Aug. 26, 1930. A. BOYNTON 1,773,941

METHOD OF AND DEVICE FOR CEMENTING WELLS

Filed Oct. 1, 1925 3 Sheets-Sheet 1

Fig. 1.

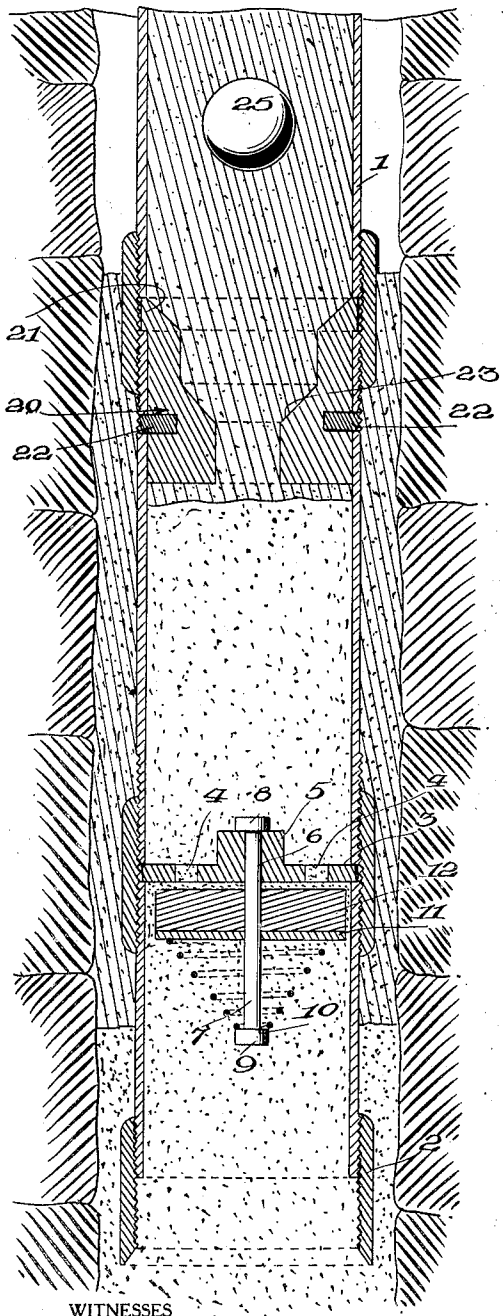
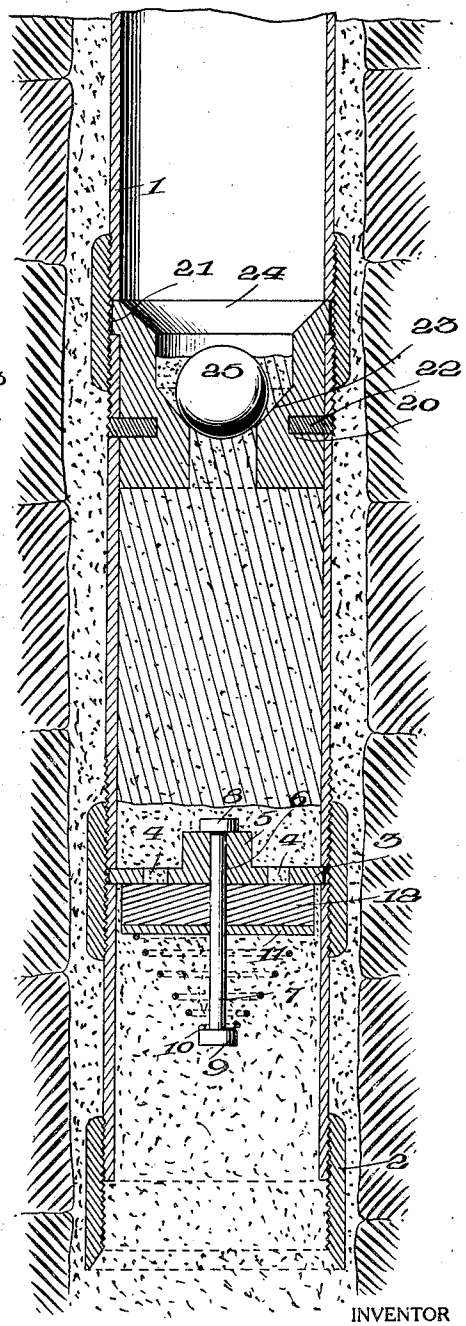


Fig. 2.



