Dec. 14, 1948. B. W. SEWELL 2,456,331

CORE BARREL

Filed May 2, 1944 2 Sheets-Sheet 1

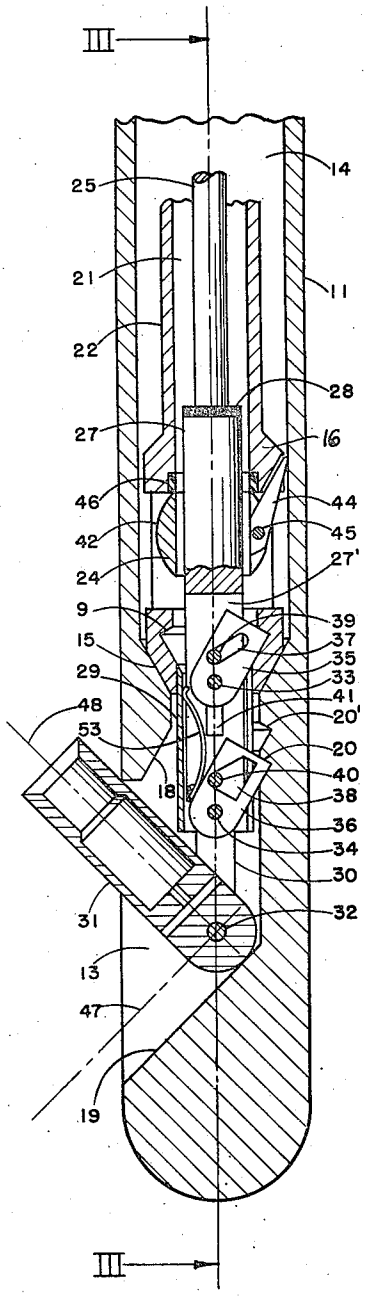

FIG. 1.

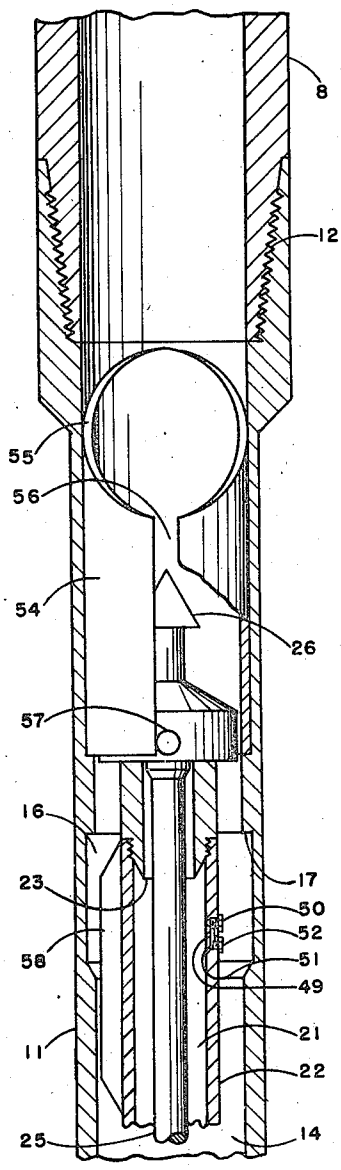

FIG. 2.

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CORE BARREL

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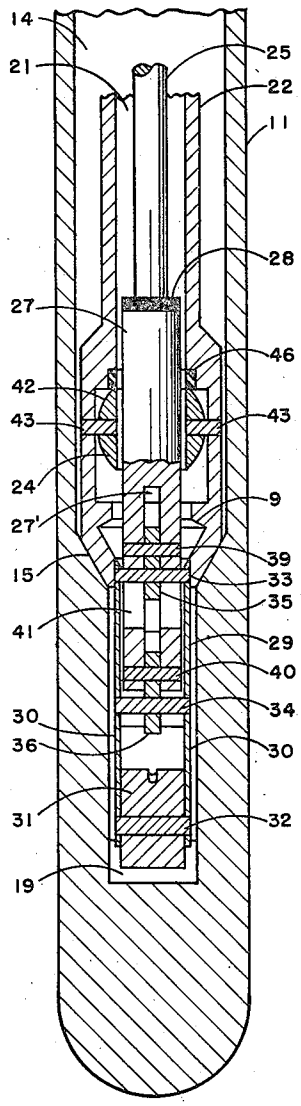

FIG. 3.

