April 28, 1931. Z. A. DYER 1,803,057

PLUG FOR USE IN THE PROCESS OF CEMENTING OIL WELLS

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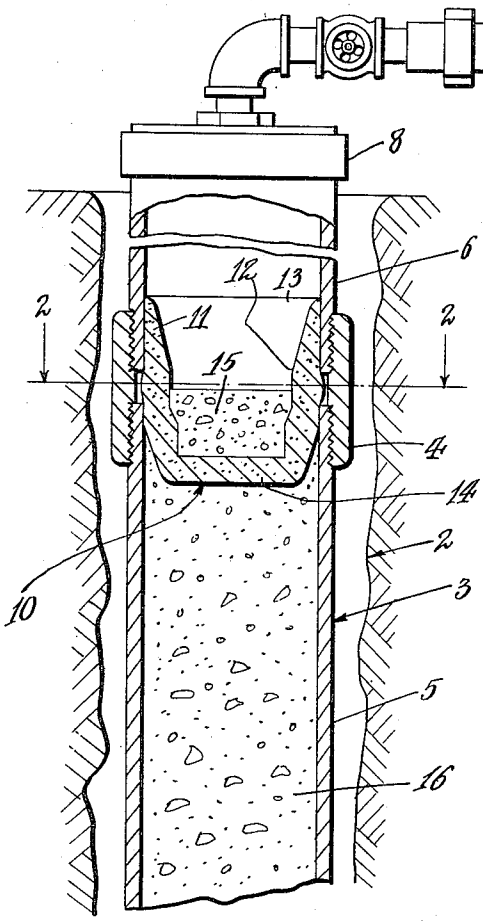
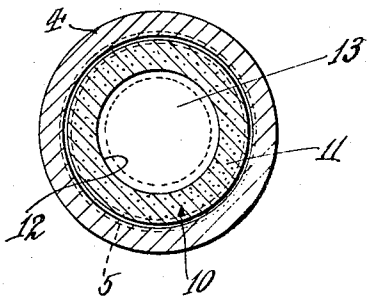


Fig. 1.

Fig. 2.



Inventor

Zeb Allen Dyer

By Lyon & Lyon

Attorneys

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UNITED STATES PATENT OFFICE

ZEB ALLEN DYER, OF WHITTIER, CALIFORNIA

PLUG FOR USE IN THE PROCESS OF CEMENTING OIL WELLS

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This invention relates to a plug for use in following fluid cement down a well casing and separating fluid cement from the hydraulic fluid which is employed for forcing the cement into place.

In the cementing of oil wells, when it is necessary to deposit cement back of a well casing to shut off the formations above and at the bottom of the well casing from the well bore below the well casing, it is the practice to introduce fluid cement, before the same has come to set, into the well casing and then force the cement by hydraulic fluid, such as water or fluid mud, down through the well casing, whereupon discharging below the well casing, it is forced upwardly around the exterior of the well casing.

It is the usual process to introduce a plug into the well before the cement is inserted to keep the cement from being admixed with the fluids in the well and after the cement has been placed in the well casing, to put upon the top of the cement, a plug for separating the cement from the water or hydraulic mud which is used to force this cement into place. One important function of the top plug used in the cementing process is to stop the downward travel of the fluids when this plug reaches the bottom or near the bottom of the well hole and then to offer a seal against further downward passage of circulating fluid. In this way, the operator at the top of the well, by the pressure that is built up against the circulating means, recognizes that the cement has been lodged in position.

It has been the current practice prior to the present invention, to use for this top plug, a plug made mainly of wood with small rubber sealing cups surrounding the same. The difficulties with these plugs are that the well casing which is being cemented has not an entirely smooth internal surface, but at various places, there are projections from the well casing or enlargements of the well casing bore, and if the plug should happen to be arrested at one of these positions, a fluid-tight seal is not made and the plug does not properly perform its function, and further, with the plugs which have been generally used prior to the present invention, after the cementing operation, it was necessary to drill out the plugs and cement from the bottom of the well hole when further drilling was to be performed. The wooden cementing plugs deposit fiber in the well hole which works back into the valves of the circulating pumps and holds these valves open.

It is the primary object of the present invention to provide a well cementing plug which consists in the main part of a substantially cylindrical outer walling of sufficient length to bridge any irregularities that may exist in a well hole and to form this cylindrical walling of a material sufficiently flexible that it may form a fluid-tight seal around any such well casing irregularity, and to provide such a well cementing plug with a substantially hollow interior for the entrance of the fluid being pumped, so that the sealing walling is held tightly against the well casing walls by the hydraulic pressure of the fluids being pumped. By the plug of the present invention danger of loss of the seal by stopping the plug at an irregularity in the casing is avoided, and at the same time, the sealing means of the plug does not need to be supported or mounted upon a body of material, such as wood, which does not properly grind up when it is desired to remove the plug from the well hole.

