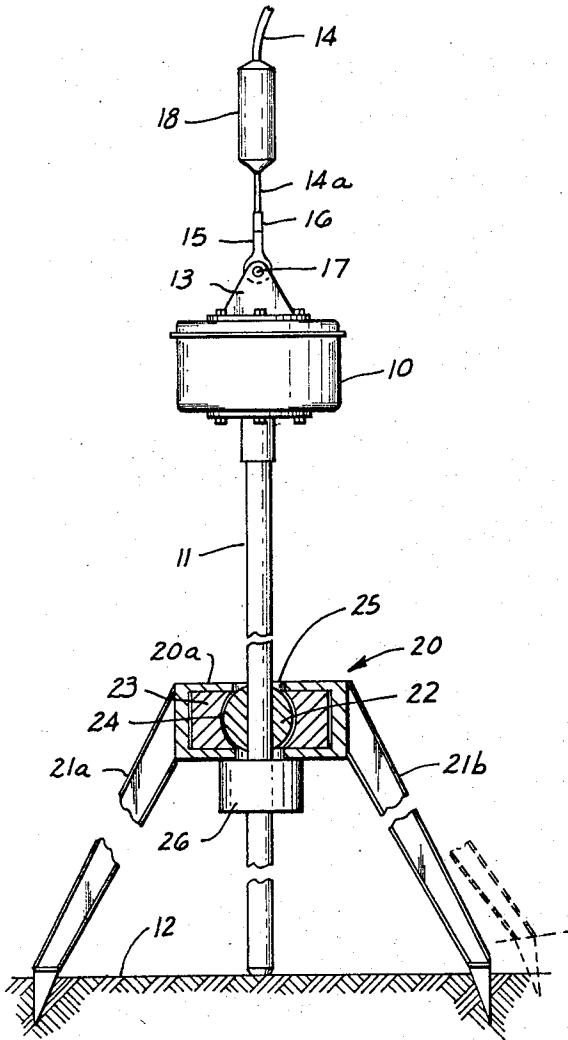
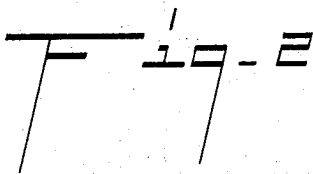
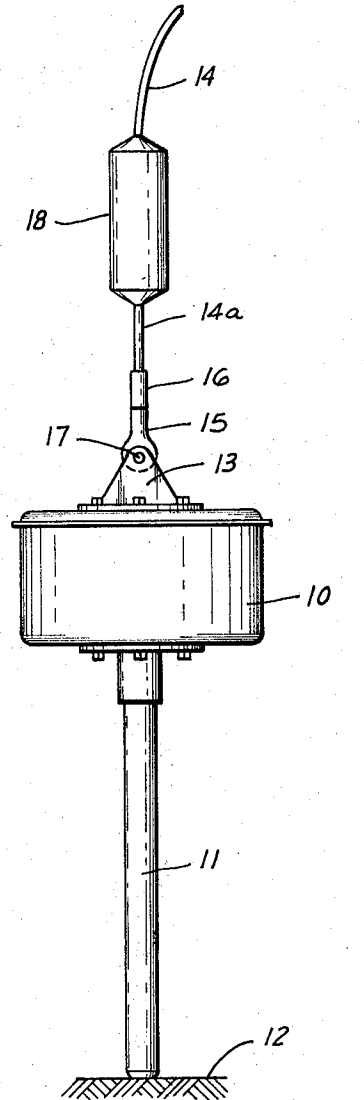
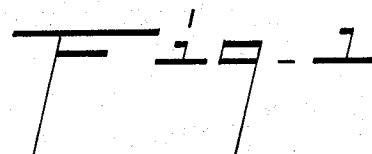


March 19, 1968

J. N. BIRON ET AL
APPARATUS FOR CORING SUBTERRANEAN FORMATIONS
UNDER A BODY OF WATER
Filed June 14, 1966

3,373,827



JULES N. BIRON
DURWARD B. JONES
DARRELL L. SIMS
INVENTORS.