WITNESSES

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Fig. 3.

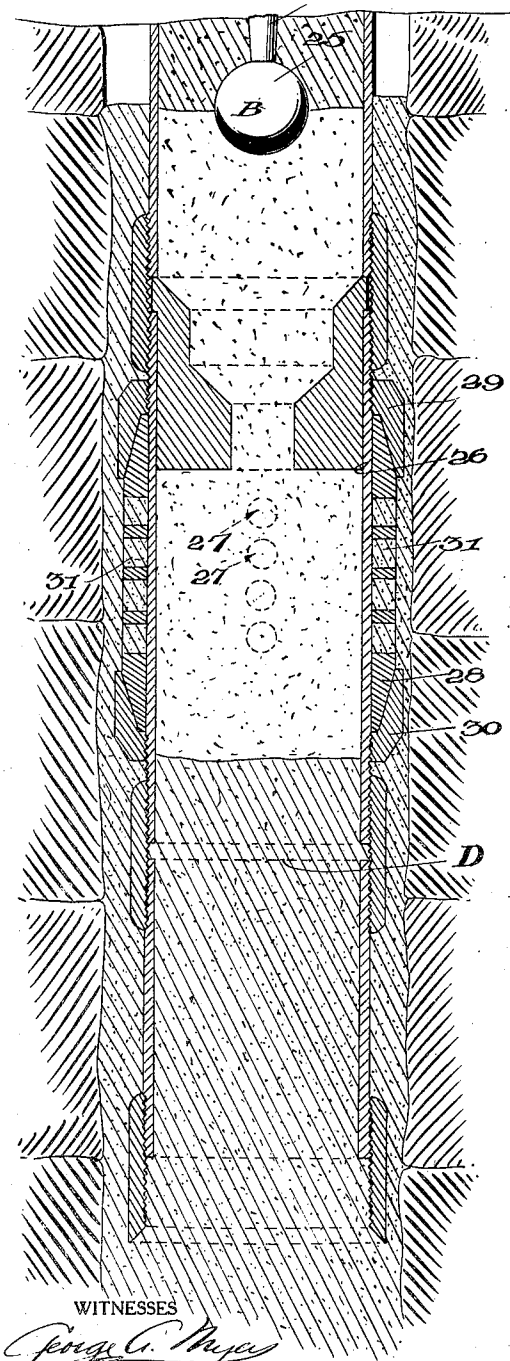
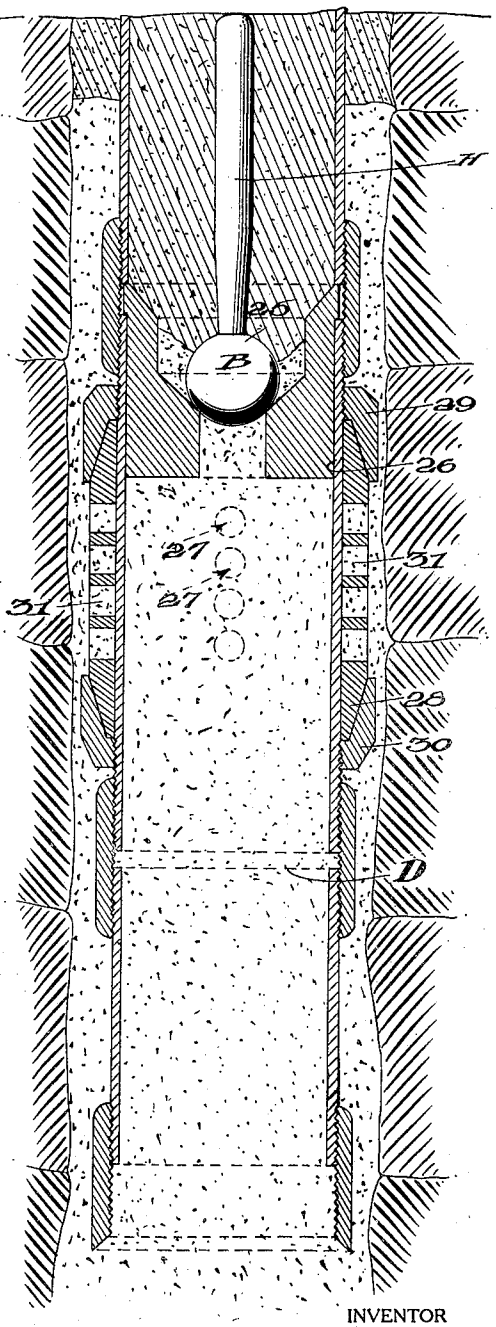


Fig. 4.