Various further objects and advantages of the present invention will be apparent from a description of a preferred form of well plug embodying the invention. For this purpose, there is hereafter described one form or forms of a well plug embodying the present invention, description being given in reference to the accompanying drawings, in which—

Figure 1 is an elevation in vertical section through a well hole showing the plug of the present invention in operative position, and

Figure 2 is an enlarged fragmentary section of the well plug.

Referring to the drawings, 2 generally indicates a well hole in which there is disposed a well casing 3 of the conventional type. At the bottom of the well casing 3, there may be employed any suitable means for arresting a plug, such as a guide shoe (not shown).

The well casing 3 at times consists of a riveted casing and therefore its inner surface is made irregular by the rivet heads or other couplings or the well casing 3 may be of the coupled type, as shown having the couplings 4 connecting adjoining sections 5 and 6 of pipe proper. In such a case, the ends of the sections 5 and 6 of the well casing pipe do not come together and so there are formed between the ends of this pipe and the couplings 4 connecting them together, annular grooves or enlargements of the well bore. It is essential that the plug employed for cementing through a well casing of this kind be provided with a sealing means which is effective to provide a seal over the irregularities thus described. The well casing also ordinarily includes, at its top, a head 8 connected with a pipe 9 by which fluid, such as liquid mud, may be introduced into the well casing after the cement for forcing the cement and plug downwardly through the well casing.

10 indicates generally the well cementing plug of the present invention which, in this instances, is illustrated as serving as the top plug of the usual cementing process. This plug 10 comprises, generally, speaking, an outer side walling 11, generally cylindrical in shape, although it may possess a slight downward taper, as indicated. This outer cylindrical walling 11 of the plug is made of sufficient height to insure that an adequate amount of sealing material will be present at both sides of any irregularity, such as that formed by the coupling 7 in the well casing. The cylindrical wall 11 of the cementing plug is formed of a flexible material adapted to be pressed against the well casing 3 by hydraulic pressure applied to its inner surface, and the material found best suitable for this purpose is soft rubber. While other materials may be substituted for rubber, they should possess a flexible property and should be preferably free of fiber or sufficiently solidly composed of fiber, that all of the fiber will be adequately ground up when it is necessary to drill the plug from the well hole.

The plug 10 has a general hollow interior or bore 12 which is open to communicate with hydraulic fluid, such as indicated at 13, which is to be used to force the plug downwardly in the well casing 3.

The cylindrical or outer side walls 11 of the plug must be connected in a fluid-tight manner by suitable means and for this purpose, I would prefer to provide what may be termed a bottom rubber diaphragm 14, so that the entire plug may be molded out of the same material. It is generally preferable that this diaphragm 14 should be rounded at the bottom in order to prevent the fluid pressure above the plug from excessively distorting the same.

In certain cases, where the plug is to be employed for cementing a well hole of large diameter and under successive pressures, it may be desirable to include within the well plug 10, a means for stiffening the plug and for holding the wallings in expanded position. For this purpose, I prefer to introduce into the plug, or at the bottom thereof, a disc 15 of material readily drilled from the well. For this purpose I have found that a disc of previously hardened cement is most satisfactory.

By means of the cement plug herein described, the fluid cement which is indicated at 16, below the plug, is adequately sealed from the hydraulic fluid 13 used to force such cement and plug 10 down the well bore 2. The long cylindrical sealing walling 11 of the plug provides an adequate seal operative under all conditions, even those where the plug is stopped opposite an irregularity in the surface of the well casing.

While the particular form of the well plug herein described is well adapted to carry out the objects of this invention, it will be understood that various modifications may be made in the well plug all coming within the scope of the present invention and this invention includes all such modifications and changes as come within the scope of the appended claim.

I claim:—

A plug for following cement down a well casing under hydraulic pressure, said plug comprising an integral body of soft rubber having a substantially tubular outer walling of sufficient height to form a surrounding seal whenever the plug is stopped opposite an irregularity in the well casing, the plug also being provided with a cross-wall for forming a fluid barrier against the passage of fluid through the well casing by the plug, the hollow space within the tubular outer walling of the plug being adapted to receive hydraulic fluid for expanding the tubular walling and pressing the same against the well casing wall, and a disc of solidified cement within the tubular walls of the plug and resting upon said cross-wall.

Signed at Whittier, California, this 1st day of December, 1928.

ZEB ALLEN DYER.