

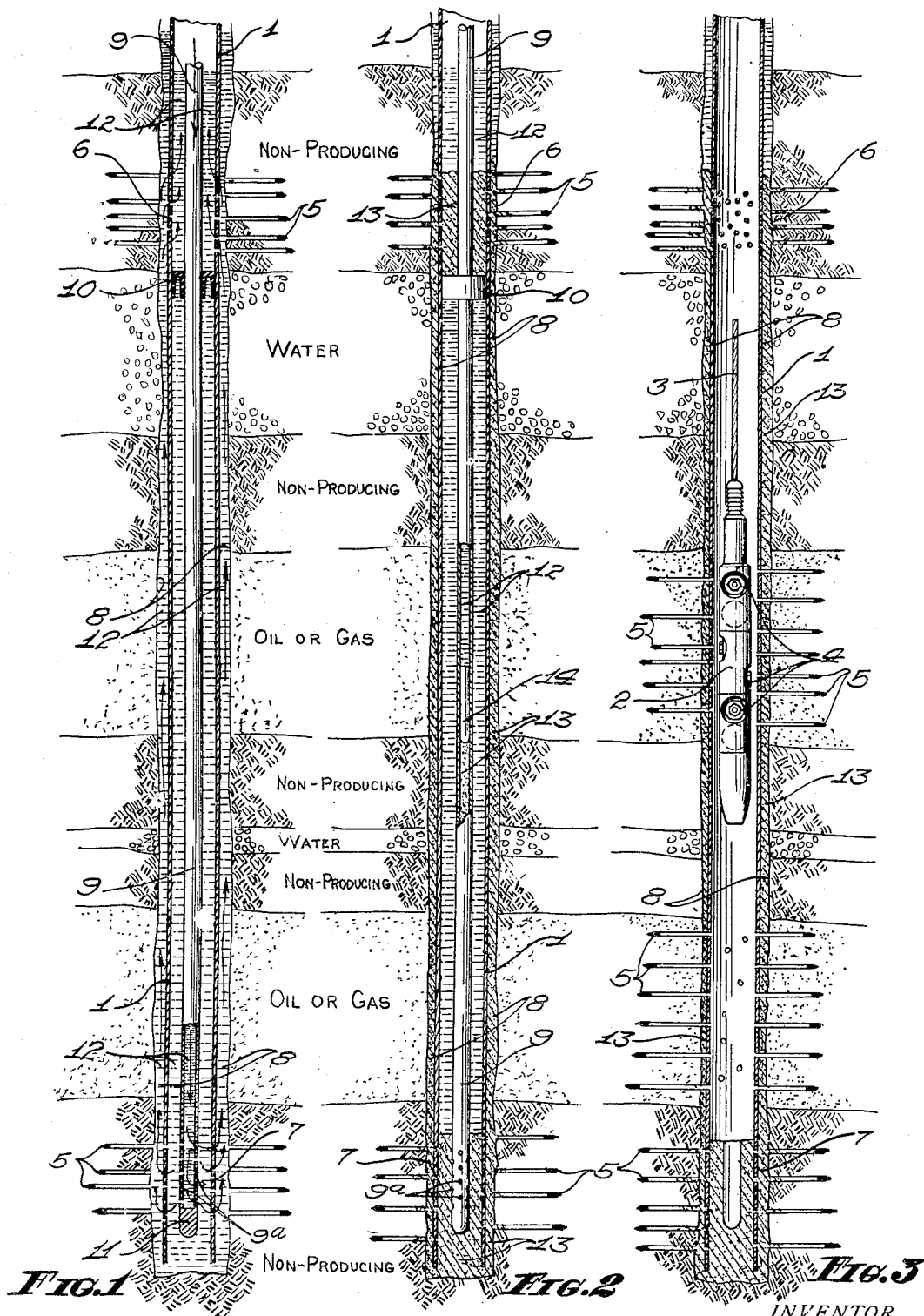
March 10, 1936.

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2,033,562

METHOD OF PREPARING OIL WELLS FOR PRODUCTION

Filed July 23, 1934



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2,033,562

METHOD OF PREPARING OIL WELLS FOR PRODUCTION

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Application July 23, 1934, Serial No. 736,533

14 Claims. (Cl. 166—21)

My invention relates to methods of preparing oil wells for production and the objects of my invention are:

First, to provide a method of this character whereby contamination of oil or gas-producing formation by water introduced in any manner between the casing and well bore is effectively eliminated:

Second, to provide a method of this character which materially reduces the number of casing strings needed in order to isolate undesirable formations from producing formations, thereby effecting a substantial saving in both labor and materials;

Third, to provide a method of this character whereby the size of the casing, particularly in deep wells may be materially increased;

