

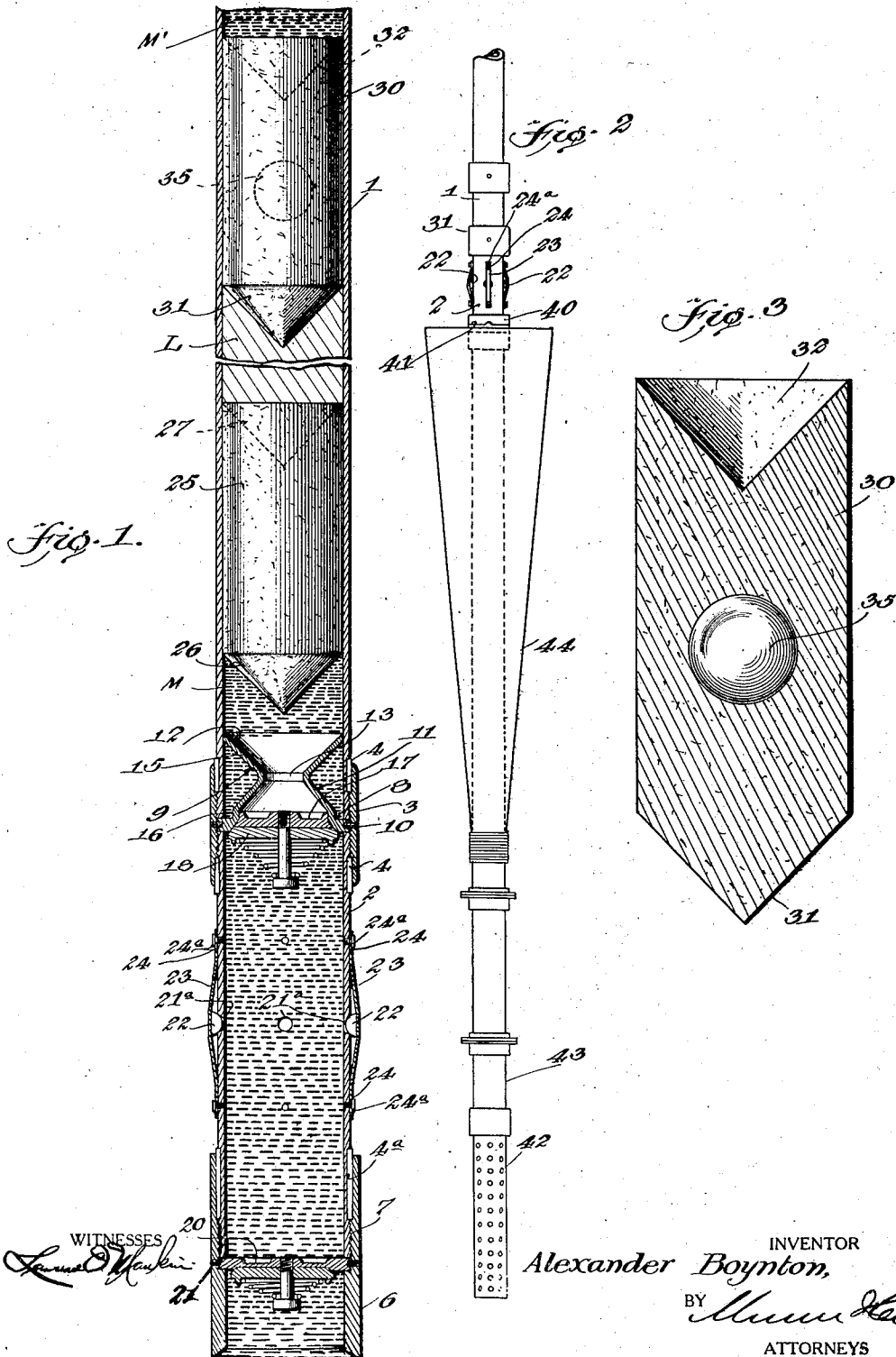
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A. BOYNTON

METHOD OF AND DEVICE FOR CEMENTING WELLS

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ALEXANDER BOYNTON, OF SAN ANTONIO, TEXAS.

METHOD OF AND DEVICE FOR CEMENTING WELLS.

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This invention relates to a method of and device for cementing wells.

The object of the invention is to provide a method and device of this character which separates the cement from the mud fluid during passage of the cement into the well casing, which prevents the adherence of the cement to the well casing as well as the admixture of the cement with the mud fluid; which affords an unmistakable signal to the operator when the cement has been expelled from the casing to the point of cementation and also prevents displacement of the cement beyond the point where it is desired to apply the same; which has all of these advantages without necessitating manipulation of the well casing and without liability of any of the parts of the device becoming stuck or jammed in the well casing.

