Dec. 6, 1966 R. J. SMITH ETAL 3,289,761

METHOD AND MEANS FOR SEALING WELLS

Filed April 15, 1964 2 Sheets-Sheet 1

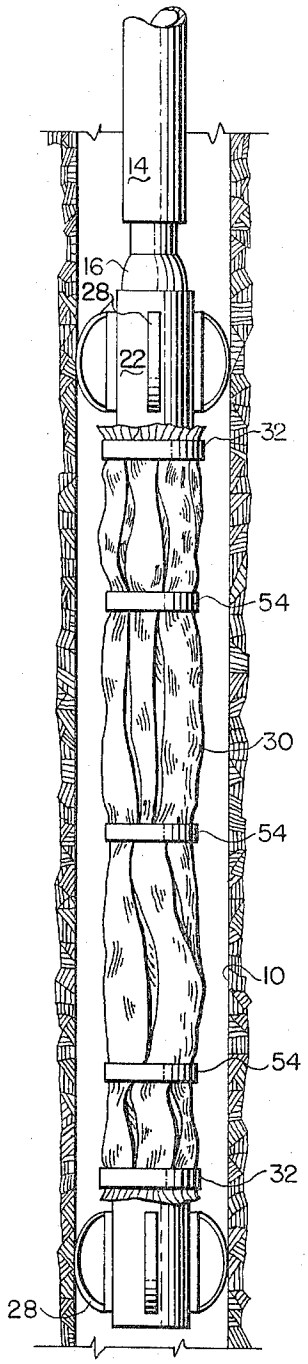

FIG. 1

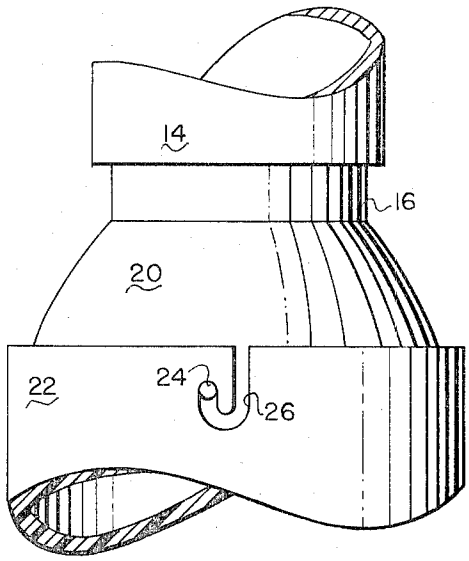

FIG. 4

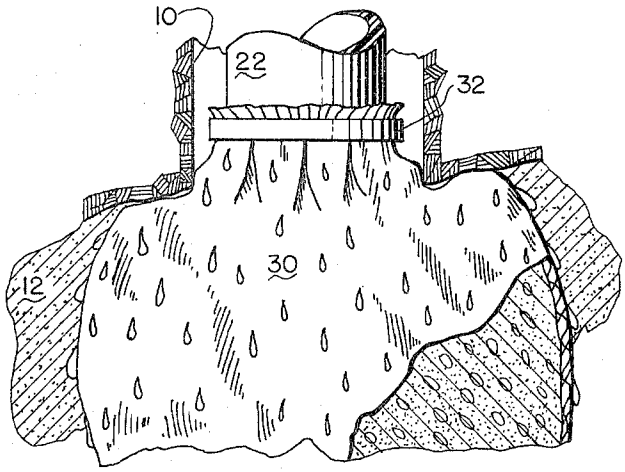

FIG 5

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FIG. 3

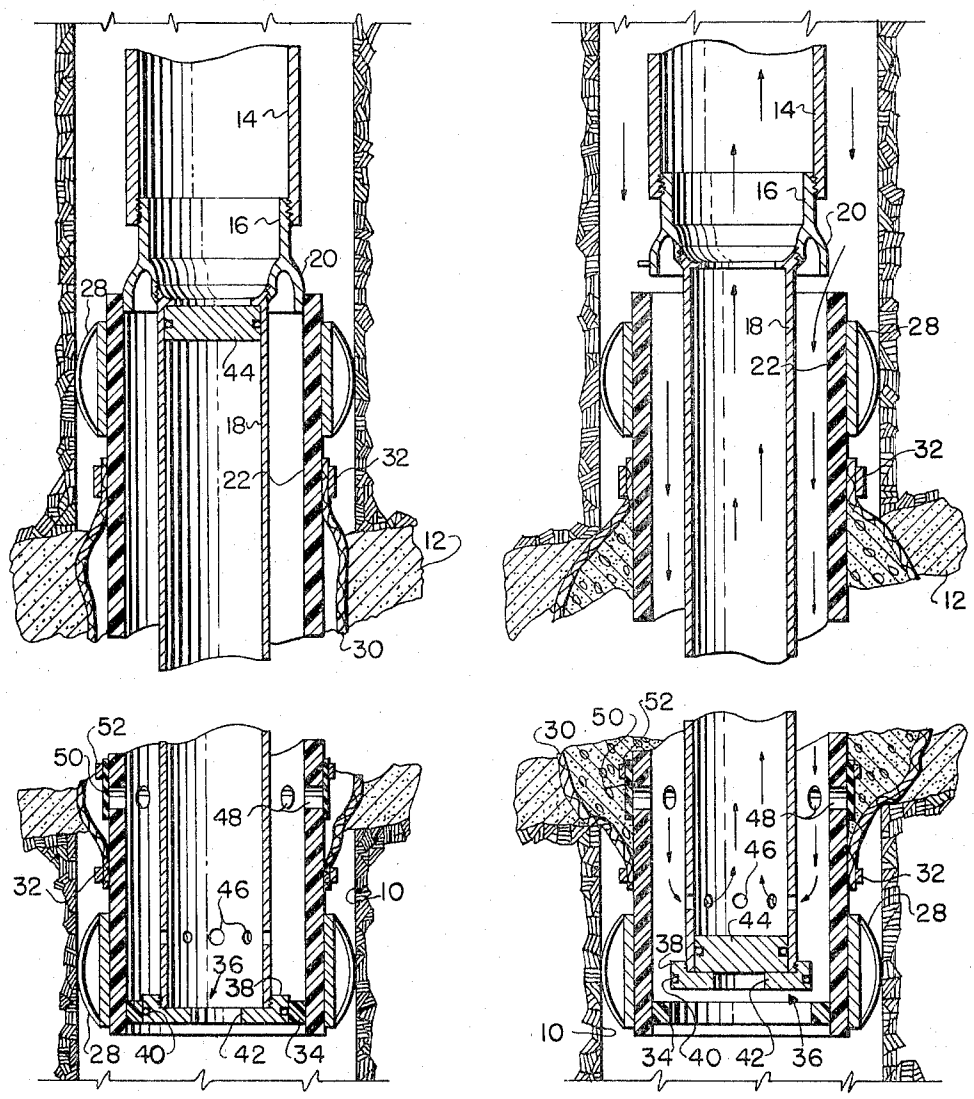

FIG. 2

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METHOD AND MEANS FOR SEALING WELLS

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5 Claims. (Cl. 166—27)

This invention relates to sealing off an interval in a well.

In the drilling and production of wells, more particularly oil wells, often difficulty is experienced by an area of permeability. During the life of producing wells or drilling new wells that have more than one permeable zone due to watering out, thiefing, excessive gas production, etc., it is extremely desirous that an interval be sealed off as is explained in the prior patent of R. J. Smith, one of the co-inventors here, U.S. Patent No. 3,032,115. After the interval has been sealed off or plugged, it is desirable to have an open hole therethrough so that items such as pipe strings or eduction tubing may be run in and out the well. Also on production and injection wells it is desirable to have an open hole.

In the sealing off of these intervals a sac is used to contain the cement and prevent it from dispersing within the well bore. We have found it desirable to have this cement to ooze through the fabric of the sac so that a good bond is formed between the sac and the walls of the well bore.

An object of this invention is to seal off intervals in a well.

Another object of this invention is to seal off an interval while leaving a hole through the well without the necessity of drilling out the cement by which the interval was sealed.

A further object of this invention is to provide an improved seal between a cement containing sac and the walls of the well bore.

Still further objects are to achieve the above with a device that is sturdy, compact, durable, simple, versatile, and reliable, yet inexpensive and easy to manufacture and operate.

Still further objects are to achieve the above with a method that is rapid, inexpensive, and easy for inexperienced, unskilled people to perform.

The specific nature of the invention as well as other objects, uses, and advantages thereof will clearly appear from the following description and from the accompanying drawing the different views of which are not to the same scale, in which:

FIG. 1 is a sectional view of the well with an elevational view of an embodiment of this invention as it is lowered into the well, broken in parts due to its length.

FIG. 2 is a sectional view of the tool of FIG. 1 in place opposite the interval to be sealed off.

FIG. 3 is a sectional view of the tool with the cement in the sac showing excessive cement being washed away.

FIG. 4 is an elevational view of a portion of the tool showing details of construction.

FIG. 5 is a detail view partially broken away showing the sac weeping cement.