Fourth, to provide a method of this character which not only materially insures against channeling of the cement or other difficulties that may occur while cementing in; but is so performed that in the event of an imperfect cement job, the process may be repeated without difficulty until the cementing is accomplished to perfection;

Fifth, to provide a method of this character which enables long sections of casing or the entire casing to be cemented in;

Sixth, to provide a method of this character whereby the effectiveness of the cementing job is apparent in the form of accumulations of cement on the apparatus used; and,

Seventh, to provide on the whole a novel method of cementing in well casing which is particularly flexible in its execution to meet the various conditions and situations encountered in oil well drilling;

With the above and other objects in view as may hereinafter appear, reference is made to the accompanying drawing in which;

Figure 1 is a diagrammatical sectional view of a well bore at its lower portion showing a casing in position after it has been perforated at spaced points, a tubing string run in, and water circulated; Figure 2 is a similar diagrammatical view showing the succeeding step in which cement is circulated through the two sets of perforations; and Figure 3 is a similar view showing the final step of perforating the casing and cement opposite the producing zones.

In conjunction with my method of preparing an oil well for production, it is intended to drill through the several formations whether non-productive or productive of water, gas or oil. After the desired depth is reached a casing 1 is lowered.

Thereafter, the casing is perforated by gun-

fire. This being accomplished preferably by a perforator gun such as illustrated and described in the following co-pending applications of one, Wilfred G. Lane; Well casing perforator; Serial No. 642,410; filed Nov. 12, 1932; and Method and means for controlling deep well gun-fire for perforating casing; Serial No. 648,049, filed December 20, 1932. Said gun is represented diagrammatically in Figure 3 and comprises a body 2 suspended from a conducting and supporting cable 3 and carrying a plurality of gun units 4 arranged to discharge bullets 5 laterally through the casing 1.

The casing is perforated in two zones designated 6 and 7, which are preferably located opposite unproductive formations above and below the several water bearing and oil or gas bearing formations. The distance between zones 6 and 7 is determined by the pressure required to force water and cement from zone 7 to zone 6. The lower the pressure used, the closer should be the zones. The distance between zones 6 and 7 is also dependent upon the tightness or concentricity of the casing in the well bore; that is, the area or condition of the passage 8 between the casing and well bore. In other words, the zones 6 and 7 should be sufficiently close to permit circulation through passage 8 and far enough apart to embrace as much of the oil bearing and water bearing formations as possible.

Upon accomplishing the perforation of zones 6 and 7 the gun is withdrawn and a tubing string 9 inserted. Said tubing string is provided with a packer 10 of any suitable construction and so disposed as to occupy a position immediately below zone 6. The tubing string continues below the packer 10 and terminates approximately opposite the lower zone 7. At this end the tubing string is closed by a plug 11 but is provided with apertures 9a immediately above the plug.

It should be noted here, that if the casing is to be cemented from its extreme lower end, the lower set or zone of perforations 7 may be omitted and the usual openings provided in the float or shoe, not shown, but often used at the lower ends of casing in deep wells, may be used. However, inasmuch as it is preferable to rest the casing on the bottom of the bore, it is often better practice to perforate the lower zone 7 to insure proper communication with the passage 8.

After the tubing string 9 has been positioned, water, indicated by 12, is circulated down through the tubing string 9 out the apertures 9a through the perforations of zone 7 upward through passage 8 and returning to the casing 1 through zone

8, so as to thoroughly clean passage 8 of drilling mud and other soluble or loose material.

This washing operation is of substantial importance for it washes accumulations of drilling mud from the walls of the bore so that the cement is applied directly to the formation. Heretofore, in other methods of cementing known to applicant, this mud has not been removed except in a restricted area adjacent to the bottom of the casing. Inasmuch as the mud is more or less soluble in water, its presence between the cement and formation prevents an adequate seal or permanent bond, thereby preventing the cementing in of long sections of the casing. Of course, it is customary to wash the bore to a limited extent before running the casing; but without the circulation established, as explained above, the encrustations of mud are not sufficiently removed to insure a proper bond between the cement and formation.

After inspection of the quantity and condition of the water returning through casing 1 has indicated that a good circulation through passage 8 has been established and the accumulations of deleterious matter removed therefrom, cement 12 is pumped down the tubing string 9 and caused to follow the path taken by the water until some of the cement has returned through zone 6, as shown in Figure 2. The flow of the cement may be facilitated by inserting a plug 14 on top of the cement introduced into the tubing string 9 and then pumping water against the plug to drive it to the bottom. By making the plug 14 of such length as to cover the apertures 9a it is possible to tell by the pump pressure when the plug has reached the bottom and the cement driven out and into passage 8.

It should be noted that water entirely fills the casing below the packer 10 so that the cement can rise no higher therein than zone 7. However, a second packer 10 may be disposed immediately above the apertures in the tubing string.

