

Aug. 1, 1939.

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2,167,778

CEMENTING PLUG

Filed April 6, 1938

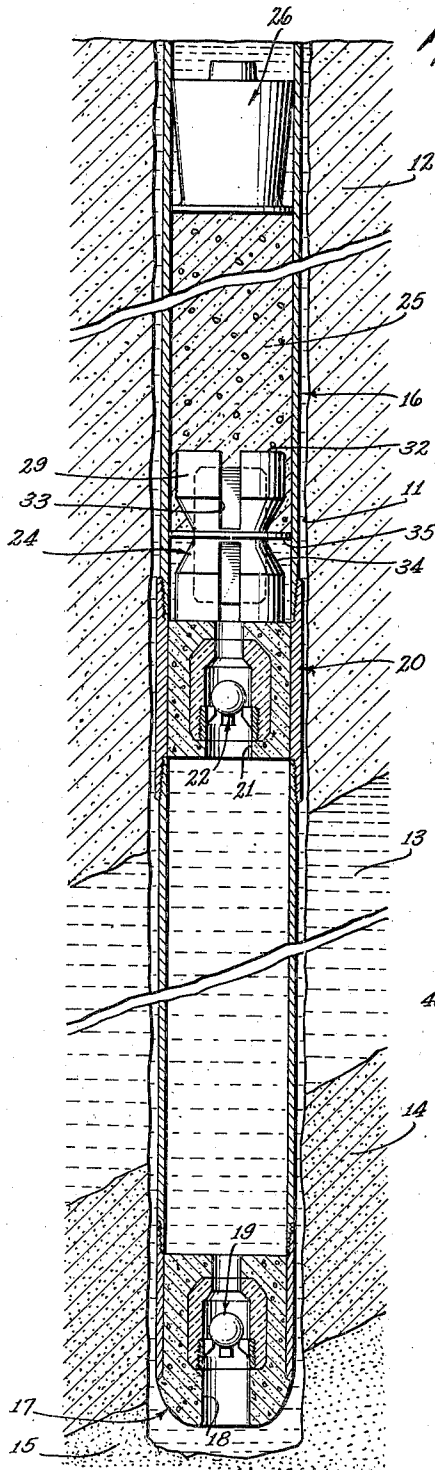


Fig. 1.

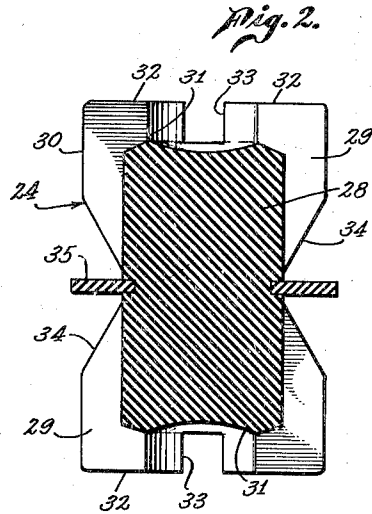


Fig. 2.

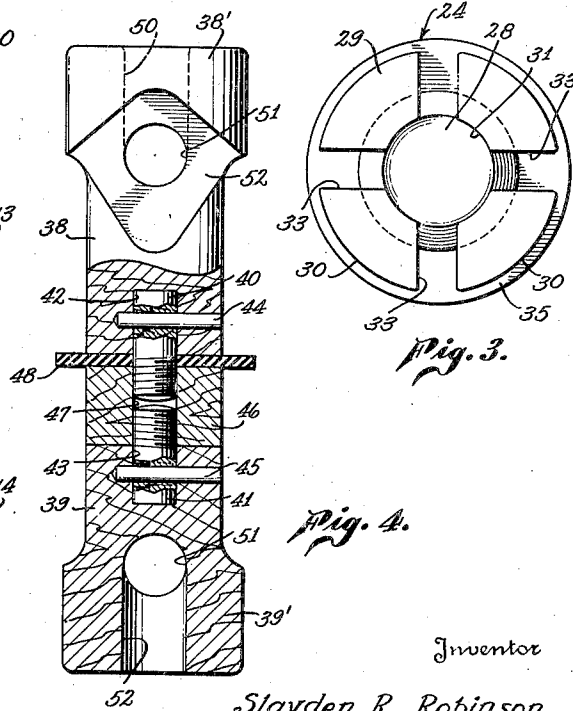


Fig. 3.

