June 15, 1926. 1,588,643

F. I. ALEXANDER

PROCESS OF CEMENTING WELLS

Filed July 1, 1924

Fig. 1

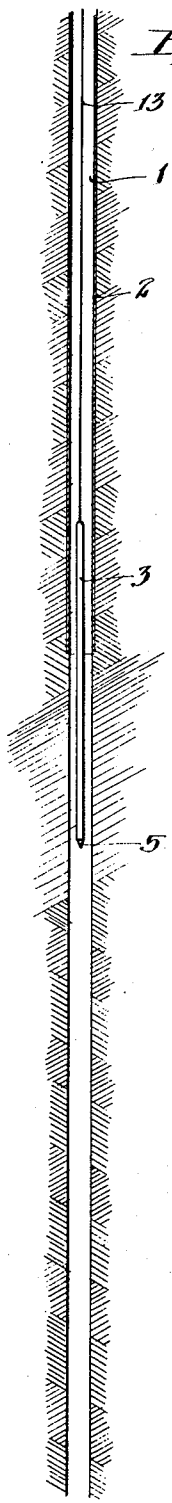
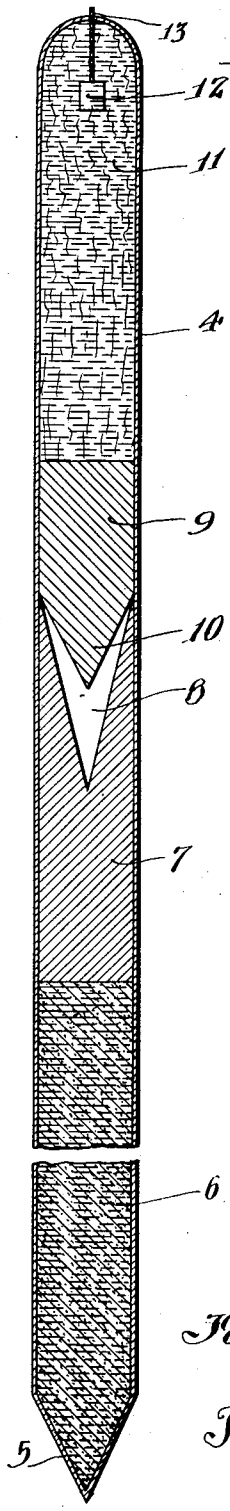


Fig. 2



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UNITED STATES PATENT OFFICE.

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PROCESS OF CEMENTING WELLS.

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This invention relates to a process or method for shutting off water in an oil well, and refers particularly to a method of shutting off water from an oil well by cementing off the water strata.

An object of the present invention is to provide a method by which the water may be shut off from the well by the use of a small quantity of cement, and in which the water will be more thoroughly cemented from the well than by the present methods.

Another object of the present invention is to provide a method of cementing wells whereby the cementing operation is completed in an extremely short length of time and the necessity of leaving the well standing from four to ten days after the cementing job, when carried out in the customary manner can be eliminated.

I have found that if, in place of attempting to cement off a water stratum with cement merely under the pressure of the head of the cement column or water column above the cement, plus a pump pressure, the cement is driven into the formation which it is desired to seal from the well by pressure or force created through the use of explosives, the cement will be forced into the formation at an extremely high pressure and wedge into all crevices or openings in the formation, with the result that an extremely effective shut-off of water is attained. Moreover, due to the terrific pressure placed upon the cement, and the temperature applied to the cement by the heat of the discharging explosive, the cement is caused to set very rapidly, permitting a determination, within a few hours, of the result of the cementing job, and accordingly the well is ready for use within a few hours after the cementing job, in place of the present delay of from four to ten days with the generally practiced methods.

Various further objects and advantages of this invention will be apparent from a description of a preferred embodiment of the invention and will present themselves from or through the practice or use of the invention. An example of a process of cementing wells embodying the invention is herein described, reference being made to the accompanying drawings, which somewhat diagrammatically indicate certain apparatus employed to conduct the process.

Referring to the drawings:—

Figure 1 is a vertical elevation taken through a well hole, showing a cementing torpedo being lowered down the well.

Fig. 2 is an enlarged vertical section through the cementing torpedo.

In the drawings, 1 indicates a well hole having a well casing 2 therein, and 3 indicates a cementing torpedo. The cementing torpedo comprises a cylindrical torpedo casing 4, preferably pointed at its lower end as indicated at 5. The lower portion of the torpedo is filled with fluid cement, as indicated at 6, and above the cement there is placed a plug 7 having a recess 8 in its upper end which may be either tapered or cone-shaped, the plug 7 being formed of soft material which will also have a tendency to batter or expand. In practice, I prefer to form the plug 7 of a material such as lead.

Above the expanding plug 7 is provided a wedging plug 9 having a chiselled or cone-pointed end 10 which is adapted, when forced into the recess 8 of the expanding plug 7, to spread or batter the end of the plug 7 into an enlarged position. On the top of the wedging plug 9 is placed a quantity of explosive 11, which may be any suitable explosive, and in this explosive is embedded a detonating cap 12, connected to an electric lead 13 by which the torpedo may be exploded from the top of the well.