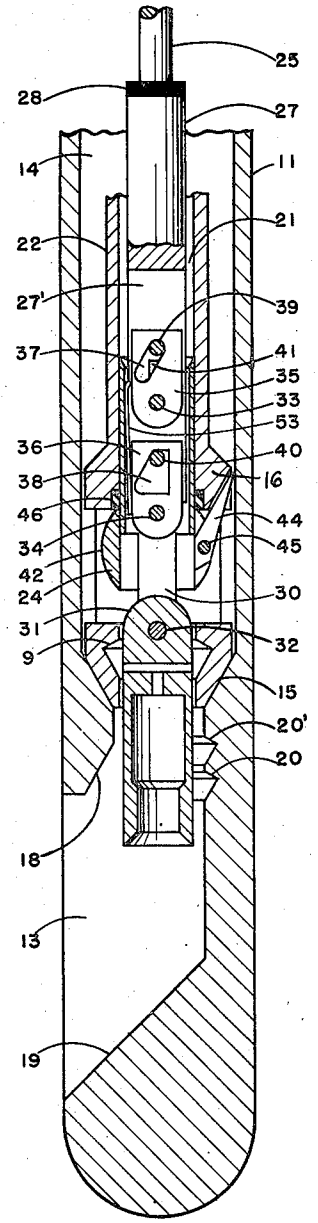

FIG. 4.

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UNITED STATES PATENT OFFICE

2,456,331

CORE BARREL

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Application May 2, 1944, Serial No. 533,725

13 Claims. (Cl. 255—1.4)

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The present invention is directed to a wire line sidewall pressure core barrel, and is a continuation in part of my application Serial No. 381,487, filed March 3, 1941, now abandoned.

In the drilling of boreholes in the earth it is frequently desirable to obtain formation samples along the wall of the hole.

Since the formations below the surface of the earth are almost invariably at a pressure substantially greater than that prevailing at the surface, it is also desirable that the cores be sealed under the pressure of the formation at which they were taken and removed from the borehole at this pressure. Such a sealing of the sample is desirable not only to retain in the sample the amounts of fluid present therein under the pressure of the formation, but also to prevent washing and contamination of the sample by drilling fluid in the borehole as the sample is withdrawn.

It is an object of the present invention to produce a device capable of taking sidewall samples in a borehole, and which will seal the samples under the pressure at which they are taken so that they may be available at the surface of the earth under such pressures.

A further object of the present invention is to produce a pressure sidewall core barrel which is arranged so that it may be dropped down a drill stem, locked in place at the lower end of the stem until a sample is taken, and then retrieved by use of a wire line.

Other objects and advantages of the present invention will appear from the following detailed description of the accompanying drawing, in which:

Figs. 1 and 2 constitute together a vertical section of a core barrel according to the present invention, said figures being arranged in sequence beginning with the bottom of the core barrel;

Fig. 3 is a cross section along line III—III of Fig. 1; and

Fig. 4 is a fragmentary view similar to Fig. 1, but showing the core-receiving mechanism retracted within an outer casing.

Referring to the drawing in detail, an elongated tubular member 11 is provided at its upper end with a conventional box connection 12 so that it may be attached to the lower end of a drill stem, of which a fragment is shown on the drawing designated by numeral 8. The lower end of member 11 is provided with a window 13.

Member 11 is substantially tubular in configuration. A central passage 14 extends from the upper end through most of the length of the member with the passage constricted near the

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lower end by a tapering seat 15. Below the tapering seat the passage opens out into a window 13 which is defined by an upper, outwardly slanting wall 18 and a lower, similarly slanting wall 19. Along the wall of the passage below seat 15 are notches 20 and 20'.

At the upper end of member 11 is a cylindrically shaped insert 54, having its upper end cut at a slant and the slanting surface designated by numeral 55. A longitudinal groove 56 extends vertically downwardly from the lower edge of surface 55. Member 54 is commonly known to the art as a sleeve cam or mule shoe throw guide. A short distance below member 54 an enlarged section 16 is provided in member 11, with the upper portion of this enlarged section defined by inwardly projecting shoulder 17.

The member 11 just described is arranged to be attached to the lower end of a string of drill pipe or tubing for lowering into a borehole. A core barrel assembly designated by numeral 21 may then be positioned in assembly 11 with a core-taking tube in position for taking a sample and a locking means securing the core barrel assembly to member 11. By manipulating the drill pipe a core may be obtained and later the core barrel assembly may be released from member 11 and retracted to the surface by means of a conventional wire line retrieving tool.