BY
Browning, Simms, Hoyer & Eichenmiller
ATTORNEYS

1

3,373,827

APPARATUS FOR CORING SUBTERRANEAN FORMATIONS UNDER A BODY OF WATER

Jules N. Biron, Durward B. Jones, and Darrell L. Sims, Houston, Tex., assignors, by mesne assignments, to the United States of America as represented by the National Science Foundation

Filed June 14, 1966, Ser. No. 557,531

1 Claim. (Cl. 175—6)

This invention relates generally to apparatus for obtaining cores of subterranean formations below a body of water, and, in particular, to such apparatus that is lowered to the bottom on a flexible line or cable.

When coring subterranean formations, it is important to know the orientation of the core barrel during the coring operation. When coring apparatus is lowered to the bottom of a body of water on a flexible line, usually, the line is held taut to partially support the apparatus and hold the core receiving and cutting portion of the apparatus vertical. This system is satisfactory in shallow water. In deep water, however, where the apparatus passes through layers of water moving at different speeds and in different directions, the line may or may not extend vertically upward from the apparatus, when it reaches the bottom. Thus, the orientation of the core barrel during the coring operation is unknown.

It is an object of this invention to provide apparatus for lowering on a flexible line to core subterranean formations below a body of water, in which the core barrel of the apparatus will be substantially vertically oriented, while being lowered through the water, and while cutting the core, even though the flexible line supporting the apparatus does not extend vertically to the surface of the water.

It is another object of this invention is provide apparatus for lowering on a flexible line to the bottom of a body of water for coring subterranean formations below the bottom in which the core barrel of the apparatus will be substantially vertical when it first engages the bottom even though the flexible line does not extend vertically therefrom to the surface of the water, and in which the core barrel will be held at the same angle throughout the coring operations.

These and other objects, advantages, and features of the invention will be apparent to those skilled in the art from a consideration of this specification and attached drawings.

The invention will now be described in detail in connection with the attached drawings in which,

FIGURE 1 is a view in elevation of the apparatus of this invention as it initially engages the bottom of a body of water preparatory to coring subterranean formations therebelow; and

FIGURE 2 is a view partially in elevation and partially in vertical section of an alternate and preferred embodiment of the invention as it begins coring subterranean formations below the bottom of a body of water.

The apparatus comprises a coring assembly, which includes sonic frequency elastic wave generator 10 and elongated elastic stem 11. The stem is made of an elastic or resilient material, preferably steel. At least the lower portion of the stem is hollow to form a core barrel. Sonic wave generator 10 is acoustically coupled to the stem to vibrate the stem longitudinally at its resonant frequency. This sets up a longitudinal elastic standing wave vibration in the stem that causes the lower end of the stem to oscillate vertically and cut through the subterranean formation below bottom 12 of a body of water. For a complete description of the coring assembly, see U.S. Patent No. 3,194,326, which issued July 13, 1965 to A. G.

2

Bodine, Jr., and entitled, "Sonic Tool for Ocean Floor Coring."

Support bracket 13 is mounted on the top of the housing of the sonic wave generator for pivotally connecting the coring assembly to flexible line 14. The flexible line is connected to the support bracket through clevis 15 and rope socket 16. The clevis is pivotally connected to the bracket by pin 17 to allow the coring assembly to pivot relative to the flexible line.

The coring assembly is made of a material that will cause it to sink in the water. In other words, its weight exceeds its buoyancy. By holding an upward tension on the flexible line, the coring assembly will tend to descend through the water more or less in the position shown, i.e., with the stem extending downwardly from the sonic wave generator. In deep water, however, due to the different currents through which the apparatus passes before reaching the bottom, the apparatus usually will be moved laterally of a vertical line extending down from the vessel supporting it at the surface before it reaches the bottom of the water. This lateral movement will cause the support line to extend upwardly at an angle from the coring apparatus to the surface vessel. Thus, the line will tend to cause the coring apparatus to tilt from the vertical and the core barrel will engage the bottom at something other than a vertical position.

In accordance with this invention to insure that the core barrel is substantially vertical, when it engages the bottom preparatory to coring, float 18 is attached to flexible line 14 immediately above wire line socket 16. By placing the float adjacent the apparatus and by controlling its buoyant force, the float tends to nullify the effect on the attitude of the core barrel of the wire line extending upwardly from the apparatus at an angle. The buoyant force exerted by float 18 must, of necessity, be less than the weight of the apparatus in the water. Otherwise, the apparatus would not sink. The float, however, should exert a buoyant force sufficient to keep the short section of line 14a between the float and the coring assembly taut, when the apparatus is being lowered through the water, which will tend to keep the coring assembly vertical.

