means for lowering said piston, cylinder and core tube toward the floor of a body of water, and a shoe on said cylinder projecting beyond the end of said core tube to engage the floor of a body of water and to hold the core tube spaced from said floor until said piston is actuated.

11. In a device for taking earth cores from underwater locations, a core tube, a cylinder and piston associated with said core tube to drive said core tube under the influence of the pressure of water above said piston when said cylinder and piston are submerged, means for preventing movement of said piston, means for lowering said piston, cylinder and core tube toward the floor of a body of water, a sleeve on said cylinder projecting beyond the end of said core tube to engage the floor of a body of water in advance of contact therewith by said core tube, and means actuated by engagement of said shoe with said floor for releasing said preventing means to cause said core tube to be accelerated prior to its contact with said floor.

12. In a device for taking earth cores from underwater locations, an elongated cylinder, an elongated core tube slidable through the bottom of said cylinder, the bottom of said cylinder being closed to the passage of water between said cylinder and said core tube, and a piston on said core tube operable by the hydrostatic pressure of the fluid in which the cylinder is immersed to force said core tube into the earth.

13. In a device for taking earth cores from

underwater locations, an elongated cylinder, an elongated core tube slidable through the bottom of said cylinder, the bottom of said cylinder being closed to the passage of water between said cylinder and said core tube, a piston on said core tube operable by the hydrostatic pressure of the fluid in which the cylinder is immersed to force said core tube into the earth, means for holding said piston in elevated position in said cylinder, and mechanical means for releasing said piston holding means.

14. In a device for taking earth cores from underwater locations, an elongated core tube, an elongated cylinder surrounding said core tube and having a closed bottom through which one end of said core tube projects, said tube being slidably mounted in said bottom for movement there-through, a piston operable in said cylinder and engaging said core tube in spaced relation to the end thereof, the other end of said cylinder being open to receive the effect of hydrostatic pressure upon said piston, means for holding said piston near the open end of said cylinder whereby when said instrument is lowered beneath the surface of a body of water the hydrostatic pressure of the water above said piston will tend to drive said piston downwardly in said cylinder, means for releasing said piston to permit said hydrostatic head of water to drive said piston downwardly in said cylinder to drive said core tube downwardly relative to said cylinder, and means to hold said cylinder in desired position in relation to said surface to be cored.

15. In a device for taking earth cores from underwater locations, a core tube, a cylinder having a closed end through which said core tube projects and piston associated with said core tube to drive said core tube under the influence of the pressure of water above said piston when said cylinder and piston are submerged, means for preventing movement of said piston, means for lowering said piston, cylinder and core tube toward the floor of a body of water, and means for releasing said preventing means before said core barrel encounters said floor.

16. In a device for taking earth cores from underwater locations, an elongated cylinder, an elongated core tube slidable through the bottom of said cylinder, the bottom of said cylinder being closed to the passage of water between said cylinder and said core tube, a piston on said core tube operable by the hydrostatic pressure of the fluid in which the cylinder is immersed to force said core tube into the earth, means for holding said piston in elevated position in said cylinder, and mechanical means for releasing said piston-holding means before said core tube encounters the earth.

17. In a device for taking earth cores from underwater locations, an elongated cylinder, an elongated core tube slidable through the bottom of said cylinder, the bottom of said cylinder being closed to the passage of water between said cylinder and said core tube, a piston engaging said core tube operable by the hydrostatic pressure of the fluid in which the cylinder is immersed to force said core tube into the earth, and means for braking the movement of said piston and said core tube at the end of their stroke.

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