It is an advantage of this arrangement that a large number of sidewall samples may be taken, sealed under the pressure of the formation from which they are obtained, and withdrawn to the surface without the withdrawal of the drill pipe. The core barrel assembly 21 is arranged so that it may be dropped freely down the drill pipe, and upon reaching member 11 it is oriented, seated and latched in position without any manipulation by an operator. The duty of the operator is limited to the dropping of the assembly into the upper end of the drill pipe, and then after the device has had time to fall through the pipe and lock itself into position the operator must manipulate the drill pipe to take a core and then retract the assembly with the wire line retrieving tool.

Core barrel assembly 21 is comprised of an outer tubular pressure barrel 22 provided at its upper end with a valve seat 23 and at its lower end with a rotary ball plug valve 24. Within tubular pressure barrel 22 is arranged rod 25 having its upper end secured to a spearhead member 26, which remains outside of the outer casing. The lower end of rod 25 is attached to cylindrical member 27 which is of larger diameter than the rod so that its upper surface forms a shoulder,

this shoulder being provided with a gasket 28, preferably of rubber. The size of cylinder 27 is proportioned so that when this cylinder is raised, as will be hereafter explained, gasket 28 comes in contact with valve seat 23, the two members cooperating to form a valve closing the upper end of sleeve 22. The lower portion of cylinder 27 is divided, a slot 27' causing it to have a bifurcated configuration. A second slot 41, of relatively short length, extends through the bifurcated portion of member 27 at right angles to slot 27'. A slotted tubular sleeve 29 is fitted slidably over the lower portion of member 27. The lower end of this sleeve terminates in a pair of arms 30—30, and to the lower ends of these arms is secured a core-receiving tube 31 by means of a pivot 32.

Sleeve 29 serves as a mounting means for upper dog 35 and lower dog 36. A transverse pin 33 extends from one wall to the other of sleeve 29 through slot 41 of member 27 and serves as a pivot for dog 35, while a second pin 34 extends from one wall to the other of sleeve 29 and serves as a pivot for dog 36, with the upper or free ends of these dogs extending through the slotted portion of sleeve 29. A leaf spring 53 is secured to dog 36 and arranged with its unsecured end resting against sleeve 29 to bias the free end of dog 36 outwardly. Dog 35 is provided with an elongated slot 37 and dog 36 with a slot 38 of a general trapezoid form. A transversely extending pin 39 extends through slot 37 of upper dog 35 and a second transversely extending pin 40 is arranged in slot 38 of the lower dog, with the ends of pins 39 and 40 secured to the bifurcated portion of member 27.

The arrangement of dogs 35 and 36 with respect to sleeve 29 and member 27 causes the free ends of the dogs to be moved inwardly upon upward motion of member 27 with respect to sleeve 29. The slot 38 of a general trapezoid form in the lower dog allows this member to be moved inwardly without disturbing member 27.

Dog 35 serves to lock sleeve 29 to the outer pressure barrel 22, with the core-receiving tube 31 below member 22 when the device is assembled and ready to be dropped down the drill stem for taking a core. Dog 36 is arranged to engage with notch 20 when the core barrel assembly is within member 11 and in position for taking a core. It is to be noted that a second notch 20' is provided in unit 11 above notch 20, so that if a foreign body prevents the seating of the assembly on seat 15 the dog 36 may engage the upper notch 20' and lock the device in position. The trapezoidal slot 38 allows dog 36 to be pushed inwardly by seat 15 when the core barrel assembly 21 is going into position with respect to member 11, without causing movement of member 27, and allows the assembly including the outer sleeve and the core-receiving tube 31 to remain locked together.

Pressure barrel 22 is provided with a notch 9 to receive dog 35 when this dog is in operative position to lock the sleeve 29 to barrel 22.

Rotary ball plug valve 24 comprises a ball 42 having flattened ends supported by axles 43 for rotation. Arm 44, secured to ball 42 by pivot 45, is arranged so that when the core barrel assembly is drawn upwardly, the upper end of the arm will be caught by shoulder 17 and rotate ball 42 through an angle of 90° to close the valve. Ring 46 is arranged to seal the space between ball 42 and the central passage in the outer casing. Further lifting of the wire line brings the core barrel to the surface of the earth with the core sample sealed under formation pressure. The sample may then be analyzed as desired.

