Feb. 29, 1944. J. C. STOKES 2,343,032

PRESSURE CORING APPARATUS

Filed May 11, 1942 2 Sheets-Sheet 1

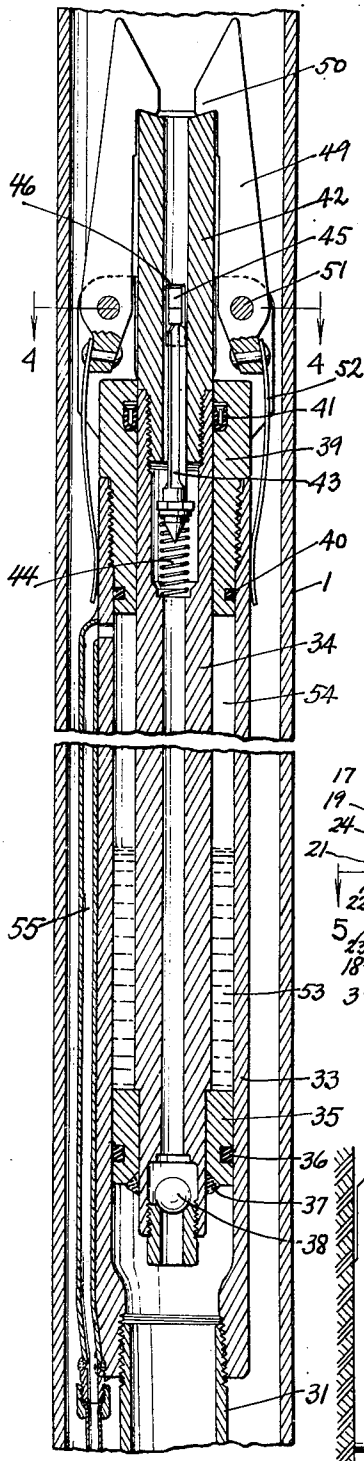


Fig. 1.

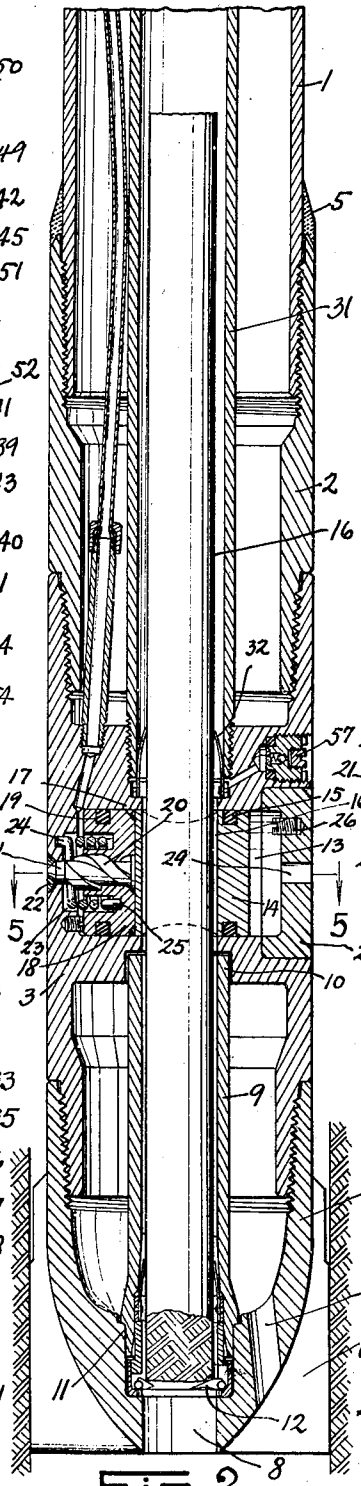


Fig. 2.

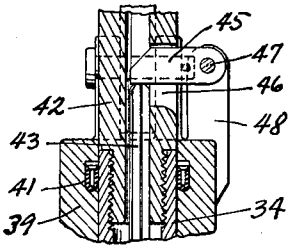


Fig. 3.

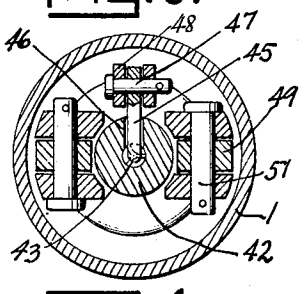


Fig. 4.

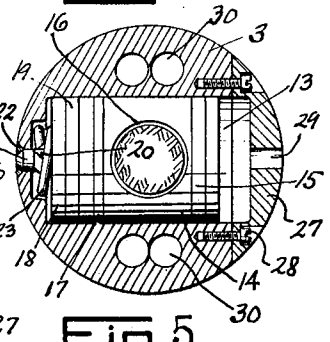


Fig. 5.

