May 2, 1933. E. S. WHITE 1,906,891

CEMENT VALVE

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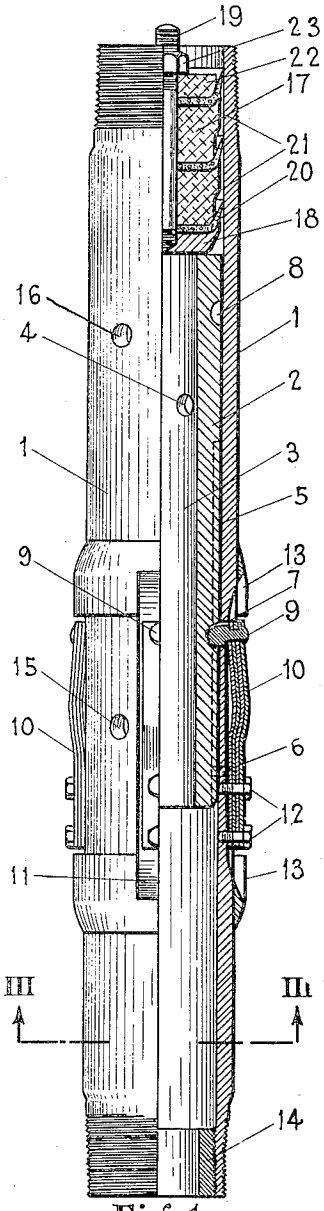


Fig. 1

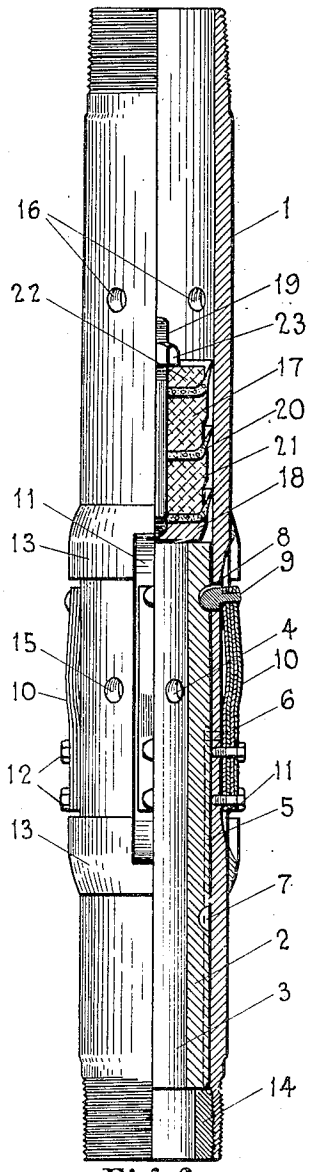


Fig. 2

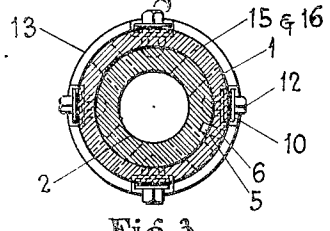


Fig. 3

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# UNITED STATES PATENT OFFICE

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## CEMENT VALVE

Application filed November 23, 1931. Serial No. 576,847.

This invention relates to improvement in devices for placing plugs or bridges of cement or other semi-fluid or plastic material in oil, gas, or water wells.

Heretofore in the art, it has been the general practice to pump the cement into a well through tubing or drill pipe and to depend on measurements and volumetric calculations to ascertain when the cement is in the desired position. In this old process a string of tubing is first lowered into the hole to a point such that the bottom of the tubing is near the bottom of the hole, if a plug is to be placed. If a bridge is to be placed, the tubing is lowered into the hole to a point such that the bottom of the tubing is at the point where it is desired to have the bottom of the bridge. When bridges are to be placed, it is the usual practice to fill the lower portion of the hole with heavy mud or sand to the point where it is desired to have the bottom of the bridge, thus the cement or other material is prevented from settling below the desired point. With the tubing in the proper position, the cement or other material for the bridge or plug is mixed and pumped into the tubing. When the cement, or other material, has all been pumped into the tubing it is then pumped on down through the tubing with fluid of the same specific gravity as that of the average fluid filling the hole. Calculations have been previously made so that it is known approximately how far the cement, or other material, used will fill the hole above the bottom of the tubing. This point is called the point of equalization or in other words the point at which the length of the column of cement outside the tubing equals the length of the column of cement inside the tubing. Calculations are made to determine the volume of well fluid that will be required to fill that portion of the tubing above the point of equalization. Pumping is stopped as soon as the predetermined amount of fluid (obtained by calculations) to equalize the cement, or other material, has been introduced into the tubing following the cement. Then, theoretically, the columns of cement inside and outside the tubing are equal and the columns of well fluid above the cement inside and outside the tubing are also equal. The tubing is then pulled out of the hole, leaving the cement in the desired position providing all calculations and gauging have been done correctly.

