June 17, 1930. H. H. DIEVENDORFF ET AL 1,763,642

APPARATUS FOR CEMENTING WELLS

Filed June 6, 1928

FIG. 1

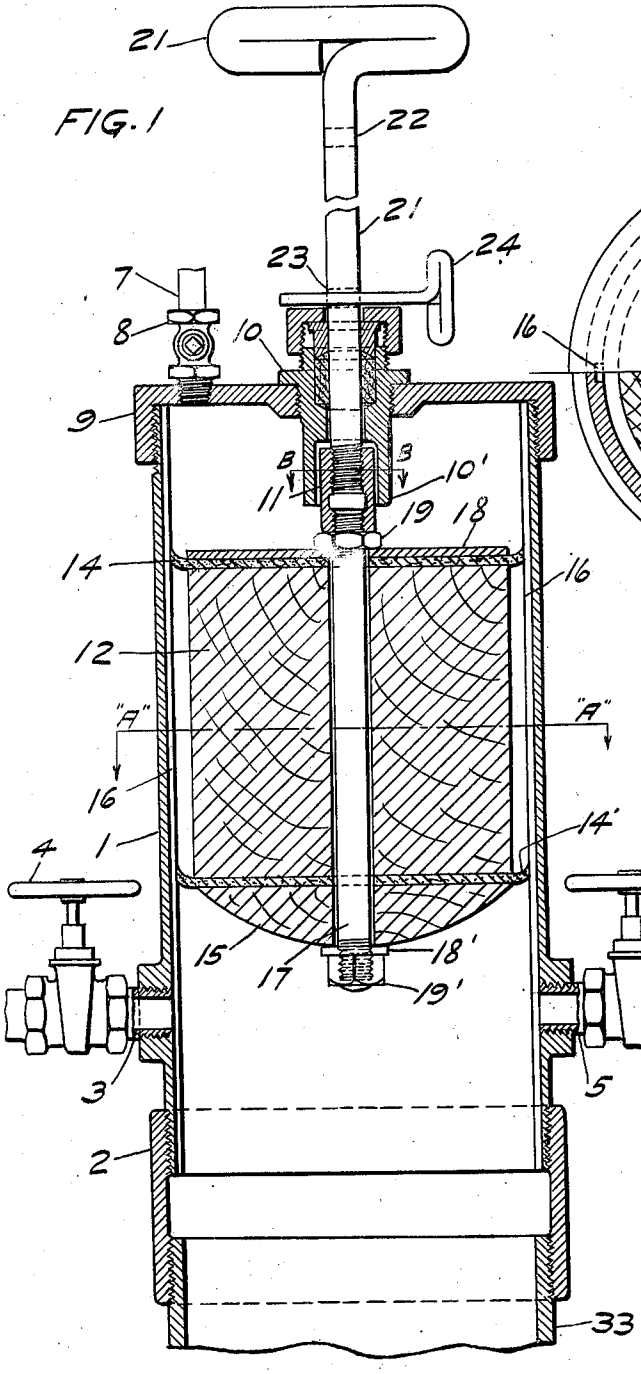


FIG. 2

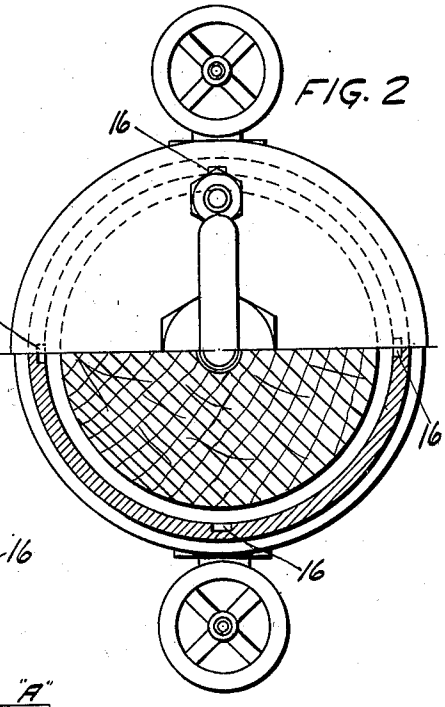
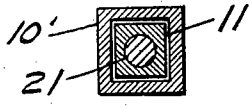


FIG. 3



INVENTORS
HORTON H. DIEVENDORFF.
BY SIDNEY O. BARTON.
Marvin L. Chappell
ATTORNEY

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UNITED STATES PATENT OFFICE

HORTON H. DIEVENDORFF, OF SANTA PAULA, AND SIDNEY O. BARTON, OF VENTURA, CALIFORNIA, ASSIGNORS TO PACIFIC OIL WELL CEMENTING COMPANY, INCORPORATED, OF LOS ANGELES, CALIFORNIA, A CORPORATION OF CALIFORNIA

APPARATUS FOR CEMENTING WELLS

Application filed June 6, 1928. Serial No. 283,352.