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Fig. 5.

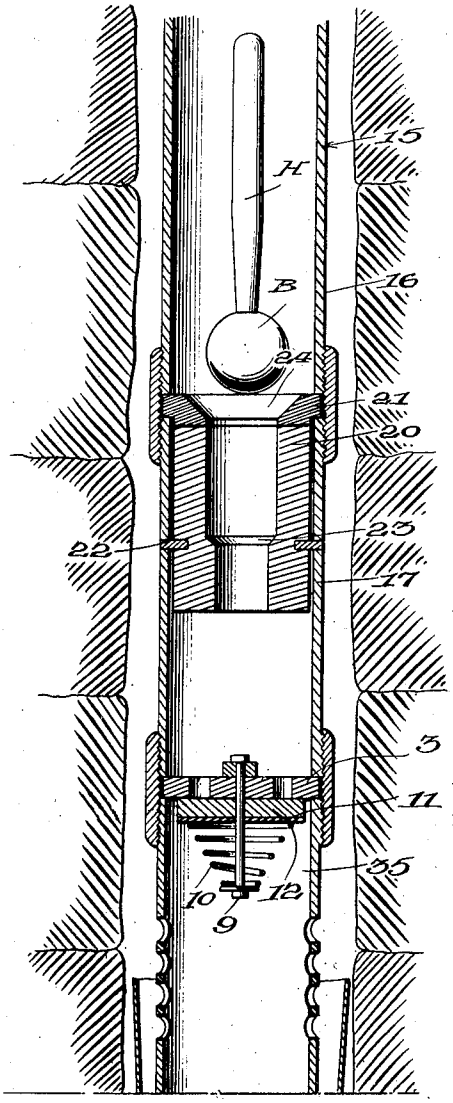
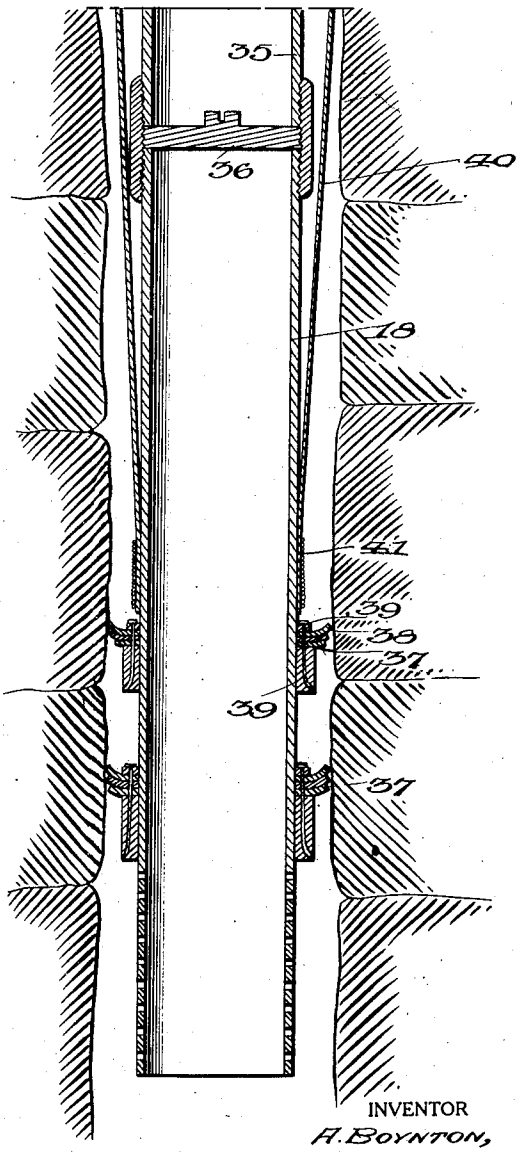


Fig. 5a.



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UNITED STATES PATENT OFFICE

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METHOD OF AND DEVICE FOR CEMENTING WELLS

Application filed October 1, 1925. Serial No. 59,888.

This invention relates to an improved device for cementing oil, gas and water wells.