The upper end of pressure barrel 22 is provided with a longitudinal bore 49 communicating with the interior of tubular member 22 and provided with a needle valve 50 controlling the passage. This longitudinal passage is provided with a lateral outlet 51 carrying a plug 52. These passages, the needle valve, and the plug enable the gaseous constituents to be readily removed and be conserved for analytical purposes, when the device containing a sample under pressure reaches the surface of the earth.

A means for orienting the core barrel assembly 21 with respect to unit 11 is provided by a transversely extending pin 57 secured to the spearhead member 26. Fins 58 are attached to member 22 for the purpose of centering the upper portion of the core barrel as it passes through sleeve 55. As the core barrel assembly drops into member 11, pin 57 is brought into contact with surface 55 and this cam surface rotates the core barrel assembly as much as is necessary to bring pin 57 into alignment with slot 56. This orienting means insures that tube 31 can pivot on member 32 and project out through window 13 upon its lower edge coming in contact with surface 19. It will be understood that notches 20 and 20' may extend a considerable distance around the circumference of the inner surface of passage 14, but that the orienting means also aids the proper engagement of dog 36 with either notch 20 or 20'.

From the above description the method of operation of the device will be evident. Member 11 is attached to the lower end of a string of drill stem, and lowered into a well from which the samples are taken until window 13 is opposite the formation from which a sample is desired. The core barrel assembly is then arranged with the portion including sleeve 29 and tube 31 latched to pressure barrel 22 by means of dog 35 and the assembly is then allowed to drop freely down the drill stem. As this assembly, dropping under the influence of gravity, enters member 11, the orienting means including sleeve cam 54 and pin 57 orients the movable portion with respect to member 11 so that the core-receiving tube pivots on member 32 and its free end passes out through window 13, with its longitudinal axis lying on center line 47. As the movable assembly drops into this position, the dog 36 will have been pushed inwardly upon coming into contact with seat 15 and then pushed outwardly by spring 53 when its free end reaches a position adjacent notch 20 or 20' to latch the assembly to member 11. The upper dog 35 is engaged with notch 9 at the surface and remains in this locked position as the assembly is being positioned preliminarily to taking a core.

When the core barrel assembly has been seated on seat 15 with dog 36 locking it with member 11, the core may be taken simply by moving the drill stem downwardly a sufficient distance to cause core tube 31 to describe an arc and assume a position with its center line along center line 48, as shown in Fig. 1. This manipulation of the drill stem forces a sample of the formation into the core tube. The drill pipe is then raised to return the core tube to its first position with its axis line on center line 47.

After this operation a conventional wire line retrieving tool may be lowered into the drill pipe bore to engage spearhead 26. An upward pull of such a retrieving tool lifts rod 25 carrying with

it member 27, to which transverse pins 39 and 40 are attached. Upward movement of these pins disengages dogs 35 and 36 from notches 41 and 20, respectively. Continuing the pull causes rod 25 to move upwardly until gasket 28 is in contact with seat 23, sealing the upper end of the pressure barrel 22. When this contact is made, an additional upward pull causes both the assembly attached to rod 25 and the pressure barrel 22 to move upwardly together with the end of core tube 31, now inside of pressure barrel 22 and slightly above ball 42 of the lower valve. As the core barrel assembly moves upwardly, the arm 44 above valve 24 reaches enlarged space 16, which allows the outer end of the lever to fall outwardly. Continued upward movement brings arm 44 in contact with shoulder 17, whereupon the arm rotates ball 42 through an arc of 90° to close the lower end of the pressure barrel.

After a sample has been taken as above described, the drill stem may be moved longitudinally in the borehole so that window 13 is opposite another formation from which a sample is desired and the process repeated. Accordingly, a series of samples may be readily obtained along the axis of a borehole with only one round trip of the drill stem carrying member 11 since the inner core-receiving assembly may be dropped into position and removed by a wire line any desired number of times, while the drill stem remains in the borehole.

It is to be understood that the above described mechanism represents only a single embodiment of the present invention and is not intended to define the limits of the present invention. It will be apparent that many changes can be made in the size, shape and arrangement of parts without departing from the fundamental principles underlying the present invention.