As an example of a method for shutting off water from a well by the process of this invention, the first operation is to create a cavity at a predetermined point in the well substantially where it is estimated there exists the top of the water strata. This cavity is formed by discharging an explosive at the top of the water strata by the use of any well known explosive exploded in any customary or preferred way, the concavity created by the explosive being then preferably cleaned out. This cleaning of the cavity may be accomplished by bailing

out the débris in the concavity or by establishing circulation in a well, this being done by closing the upper end of the well casing 2 and pumping circulating water or other fluid down the well casing 2, from which it will pass out the created cavity and be forced back up the outside of the well casing 2, which is somewhat loose in the formation 1 of the well, carrying débris away from the cavity.

After the cavity is sufficiently clean, it is preferable to permit the well to become "balanced"—that is, the fluid in the well is allowed to rise or settle to that point where the head of fluid in the well is just sufficient to balance the pressure of water seeping through the water formation so that no water is either leaving or going into the formation. In this manner, the water or fluid in the well is quiet at the time of the cementing operation and after the cementing operation it will be substantially quiet to allow the cement placed to be set.

Subsequently, a quantity of fluid cement is placed in the cavity, either by being dumped down at the cavity by means of a bailer, or placed at this point in any other preferred manner. I then blast the cement thus placed into the formation by lowering an explosive over the cement and exploding the same, preferably making use of the torpedo 3 already described, it being understood that the cement to be forced into the formation may all be placed in the torpedo, as indicated at 6, or a quantity of the cement may first be lowered into the cavity and the torpedo lowered with further cement for the cementing operation, or no cement may be positioned in the torpedo, relying solely upon the cement positioned in the concavity by the bailer or other means to close the formation. This torpedo is lowered to the desired point or to the top of the pre-dumped cement, and the explosive of the torpedo is then discharged. The discharge of the explosion drives the wedging plug downward with a tremendous force. The lower expanding plug, being shot into the cement, forces the cement into every possible void or crevice which may exist in the water strata. The lead plug, being soft, will expand during this operation, which will enlarge the plug so that the plug acquires a circumference greater than its original circumference, with the result that the plug becomes wedged or stuck into the sides of the well, preventing a rebound of the plug therefrom.

In the cementing operation, the consistency of the fluid cement to be employed is governed somewhat by the depth of the well and the temperature and pressure which will be applied to the cement by the explosion of the explosive or other means; thus, in cementing at a point below four thousand feet where the cement will be raised to a temperature of from 170° F. it is desirable to have the cement in quite liquid form in order to keep it from setting before reaching the desired point, as the cement, when lowered to such a depth, is placed under considerable pressure by the well, which has a tendency to seep out the moisture from the cement and the temperature, of course, operates to dry or cause the cement to set.

Accordingly, the cement must be quite soft to prevent its being set before the explosion of the torpedo. After the explosion of the torpedo, the cement forced into the crevices of the formation is caused to set very rapidly, due to the tremendous pressure placed thereon through the explosive, and to the action of the heat of the explosion.

The quick setting of the cement is a considerable advantage, as it permits further operation on the well without the customary delay of a number of days. When the process is conducted in the preferred manner, the fluid in the well being balanced after the explosion, there will be no tendency of water to pass in or out of the formation, and thus displace the cement before the same has an opportunity of setting.

While I have described the invention in its preferred form, it is understood that the invention may be modified or embodied in other forms without departing from the spirit of the same and this invention is of the scope set forth in the following claims.

I claim:—

1. A process of cementing a well, comprising lowering cement down a well, and driving the cement into the well formation by blasting a plug against the cement.

2. The process of cementing a well, comprising forming a cavity at a water bearing stratum by blasting the well at this point, lowering cement to the cavity, and driving the cement into the well formation at the cavity by blasting a plug against the cement.

3. The process of cementing a well, comprising forming a cavity at a water stratum, lowering cement to the cavity, and driving the cement into the well formation at the cavity by blasting a plug against the cement.

4. The process of cementing a well, comprising balancing the water pressure in the well, lowering cement to the point at which it is desired to cement, and driving the cement into the well formation adjacent the point by blasting a plug against the cement.

5. The process of cementing a well comprising forming a cavity at the point where it is desired to cement the formation by blasting the well at this point, cleaning out the cavity, lowering cement to the cavity, and driving the cement into the well formation adjacent the cavity by blasting the plug against the cement.

6. The process of cementing a well, com-

prising forming a cavity in the water strata by blasting the well at such point, balancing the fluid pressure within the well, lowering fluid cement to the cavity, and driving the cement into the well formation by blasting an expanding plug against the cement.

7. The process of cementing a well, which comprises lowering cement down a well to the point which is to be cemented, and driving the cement into the well formation by blasting an expanding plug against the cement.

Signed at Los Angeles Calif. this 23 day of June 1924.

FORD I. ALEXANDER.