JOHN C STOKES.
INVENTOR.
By J. Vincent Martin
and
Ralph L. Browning
ATTORNEYS

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PRESSURE CORING APPARATUS

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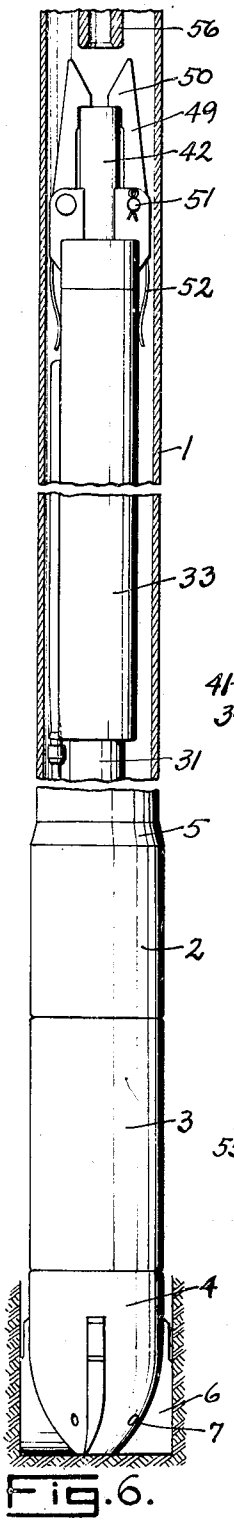


Fig. 6.

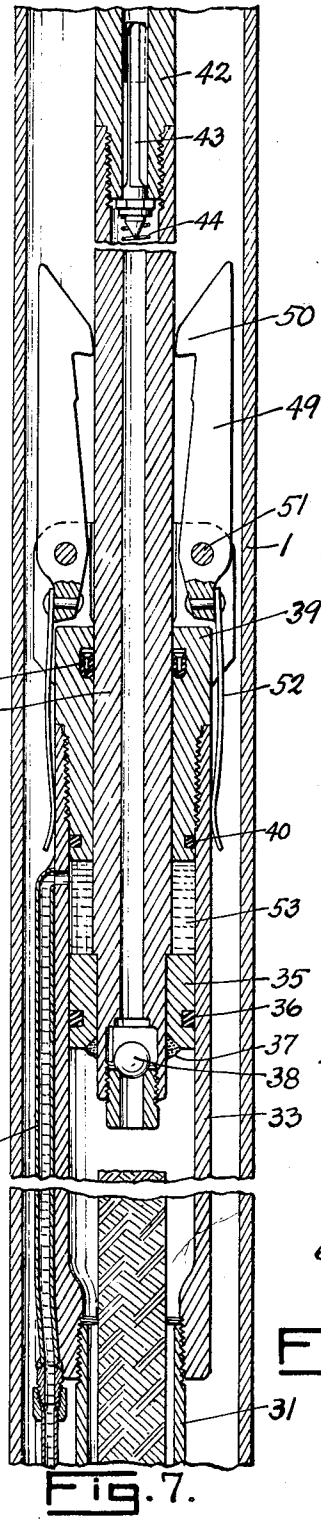


Fig. 7.

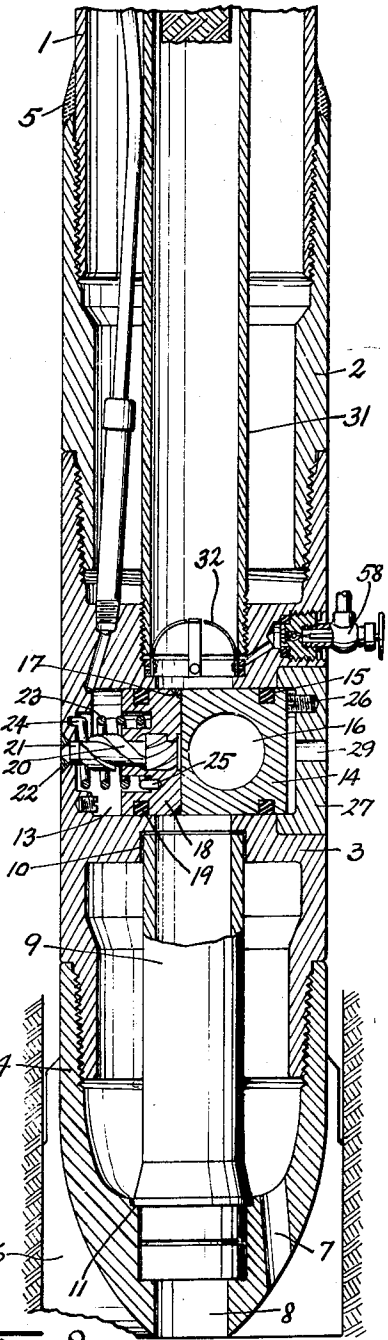


Fig. 8.