This invention relates to an improved apparatus for cementing wells for the permanent exclusion of water from petroleum oil and gas bearing formations. In the drilling of wells, steel casing of varying diameters is employed as a means of keeping the hole open and as a conveyor of the oil and gas to the surface. A well-known method of excluding water from the oil and gas bearing formations consists in filling the space between the wall of the drill hole and the casing with a suitable cement such as Portland cement, which may or may not be mixed with a reagent to regulate the setting time of the cement. Before the cementing operation the hole is drilled to a point below all water bearing formations and into a formation which is impervious to water, such as shale and the like, in order that a water-tight bond may be established between the shale or other formations impervious to water, and the casing, which is extended to a predetermined point within a few feet of the bottom of the hole.

The common method now employed for cementing oil wells to establish a water-tight bond below all water bearing formations between the casing and the drill hole, is generally known as the Perkins and Double method, in which a mud or water circulation is first established down through the casing and up through the space outside the casing so that the mud or water overflows at the top.

This mud or water circulation operation is employed to clean the space between the casing and the drill hole. After the space between the casing and the drill hole has been cleaned by the mud or water circulation operation, a barrier consisting of a wooden plug with two circular pieces of leather attached thereto, commonly called "packing rings," is inserted into the casing from the top. The calculated amount of cement grout is then pumped into the casing from the top or side which forces the plug or barrier down the casing by the hydraulic pressure and weight of the ingoing cement grout. As soon as the required calculated quantity of cement grout has been introduced, a second wooden plug fitted with a leather cupped gasket and a leather disc, is inserted into the casing, and the plug or barrier forced to the bottom of the drill hole, together with the cement grout, the cement grout passing out the side or out through openings in the bottom plug and upward around the casing to the required height, together with the air which is retained between the cement grout and the top plug. Due to the weight of the column of cement grout being greater than the column of mud or water between the casing and the drill hole, the top surface of the cement grout charge may be at a depth of 50 feet or more down the casing, before the insertion of the second plug, thereby trapping a large quantity of air. This trapped air passing up and into the cement grout may be wholly or partly retained therein, whereby a porous cement set may be obtained and in some cases the desired water-tight bond between the casing and the drill hole is not obtained, requiring another cementation.

Now, we have discovered that these difficulties may be overcome by the employment of a new and novel device comprising an air-tight cementing head which may be attached to the casing and the operation performed with the substantial exclusion of air. Inside of the cementing head, a special plug or barrier provided with two leather or fabric cupped gaskets, is suspended by a controlling rod above two inlet pipes provided with suitable valves, by means of which controlled amounts of rotary mud, water and cement grout may be separately introduced as required. The inside wall of the cementing head contains grooved channels extending the full length so that the air pressure will be equalized until the plug has been lowered to a point below the inlet pipes.

Arrangements are made so that when the calculated quantity of cement grout has been introduced into the casing, the plug or barrier may be disconnected and quickly lowered by first withdrawing a cotter pin and then imposing a manual downward pressure on the handle of the control rod, after which the plug is forced to the bottom of the casing by hydraulic pressure.

With the foregoing preliminary explanation, the preferred embodiment of our inven-

tion will now be more fully explained by reference to the accompanying drawing.

Figure 1 shows a sectional elevation of the complete assembled cementing head and plug in place before the cementing operation.

Figure 2 is a sectional view taken on the line "A—A" of Figure 1 looking in the direction of the arrows.

Figure 3 is a sectional view taken on the line "B—B" of Figure 1 looking in the direction of the arrows.

In the drawing, 1 represents an annular tube of steel having threaded ends, one end being connected to a coupling 2 at the bottom and the other end to a casing head cap 9. The coupling 2 is screwed into well casing 33. The cementing head 1 is provided with two inlet pipes 3 and 5 controlled by valves 4 and 6. 12 represents the plug or barrier in the top of the cementing head 1 attached to controlling rod 21. The controlling rod 21 is provided with two openings, 22 and 23, through which a cotter pin 24 may be inserted to hold the controlling rod in place. A casing head cap 9 is attached to the cementing head 1 by means of a screw joint. A pipe 7 controlled by the valve 8 is connected to the casing head cap 9. The controlling rod 21 passes through a stuffing box 10 and is connected to the plug 12 by a coupling 11. The barrier or plug 12 is provided with two leather cupped gaskets 14 and 14′ so that an air tight connection may be had between the plug and casing wall when the plug is below the inlet pipes 3 and 5. The top leather cupped gasket is held in place by means of a plate or disc 18 and a lock nut 19. A rod 17 provided with a lock nut 19′ and a washer 18′ holds the leather cupped gasket 14′ and the lower section of the plug 15, in place. 16 represents a grooved or furrowed passageway for the air to pass when the plug is being lowered, so as to maintain the same pressure above and below the plug since a reduced pressure is produced by the column of cement receding down the casing, to a depth of 50 feet or more.

Figure 2 which, as described above, is a section on the line "A" "A" of Figure 1, shows the grooved channels 16 on the inside walls of the cementing head.

Figure 3 which, as described above, is a section on line "B" "B" of Figure 1 through the lower part of stuffing box 10, shows the control rod 21 connected to the plug 12 with the square fittings 10′ and 11 to prevent the plug 12 from turning when it is disconnected.