In carrying out the present invention the well casing is provided with cement discharge means which may be located at any point therein. Adjacent, and preferably just above the cement discharge means, the casing is provided with a valve seat which may take any suitable form. A lower plug of soft pliable material adapted to snugly fit the casing and to be broken up when forced against the valve seat, is introduced into the casing above the mud fluid; that is, above the liquid employed to effect circulation. Liquid cement is introduced into the well casing above the lower plug and on top of the cement an upper plug of soft pliable material also adapted to snugly fit the casing and to be broken up when forced against the valve seat is introduced into the casing. In the upper plug a relatively small and hard incompressible valve and indicator member, which may be in the form of a ball, is imbedded and this valve and indicator member is adapted to co-act with the valve seat to close the bore of the well casing when the plug in which it is carried has been broken up. After the introduction of the upper plug into the well the well casing is capped and connected with the pump and mud fluid is forced down on top of the upper plug. The plugs may be constituted of any suitable soft and pliable material which is adapted to be broken up when forced against the valve seat under the pump pressure and preferably these plugs are constituted of silica gel, alumina gel or any other reasonably firm gelatinous substance which

is pliable though substantially inelastic. The advantage of the use of such plugs is that they provide effective packers and yet are sufficiently deformable to permit them to pass dents and imperfections in the casing. Moreover, these plugs will not swell and stick or jam in the casing although they isolate and separate the cement from the mud fluid. The lower plug sweeps and scrubs the wall of the well casing ahead of the cement so as to clean the wall of the mud fluid and also prevent the cement from being precipitated into the mud fluid. The top plug or the upper plug likewise serves as a casing sweeper and scrubber and not only serves to prevent admixture of the cement and mud fluid but also sweeps the cement off of the well casing and prevents the cement from setting thereon. When all of the cement has been discharged the top or upper plug will be forced under the great pump pressure against the valve seat and will be broken up. This will release or disassociate the ball of the upper plug and permit it to engage the seat to plug or close the bore of the well casing just above the point of cementation. The engagement of the ball valve member with the valve seat not only prevents displacement of the cement beyond the point of application but also causes the pump to stall, thereby indicating to the operator that the cementing operation has been completed. The combined indicator and valve member may be of any specific gravity.

While the plugs serve during their descent through the well casing all of the purposes of wooden plugs in so far as isolation of the cement and mud fluid is concerned they are free from the fatal objection of wooden plugs in that these gelatinous plugs are sufficiently yieldable and elastic to pass imperfections in the casing.

In order to enhance the packing action of the plugs their upper ends may be provided with a recess of such a character as to permit the fluid pressure to expand the same. The lower ends of the plugs are tapered or pointed to permit them to pass or guide themselves through obstructions or imperfections in the well casing.

Other objects and advantages reside in certain novel features of the construction, arrangement and combination of parts which will be hereinafter more fully described and particularly pointed out in the

appended claims, reference being had to the accompanying drawings forming a part of this specification, and in which:—

Figure 1 is a sectional view showing one embodiment of the invention,

Figure 2 is a view in elevation showing another embodiment of the invention, and

Figure 3 is a detail view, partly in section and partly in elevation showing the upper plug.

Referring to the drawings it will be seen that the cementing device is made up of a number of hollow cylindrical sections 1 and 2 coupled together by means of a coupling sleeve 3 which is locked to the sections by means of keys 4 driven in between the coupling sleeve and the sections.

In the form of the invention shown in Figure 1, a set shoe 6 is threadedly connected to the lower end of the section 2, as indicated at 7, and is locked to the section by means of a number of keys 4* which are identical with the keys 4 except that they are longer.

Between the sections 1 and 2 the flange 8 of a valve seat 9 is clamped and such flange is held in position by means of lock screws 10 co-acting with the coupling 3 and with the flange, as shown in Figure 1. The valve seat 9 has a conoidal portion 11 and an oppositely disposed conoidal portion 12, the conoidal portions 11 and 12 being connected by a short cylindrical portion 13 and in the conoidal portion 12 a valve seat 15 is provided. The flange 8 is connected with the lower end of the conoidal portion 11 by means of a short cylindrical connecting portion 16. A spider 17 is integral with or suitably connected to the flange 8 and to the short cylindrical portion 16 and carries a back pressure valve, designated generally at 18. A second back pressure valve 20 is provided between the lower end of the section 2 and the set shoe 6 and the back pressure valve 20 is held against spinning by means of lock screws 21.

