UNITED STATES PATENT OFFICE

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WELL CEMENTING PLUG

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This invention relates to well cementing plugs. Such plugs are employed in the operation of cementing off water from a well. Briefly stated, to accomplish the cementing off, a plug is inserted in the upper end of the casing, cement is then pumped in on top of the plug, which is termed the lower plug, and this forces the lower plug downwardly in the casing. When the predetermined quantity of neat cement has been pumped into the casing above the lower plug, another plug, or plugs, termed upper plug, is then inserted in the casing on top of the cement. This upper plug is of such construction as to seal the cement from the mud which is pumped in on top of the plug.

The mud is pumped onto the upper plug until it has forced the lower plug into contact with a baffle plate which is inserted between two casing sections near the lower end of the well hole.

As soon as this occurs, gradually all of the cement is forced past the lower plug because of the continued pumping of the mud on top of the upper plug. The cement that passes the lower plug passes through the baffle plate and discharges out of the lower end of the casing and flows into the cavity around the casing, thus shutting off water that formerly ran into the casing from said cavity. The mud is continued to be pumped until the upper plug seats against the lower plug, whereupon the sudden rise in pressure of the mud is disclosed on a pressure gauge to the driller who then stops the pump. When it is desired to drill the well deeper, after the cement has set, the cement that remains in the lower end of the casing below the baffle plate, the baffle plate, and the upper and lower plugs are drilled through and the drilling is then continued into the stratum below the level of the casing and a smaller string of casing is inserted inside of the larger string so as to case that portion of the hole below the larger string.

It will be readily understood from the foregoing description that it is of the utmost importance that the lower plug yield under sufficient pressure to permit the cement to pass by it and that it is of as great importance that the upper plug perfectly seal the casing against the flow of mud past the top plug into the cement below said top plug.

If the mud passed the upper plug and mixed with the cement the cementing operation would be ruined.

An object of the present invention is the production of superior plugs for use as above described. Heretofore the lower plugs have been constructed of wood with a rubber collar secured thereto. These old lower plugs are very unreliable since the relatively high pressures that it is necessary to employ often produce splitting of the wood at the collar. Heretofore the upper plugs have been constructed of cement and rubber and because of the cement and rubber being so unlike in composition the rubber portion is sometimes torn from the cement, thus making it impossible for the upper plug to properly function, as explained above.

Other objects and advantages will appear in the subjoined detailed description.

The accompanying drawings illustrate the invention.

Fig. 1 is a longitudinal section of a string of casing with plugs therein constructed in accordance with the provisions of this invention, cement being shown between the lower plug and the upper plugs.

Fig. 2 is a bottom end view of the lower plug.

Fig. 3 is a vertical section on the line indicated by 3—3, Fig. 2.

Fig. 4 is a plan view of one of the upper plugs.

Fig. 5 is a vertical section on the line indicated by 5—5, Fig. 4, a fragment of a duplicate upper plug being also shown.

Fig. 6 is a reduced view, partly in section, of a modified form of lower plug.

Referring to the drawings, a lower plug is indicated at 8 and upper plugs are indicated at 9, it being understood that sometimes but one upper plug will be employed.

However, the upper plugs 9 are of identical construction and, accordingly, a detailed construction hereinafter of one of them will suffice for both. Neat cement 10 is shown between the upper and lower plugs. The plugs...
and cement are shown in the positions they would occupy in the casing 11 when the lower plug seats against the baffle plate 12 and before the pumping pressure of the mud is increased sufficiently to force the cement past the lower plug.

Now referring more particularly to Figs. 2 and 3, illustrating the lower plug, said plug is constructed as follows: There is a cylindrical body 13 of flexible fibrous material of compounded rubber substance. This body 13 has a portion 14 of larger diameter, a portion 15 of reduced diameter, and an upper end portion 16 of still smaller diameter. The portions 15, 16 define between them a shoulder 17 against which seats a collar 18 of pliable tenacious wear resisting rubber substance such as may be produced in the compounding of rubber with other ingredients. The body 13 and collar 18 are vulcanized together in the manner well understood in the art relating to the manufacture of rubber.

Extending transversely in the lower end of the body portion 14 is a slot 19 and communicating with said slot are grooves 20 formed in the opposite sides of the body portion 14 and extending to the upper end of said portion 14.

The collar 18 will be sufficiently stiff to withstand the relatively slight pressure that is employed when forcing the cement and plugs downwardly in the casing until the lower plug seats upon the baffle plate 12, but said collar is sufficiently pliable to yield after the lower plug seats against the baffle plate and the pressure of the mud is increased, thus permitting the outer margins of the collar 18 to bend downwardly so that the cement can pass by said collar.

In the modified form of the lower plug, illustrated in Fig. 6, the parts that functionally correspond with those above described are indicated by the same reference characters with the suffix “a.”

In this instance, there is an axial bore 20a which communicates with a transversely extending bore 19a to permit the cement, after passing the collar 18a, to pass by the larger diametral portion 14a of the plug. The construction illustrated in Figs. 2 and 3 is preferred for the reason that the stiffness of the body 13 is not affected so much by the slot 19 and grooves 20 as it would be by the bores 19a, 20a. Furthermore, the construction illustrated in Figs. 2 and 3 provides for greater volume of flow of the cement.

Now referring more particularly to Figs. 4 and 5, the upper plug is constructed as follows: There is provided a body 21 of fibrous, flexible rubber substance. The body 21 has a tapered lower portion 22 and an approximately cylindrical upper portion 23 and vulcanized to said body is a cup 24 of a pliable tenacious substance such as may be produced in the compounding of rubber with other ingredients. Preferably the portion 23 projects somewhat above the level of the rim 25 of the cup 24 so that when two upper plugs are employed, the uppermost one will seat upon the rigid portion 23 and thus be prevented from interfering with the proper functioning of the pliable portion 24, said function being to be expanded by the pressure of the mud into such close engagement with the inner wall of the casing as to prevent passage by the cup of the mud. The portion 22 is tapered as is also the outer face of the cup 24 and said outer face is flush with the portion 22, as is clearly seen in Fig. 5.