One of the principal objects of the invention is to provide a device of this character which may be conveniently used to properly cement the well and which does not require the use of wooden plugs and barriers, or the raising and lowering of the well casing.

Heretofore in the art it has been proposed to carry out the cementation of wells by the use of a process wherein the cement was spaced from the mud fluid by means of two wooden plugs. In this old process, the well casing is first let down upon the bottom of the well in order to find the bottom, and then picked up a few inches in order that the pump may set up circulation. Just at this point in the process difficulty is not infrequently encountered since it is not always possible to pick up the casing. After the casing has been picked up a bottom plug is inserted. Then the cement is pumped into the casing and on top of the cement a top plug is placed. The mud fluid is then pumped in on top of the top plug until the bottom plug strikes the bottom of the well. The casing having been picked up, say six inches from the bottom as above described, and the botton plug being say twelve inches long, the pump will, of course, stall when the bottom plug strikes the bottom of the well. Then the casing is picked up again to a point say six inches above the top of the bottom plug and the pump is started again and run until the top plug strikes the bottom plug.

The casing is apt to stick or freeze at any time. If the casing could not be pulled up the second time, the cement is trapped and must be removed. The pump again stalls when the top plug strikes the bottom plug, because the bottom plug is about twelve inches long, and as just stated, the casing has been picked up to a point six inches above the top of the bottom plug. When the top and bottom plugs come together as stated, the cement is all outside of the casing. Then the casing is lowered to the bottom. Sometimes, however, it can not be lowered. If no trouble is encountered in picking up the casing twice as set out and then letting it down again, this process works all right unless one or both of the plugs should stick in the casing. Serious difficulty has been encountered due to the plugs sticking. The plugs are made of wood, and the kind of wood of which the plugs are constituted varies. Different kinds of wood expand to different degrees, but all plugs expand more or less when exposed to the mud fluid, and the amount of expansion depends not only upon the character of the wood, but also upon the moisture contained in the wood at the time the plugs are used. Moreover sticking of the plugs results not only from swelling and expansion, but may also be caused by any imperfection in the casing, such as dents, slivers or bends.

Frequently casings become distorted from great outside pressure, and it is not uncommon in deep wells to have the casing collapse when great pressure of water or mud fluid on the outside comes against the casing and bends it or partially collapses it. Not only must the quality of wood and its moisture content be always observed with care, but the greatest care must always be used to accurately caliper the plugs the proper diameter in order to avoid sticking of the plugs, if too large, and leaking of cement past the plugs if too loose. For these reasons it has been found that the process heretofore proposed in the art is very often unsatisfactory.

The present invention avoids the difficulties and disadvantages of the old process since no plugs are used. At the same time the present invention insures the proper application of the cement to the proper place or places and the operator is accurately advised when the cementation has been completed.

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 view in section with the parts shown in elevation and illustrating one phase of the action of one embodiment of the invention.

Figure 2 is a view similar to Figure 1 but illustrating another phase of the action of this embodiment.

Figure 3 is a view partly in section and partly in elevation illustrating one phase in the operation of another embodiment of the invention.

Figure 4 is a view similar to Figure 3 but illustrating a different phase of the operation.

Figure 5 is a fragmentary view showing another embodiment of the invention.

Figure 5ª is a view similar to Figure 5 and illustrating the lower part of the apparatus shown in Figure 5.

Referring to the drawings and more particularly to Figures 1 and 2, the numeral 1 designates the well casing. At its lower end the casing is provided with the ordinary casing shoe 2. Just above the casing shoe a perforated disc 3 is clamped in between the sections of the casing, the perforations of the disc affording discharge openings 4. Centrally the disc 3 has a boss 5, and the boss and disc are provided with an axial guide opening 6 in which a valve stem 7 is fitted. The valve stem 7 has a head at one end engaging the boss 5 and at its other end has a head 9 providing an abutment for one end of a coil spring 10, the other end of the coil spring engaging a washer 11 on the underside of a valve 12. The spring 10 is tensioned to hold the valve 12 up against the under side of the plate 3 so that the valve closes the discharge opening 4 of the plate. The plate 3 may be made of soft brass or other suitable metal so that it may be drilled out after cementing has been completed. This assembly is commonly known as a back pressure valve.

