Jan. 3, 1967 J. D. CHARLTON ETAL 3,295,616

FREE CORING DEVICE

Filed Dec. 2, 1964

FIG. 1

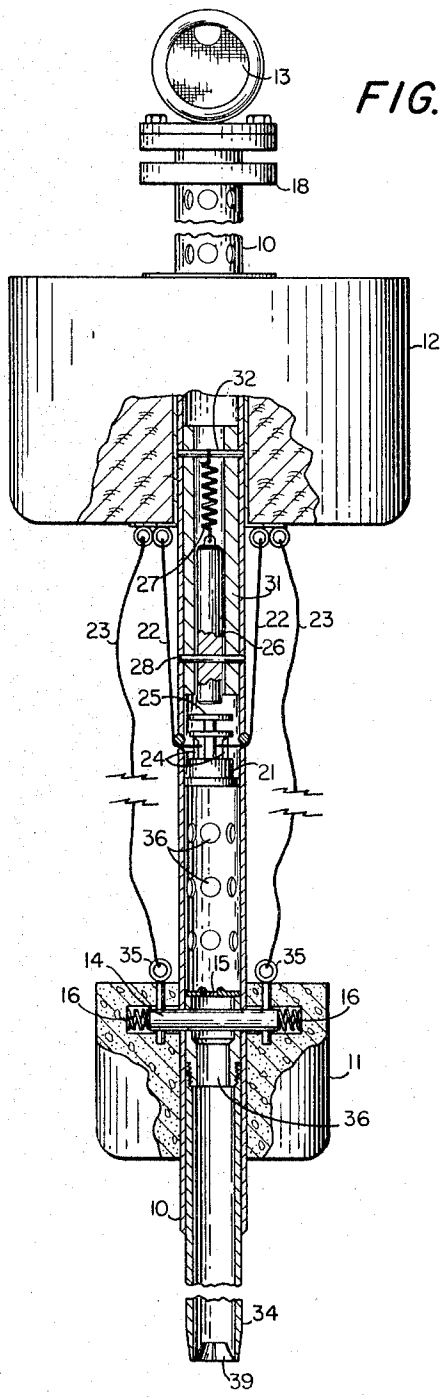
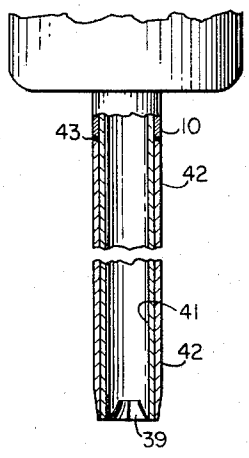


FIG. 2



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FREE CORING DEVICE

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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 is directed to apparatus for extracting an earth core sample from the floor of a body of water and more particularly directed to an improved, free-falling earth corer which may be dropped from a vessel into a body of water as a completely self contained assembly which free falls to the bottom, obtains a core sample and automatically returns to the surface of the water.

Heretofore ocean floor core samples have been obtained in a number of ways. One type makes use of a winch operated cable that is secured to the corer device to lower the corer into the water. A lever trips the corer which is forced into the bottom to obtain a core sample then the winch is wound-in to obtain the core sample. Other types are free-falling corers which free fall to the water's bottom and obtain a sample, weights are released and the device is returned to the surface by a float of some type. Some of these types get stuck and do not return, some do not always release their weights for some reason. One type makes use of gasoline for its buoyant material. This is dangerous on board ship and creates a safety hazard.

The present invention overcomes some of these disadvantages by using a non-flammable buoyant material and a weight release mechanism which will always release the weights. Thus the device will be brought back to the surface of the water after being released.

It is therefore an object of the present invention to provide an improved free-fall core sampling device.

Another object is to provide a water's bottom sampling device which requires no power equipment for launching the device.

Still another object is to provide a simple, efficient operating under water core sampler.

Yet another object is to provide a system by which a plurality of core samples may be obtained in a relatively short time.

While still another object is to provide a system in which the buoyant material has no effect on the penetration of the core sampler.

Other objects and advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in conjunction with the accompanying drawing, in which:

FIG. 1 is a cross sectional view which illustrates the relative parts of the device; and

FIG. 2 is a modification of the corer arrangement.