This old process is suitable and satisfactory for some operations of this kind, particularly in shallow holes, or where large quantities of cement are used. However, in small deep holes when it is desired to place small quantities of cement, errors in calculations and measurement of fluid, and irregularities in the specific gravity of the well fluid, causing unbalanced columns of fluid, often make it difficult to put the cement exactly where it is desired.

An object of this invention is to provide a positive device which will accurately place cement in a desired position in a well without calculations and measurements of fluid to equalize pressure thereon inside and outside the tubing.

Another object is to provide a device which will prevent the disturbance of the cement after it has been pumped into the well, by unbalanced columns of well fluid above the cement.

A further object of this invention is to provide a device of this character which is simple and durable in construction, reliable, accurate and effective in operation, and easy and inexpensive to manufacture and use.

A still further object of this invention is to provide a well cementing valve which is positively operated and which leaves none of its parts in the well.

Another object is to disclose a method of accurately placing cement in a well at a closely controlled and definite position, by simple and dependable means, which can be operated by relatively unskilled labor and at a minimum of time and expense.

Other objects and advantages will be evident from the subjoined description and drawing which show the construction and operation of a preferred embodiment of the invention.

In the drawing:

Figure 1 is a partial longitudinal section of the device constructed in accordance with

this invention, and shows the valve in its upper or closed position.

Figure 2 is another partial longitudinal section of the device and shows the valve in its lower or open position.

Figure 3 is a sectional view on the line III—III of Figure 1.

Referring to the figures, the outer body or barrel of the valve is made from a length of heavy seamless steel tubing 1, threaded at both ends as shown to permit its insertion at any desired point in the string of tubing (not shown) which is to be used for cementing the well. Within the barrel 1 is a tubular valve 2, also made from heavy seamless steel tubing and of such outside diameter that it is a free sliding fit in the bore of the barrel 1. The bore of the sliding valve is designated 3 and extends completely through the valve.

Valve 2 is provided with accurately spaced ports 4 through its walls, for a purpose which will be explained later. It is also fitted with a longitudinal guide slot 5, which cooperates with a steel pin 6 extending inward from the wall of barrel 1 to insure accurately guided longitudinal motion of the valve and prevent any tendency to rotate. Two sets of hemispherical recesses 7 and 8 are also provided in the outside of valve 2 as shown, which recesses act as receivers for spring actuated dogs 9 which pass through holes in the outer barrel and retain the valve 2 in either of its two extreme positions.

The dogs or latches 9 just referred to are mounted upon and are pressed inward by laminated leaf springs 10, which are in turn secured at the bottom of the longitudinally milled slots 11 by cap screws 12. Annular collars 13 are welded as shown onto the outer barrel 1 adjacent both ends of the springs 10 to act as buffers or guides to protect and prevent the projecting springs and cap screws from catching on the joints of the well casing (not shown) as the valve and tubing are inserted or withdrawn.

Inside the outer barrel 1 and at its lower end is screwed an annular steel sleeve or stop ring 14 which limits the downward travel of the sliding valve 2.

Ports 15, which are accurately spaced both longitudinally and circumferentially pass through the wall of the outer barrel 1. Ports 15 are so spaced that they coincide with ports 4, in the sliding valve, when the latter is in the lower or open position, as shown in Figure 2. Valve 2 is so proportioned that ports 15 are closed at all other times.

Ports 16 pass through the wall of barrel 1 near its upper end and are merely located so that they are covered and closed by the sliding valve 2 when it is in its upper or closed position as shown in Figure 1. These ports are uncovered and open when the valve is in its lower or open position as shown in Figure 2.

An actuating plug 17 is provided to actuate the valve 2 when the latter is to be opened. Plug 17 is built up of a circular steel disc 18, into the center of which is threaded a steel stud bolt 19. Composition or leather cups 20 and cast aluminum spacers 21 are centered over the stud bolt as shown and are held in place by the aluminum washer 22 and the nut 23.

To explain the operation of this device, it will be assumed that a certain formation is to be sealed off by cementing in a "bridge". Heavy mud or sand is first introduced until the bottom of the drill hole is filled to the level of the bottom of the proposed bridge. The sliding valve 2 of the valve barrel, as the latter is lying on the derrick floor, is set in its upper or closed position (Figure 1) with the dogs 9 engaged in recesses 7. Assuming that a bridge 100 feet deep is to be placed at any desired level in the well, a little less than that length of tubing, say 90 feet, is suspended in the well. The valve barrel is then screwed onto this tubing and the remainder of the string is then made up of tubing, by adding and lowering successive joints in the usual manner, until the valve barrel is somewhat above the level of the top of the proposed bridge. This latter distance, i. e., the distance between the level of the top of the proposed bridge and the valve barrel should be equal to the displacement of the tubing below the valve barrel divided by the area of the hole to be cemented. Circulation may be maintained at all times, through the valve bore 3.