It is preferable to locate the perforations of zone 6 as close as possible in order to restrict the extent of zone 6. This reduces the amount of cement that must return to the casing 1 in order to close the zone 6 when the tubing string is withdrawn. Withdrawal is made after the cement has set sufficiently to maintain its position but before it is hard. As the tubing string is withdrawn, the packer 10 swabs the excess cement out and tends to further close any perforations in zone 6.

If it is desired to cement the casing for a greater distance than is feasible in a single operation, additional sets of perforations may be made in the adjacent portion of the casing and the washing and cementing operations repeated. This may be continued if desired until the entire casing is completely cemented in. In the repetitions of the process the zone 7 of the upper section preferably overlaps slightly the zone 6 of the lower section thereby insuring against any gaps in the cement.

Should a greater distance be provided between zones 6 and 7 than is practical, or should insufficient cement be introduced, it is merely necessary to perforate again at the calculated upper terminus of the cement and repeat the process.

After the casing has been properly cemented in, the perforator is again lowered and the casing perforated opposite the oil or gas producing formations as shown in Fig. 3. Inasmuch as the different formations have been adequately sealed one from the other, the casing may be perforated at any desired point, and it is possible to produce from more than one formation at a time by utiliz-

ing packers between the producing zones and separate means of communication with the surface, such as a tubing string for one formation and the space between the casing and tubing string for another formation.

I claim:

1. A method of preparing wells for production characterized by; drilling a well bore past a plurality of formations, including non-productive formations and those productive of water, gas, or oil, as the case may be; running a casing in said bore; then providing at least two zones of communication between the casing and the well bore so positioned to embrace a plurality of the formations; then establishing a circulation of fluid between said zones externally of the casing; then introducing into the bore externally of the casing through one of the zones a quantity of cement calculated to return in part through another; removing the excess cement within the casing; and then perforating the casing and cement opposite at least one of the producing formations.

2. A method of preparing wells for production wherein a casing has been run in a well bore characterized by; perforating the casing to establish at least two zones of communication from the interior of the casing to the space between the casing and the well bore; then introducing into the well bore externally of the casing through one of the zones a quantity of cement and venting the fluid displaced by the cement into the casing through another of the zones; and then perforating the casing and cement.

3. A method of preparing wells for production characterized by; drilling a well bore past a plurality of formations, including non-productive formations and those productive of water, gas, or oil, as the case may be; running a casing in said bore; then providing at least two zones of communication between the casing and the well bore so positioned to embrace a plurality of the formations; then introducing into the bore externally of the casing through one of the zones a quantity of cement and venting the fluid displaced by the cement into the casing; and then perforating the casing and cement opposite at least one of the producing formations.

4. A method of preparing wells for production characterized by; drilling a well bore past a plurality of formations, including non-productive formations and those productive of water, gas, or oil, as the case may be; running a casing in said bore; then firing projectiles through the casing so as to establish at least two zones of communication between the casing and well bore so positioned as to embrace a plurality of formations therebetween; then establishing a circulation of fluid between said zones externally of the casing; then introducing into the bore externally of the casing through one of the zones a quantity of cement calculated to return in part through another; and then firing projectiles through the casing and cement into at least one of the producing formations.

5. A method of preparing wells for production upon running a casing in a well bore past a plurality of formations, including those producing water, gas, or oil, as the case may be, said method characterized by; perforating the casing so as to establish at least two zones communicating with the exterior of the casing and embracing a producing zone; sealing the interior of the casing between the zones; then introducing water through one of the zones into the well bore in

such a manner as to cause return flow of the water into the casing through another of the zones, and continuing such supply of water until the well bore between the zones has been thoroughly washed; and then forcing cement through one of the zones into the portion of the well bore cleaned by the water, in a sufficient quantity calculated to fill the same.

6. A method of preparing wells for production upon running a casing in a well bore past a plurality of formations, including those producing water, gas, or oil, as the case may be; firing projectiles through the casing so as to establish at least two zones communicating with the exterior of the casing and embracing therebetween a producing zone; introducing a single tubing string into the casing; sealing the interior of the casing between the zones and around the tubing string; then introducing water through said tubing string and out of one of the zones into the well bore in such a manner as to cause return flow of the water into the casing through another of the zones, and continuing such supply of water until the well bore between the zones has been thoroughly washed; and then forcing cement through one of the zones into the portion of the well bore cleaned by the water, in a quantity calculated to fill the same; and then firing projectiles through the casing and cement and into a producing formation.