The section 2 is provided with cement discharge openings 21* which have their outer portions or walls countersunk to provide valve seats. Metal valves 22 in the form of half spheres co-act with the valve seats and these metal valves 22 are spot welded or otherwise suitably secured to blade spring-like carriers 23, the ends of which have slots 24 co-acting with headed pins 24* fastened to the section 2. The spring carriers 23 are tensioned to hold the valves against their seats but under the influence of a certain predetermined degree of pressure exerted against the valves and the carriers, these spring carriers may be flexed outwardly to permit discharge through the openings 21. Outward flexure is permitted by virtue of the provision of the slots 24. This cement discharge means is fully shown, described

and claimed in my co-pending application filed Dec. 21, 1925, Serial No. 76,839.

A lower plug 25 of soft pliable and somewhat yieldable and elastic material is provided and has a body portion of cylindrical form, a pointed or tapered lower end 26 and a conical recess 27 in its upper portion. The plug 25 snugly fits the well casing and also the section 1 which are incorporated in the well casing and which are of the same size as the well casing. The plug 25 is interposed between the liquid cement L and the underlying mud fluid. Between the cement and the overlying mud fluid an upper or top plug 30 is provided and also has a cylindrical body, a pointed or tapered lower end 31 and a conical recess 32 at its upper end. The plugs 25 and 30 may be constructed of any soft and pliable material having some slight degree of yieldability and elasticity and adapted to be broken up when forced against the valve seat but preferably the plugs are constructed of gelatinous substance such as alumina gel or silica gel although the plugs have sufficient elasticity or yieldability to pass imperfections in the casing they have not any material or substantial property of elasticity and under the influence of great pressure and when striking the valve seat readily become disintegrated or broken up. In the upper plug 30 a ball 35 of hard, non-compressible substance is imbedded. The ball 35 is relatively small with respect to the well casing but as this ball is carried by and within the plug 30 the specific gravity is immaterial. It may be of greater specific gravity than the cement or not as may be desirable or convenient. The valve 35 is adapted to coact with the valve seat 9.

This device may be readily converted for use with one string wells by omitting the set shoe 6 and the back pressure valve 20 and replacing these parts with a coupling 40 and brass plate barrier 41 as shown in Figure 2. In one string wells the liner 42 is suspended below the well casing 43 as shown in the drawing and it will be desirable to provide suitable formation packers, such as indicated at 44, below the cementing device and above the liner.

The valve seats are made of soft brass or any other suitable material which may be easily drilled out after the cementation has been entirely completed.

In carrying out the method the plug 25 is first introduced into the casing on top of the mud fluid M. The plug 25 snugly fits the casing and when the liquid cement L is placed on top of the plug 25 within the casing it is separated from the underlying mud fluid M by means of this plug 25 because of the snug fit of the plug in the casing and also because the upper end of the plug is expanded in packing engagement with the well casing by the action of liquid

cement. On top of the cement the plug 30 is placed and after the well casing has been capped and connected up to the pump mud fluid M' is forced down on top of the plug 30 and this forces the plug 30, the liquid cement L, plug 25 and mud fluid M down through the casing until the plug 25 strikes the valve seat 9 when it is broken up or disintegrated whereupon the liquid cement flows through the opening of the valve seat and out through the check valve controlled cement discharge openings 21^a. When all of the cement has passed through the opening of the valve seat the plug 30 strikes the valve seat and is disintegrated and broken up which permits the ball valve 35 to engage the valve seat 9 and block or close the casing at this point, thereby preventing the mud fluid M' from being pumped down through the valve seat and displacing the cement beyond the point desired. The pumps stall at this time and advise the operator that the cementation has been completed.

The advantages of plugs are had without any of the disadvantages incident thereto. In other words, the cement is separated and isolated from the mud fluid so that admixture is prevented and the wall of the well casing is cleaned and scrubbed of cement which precludes the cement from setting thereon. Except for the upper plug 30 cement would adhere to the casing and settle down upon ball 35 after same has seated. This plug 30 not only saves the cement for use outside the casing, but avoids having to drill it out when set. Along with these advantages it is not necessary to manipulate the well casing and the possibility of plugs jamming or sticking in the casing is avoided.