A valve seat 20 of wood, brass, or other suitable material is provided and has an outwardly directed annular flange 21 engaged and held between the adjacent ends of the sections 16 and 17. The body of the valve seat 20 is preferably a driving fit in the casing and for the purpose of further securing the valve seat in position transversely extending openings may also be formed in the valve seat and in the section 17 and these openings filled with babbitt 22. The valve seat 20 has a beveled valve facing 23 intermediate its ends, and the upper end is formed with a beveled guide surface 24. A differential float providing a combined signal and valve is designated at 25 and is cooperable with the valve seat 20. As shown in Figures 1 and 2, this combined valve and signal 25 may be a ball or body of hard rubber, hard wood, alloy of aluminum and lead, or any suitable material provided only that its specific gravity is greater than the mud fluid and less than the cement, so that it will sink in the mud fluid but will remain on the top of the cement. The construction of a ball having these properties is entirely practical in view of the great difference in the specific gravity of the mud fluid and of the cement, cement as usually mixed and used ranging from 1.67 to 1.85 while the ordinary mud fluid ranges from 1.10 to 1.20.

The embodiment of the invention shown in Figures 3 and 4 is identical with that illustrated in Figures 1 and 2 except that a different means is provided for preventing back flow of the cement and a somewhat different form of signal and valve is employed, and that in addition to the elements shown in the embodiments illustrated in Figures 1 and 2, an imperforate barrier comprising a plate or disc D is fixed to the casing and obstructs the opening therethrough at a point a short distance above the shoe. The valve 12 and its associated structure are omitted in the form of the invention shown in Figures 3 and 4 and in lieu of these parts a nipple 26 is incorporated in the string of casing and is provided with a number of diametrically opposite openings 27. Only two sets of openings 27 are provided and at one set is diametrically opposite the other. A sleeve valve 28 of rubber or other elastic material is fitted on the nipple 26 and has an imperforate portion covering the opening 27. The sleeve valve 28 is held in position by a relatively small upper retaining cup 29 and a relatively large lower retaining cup 30, both cups being screw threaded on the nipple. As stated the sleeve valve 28 has imperforate portions covering the openings 27 but at points angularly spaced ninety degrees from the openings 27, the sleeve valve 28 is formed with discharge ports 31. The valve sleeve is preferably constituted of heavy rubber or other elastic material and is tensioned to snugly fit and firmly clamp the nipple 26. This valve, due to its elasticity, may be expanded when subjected to pressure within the nipple to permit fluid within the nipple to pass through the openings 27 in the space between the outside of the nipple 26 and the expanded or stretched valve 28 and out through the discharge port 31, but when subjected to outside pressure or to a pressure greater on the outside than on the in, the elasticity of the nipple will be aided by the greater outside pressure in forcing the imperforate portions of the nipple over the openings 27 thereby sealing the openings 27. In this way the valve 28 serves as a check valve and effectively prevents the cement from running back into the casing as will be hereinafter more fully explained.

In Figures 3, 4, 5 and 5ª a somewhat different form of combined valve and signal is employed and which comprises a ball B made up of any hard non-compressible metal or alloy or other substance such as guttapercha or an alloy of aluminum and any other light soft metal. A handle H is rigidly and securely connected to the ball or body B and is

constituted of white pine or any other soft wood or similar substance. The handle H is shellacked or painted to prevent it from absorbing water and thereby changing its specific gravity while under the great fluid pressures existing in the lower regions of the well. This type of combined signal and valve may be readily varied to cause it to have the exact specific gravity required under the prevailing conditions. The problem is always to use a combined signal and valve of such specific gravity that it will float in the cement and yet sink in the mud fluid used to force the cement down into place. In modifying the combined valve and signal shown in Figure 2 to cause it to have these properties it is placed in the cement which has been mixed in the cement mixing box on the derrick floor. The point at which the handle H becomes submerged is marked. The handle H is then cut off slightly above this mark thus varying the material content. It is to be understood that the ball B is always of a specific gravity heavier than the cement. Cement is usually mixed and used at a specific gravity of about 1.7. The specific gravity of ball B should therefore be about 1.75 so that it will barely sink in the heavier cement. The correct specific gravity to cause the signal ball to float safely in any cement mixture is then determined as described by cutting off the handle just above the point at which it sinks in the cement mixture. In this way the combined valve and signal may be readily adapted to different cements and different mixtures of the same with water and sand in order to compensate for the varying specific gravities of such cement mixtures. Likewise the combined valve and signal is adapted for use with the mud fluids produced by different wells and different fields and which also have varying specific gravities.