When the lower end of the stem engages the bottom the weight of the apparatus will be transferred to the bottom. Float 18, of course, will continue to exert the same upward force on the coring apparatus. Therefore, the weight on the end of the core barrel for coring purposes will be the difference between the weight of the apparatus in the water and the buoyant force exerted by float 18. This difference should be sufficient to produce good coring action, when the sonic vibrations are established in the stem. Usually, this weight can be a substantial portion of the total weight in water of the apparatus. Therefore, the upward force of float 18 need not be a great deterrent to the speed at which the coring assembly will descend through the water.

FIGURE 2 illustrates an alternate and preferred embodiment of the invention in which means are provided to hold the core barrel at the same angle throughout the coring operation. In the embodiment shown, stand 20 is provided for that purpose. The stand includes housing 20a and three downwardly extending legs 21, legs 21a and 21b being shown in the drawing. Means are provided to mount stand 20 on stem 11 for longitudinal movement relative to the stem and for limited pivotal movement relative thereto. Located in housing 20a is ball 22. The ball is provided with an opening there-through through which stem 11 extends. The ball is rotatably mounted in bearing block or race 23, which has a spherical shaped cavity 24 to receive the ball. The amount of rotation of the stem relative to stand 20 is

limited by the size of opening 25 in stand housing 20a in which the ball and race are located. In other words, as the stem pivots the ball will rotate in cavity 24 of the race until the edges of opening 25 engage the stem. The stand is allowed limited pivotal movement relative to the stem to allow all three legs of the stand to fully engage the bottom even though it is unlevel. This action is shown by the dotted line position of leg 21b in FIGURE 2.

Means are also provided to limit the downward travel of the stand relative to the stem. In the embodiment shown, stop 26 is located on the stem below the stand housing. Preferably, the stop is located on the stem so the legs of the stand will firmly engage bottom 12 before the end of the core barrel engages the bottom. This allows the stand to be in position before coring begins. Then when the lower end of the stem has entered the subterranean formations below bottom 12, stand 20 will hold the stem at the angle at which it initially entered such formations throughout the coring operation. It will do so, of course, only if the formation through which the core barrel passes do not themselves cause the core barrel to drift.

The legs of the stand should be long enough for the complete core barrel to be forced into the ground before either the sonic wave generator engages the stand or stop 26 engages bottom 12.

From the foregoing, it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth, together with other advantages which are inherent to the apparatus and structure.

It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be interpreted as illustrative and not in a limiting sense.

The invention having been described, what is claimed is:

1. Apparatus for coring the subterranean formation lying under the bottom of a body of water, comprising, a coring assembly including an elongated elastic stem at least the lower portion of which is hollow to form a core barrel, a sonic frequency elastic wave generator acoustically coupled to said stem and operable at a longitudinal resonant frequency of the stem to establish a longitudinal elastic standing wave vibration in the stem to cause the lower end thereof to cut through a subterranean formation and collect a core of same in the core barrel, a flexible cable connected to the coring assembly to lower it into position to cut such core and to raise it with the core to the surface, a float attached to the cable immediately above the coring assembly to exert a buoyant force on the coring assembly that is less than the force required to keep the assembly from sinking but sufficient to hold the core barrel substantially vertical when it moves into engagement with the bottom of a body of water, a stand, means mounting the stand on the stem for longitudinal and limited pivotal movement relative to the stem, and stop means limiting the downward longitudinal movement of the stand relative to the stem, said stand having at least three downwardly extending legs extending below the bottom of the core barrel when the stand is in engagement with the stop means to engage the bottom before the core barrel does and stabilize the core barrel against lateral movement during the coring operation.

References Cited

UNITED STATES PATENTS

2,665,885	1/1954	Gignoux	175—6
3,194,326	7/1965	Bodine	175—5
3,279,547	10/1966	Berne et al.	175—6

CHARLES E. O'CONNELL, *Primary Examiner*.

40 RICHARD E. FAVREAU, *Examiner*.