

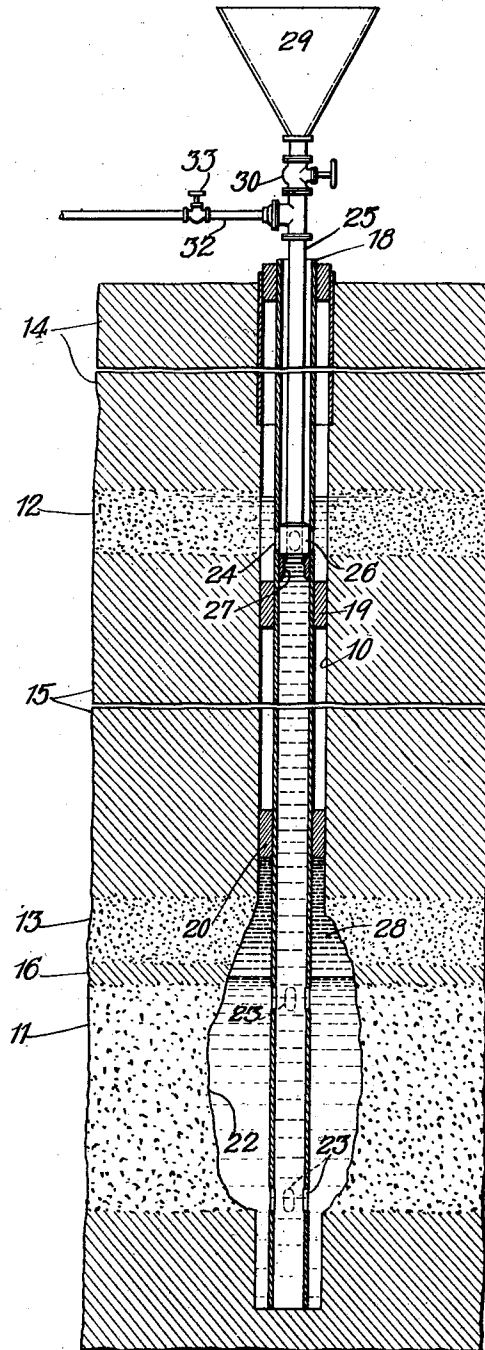
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METHOD OF PLUGGING OR PACKING OFF STRATA IN WELLS

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METHOD OF PLUGGING OR PACKING OFF STRATA IN WELLS.

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This invention relates to a method of plugging or packing off porous strata of sand or other material encountered in drilled oil and gas wells.

5 Heretofore, plugging or packing off a particular stratum in drilled wells has been accomplished by means of packers of rubber, or other suitable material, arranged about the usual well casing or tube in the vicinity of, for example, above and below, the stratum to be sealed. However, such a method is not always practicable, as for example in the case of an irregularly shaped well wall, which irregular shape may be due to many causes, as for example, caving, shooting, etc.

The general object of this invention is to provide an inexpensive, reliable and effective method for sealing undesirable strata, regardless of the irregularity of the well wall, whereby such strata are rendered non-permeable to water.

Other objects and advantages of the invention will become apparent from the following description, taken in connection with the accompanying drawing which is a diagrammatic sectional view of a plurality of strata through which a well has been drilled, one of which strata is shown as plugged or packed off according to the herein described method.

Although the method embodying this invention may be employed in connection with various types of wells, it will be described particularly in connection with a water intake well 10, such as is ordinarily employed in "flooding" processes for increasing oil recovery. The well 10 is illustrated as drilled from the surface of the ground to an oil bearing stratum of sand 11, through a water bearing stratum 12, a porous stratum 13 and other strata 14, 15 and 16 of various kinds. The well 10 is shown equipped with the usual well casing or tube 18, around which are arranged suitable packers 19 and 20 of well known forms adapted to prevent water from being lost in the stratum, 15. The casing or tube 18 is shown provided with a plurality of openings 23 and 24, the former of which open into the shot hole 22, and the latter of which open into the well 10 in the vicinity of the water bearing stratum 12 and at a point above the packer 19.

The casing 18 is shown surrounded at its top by the usual plug 26; and provided at a point just below the opening 24 with a suitable seat 27 of the type commonly known as the "McGregor seat".

In a well of the type herein shown, which is ordinarily used in "flooding" processes for increasing oil recovery, water is either supplied from a suitable source above ground or is allowed to pass from the water bearing stratum 12 into the well casing or tube 18, from which it escapes into the shot hole 22, from which it is forced, due to hydrostatic pressure within the well casing or tube 18, into the oil bearing stratum 11, thereby forcing the oil along such stratum to other wells or pumping stations from which the oil is recovered.

Should a well be so formed that communication is afforded between an oil bearing stratum and a porous stratum, which may or may not be located contiguous to the oil bearing stratum, a large portion of the water employed in the above mentioned "flooding" process may be wasted by reason of its being absorbed in the porous stratum, thus rendering such "flooding" process more or less inefficient due to the impracticability of furnishing a sufficient supply of water to the well to overcome the amount lost through the porous stratum. Such a porous stratum 13 is herein shown contiguous to the oil bearing stratum 11, so that communication between these strata would be afforded through the irregularly shaped shot hole 22, if the stratum 13 were not sealed. The illustration shown in the drawing furnishes a striking example of a possible condition under which it would be practically impossible to seal off communication between the oil bearing stratum 11 and the porous strata 13, by such packers of rubber or other material as have heretofore been employed. However, with the method embodying this invention, communication between the stratum 11 and the stratum 13 may be effectively closed. In carrying out this method, a pipe 25 is inserted into the well casing or tube 18 from the top thereof; this pipe being provided at its lower end with a packer 26, which is adapted to rest