The calculated amount of cement slurry required for the filling of the hole for the desired distance is next pumped into the tubing on top of the mud fluid already there by means of the mud fluid circulating pump, or another separate pump, through the usual pipe connections at the top of the tubing. The tubing connections to the pump are removed and the plug 17 is placed in the tubing above the cement. The connections between the top of the tubing and the pump are replaced and the plug and cement slurry are pumped down through the tubing using the regular mud fluid on top of the plug. Since the sliding valve 2 is in its upper position ports 4, 15 and 16 will all be closed and the cement slurry will pass downward through the axial bore 3, down through the tubing below the cement valve and then up outside the tubing, between the tubing and the well bore or the casing.

When the plug 17, which is on top of the cement slurry, strikes the top of the sliding valve 2, the flow through the tubing will be momentarily interrupted until sufficient pressure has built up in the tubing above the plug to overcome the resistance of the springs 10 which hold the dogs 9 in the recesses 7. When the circulating pump pres-

sure has built up to this point the holding effect of the dogs 9 is overcome and the sliding valve 2 will be forced down until it seats on the stop ring 14 as shown in Figure 2. When this occurs the dogs 9 will engage recesses 8 in the valve 2 to prevent upward motion of the valve from any cause.

At this time, if the computations have been correct, the cement slurry should be up on the outside of the tubing and between the tubing and the well bore or casing to, or somewhat above, the level of the valve barrel. Ports 15 in the barrel will then coincide with ports 4 in the sliding valve (see Figure 2). Ports 16 will also be uncovered, and will allow the circulating mud fluid or water to pass out from the inside of the tubing and return up the casing around the tubing, carrying with it any excess of cement slurry which may be above these ports. This definitely limits the height of the slurry in the casing.

The next step is the withdrawal of the tubing and valve from the well. During this process the mud fluid will drain out of the tubing through ports 16, thus making the work on the drilling floor a "dry job" and not precipitating a shower of mud fluid each time a section of tubing is removed. As the tubing is lifted mud can flow from the casing through aligned ports 4 and 15 into the space below the plug 17 on top of the cement inside the tubing, thus preventing a vacuum there, with its resulting agitation and disturbing of the cement. In other words, a solid column of mud fluid is left above the cement within and without the tubing as the tubing is withdrawn, without any possibility of unbalancing or subsequent disturbing the cement.

The cement, which has now been accurately and properly placed in the well bore or casing by means of the device embodying this invention, may be allowed to stand until it has hardened, after which any of the usual subsequent drilling operations may be performed in the well.

It is understood that various modifications and changes can be made to the apparatus disclosed without departing from the essential features of the invention, which invention embraces all changes, variations and substitutions coming within the scope of the appended claims.

I claim:

1. A cement valve comprising a tubular section having upper and lower longitudinally spaced ports therethrough, a movable sleeve section therein closing said ports and means to move said sleeve section to open said ports said means providing a positive separation in said tubular section between said upper and lower ports.

2. A cement valve comprising a tubular section having upper and lower longitudinally spaced ports therethrough, a movable sleeve section therein closing said ports, means for yieldingly engaging said sleeve section in closing position, and means for releasing said engagement to open said ports said last named means providing a positive separation in said tubular section between said upper and lower ports.

3. A cement valve comprising a tubular section having longitudinally spaced ports therethrough, a movable sleeve section therein closing said ports, means for yieldingly engaging said sleeve section in closing position, and a movable plug adapted to coact with said sleeve section to release said engagement and open said ports.

4. A cement valve comprising a tubular member having ports therethrough, a tubular sleeve therein capable of limited longitudinal movement to open and close said ports, latching means to hold said sleeve in its upper or port closing position, a plug member adapted to be forced downward through said tubular member to release said sleeve from its upper latching means and to move said sleeve to its lower or port opening position, and latching means for said lower position.

5. A cement valve comprising a tubular member having upper and lower ports therethrough, a movable sleeve therein closing said ports, ports in said sleeve, a sealing member adapted to be forced downward in said tubular member to a point between said upper and lower ports, thereby moving the said sleeve to uncover the said upper ports and registering the said lower ports with the ports in said sleeve.

6. A cement valve comprising a tubular member provided with upper and lower longitudinally spaced ports, means in said member adapted to open and close said ports, and means adapted to actuate said last named means, said actuating means providing a positive separation in said tubular section between said upper and lower ports.

Signed at South Pasadena, this 16th day of November, 1931.

EYNON S. WHITE.