JOHN C. STOKES
INVENTOR.

By J. Vincent Martin
and
Ralph L. Browning
ATTORNEYS

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UNITED STATES PATENT OFFICE

2,343,032

PRESSURE CORING APPARATUS

John C. Stokes, Houston, Tex., assignor to Reed Roller Bit Company, Houston, Tex., a corporation of Texas

Application May 11, 1942, Serial No. 442,400

5 Claims. (Cl. 255—72)

This invention relates in general to coring apparatus and has for its general object the provision of an apparatus which will make it possible to take a core and remove it from a well under the pressure under which it existed when taken from the bottom of the well.

Customarily during the drilling of a well by the rotary drilling method cores are taken whenever it is desired to obtain a sample of the formation through which the well is being drilled. Customarily such a core is cut by a drill known as a core drill that cuts an annular path and leaves a core standing in the center of the well. This core moves upwardly into a core barrel and this core barrel has a means therein for retaining and breaking off the core when the core barrel is raised. The core barrel is then raised to the surface of the ground and the core is removed and examined.

Pressure coring devices have been proposed, but in the ordinary methods of taking a core, however, the core is not maintained under the pressure under which it was taken but as the core is raised up through the drilling fluid which is customarily employed in the drilling of wells, the hydrostatic pressure on the core is gradually released and as this pressure is released the gases and other constituents within the formation of the core itself will gradually come out. Therefore, when the core has finally reached the surface of the ground and is taken out for examination, only the solid matter forming the core will remain intact. Any liquids or gases which may have been entrained within the core at the pressure under which the core was taken will have been at least partially depleted and no true indication of such content of the core can be obtained.

It is an object of this invention to provide an improved form of apparatus whereby a core may be taken and then hermetically sealed so that it may be removed from a well without the loss of gaseous or liquid constituents that might be entrained in the body of the solid core itself.

Another object of this invention is to provide such a structure in which the pressure of the fluid existing within the well at the point where the core is taken will be utilized to move the core upwardly into a chamber provided for the purpose and to hermetically seal the core within said chamber.

Another object of this invention is to provide a structure of the character referred to in which there shall be the minimum number of moving parts.

Another object of this invention is to provide a structure of the character referred to in which there is a valve adapted to admit the core into the core barrel within which it is to be sealed, such valve being initially held open by means of an unequalized fluid pressure within the well and being adapted to be closed by a spring or the like when such pressure has been equalized.

Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawings wherein is illustrated by way of example one embodiment of this invention.

In the drawings:

Fig. 1 is a view in longitudinal cross section illustrating the upper portion of a coring device constructed in accordance with this invention.

Fig. 2 is a similar view illustrating the lower portion of the same device.

Fig. 3 is a fragmentary longitudinal cross section taken at right angles to Fig. 1 and illustrating the structure whereby the venting valve at the upper end of Fig. 1 is held in open position during the taking of a core.

Fig. 4 represents a transverse cross section through the device illustrated in Fig. 1 the same being taken along the line 4—4 of Fig. 1.

Fig. 5 is a transverse cross section taken along the line 5—5 of Fig. 2.

Fig. 6 is a view partly in longitudinal cross section and partly in side elevation illustrating the device shown in Figs. 1 to 5 inclusive and showing the same on a reduced scale.

Fig. 7 is a view similar to Fig. 1 but showing the structure with the parts in the position that they occupy after a core has been taken and hermetically sealed for withdrawal to the surface of the ground.

Fig. 8 is a view similar to Fig. 2 but showing the parts in the position which they occupy after a core has been taken and hermetically sealed as mentioned in connection with Fig. 7.

Referring now more particularly to the drawings, the numeral 1 indicates an outer core barrel which may be secured to the lower end of a drill stem of suitable construction, this core barrel at its lower end being secured by means of a sub 2 to the upper end of a valved fitting 3. The core drill 4 which may be of any suitable and conventional construction is secured to the lower end of the valved fitting 3. The sub 2 may be connected by threads to the outer core barrel 1 and is preferably additionally secured to the outer core barrel by means of welding 5.