7. A method of preparing wells for production, characterized by: running a casing into a well bore; arranging at least two zones of communication from the interior of the casing to the space between the casing and well bore; introducing a tubing string into the casing; forming a sealing connection between the tubing string and casing and between said zones; establishing circulation of a washing fluid through the tubing string, externally of the casing between the zones, and between the tubing string and casing above the zones; then introducing a quantity of cement calculated to fill the space between the zones externally of the casing.

8. A method of preparing wells for production, characterized by: running a blank casing into a well bore past at least one producing formation; arranging at least two zones of communication from the interior of the casing to the space between the casing and well bore; introducing a tubing string into the casing; forming a sealing connection between the tubing string and casing and between said zones; establishing circulation of a washing fluid through the tubing string, externally of the casing between the zones, and between the tubing string and casing above the zones; then introducing a quantity of cement calculated to fill the space between the zones externally of the casing, and then perforating the casing and surrounding cement opposite a producing formation.

9. A method of preparing wells for production, characterized by: running a blank casing into a well bore; perforating the casing to form two zones of communication with the surrounding bore; arranging at least two zones of communication from the interior of the casing to the space between the casing and well bore; introducing a tubing string into the casing; forming a sealing connection between the tubing string and casing and between said zones; establishing circulation of a washing fluid through the tubing string, externally of the casing between the zones, and between the tubing string and casing above the zones; removing the tubing string; again perforating the casing to form a second set of two

zones of communication with the well bore, the lowermost of said zones being opposite and adjacent the calculated upper level of the previously introduced cement; then repeating the process of washing and cementing between the second set of zones.

10. A method of preparing wells for production characterized by: drilling a well bore past a plurality of formations, including non-productive formations and those productive of water, gas, or oil, as the case may be; running a casing in said bore; providing a pair of zones communicating with the exterior of the casing; establishing circulation of fluid externally of the casing between said zones only; introducing into the bore externally of the casing through one of said pair of zones a quantity of cement calculated to fill the bore to the other of said pair of zones; providing successively other pairs of communicating zones and repeating the introduction of cement between said other zones.

11. A method of cleaning a well bore of drilling mud and deleterious matter for the purpose of facilitating the cementing of a casing within the well bore, wherein the well bore has been drilled past a plurality of formations including non-producing formations as well as those productive of water, gas or oil as the case may be and wherein blank casing has been landed, characterized by: perforating said casing in at least two zones located opposite non-productive formations and embracing a productive formation, the relative spacing of said zones being sufficiently adjacent to insure flow of washing fluid externally of the casing therebetween; establishing two flow channels within said casing and communicating with said zones; and introducing a washing fluid through one flow channel outwardly through one of said zones along the exterior of the casing between the zones and returning the washing fluid and accumulated mud and deleterious matter through the other zone and flow channel.

12. A method of cleaning a well bore of drilling mud and deleterious matter for the purpose of facilitating the cementing of a casing within the well bore, wherein the well bore has been drilled past a plurality of formations including non-producing formations as well as those productive of water, gas or oil as the case may be and wherein blank casing has been landed, characterized by: perforating said casing in at least two zones located opposite non-productive formations and embracing a productive formation, the relative spacing of said zones being sufficiently adjacent to insure flow of washing fluid externally of the casing therebetween; introducing a tubing string into the casing to a point below the upper perforated zone; packing the space between the tubing string and casing and intermediate said perforated zone, whereby the interior of said tubing string communicates with the lower perforated zone and the upper perforated zone communicates with the area between the tubing string above the packer and the surrounding casing; then introducing washing fluid into one of said zones to cause its flow along the exterior of the casing to the other of said zones and return therethrough along with accumulated mud and deleterious matter.

13. A method of sectionally cleaning a well bore of drilling mud and other deleterious matter for the purpose of facilitating the cementing of the casing within the well bore, characterized by: perforating said casing in situ in at least two zones, the relative spacing of said zones being sufficiently adjacent to insure flow of washing

fluid externally of the casing therebetween; establishing two flow channels within said casing and communicating with said zones; and introducing a washing fluid through one flow channel outwardly through one of said zones along the exterior of the casing between the zones and returning the washing fluid and accumulated mud and deleterious matter through the other zone and flow channel.

10 14. A method of sectionally cleaning a well bore of drilling mud and other deleterious matter for the purpose of facilitating the cementing of the casing within the well bore, characterized by: perforating said casing in situ in at least two

15 zones, the relative spacing of said zones being sufficiently adjacent to insure flow of washing fluid

externally of the casing therebetween; introducing a tubing string into the casing to a point below the upper perforated zone; packing the space between the tubing string and casing and intermediate said perforated zones, whereby the interior of said tubing string communicates with the lower perforated zone and the upper perforated zone communicates with the area between the tubing string above the packer and the surrounding casing; then introducing washing fluid into one of said zones to cause its flow along the exterior of the casing to the other of said zones and return therethrough along with accumulated mud and deleterious matter.

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