The operation of the apparatus just described is as follows:

In the drilling of oil or gas wells, as soon as the drill hole approaches a productive zone, the water formations are definitely located by core drilling, after which the casing is lowered to within a few feet of the bottom of the drill hole, and the quantity of cement grout calculated to fill the space between the casing and the drill hole to the desired height. The drill hole is usually full of rotary mud employed in the drilling operation and the end of the casing is provided with a casing shoe and a float or check valve, so as to prevent any fluid from entering the casing through the bottom, thereby acting as a seal after the introduction of the cement grout. Water or mud is introduced into the casing at the top while the casing is being lowered into the drill hole, in quantities sufficient to cause the casing to sink into the mud at the desired rate of speed. After the casing has been lowered to within a few feet of the bottom of the drill hole, the cementing head 1 is connected to the top of the casing 33 by the collar 2. The plug or barrier 12 suspended by the control rod 21 is placed in position in the cementing head, this position being maintained by the cotter pin 24. Rotary mud, which is employed for the drilling operation, is then introduced into the casing through pipe 5 controlled by the valve 6, the pipe 5 leading to a pump and a source of mud not shown. The casing 33 is filled with mud and a circulation of the mud maintained through the casing and out through the space between the casing and the drill hole to a storage, for a period of time sufficient to clear the space between the drill hole and the casing. When the specific gravity of the mud leaving the space between the casing and the drill hole is substantially the same as the specific gravity of the mud within the casing, the mud circulation is discontinued, and a rapid flow of water is introduced through the same pipe 5 controlled by the same valve 6, the pipe 5 leading to a pump and water supply not shown, which may be the same pump employed in the circulation of the mud as heretofore described.

As soon as a sufficient supply of water has been introduced into the casing 33 to wash the mud off the walls of the casing and serve as a barrier between the mud and the cement grout, the introduction of water is discontinued and valve 6 is closed. Immediately thereafter, valve 4 is opened and a pumpable water mixture of Portland cement, which we term "cement grout," is introduced into casing 33, passing through the pipe 3 which leads to a pump and source of supply not shown. A rapid flow of cement grout into casing 33 is maintained until the calculated quantity has been introduced. Immediately following the introduction of the cement grout, the valve 4 is closed and plug 12 is disconnected and lowered to a point below the inlet pipes 3 and 5. The plug 12 is lowered by withdrawing the cotter pin 24, employing a manual pressure to the top of the control rod 21, after which valve 6 is opened and mud is introduced through the pipe 5 in sufficient quantities and under sufficient pressure to force the plug 12 by hydrostatic pressure to the bottom of the casing

33, the cement grout charge passing through a float or check valve and thence upward around the casing to the required height. After the plug 12 has reached the bottom of the casing 33, which is noted by a sudden increase in pressure on the charging line 5, valve 6 is closed and the hydrostatic pressure of the mud column is maintained on the plug until the cement grout has set and hardened to the required degree, after which a water test is made and drilling operations continued by methods known in the art.

While the apparatus herein described is well adapted for carrying out the object of the present invention, it is to be understood that various modifications and changes may be made without departing from the spirit of the invention, and the invention includes all such changes and modifications as come within the scope of the appended claims.

What we claim is:

1. A well cementing apparatus, comprising, a capped metal casing head with grooved passageways extending longitudinally along the inside wall of the casing head, means for attaching the casing head to a well casing, a mechanically controlled slidable plug in said casing head and controlled inlet means into the casing head.

2. A well cementing apparatus, comprising, a metal casing with grooved passageways extending longitudinally along the inside wall of the casing, a metal cap closing one end of the casing, means for attaching the casing head to a well casing, a mechanically controlled slidable plug suspended within said casing by a controlling rod with means for disconnecting the controlling rod from the plug, said controlling rod passing through a stuffing box in the metal cap, and controlled inlet means into the casing head.

3. A well cementing apparatus, comprising, a capped length of casing with grooved passageways extending longitudinally along the inside wall of the casing, a mechanically controlled slidable plug with gasket means between the wall of the casing and the plug, a controlling rod attached to said plug with means for disconnecting and adjusting the plug at desired levels, means for disconnecting the controlling rod from the plug, and controlled inlet means into the casing head.

4. A well cementing apparatus, comprising, a capped casing head, means for attaching the casing head to a well casing, a slidable plug in said casing head above valved inlets for mud, water and cement grout, vertical grooves inside the casing head for equalizing fluid pressures above and below the plug, and mechanical means for disconnecting and controllably lowering the plug to a predetermined distance below the valved inlets.

5. A well cementing apparatus, comprising, a capped metal casing head, means for attaching the casing head to a well casing, a plug in said head above valved inlets for admitting mud, water and cement grout into the casing head, said plug having upper and lower cupped gaskets, vertical grooves inside the casing head for equalizing fluid pressure above and below the plug, and means for disconnecting and controllably lowering the plug into the well casing by a manually operated rod passing through a stuffing box in the cap, said rod being adapted to disengage a screw connection on top of the plug.

In testimony whereof we affix our signatures.

HORTON H. DIEVENDORFF.
SIDNEY O. BARTON.