I claim:—

1. The herein described method of cementing walls equipped with casing provided with cement discharge means which consists in providing a valve seat adjacent the point of discharge, introducing into the casing above the mud fluid a lower plug of soft, pliable material adapted to snugly fit the casing and to be broken up when forced against the valve seat, introducing cement into the casing above the lower plug, introducing into the casing above the cement an upper plug of soft, pliable material adapted to snugly fit the casing and to be broken up when forced against the valve seat and having imbedded therein a relatively small and hard valve member adapted to engage the valve seat when the plug which carries the same is broken up, and introducing mud fluid in the casing above the upper plug.

2. The herein described method of cementing wells equipped with casing provided with cement discharge means which

consists in providing a valve seat adjacent the point of discharge, introducing cement into the casing, introducing into the casing above the cement a plug of soft, pliable material adapted to snugly fit the casing and to be broken up when forced against the valve seat and having imbedded therein a relatively small and hard valve member adapted to engage the valve seat when the plug which carries the same is broken up, and introducing mud fluid in the casing above the plug.

3. In the herein described method of cementing walls equipped with casing provided with cement discharge means, an improved step which consists in introducing into the casing above the cement a plug of soft, pliable material adapted to snugly fit the casing and to be broken up when forced against the valve seat and having imbedded therein a relatively small and hard valve and indicator member adapted to engage the valve seat when the plug is broken up.

4. A cementing device for wells comprising a well casing having cement discharge means, a valve seat adjacent said discharge means, spaced plugs of soft pliable material adapted to be broken up when forced against the valve seats and snugly fitted in the casing on the opposite sides of the cement to prevent admixture of mud fluid and cement and to prevent adherence of the cement to the inner wall of the well casing, and a relatively small and hard valve and indicator member imbedded in the upper plug and co-operable with the valve seat when the plugs have been broken up.

5. A cementing device for wells comprising a well casing having cement discharge means, a valve seat adjacent said discharge means, spaced plugs of gelatinous material adapted to be broken up when forced against the valve seats and snugly fitted in the casing on the opposite sides of the cement to prevent admixture of mud fluid and cement to prevent adherence of the cement to the inner wall of the well casing, and a relatively small and hard valve and indicator member imbedded in the upper plug and co-operable with the valve seat when the plugs have been broken up.

6. A cementing device for wells comprising a well casing having cement discharge means, a valve seat adjacent said discharge means, spaced plugs of soft, pliable material adapted to be broken up when forced against the valve seats and snugly fitted in the casing on the opposite sides of the cement to prevent admixture of mud fluid and cement and to prevent adherence of the cement to the inner wall of the well casing, said plugs having expansible upper ends forced against the casing by the pressure of the fluid above the same, and a relatively small and hard valve and indicator member imbedded in

the upper plug and co-operable with the valve seat when the plugs have been broken up.

7. A cementing device for wells comprising a well casing having cement discharge means, a valve seat adjacent said discharge means, spaced plugs of soft, pliable material adapted to be broken up when forced against the valve seats and snugly fitted in the casing on the opposite sides of the cement to prevent admixture of mud fluid and cement and to prevent adherence of the cement to the inner wall of the well casing, said plugs having recesses in their upper ends adapting the upper ends to be forced into packing engagement with the casing, and a relatively small and hard valve and indicator member imbedded in the upper plug and co-operable with the valve seat when the plugs have been broken up.

8. A cementing device for wells comprising a well casing having cement discharge means, a valve seat adjacent said discharge means, spaced plugs of soft, pliable material adapted to be broken up when forced against the valve seats and snugly fitted in the casing on the opposite sides of the cement to prevent admixture of mud fluid and cement and to prevent adherence of the cement to the inner wall of the well casing, said plugs having pointed lower ends to facilitate movement of the plugs down

through the casing, and a relatively small and hard valve and indicator member imbedded in the upper plug and co-operable with the valve seat when the plugs have been broken up.

9. A cementing device for wells comprising a well casing having cement discharge means, a valve seat adjacent said discharge means, spaced plugs of soft, pliable material adapted to be broken up when forced against the valve seats and snugly fitted in the casing on the opposite sides of the cement to prevent admixture of mud fluid and cement and to prevent adherence of the cement to the inner wall of the well casing, and a relatively small, hard and incompressible valve and indicator ball member imbedded in the upper plug and co-operable with the valve seat when the plugs have been broken up.

10. A cementing device for wells comprising a well casing having cement discharge means, a valve seat adjacent said discharge means, spaced plugs snugly fitted in and having packing engagement with the casing on the opposite sides of the cement, and a relatively small and hard indicator and valve member carried by the upper plug and co-operable with the valve seat when disassociated from its plug.

ALEXANDER BOYNTON.