The present invention is directed to a corer for taking a sample core of the earth under a body of water. The device is assembled, dropped over the side of a water vessel wherein the device free falls to the bottom due to attached weights. Upon striking the bottom, a spring held weight trips a buoyant material holding means which releases the buoyant material. The weights then force the corer into the earth as the buoyant material "free-floats" for a designated distance. The buoyant material then withdraws weight retaining pins which secures the weights in place and the weights are forced off by springs under

compression. The buoyant material then strikes a buoyant material stop ring which applies an upward force onto the corer device to withdraw the core sample holder from the bottom and floats the device to the surface of the water free of the weights. A screen is secured to a recovery ring on the top of the device so that the device may be located by radar. Also, other means may be used to locate the device such as a water activated radio beacon or signal light. The device is then recovered by a cable means or lifted onto the vessel by other means.

Now refering to the drawing, there is shown by illustration an earth corer usable within a surrounding of water to obtain a core sample of the water's bottom without the use of an attached cable or any other shipboard means for lowering and raising the corer device through the water. The illustrated device includes a light weight tube **10** such as aluminum upon which the necessary elements are assembled to carry out the invention. The assembly includes expendable weights **11** which sink the device, a buoyant material arrangement **12** which lifts the core to the surface of the water, and means for securing the weights and float in place while the device is sinking. A radar reflector **13** or other suitable marking or identifying means may be used for aiding in the recovery of the core device once it has floated to the surface of the water.

The expendible weights **11** are formed of any expendible material such as cement and iron and should weigh enough to override the lifting force of the buoyant material. A suitable weight for the illustrated device being 1500 lbs. of weight for a buoyant material having a buoyant force of about 300 lbs. The weights are formed in two sections of semi-circular form that fit around the tube and are secured thereto near the bottom of the tube by a steel bar **14** secured perpendicular to the tube axis with the ends thereof extending outwardly from the surface of the tube. A weight retaining pin **35** fits through an aperture in the upper portion of the cement weight that receives the end of the steel bar **14** and an aperture in the steel bar. A spring **16** under compression is positioned between each end of the steel bar and each section of the weight such that when the pins are pulled the springs force the weights away from the steel bar and the tube. The weights are then dropped off to permit the remainder of the device to rise under the buoyant force of the buoyancy material.

The buoyant material **12** may be formed of any suitable material such as INLYTE (a trade name of General Motors Corporation) in which the assembly includes twelve cylindrical modules of material each measuring 23.50 inches in diameter and six inches thick, each cemented together to form a buoyant force of about 300 lbs. The buoyant material is placed over the upper portion of the tube and a float stop **18** is secured to the tube adjacent to the top thereof to provide a structure upon which the buoyant material applies its buoyant force in raising the tube corer.

The buoyant material must be held in place during descent of the corer therefore a quick release device **21** such as a parachute type release is secured within the tube below the buoyant material. Two pairs of cables **22** and **23**, one pair much longer than the other, are secured to the buoyant material on the bottom surface thereof. The shorter pair **22** is secured to the quick release device and the long pair **23** is secured to the weight retaining pins that secure the weights to the steel bar **14** and consequently to the tube. The longer cables are sufficiently long that they hang loose when the buoyant material is secured in place by the shorter pair of cables. The length of the longer cables are such that the pins securing the weights in place will be removed by move-

ment of the buoyant material upwardly and at a time just prior to the upper surface of the buoyant material striking the float stop, the operation of which will be explained later.

The parachute type release includes two pins **24** which move upwardly with a central plunger **25** to secure the short pair of cables in place which hold the buoyant material below the float stop a desired distance. The short cables are released by movement of the plunger downwardly which in turn moves the pins downwardly to release the cables. The plunger **25** is forced downwardly by a drop weight bar **26** secured to a spring **27** under tension and held in place just above the plunger by a water soluble rod **28** of any suitable material such as any material that dissolves in water The water soluble rod **28** dissolves while the device is descending to the bottom of the water. Suitable drop weight bar guides **31** and the drop weight spring are held within the tube by any suitable means such as a pin **32** that passes through the tube perpendicular to the axis of the tube and held in place by friction.

The core holder **34** is slid into the bottom of the tubular device and secured by any suitable means such that the core holder will not be lost when withdrawn from the earth. One suitable means for holding the core holder in place is a coupling arrangement **36** having screw threads on the end toward the core holder to which the core holder may be screw threaded. The steel bar **14** passes through the coupling thereby securing the coupling in place relative to the tube and the weights about the tube. The steel bar will support the core holder to aid in driving the core holder into the earth and to retrieve the core holder with the tubular device.