Fig. 4.

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UNITED STATES PATENT OFFICE

2,167,778

CEMENTING PLUG

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Application April 6, 1938, Serial No. 200,400

2 Claims. (Cl. 166—1)

This invention relates generally to oil well cementing operations and particularly to plugs used in such operations.

In the drilling of oil wells water sands are often encountered above the oil sands, the two sands usually being separated by a relatively impervious strata of rock or shale which prevents the water from entering the oil sands. The water, between its confining strata, may be under considerable pressure so that as the drilling of an oil well progresses and the drilling tools perforate the confining strata above and below the water bearing sands the water flows into the well. If drilling is continued into the oil sands without shutting off the water the water will follow the bore hole into the oil sands and the water and oil will become mixed together. It is therefore necessary to seal off the water by some means.

The ordinary method of sealing off the water is to set casing at a point below the water sands, cementing the casing to the formation. This is accomplished by withdrawing the drill string from the hole and lowering the casing into the hole. Ordinarily before the casing is lowered into the hole a float shoe having a check valve therein which allows downward passage of fluid therethrough, is mounted on the lower end of the casing. Vertically spaced above the float shoe a suitable distance is mounted a float collar which is also provided with a similar check valve. The casing is lowered into the well until it rests on the bottom of the hole, after which it is raised a short distance so that the bottom of the casing will be spaced above the bottom of the hole. Circulation is then established by pumping fluid down the casing, the fluid emerging at the bottom of the casing and flowing up the hole on the outside of the casing.

After the circulation has been established, a cementing plug, known as a bottom plug, is placed in the casing at the top. This plug is adapted to yieldingly engage the sides of the casing. The desired amount of cement slurry, according to the requirements of the particular job being performed, is then pumped into the casing on top of this bottom plug. After this operation a top plug is placed in the casing and fluid is forced into the casing on top of the top plug forcing both cementing plugs and the cement confined between them downwardly to the bottom of the casing until the bottom plug strikes against the upper face of the float collar.

Continued pumping of fluid into the top of the casing forces the cement around the bottom plug and through the float collar and float shoe into

the formation around the lower end of the casing. As pumping continues, the top plug strikes the lower plug and as the top plug is not designed to permit passage of fluid, the pressure in the casing immediately increases, indicating that the cement has been forced from between the plugs.

Following this operation the cement is allowed to set. After the cement has set drilling may again proceed, the cement in the casing, the plugs, and the float collar and float shoe being drilled out.

The ordinary bottom plug used in cementing operations comprises a member having an enlarged head substantially the size of the internal diameter of the casing and through which passages are formed for the flow or by-passing of cement therethrough. The top of the bottom plug is provided with a flexible member or wiper for engaging the inside of the casing. It is essential to a successful cementing operation that this plug be dropped into the casing with the top end uppermost. If it is placed in the casing upside down the flexible casing engaging member will seat on the float shoe and effect a sealing or plugging of the passage through that member. It frequently happens that through the carelessness of a workman the bottom plug is placed in the casing upside down with the result that the passage in the float collar is blocked and the cement is retained in the casing above the bottom plug. It then becomes necessary to drill this column of cement out, pull the casing, insert a new float collar and shoe, lower the casing and perform the cementing operation again.

It is also true that whenever a cementing operation goes wrong or is unsuccessful the excuse is made that the bottom plug was put in upside down, and as this is a point about which no one can be certain after the plug has reached the bottom of the hole, the operators are often misled as to the real cause of failure of the cementing operation.