At its lower end the body 21 is provided with a reduced portion 26 which with the portion 22 defines a shoulder 27 against which seats a collar 28 that is constructed of the same material as the cup 24. The collar 28 and body 21 are vulcanized together. The lower end of the body 21 is flush with the lower face of the collar 28 so that, when the upper plug has been forced down into engagement with the lower plug, the collar 28 will seat on the collar 18 and thus be reinforced so as to produce an additional seal against the passage of mud past the upper plug. The rim portion of the collar 18, as stated above, will be depressed by the cement as said cement passes by it and, if some mud should be forced past the cup 24, the collar 28 thus reinforced by the collar 18 would prevent the passage of mud thereby. Prior known upper plugs were constructed so that the body extended below the level of the under face of the collar, and prior known lower plugs were constructed with the upper end of the body extending above the level of the upper face of the collar and, accordingly, when the upper plug seated upon the lower plug, the collar 18 was spaced from the collar 28 and could not reinforce it as is accomplished by the above described construction of the plugs.

From the foregoing it will be readily understood that the bodies 13, 21 are of a substance of sufficient firmness to hold them against collapsing under the pressure of the drilling fluid, that the collar 18 is of a substance sufficiently pliable to permit it to flex under pressure so that the cement will pass by it, and that the cup 24 is of a substance sufficiently pliable to permit it to yield and expand into close contact with the inner face of the casing in order that no drilling fluid can pass the periphery of said cup. The body 13 is of sufficient stiffness to hold the collar 18 in its proper form and the body 21 is of sufficient stiffness to hold the cup 24 and collar 28 in their proper forms.

It will be noted that the junction of the portions 22, 23 defines an annular shoulder 29 on which the cup 24 seats and to which the cup is vulcanized, thus providing a strong
attachment between the body and the cup. The collar 28 is of larger outside diameter than the portion 22 and thus said portion 22 will not engage the casing but only the cup and collar will so engage.

The foregoing will clearly the construction and operation of the invention and, briefly stated, the operation is as follows:

The plug 8 will be inserted in the upper end of the well casing 11. Then next cement will be pumped into the casing on top of the plug 13. This causes the plug 13 to descend.

After the requisite amount of cement has been pumped (the amount varies according to conditions), the upper plug or plugs 8 will be inserted in the upper end of the casing above the cement and then the drilling fluid, or mud as it is termed, is pumped into the casing on the portion of the plug 9 thus forcing both plugs, with the cement between them, downward until the plug 8 is stopped by the baffle plate 12. The pumping of the mud is continued at an increased pressure, thus causing the cement to bend down the flange 18 and pass the plug 8. The cement is forced out of the lower end of the casing and into the cavity around said casing until the plug 9 engages the plug 8 and the pumps are then shut down. At this time, the flange 28 rests upon the flange 18 and, accordingly, said flange 28 seals the casing against the leakage thereby of any mud. This is a safety precaution as the pressure of the mud within the cup 24 expands said cup forcibly against the inner face of the casing and this ordinarily effectively seals the casing against the passage of mud. Heretofore, trouble has been experienced at times in using the old types of plugs having wooden or cement bodies because of the extreme physical difference between the material of the bodies and that of the collars and cups, the bodies being extremely rigid while the collars and cups yielded, thus often entailing the tearing away of the collars and cups from the bodies, with a consequent penetration of the cement by the mud, resulting in a defective cementing job and consequent monetary loss in the drilling of wells.

I claim:

1. A well cementing plug comprising a body of flexible fibrous material of sufficient stiffness to hold it against collapsing when under pressure of the drilling fluid, said body provided with an approximately cylindrical upper portion and a tapered lower portion, the junction of the upper and lower portions defining an annular shoulder, a cup surrounding said upper portion and seated on said shoulder and vulcanized to said body, said cup being formed of flexible tenacious rubber substance and being externally tapered and flush with the tapered lower portion, and a collar secured to said lower portion.

2. In combination, for use in a well casing, upper and lower cementing plugs for retaining a mass of cement therebetween while being forced down a well casing, said upper plug having a sealing member adjacent its top adapted to be forced against the casing by hydraulic pressure thereabove and having a lower flexible sealing ring adjacent the bottom thereof, a flexible sealing ring in said lower plug adjacent the top thereof that is capable of yielding downwardly at its outer circumference in response to predetermined hydraulic pressure thereabove to permit escape of fluid material contained between the plugs, said upper and lower plugs being so shaped that when in the cementing operation they are forced together the sealing ring on the lower plug contacts with and supports and reinforces the lower sealing ring on the upper plug thereby more effectively sealing against leakage of hydraulic fluid past the upper plug.

3. In combination, for use in a well casing, upper and lower cementing plugs for retaining a mass of cement therebetween while being forced down a well casing, said upper plug having a sealing member adjacent its top adapted to be forced against the casing by hydraulic pressure thereabove and having a lower flexible sealing disc flush with the bottom thereof, a flexible sealing disc on said lower plug flush with the top thereof that is capable of yielding downwardly at its outer circumference in response to predetermined hydraulic pressure thereabove to permit escape of fluid material contained between the plugs, said upper and lower plugs being so shaped that when in the cementing operation they are forced together the sealing disc on the lower plug contacts with and supports and reinforces the lower sealing disc on the upper plug thereby more effectively sealing against leakage of hydraulic fluid past the upper plug.

Signed at Los Angeles, California, this 15th day of April, 1929.

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