The core drill 4 which is illustrated in the

drawings is provided with fishtail type of blades 6 and with fluid passageways 7 for conducting slush to the blades 6. This drill has an opening 8 upwardly through its center for the purpose of receiving a core.

Extending between the lower portion of the core drill and the valve within the valved fitting 3 is a tube 9 through which a core is adapted to pass into the inner core barrel as will be presently described. The upper end of this tube 9 is seated at 10 in a socket in the valve housing of the valved fitting 3. The lower end of this tube 9 is seated at 11 within the drill bit and carries core catchers 12 therein whereby a core may be broken off and retained in the well known manner.

The valved fitting 3 is provided with a transversely extending part intermediate its ends, this part having formed therein a cylindrical opening 13 adapted to receive the cylindrical valve member 14. This valve member 14 has a sealing ring 15 surrounding the same on one side of the opening 16 through which the core is adapted to pass, and on its opposite end is secured as by welding or the like 17 to a cylindrical nut 18 that has a similar sealing ring 19 thereabout. This nut 18 has a coarse thread therein adapted to receive the thread 20 on the shaft 21 which is welded at 22 to the body of the fitting 3.

The spring 23 which surrounds the shaft 21 has one end 24 engaged with the body of the fitting 3 and the other end 25 engaged with the nut 18 so that when the same is in the position illustrated in Fig. 2 this spring will tend to rotate the nut 18 and the valve member 14 in a direction to move the same to the right as it appears in Fig. 2 and will at the same time by virtue of its compression tend to move this body toward the right. Such movement of this body toward the right will be limited by means of the set screw 26 which is mounted in the cap 27 that closes the cylindrical opening 13 on the end thereof which is opposite the shaft 21. This cap 27 is held in place by any suitable means such as the cap screws 28 and has a vent opening 29 therethrough so that the right-hand end of the cylinder as it appears in Fig. 2 will at all times be open to the pressure within the well at the location of the bit.

It will be observed also that the fitting 3 is provided with longitudinal slush passageways 30 on opposite sides of the cylindrical valve chamber just referred to.

Threaded into the upper end of the transverse valve body within the fitting 3 is the inner core barrel 31. This core barrel 31 has a core retainer 32 at its lower end and extends upwardly through the outer barrel, carrying on its upper end the fluid cylinder 33. This fluid cylinder 33 has a plunger 34 therein that carries a piston 35 with the sealing ring 36 on its lower end, the piston being secured in place by any suitable means such as the welding 37. The plunger itself is hollow and at its lower end is mounted a check valve 38 which opens upwardly and is adapted to permit the escape of fluid from within the inner core barrel during the taking of a core.

The upper end of this plunger passes through a head 39 that is secured to the upper end of the cylinder 33 and suitable sealing rings 40 and 41 are provided for the purpose of preventing leakage through the joint between this head and the cylinder and through the sliding joint between the head and the plunger respectively.

Secured to the upper end of the plunger is a valve seat element 42 within which is mounted a valve member 43 which is always urged upwardly toward closing position by means of a spring 44 but which is initially held downwardly into open position by means of the latch bar 45 that extends through a lateral opening 46 in the valve seat member 42, the bar 45 being pivotally mounted at 47 on a bracket 48 that is carried on the head 39.

Also pivotally mounted on the head 39 are the latches 49 having hook-shaped parts 50 adapted to engage over the upper end of the valve seat member 42 and hold the plunger 34 in its lowermost position as illustrated in Fig. 1. These latches 49 are pivotally mounted at 51 on the head 39 and are provided with springs 52 which normally urge them into engaging position.

The cylinder 33 above the piston 35 is preferably partly filled with liquid as illustrated at 53 and partly with air at atmospheric pressure as illustrated at 54. This upper portion of the cylinder 33 is connected by means of a conduit 55 with the left-hand end of the cylindrical valve chamber 13.

In operation, the device is first lowered into a well with the various parts in the position which they are illustrated in Figs. 1 and 2. The core is taken in the usual manner, it being noted that whereas when the device is at the surface of the ground the valve element 14 will have been urged toward the right by the spring 23 and held in closed position, as the device is lowered into the well and the fluid pressure exerted through the opening 29 in the cap 27 will increase and force the cylindrical valve element toward the left and toward open position. When the core is taken therefore it will enter through the valve element into the inner core barrel 31.

When the taking of the core is complete the device will be lifted slightly so that the core breaker 12 will break off the core at the lower end thereof. Meantime the core barrel will have been vented during the taking of the core through the check valve 38 and through the valve 43 which is during this time held in open position by means of the bar 45.