It therefore is a primary object of this invention to provide a bottom plug for use in oil well cementing operations which is fool proof and which will function properly no matter which end of the plug is placed uppermost. In this connection it is an object of this invention to provide a plug which primarily consists of a member having a flexible casing engaging member, termed a wiper, intermediate its length, both ends of the plug having passages therein or therethrough so that no matter how the plug is inserted in the casing circulation may be maintained through the casing

past the plug when the plug rests upon the float collar.

These and other objects will be apparent from the drawing and the following description thereof. Referring to the drawing, which is for illustrative purposes only,

Fig. 1 is a fragmentary sectional elevation of a bore hole showing the cementing plug of this invention in operative relation with the casing and other elements used in a cementing operation.

Fig. 2 is an enlarged sectional elevation of the plug shown in Fig. 1.

Fig. 3 is a top plan view of the plug of Fig. 2.

Fig. 4 is an elevation, partly in section, of another form of plug.

More particularly describing the invention, reference numeral 11 generally indicates the lower portion of a bore hole which is shown traversing a stratum 12, a stratum 13 of water filled sand formation, a relatively impervious stratum 14, and partially penetrating an oil sand stratum 15.

A casing, generally indicated by reference numeral 16 is shown in the bore hole and partially raised off the bottom of the hole. The lower end of the casing is provided with a float shoe 17 which has a passageway 18 therethrough controlled by a check valve 19 which is adapted to permit downward passage of fluid through the passageway 18 but to prevent upward passage of fluid therethrough. Spaced above the float shoe is a float collar 20 which is also provided with a passageway therethrough indicated by reference numeral 21 which is controlled by a check valve 22 similar in all respects to the check valve 19 above described.

The float collar and float shoe are ordinarily constructed of a readily drillable material except for the portion which forms a continuation of the casing wall. Thus, the valve seat and cage are often of Bakelite set in a body of cement.

Shown above the float collar 20 and resting on the upper end thereof is the bottom cement plug of this invention, generally indicated by reference numeral 24. Above this plug is a body of cement slurry 25 which has been placed in the casing on top of the plug. On top of this cement slurry is the top cementing plug 26 which separates the cement slurry from the fluid pumped into the well and prevents mixing of those two liquids.

The casing 16 has been shown raised off the bottom of the hole in a position where circulation may be established downwardly through the interior of the casing outwardly through the float shoe 17 and upwardly exteriorly of the casing. In the cementing operation, after circulation has been established the plug 24 is placed in the top of the casing and cement slurry 25 pumped in on top of it until the desired amount has been placed in the casing. The plug 26 is then placed on top of the slurry and liquid is pumped on top of plug 26, forcing the two plugs downwardly in spaced relation with the body of cement slurry 25 confined between them. The drawing (Fig. 1) illustrates the position of the plugs at the time the bottom plug comes to rest upon the float collar. Subsequent pumping of liquid into the top of the casing forces the top plug 26 closer to the bottom plug 24 and cement slurry 25 escapes past the plug 24 (deflecting the flexible wiper thereon) and through the passages therein through the float collar 20 and downwardly and out of the casing through float shoe 17 after which it may fill the bottom of the hole and flow

upwardly in the hole surrounding the casing and to some extent enter the formation.

Referring to Figures 2 and 3 for details in the construction of the bottom cementing plug of this invention, the plug essentially comprises a member having enlarged fluted end portions and an annular flexible wiper encircling a reduced middle portion and extending beyond the outer diameter of the other portions of the plug.

More particularly the plug comprises a cylindrical central body portion 28 upon which is formed on each end segmental end portions 29 having curved outer surfaces 30, which together form an interrupted cylindrical surface. These segmental end portions extend beyond the end of the portion 28 and form a cup-like recess 31 at each end of the plug. The end surfaces 32 of the portions 29 are flat.

Separating the segmental portions 29 at each end of the plug are four radially disposed passageways, grooves, or flutes 33 which act as fluid passageways for the purpose of permitting fluid to by-pass the ends of the plug.