For the purpose of preventing wash out of the core during ascent, a butterfly type valve **15** under spring action is assembled onto the couple above the steel bar in the tube. When the device is being lowered, water passes up through the core holder and the tube forcing the valve doors open so that water passes out through appropriate apertures **36** in the tube between the valve and the bottom of the parachute type release mechanism that closes off the tube. As the device rises through the water, the valve closes to prevent washout of the core sample. The foot of the corer is also provided with core catchers **39** to retain the sample in the core holder.

The device may be operated with a core holder that is provided with a core cutting end wherein the core holder **34** does the cutting and obtains the sample as a single unit. Another way, FIG. 2, is to make use of a well known plastic transparent core holder **41** which forms a liner of a cutter tube **42**, wherein the cutter is formed on the end of the tube **42** placed over the plastic liner. The cutter tube **42** is then secured to the bottom of the tubular device **10** and extends downwardly surrounding the core holder tube. This cutter tube is secured in place by a water soluble material **43** which dissolves to separate the cutter tube from the tubular device. Thus the cutter tube remains in the earth and the core holder is withdrawn from the cutter tube as the device is raised from the bottom by the buoyant material. This removes the possibility that the corer device will get stuck in the earth and cannot be floated out by the buoyant material.

One of the big advantages of the present invention over other free-fall corers is the manner in which the buoyant material applies a force onto the device to free the core holder from the earth. This advantage will be obvious from the following description of the operation of the device. The assembly is prepared for launch from ship board by placing the buoyant material about the tube, securing the core holder in place and attaching the weights onto the device near the bottom of the device in vicinity of the upper end of the core holder. The short cables secured to the bottom of the buoyant material are secured by the quick release clamp mechanism and the long cables secured to the bottom of the buoyant material are secured to the weight release pins. The quick release clamp activating weight is secured in place by a water soluble rod and the device is ready for launch.

A plurality of the devices may be assembled and readied for launch so that a plurality of core samples may be taken from a desired area at different points by launching one assembly at each of the desired locations and returning shortly thereafter to pick up the devices after having automatically obtained a core sample. The core sample is taken by lifting the readied device over the side or end of the ship and permitting the assembly to free fall in the water to the oceans floor. During descent the water soluble rod dissolves permitting the quick release clamp activator weight to hang free by the spring under tension above the quick release clamp. The device free falls in a vertical position in substantially a straight line due to the weight pulling downwardly and the buoyant material pulling upwardly. When the corer hits the water's bottom, at about **15** knots, the assembly tends to stop and the quick release clamp activator weight moves downwardly against the pull of the spring to strike the quick release clamp, tripping the quick release clamp pins to free the ends of the short cables connected to the bottom of the buoyant material. The float material should be released as soon as possible after the bottom is hit, thus the activator weight should be assembled with the lower end as close to the quick release mechanism as possible. The buoyant material then starts to move upwardly free of any pull on or by the corer device. As the buoyant material moves freely upwardly there is no longer any pull on the device in the upwardly direction and the entire force is downward due to the downward momentum and to the weights which are still secured to the device. The full force downwardly due to the weights, drives the corer into the water's bottom to obtain a core sample in the core holder. The buoyant material moves upwardly free of any pull on the device until just prior to striking the buoyant material stop near the upper end of the device, the long cables secured to the bottom of the buoyant material become taut from the downward movement of the assembly and the upward movement of the buoyant material whereas the buoyant material pulls the weight retaining pins from the assembly thereby releasing the weights. The springs under compression force the weights off of the assembly and they are wasted since they are removed from the device.

The buoyant material then strikes the buoyant material stop means. This sudden arrestment of the buoyant material provides a large impulse on the corer device which forces the corer upwardly and removes the core holder from the oceans bottom by the upward thrust. The buoyant material then floats the device less the expended weights to the surface of the water where it is recovered by the ship's personnel taking the samples.

The butterfly valve and the openings in the tube serves to permit the water to flow out of the core holder during descent and during the time that the corer is being forced into the oceans bottom. Thus, there is hardly any restriction due to any water in the core holder during descent. During the ascent, the butterfly valve closes to prevent the water from washing out the sample at the top in the core holder and the core catchers at the bottom retain the core sample in the holder.

There are disclosed two operational devices, one having a tube that encircles the core holder and one which does not include the encircling tube. In operation of the device not including the encircling tube about the holder, the core holder must be made of a material which operates as the corer and core holder. Also, the buoyant material must free the core holder from the water's bottom which under some conditions the bottom may be such that the buoyant force of the buoyant material may

not be sufficient to free the core holder. Thus, the device will be lost and a sample would not be obtained.