A weighted trip sleeve 56 is now dropped into the well through the drill stem and is of such a size that when it comes in contact with the latching members 49 it will spread these latching members and release the plunger 34 for upward movement. Inasmuch as the pressure within the space 54 is atmospheric pressure whereas the fluid pressure existing outside and within the inner core barrel itself is the pressure at the bottom of the well and is much higher than atmospheric pressure, the piston 35 and plunger 34 will move upwardly very rapidly. This will cause a sudden drop in pressure at the upper end of the inner core barrel and this sudden drop in pressure will cause an upward rush of fluid into the core barrel bringing the core with it until the core itself is located above the valve 14. At the same time, when the piston 35 has travelled part way upwardly the liquid 53 will begin to enter the conduit 55 and will move downwardly into the space at the left-hand end of valve cylinder 13 equalizing the pressure on the valve and permitting the spring 23 to move this valve toward the right and toward closed position.

The device may now be removed from the well, whereupon the plug 57 may be removed and a

suitable valve 58 attached for the purpose of withdrawing from the inner core barrel any pressure fluid contained therein so that the same may be analyzed for the purpose of determining the gas and liquid content of the core. After the pressure on the core has been reduced to atmospheric pressure the core itself may be removed for examination.

From the foregoing it will be observed that a device has been provided which is capable of carrying out all of the objects and advantages sought by this invention.

Having described my invention, I claim:

1. In a coring apparatus, means for cutting a core, a core receiving chamber above said core cutting means, fluid pressure means movable by the fluid pressure in the well hole to enlarge the space in communication with the interior of said chamber and permit a sudden upward surge of fluid into the chamber after the core has been taken and retarded in the fluid by friction with the walls of said chamber, means for holding said fluid pressure means inactive, means for releasing said holding means, and means for hermetically sealing said chamber with the core inside.

2. In a coring apparatus, means for cutting a core, a core receiving chamber above said core cutting means, a spring closed valve at each end of said chamber, the valve at the upper end of the chamber being adapted to be mechanically actuated, the valve at the lower end of the chamber being adapted to be closed by mechanical means only when the pressure in the chamber is balanced, latch means for holding the upper of said valves open and differential fluid pressure means for holding the lower of said valves open, and means movable to release said latch and cause equalization of said fluid pressure differential to mechanically cause the valve at the upper end of the chamber to close and the valve at the lower end of the chamber to close by mechanical means when the pressure is balanced.

3. In a coring apparatus, means for cutting a core, a core receiving chamber above said core cutting means, fluid pressure means movable by the fluid pressure in the well hole to enlarge the space in communication with the interior of said chamber and permit a sudden upward surge of fluid into the chamber after the core has been taken and retarded in the fluid by friction with the walls of said chamber means for holding said fluid pressure means inactive, means for releasing said holding means, means for hermetically sealing said chamber with the core inside, said last mentioned means including a rotatable plug valve for closing the lower end of said chamber, said valve having a flow passage therethrough of a size to accommodate a core such as would be cut by said core cutting means.

4. In a coring apparatus, means for cutting a core, a core receiving chamber above said core cutting means, a spring closed valve at each end of said chamber, the valve at the upper end of the chamber being adapted to be mechanically actuated, the valve at the lower end of the chamber being adapted to be closed by mechanical means only when the pressure in the chamber is balanced, the lower of said valves when open providing a passage capable of passing a core and having one part subject to pressure of fluid from outside the device to hold the valve open and an opposed part subjected to a body of fluid of lower pressure, a piston movable toward the upper end of said chamber and having its lower end subjected to the pressure of fluid from outside the device to urge it upwardly and its upper end subjected to said body of fluid of lower pressure, a latch initially holding said upper valve open and said piston against upward movement, and mechanical means for releasing said latch to permit closing of said upper valve, and to permit upward movement of said piston to first permit a wash of fluid into the chamber after the core has been taken and retarded in the fluid by friction with the walls of said chamber and to then equalize the pressures on said lower valve to cause it to close by mechanical means.

5. In a coring apparatus, means for cutting a core, a core receiving chamber above said core cutting means, valves at the upper and lower ends of said chamber for closing the same, the valve at the upper end being adapted to be mechanically actuated, the valve at the lower end being adapted to be closed by mechanical means only when the pressure in the chamber is balanced, means for initially holding said valves open, means when actuated by the fluid pressure in the well hole movable to enlarge the space in communication with the interior of said chamber to permit a sudden upward surge of fluid into the chamber after the core has been taken and retarded in the fluid by friction with the walls of said chamber, and mechanical means for releasing said means for holding said valves open so as to permit them to close.

JOHN C. STOKES.