The nature and objects of the present invention having been thus described and illustrated, what is claimed as new and useful and is desired to be secured by Letters Patent is:

1. A pressure coring device comprising an elongated member provided with a central passage, a side opening for said passage, a tubularly shaped pressure barrel adapted to be lowered into and raised completely out of said elongated member, a valve for sealing the upper and a valve for sealing the lower end of said pressure barrel, a core-receiving tube arranged to extend through said side opening when in a core-taking position and to be retracted within said barrel, said valve for sealing the upper end of said barrel being adapted to be closed upon the withdrawal of said core-receiving tube within said barrel and said valve for sealing the lower end of said barrel being adapted to move to closed position upon the withdrawal of said barrel from said elongated member.

2. A pressure coring device comprising an elongated member provided with a central passage, a side window communicating with a lower end of said passage and a seat for supporting a tubular pressure barrel above said window, a tubular pressure barrel adapted for slidable movement along said central passage and to rest on said seat when in core-taking position, a core-receiving tube arranged to extend through said side window when in core-taking position and to be retracted within said pressure barrel, a slidable member adapted for longitudinal movement in said pressure barrel, means pivotally securing an end of said core-receiving tube to the lower end of said slidable member, means

associated with said slidable member projecting from the upper end of said pressure barrel at all times and arranged to engage with a grappling tool, said slidable member projecting from the lower end of said pressure barrel when it is in its lower position and retracting said core-receiving tube wholly within said pressure barrel when in its upper position, locking means arranged to secure said slidable member to said pressure barrel and to said elongated member, said locking means being releasable upon upward movement of the means arranged to engage with a grappling tool and valve means associated with the upper and lower portions of the tubular pressure barrel to make it pressure-tight the valve means for the upper portion of said barrel being operative upon the retraction of said core receiving tube into said barrel and the valve means for the lower end of said barrel being operative only after the retraction of said core receiving tube into said barrel.

3. A pressure coring device comprising an elongated member adapted to have its upper end secured to a string of drill pipe provided with a central passage and a side window in communication with the lower end of said passage, a tubular pressure barrel longitudinally movable along said central passage, a core-receiving tube arranged to project from the side window when in core-taking position and to be retracted within said pressure barrel, an assembly in said pressure barrel slidably arranged to assume an upper and lower position, releasable locking means carried by said assembly for locking said assembly to said barrel and to said elongated member, means pivotally connecting an end of said core-receiving tube to the lower end of said assembly, means carried by the upper end of said assembly adapted to engage a grappling means and valve means associated with the upper and lower portions of said barrel to make the barrel pressure-tight the valve means for the upper portion of said barrel being operative upon the retraction of said core receiving tube into said barrel and the valve means for the lower end of said barrel being operative only after the retraction of said core receiving tube into said barrel.

4. A device in accordance with claim 3 in which the valve means associated with the upper portion of said pressure barrel is closed when said assembly assumes its upper position and the valve means associated with the lower portion of said pressure barrel is closed when said pressure barrel moves upwardly with respect to said elongated member.

5. A sidewall pressure-retaining core assembly to recover a core on the surface of the ground at the same pressure that the core left the formation, comprising an elongated tubular member, a pressure barrel adapted to be lowered into and raised completely out of the elongated tubular member, a seat on the lower end of the elongated tubular member to support the pressure barrel, an open-ended core receiving tube, suspending means connected to said core receiving tube arranged to suspend the core receiving tube below the pressure barrel with its open end free for transverse movement when in a lower position and to retract the core receiving tube into said pressure barrel when in an upper position and ccoperating with the pressure barrel and elongated tubular member to lock releasably to the pressure barrel and elongated tubular member when in its lower position, a guide means on the elongated tubular member arranged to project the open end of the core receiving tube trans-

versely outwardly when the pressure barrel is supported by the seat and the suspending means is in its lower position, means associated with the suspending means to receive lifting means lowered within the elongated tubular member to release the suspending means from the elongated tubular member and the pressure barrel, to retract the core receiving tube wholly within the pressure barrel and to lift the pressure barrel completely out of the elongated tubular member when the coring is completed, and means associated with the barrel to make the barrel pressure-tight after the core receiving tube is retracted wholly within said barrel.