In the modification which includes a corer tube that encircles the core holder, the core holder may be of plastic or any other suitable material and the tubular core cutter encircling the core holder will remain in the water's bottom and the buoyant material will only be required to withdraw the core holder from the core cutter tube encircling the core holder. Thus, such an assembly will insure that the core holder assembly will be recovered less the weights and the core cutter tube which are left in the water's bottom.

The upper end of the core assembly is provided with an eyelet or ring or any suitable device for recovering the device from the water's surface by use of a ship's crane. The ring may be provided with a suitable wire screen which acts as a radar reflector for finding the device. A light system or a radio beacon activated by the water may be provided for aiding in the location of the device after it has floated to the water's surface. The aid for location of the device should be of light weight so that the buoyant material need not overcome too much weight during ascent.

The weights are secured to the device at or just above the upper end of the core holder so that the weights may force the corer into the bottom for the full length of the core holder. The length of the tubular device above the weights should be of sufficient length to permit the weights to force the corer into the bottom and yet permit the buoyant material to "free" float upwardly toward the buoyant material stop means whereby the weight retaining pins will be removed by the buoyant material just prior to the buoyant material striking the buoyant material stop. Thus, the weights are released just prior to the time that the buoyant material strikes the buoyant material stop so that the force of the buoyant material on withdrawing the core holder from the bottom is not affected by the weights. Thus, the buoyant material does not exert any upward pull on the corer during the time the corer is forced into the bottom.

Assuming a buoyant force of 300 lbs. for the buoyant material and a water weight of 1500 lbs. for the weights, there will be a net weight force downward due to the 1200 lbs. difference. Upon release of the buoyant material by the quick release mechanism, there is no upward pull from the buoyant material so there is a net downward force on the corer due to the entire 1500 lbs. of the weights plus the weight of the device. Thus there are no restrictions against the downward drive of the device except for the water's bottom and the effect of cutting the core.

Thus, the device can be assembled on board ship dropped over the side wherein it will go to the water's bottom, take a core sample, drop the weights and return to the water's surface. It can then be recovered by personnel on the ship. Such a device permits one to take different core samples in a desired pattern over a desired area almost simultaneously without the use of any attached cables.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. An underwater earth sampling corer which comprises:
A core cutting means,
Weight means secured to said core cutting means,
A float means secured to said weighted core cutting means,
Means for timely releasing said float means to free said float relative to said weighted core cutting means,
Float stop means secured at the upper end of said core cutting means,
Means for timely releasing said weight means subsequent to timely releasing said float means,
Said weight means being released prior to said float means impacting with said float stop means,
Whereby said weight means forces said core cutting means into said earth subsequent to said release of said float means and prior to release of said weight means and said weight means is released prior to said float means impacting with said float stop means to withdraw said core cutting means from said earth and float the latter to the surface of said water.

2. An under-water earth sampling corer which comprises:
A frame,
A buoyant material secured for free movement about said frame,
A buoyant material stop means secured at the upper end of said frame,
A core cutting-core receiving means secured near the bottom of said frame,
A weight assembly releasably secured about said core cutting-core receiving means near the upper end thereof,
Means for securing said buoyant material about said frame relative to said weight assembly,
Means for operating said buoyant material securing means upon impact of said core cutting core receiving means with said earth to release said buoyant material from its secured position,
Means for timely releasing said weight assembly subsequent to release of said buoyant material,
Whereby said buoyant material impacts with said buoyant material stop means to force said core cutting-corer from said earth and float same to the surface of the water.

3. An under-water earth sampling corer which comprises:
A core cutting means,
A core receiving means within said core cutting means,
A weight assembly releasibly secured about said corer above said core cutting means,
A buoyant material secured about said device,
Means for holding said buoyant material about said device relative to said weight assembly,
Means for releasing said buoyant means from its secured position relative to said weight assembly,
Buoyant material stop means positioned above said buoyant material,
Means secured to said buoyant material for releasing said weight assembly at a predetermined time prior to said buoyant material striking said buoyant material stop means subsequent to release of said buoyant material by said means for holding said buoyant material about said device,
Whereby release of said weight assembly and said buoyant material rises to strike said buoyant stop means produces a high force impulse thereon to withdraw said core holder from said core cutting means and to float the device to the surface of the water.

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