upon the seat 27, thereby temporarily preventing water from the water bearing stratum 12 from flowing down through the well casing or tube 18 below the seal afforded between the seat 27 and the packer 26. With the water from the water bearing stratum 12 shut off from that portion of the well casing or tube 18 below the seat 27, such water as may remain within the well casing or tube 18 below the seat 27 drains into the strata 11 and 13 to a level, say in the plane of the bottom of the stratum 16. After the water level within the well casing or tube 18 has thus dropped a suitable sealing material 28, having a lower specific gravity than the water within the shot hole 22, is introduced into the pipe 25 from any suitable source of supply. The sealing material 28 passes through the pipe 25 and into the well casing or tube 18, from which it passes through the openings 23 into the shot hole 22 containing water. Since the sealing material 28 is lighter than the water confined within the shot hole 22, such sealing material rises to the top thereof and displaces the water in the upper portion of the shot hole. In order to facilitate movement of the sealing material down through the pipe 25 and well casing or tube 18, when, for example, a natural head of water exists in the well and extends a sufficient distance above the oil-bearing stratum 11 to interfere with the downward movement of the sealing material, the upper end of the pipe 25 may be closed, for example by means of a valve 30 and fluid pressure, such as air pressure from a suitable source, not shown, may be placed in communication with the pipe 25 through a suitable connection 32 which may be provided with a valve 33 adapted to be opened and closed as conditions may require. The fluid pressure thus applied to the top of the column of sealing material 28 serves to force the sealing material down through the pipe 25 and well casing or tube 18 and into the shot hole 22. The sealing material 28 is preferably such that it will penetrate the porous strata only to a slight extent, if at all, and is of such a nature that it will effectively seal the cavity or space into which it is introduced. A suitable sealing material may consist of 85% of a wax distilled residue, known at the refinery as black oil, and 15% of what is known at the refinery as dark fuel oil, the black oil congealing at a temperature of approximately 50° F. This black oil is diluted with the fuel oil in order to obtain a blend of a consistency which will flow down the pipe 25 and well casing or tube 18 without necessitating the use of excessive air pressure to facilitate such movement. In practice, a sufficient quantity of sealing material 28 is employed to completely fill the cavity to a point well below the lower plane of the porous strata, as for example, in the form

of well shown in the drawing, to a plane coincident with the lower plane of the stratum 16.

After having thus sealed the porous stratum or strata, a sufficient period, for example four or five days, is allowed to lapse before water pressure is introduced into the well casing or tube 18, which water pressure may be applied by removing the pipe 25 thereby establishing communication between the water bearing stratum 12 and that portion of the well casing or tube 18 below the seat 27, or by connecting the upper end of the well casing 18 to a suitable source of water above ground. Such introduction of water, either from the stratum 12 or from a source above ground, sets up a pressure within the shot hole 22, with the result that the sealing material 28 is further packed into the upper end of the shot hole 22 and the oil within the oil bearing stratum is driven on toward the pumping wells.

If the stratum to be sealed or rendered non-permeable to water is located below the oil bearing stratum, a suitable material heavier than water or the solution ordinarily applied in "flooding" the oil bearing stratum, may be employed, in which case the process may be carried out substantially as above described.

What is claimed is:

1. The method of plugging the space around a well casing, which consists in introducing into the well a sealing material in the presence of a displaceable liquid which has a specific gravity different from that of the sealing material, leaving said sealing material and displaceable liquid undisturbed until the sealing material moves into sealing position owing to the different specific gravities of said sealing material and displaceable liquid, and applying pressure to the sealing material after it is in sealing position.
2. The method of plugging water pervious strata in wells, which consists in introducing a sealing material into the well and floating the sealing material into sealing position, and applying pressure to the sealing material after it is in sealing position.
3. The method of plugging water pervious strata in a well, which consists in introducing an oil into the well and floating said oil into sealing position by a liquid having a specific gravity greater than that of the oil, and applying pressure to the oil.
4. The method of plugging the space around the casing of a well containing liquid, which consists in introducing into the well casing a sealing material having a specific gravity less than the liquid within the well, and applying pressure to the sealing material to eject it from said casing into the space around said casing.
5. The method of plugging the space around said casing of a well containing

liquid, which consists in introducing into the well casing a sealing material having a specific gravity less than the liquid within the well, and applying pressure to the sealing material to eject it from said casing into the space around said casing whereby it will be buoyed into sealing position by said liquid, and applying pressure to the sealing material after it is in sealing position.

6. The method of sealing predetermined strata in wells used for water flooding in connection with oil and gas recovery, which consists in introducing a sealing material into the well at a selected point, and floating the sealing material into sealing position by a liquid having a specific gravity greater than that of the sealing material.

7. For use in wells used for flooding in connection with gas and oil recovery, the method of plugging the space around the well casing at a selected point with respect to a predetermined stratum to be sealed off from the gas and oil bearing stratum, con-

sisting in introducing a sealing material into the space afforded between the well casing and the wall of the well, and floating said sealing material into sealing position at said selected point.

8. For use in wells used for flooding in connection with gas and oil recovery, the method of plugging the space around the well casing at a selected point with respect to a predetermined stratum to be sealed off from the gas and oil bearing stratum, consisting in introducing a sealing material into the space afforded between the well casing and the wall of the well, and floating said sealing material into sealing position at said selected point, and applying pressure to said sealing material after it has assumed sealing position.

In testimony whereof, we have affixed our signatures to this specification.

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