6. A sidewall coring device comprising an elongated member of a general tubular shape adapted to be attached to the lower end of a drill stem, a window on one side of said elongated member and a coring assembly adapted to be lowered into and lifted out of said elongated member, including an outer barrel, a slidable member slidably mounted in said barrel and extending therethrough, a core receiving tube, having an open lower end pivotally connected at its upper end with the lower end of said slidable member and adapted to protrude through said window when in its lowermost position, means for releasably locking said slidable member to said barrel when said core receiving tube is in its lowermost position, means for releasably locking said barrel to said elongated member when said core receiving tube is in its lowermost position, means carried by the upper end of said slidable member whereby said member may be pulled upwardly to retract said core receiving tube into said barrel, means for sealing the upper end of said barrel when said slidable member is in its uppermost position, and means for sealing the lower end of said barrel after said core receiving tube is retracted into said barrel.

7. A sidewall coring device comprising an elongated member adapted to be attached to the lower end of a drill stem, a window on one side of said elongated member and a coring assembly adapted to be lowered into and lifted out of said elongated member, including an outer barrel, a core receiving tube, having an open lower end, adapted to protrude through said window when in its lowermost position and to be retracted into said barrel, said core receiving tube having a pivotal connection at its inner end adapting it for movement transversely with respect to the axis of said elongated member, means for anchoring the pivot point of said core receiving tube with respect to said elongated member during the coring operation, means for retracting said core receiving tube into said barrel after said coring operation, means for sealing the upper end of said barrel when said core receiving tube is in its retracted position and means for sealing the lower end of said barrel after said core receiving tube is retracted into said barrel.

8. A device according to claim 6 in which the means for sealing the lower end of said barrel includes a valve and coacting means between said valve and said elongated member for closing said valve upon upward movement of said barrel relative to said elongated member whereby said barrel cannot be withdrawn from said elongated member unless said valve is closed.

9. A device according to claim 7 in which the means for sealing the lower end of said barrel includes a valve and coacting means between said valve and said elongated member for closing said valve upon upward movement of said barrel relative to said elongated member whereby said barrel cannot be withdrawn from said elongated member unless said valve is closed.

10. A sidewall coring device comprising an elongated member adapted to be attached to the lower end of a drill stem, a window on one side of said elongated member, a coring assembly adapted to be lowered into and lifted out of said elongated member, including an outer barrel, a slidable member slidably mounted in said barrel and extending therethrough, a core receiving tube, having an open lower end, pivotally connected at its upper end with the lower end of said slidable member and adapted to protrude through said window when in its lowermost position, means for releasably locking said slidable member to said elongated member when said core receiving tube is in its lowermost position, means carried by the upper end of said slidable member whereby said member may be pulled upwardly to retract said core receiving tube into said barrel, coacting means carried by the upper end of said barrel and said slidable member for sealing the upper end of said barrel when said slidable member is in its uppermost position, a valve carried by the lower end of said barrel adapted to pass said core receiving tube and said slidable member when in its open position and coacting means carried by said valve and said elongated member for sealing the lower end of said barrel when said barrel is moved upwardly relative to said elongated member with said slidable member in its uppermost position.

11. A sidewall coring device comprising an elongated member adapted to be attached to the lower end of a drill stem, a window on one side of said elongated member, a coring assembly adapted to be lowered into and lifted out of said elongated member, including an outer barrel, a slidable member slidably mounted in said barrel and extending therethrough, a core receiving tube, having an open lower end, pivotally connected at its upper end with the lower end of said slidable member and adapted to protrude through said window when in its lowermost position, means on said elongated member for guiding the open end of said core receiving tube through said window, means for releasably locking said slidable member to said elongated member when said core receiving tube is in its lowermost position, means carried by the upper end of said slidable member whereby said member may be pulled upwardly to retract said core receiving tube into said barrel, coacting means carried by the upper end of said barrel and said slidable member for sealing the upper end of said barrel when said slidable member is in its uppermost position, a valve carried by the lower end of said barrel adapted to pass said core receiving tube and said slidable member when in its open position and coacting means carried by said valve and said elongated member for sealing the lower end of said barrel when said barrel is moved upwardly relative to said elongated member with said slidable member in its uppermost position.

12. A device according to claim 10 in which the valve for sealing the lower end of said barrel is a rotary valve and the coacting means carried by said valve and said elongated member for closing said valve includes an arm extending outwardly from said valve and a shoulder on said elongated member for engaging said arm when said barrel moves upwardly relative to said elongated member whereby said barrel cannot be

lifted out of said elongated member unless said valve is closed.

13. A device according to claim 1 in which the valve for sealing the lower end of said barrel is a rotary valve adapted to pass said core receiving tube when in open position and is provided with means for rotating said valve to closed position when said barrel is withdrawn from said slidable member.

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