With the form of the invention illustrated in Figures 5 and 5ª the combined signal and valve B, the valve seat 20 and the upwardly fitting spring closed valve 12 are all employed in the well casing in substantially the same relation as that illustrated in Figures 1 and 2 and hereinbefore described, except that these parts are positioned well up in the well casing since the arrangement shown in Figure 5 is designed specifically for use in cementing the so-called one string wells, that is the wells which are drilled in through the oil sands before they are cemented. In the arrangement shown in Figure 5 a perforated nipple 35 is incorporated in the well casing, the upper end of the nipple 35 engaging the perforated disc 3. At the lower end of the nipple an imperforate barrier in the form of a brass plate 36 is fixedly secured in the well casing.

With this embodiment of the invention it is essential to prevent the cement from flowing down between the outside of the casing and the wall or formation of the well hole after it has been placed, and for this purpose laminated sealing members 37 are provided. The details of these sealing members form the subject matter of a co-pending application, and here it is sufficient to note that these laminated sealing members are designed to shear off the shale and other formation defining the wall of the well causing impaction of this sheared off material between the sealing members, whereby to prevent the flow of cement down past the sealing members through the oil producing sands. The upper sealing member is slightly larger than the lower; otherwise the sealing members are identical.

In order to prevent down flow of the cement even though the laminated sealing members should fail to fulfill their function, a bootleg packer 40 is provided and consists of a tubular structure of fabric mounted on the well casing just above the sealing members 37, the lower end of the bootleg packer being fixed on the well casing by a wrapping 41 of wire. The packer 40 enlarges towards its upper end and the upper end thereof is open and is located opposite the intermediate perforations of the nipple 35. The bootleg packer has its upper open end always ready to receive the cement and check and stop the down flow of the same should conditions arise which would permit the cement to flow past the sealing members 37.

In all embodiments of the invention, the well casing with the liner attached is properly placed in the well, and its position is not disturbed in carrying out the cementing process. In cementing the well, the desired amount of cement is pumped into the top of the well casing, and the combined signal ball and valve 25 is placed on top of the fluid cement mixture where it will float only partially submerged. The casing is then connected to the pump and mud fluid is pumped on top of the cement to force the cement down through the well and through the opening of the valve seat 20.

The course which the cement takes after being passed through the openings of the ball valve seat depends on the embodiment of the invention which is employed. With the embodiment shown in Figures 1 and 2, the cement, after passing through the openings in the ball valve seat, passes down past the valve 12 and out underneath the casing shoe 2. The valve 12 permits down flow of the cement but prevents back flow thereof. With the embodiment of the invention shown in Figure 5 the cement, after passing below the valve 12, passes out through the perforations of the nipple 35. In the form of the invention shown in Figures 3 and 4, the cement, after leaving the opening of the ball valve seat passes through the openings 27 of the nipple 26 between the sleeve valve 28 and

the nipple and out through the openings 31. At this point it should be borne in mind that the pump used to force the cement into the well operates under a pressure of from three hundred to four hundred pounds per square inch, which insures the proper operation of the heavy rubber sleeve valve 28. Back flow of the cement into the well casing is prevented by the operation of the sleeve valve 28.

When practically all of the cement has been displaced from the well casing the differential float which serves as a combined signal and valve will engage and snugly fit on the bevelled facing 23 of the valve seat 20 and the pump will stall, thereby indicating to the operator that the cement job has been completed. The cement cannot flow back into the casing and where the cementation is carried out above the bottom of the well, it cannot flow down between the outside of the well casing and the wall of the well hole.

With this arrangement the casing is not picked up, but after it is properly placed in position it is left undisturbed, thus the proper cementation of the well does not depend on the ability of the operator to manipulate the casing. No plugs are used and consequently no difficulty is encountered by virtue of swelling plugs. The relatively small combined signal and valve is well adapted to pass any obstruction, dents or imperfections in the well casing.

What I claim is:

1. A device for cementing wells including a differential float having variable means whereby its specific gravity may be readily changed, and comprising a ball and a handle, said handle being adapted to be cut off to vary the specific gravity of the assembly.

2. A device for cementing wells including a differential float having variable means whereby its specific gravity may be readily changed, comprising a ball of hard rigid substance and a wooden handle.

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