The inner ends of the segmental end portions 29 are inwardly tapered at 34 to provide a reduced middle portion on the plug. Surrounding the middle of the plug is an annular flexible casing engaging member 35 which will be termed a wiper. The entire plug of Figures 1 to 3 is preferably made of rubber, although other suitable substances may be employed.

The plug has been shown as comprising a body portion upon which is mounted a flexible wiper. The wiper may either be formed of a material flexible enough to permit mounting of it by expanding it over the ends of the plug or it may be split and vulcanized into place. It is also possible to form the plug and wiper in one piece. It is further contemplated to be within the scope of this invention to form the body of the plug in two pieces adapted to be threaded together after the wiper is placed between them.

When in use the plug may be inserted in the casing with either end uppermost and it will serve to retain the cement slurry 25 above it as the cement is placed in the casing and forced downwardly therein as previously described. When the plug comes to rest on the top of the float collar further pressure upon the column of material in the casing above the plug causes the cement slurry to by-pass the plug 24. In by-passing the plug the cement passes through the grooves 33, deflects the member 35 and passes between that member and the casing and downwardly through the grooves 33 in the lower end of the plug into the cup portion 31 from which it escapes into and through float collar 20.

It should be readily apparent that with this construction the plug may be inserted in the casing with either end uppermost and will function equally well in either position.

Although the plug has been shown and described as having radially disposed grooves at each end to form the fluid passages, it is contemplated to be within the scope of this invention to provide some other form of passageway through the enlarged end portions of the plug. In this connection a central bore at each end of the plug terminating in one or more outlets in the region of the reduced portion of the plug might be used, as described in connection with the other form of the invention shown in Fig. 4.

In Fig. 4 there is shown a plug constructed of wood except for the wiper portion. This plug comprises an end member 38 and an end mem-

ber 39. Each of these members is provided with a threaded dowel indicated by reference numerals 40 and 41 positioned in recesses 42 and 43 of the respective members 38 and 39. The dowels are secured in place by means of pins 44 and 45 respectively.

In this form of the invention it is contemplated that the members 38 and 39 be made of a relatively soft wood such as redwood and therefore the dowel members 40 and 41 are made of a harder wood, as it is difficult to properly thread redwood. An intermediate member 46 is provided of relatively hard wood which has a central threaded bore 47 adapted to receive the dowels 40 and 41 to secure the parts together. Interposed between the members 38 and 46 is the annular flexible member or wiper 48, which may be formed of rubber.

Each of the members 38 and 39 are provided with enlarged end portions 38' and 39' respectively. These end portions have a central passageway 50 therethrough which terminates in a pair of lateral openings 51 which have their outer end portions on a concave surface 52.

The operation of this plug is the same as the other form of plug. When the plug comes to rest on the float collar the concrete slurry bypasses the plug through the passages 50, 51 at the ends of the plug and passes between the casing and the reduced middle portion of the plug past the flexible wiper 48 which is deflected by the pressure of the fluid.

Although the plug has been shown as comprising three main members, it is within the scope

of this invention to form the body portion of the plug in two members instead of three, and thread one of these members into the other, such construction necessitating the use of a harder wood. It is also contemplated that some material other than wood might be utilized in the construction of the plug.

I claim as my invention:

1. A cementing plug of the type described comprising two end members, said end members each having an enlarged outer end portion and having a passageway therethrough establishing communication to both sides of the enlarged portion, an intermediate member between said end members, means for detachably securing said members together, and an annular flexible wiper mounted between one of said end members and said intermediate member.

2. A cementing plug of the type described comprising two end members of relatively soft wood, said end members each having an enlarged outer end portion and having a passageway therethrough establishing communication to both sides of the enlarged portion, an intermediate member of relatively hard wood between said end members, said intermediate member being provided with a threaded bore, a threaded dowel of relatively hard wood secured in the inner end of each of said end members and threaded into the threaded bore of said intermediate member, and an annular flexible wiper mounted between one of said end members and said intermediate member.

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