Referring more particularly to the drawings, it may be seen that this equiment is adapted to be used within a well within the earth. The well will be defined by the wall **10** of the bore of the well. The object as stated above is to seal off or plug permeable intervals **12**.

The equipment is adapted to be attached to tubing **14**. It will be understood that adapters could be made and the equipment could be attached to any type of tubular good such as a string of drill steam. Sub **16** is threaded on its upper end to thread within the tubing **14**. The sub **16** on its lower end branches so that there are concentric passageways. Stated otherwise, washout tube **18** is

threaded onto the bottom of the sub **16**. A flange **20** is attached as by welding to the sub and extends outward and downwardly concentric with the washout tube **18** at the top thereof. The top of retaining casing **22** is detachably attached to the flange **20** of the sub **16**. There are many means for making a detachable attachment. Illustrated is a pin **24** attached to the flange **20** which extends through a J slot **26** in the top of the retaining casing. By moving the sub **16** downward and rotating in the correct direction, the retaining casing **22** may be detached from the sub **16** at the will of the operator.

The retaining casing **22** is constructed of some drillable material. These materials are known to the art and may consist of a synthetic resin material such as Bakelite or they may be made of certain metals which are drillable such as certain alloys of aluminum well known to the art. Centering bow springs **28** are attached to the casing **22** at the top and bottom thereof to maintain the retaining casing **22** centered within the well bore.

Sac **30** is attached to the retaining casing **22** between the centering springs **28**. The sac is sealed to the retaining casing at the top and bottom of the sac as by split rings **32**. The sac **30** is constructed of semiporous material such as coarse woven nylon. We refer to this is semi-porous and by this we mean that air will readily pass through interstices of the weave and that the fabric is quite permeable to water. However, the cement will only ooze or weep through the fabric. The larger solids of the cement are maintained within the sac **30**, but the extremely small particles of cement will pass through the fabric and sufficient cement will pass through the fabric to be sufficient to form a good seal between the fabric of the sac **30** and the wall **10** of the well bore.

It will be understood the sac **30** is quite pliable and flexible and when filled with pressure, it will conform to the retaining surroundings of the contour of the wall **10** of the well bore.

The retaining casing **22** is telescoped over the flange **20** with a snug fit so that it forms a fluid seal at that point. Internal flange **34** extends into the retaining casing near the bottom thereof. The flange is attached by threading it to internal threads upon the bottom of the retaining casing or it may be bonded thereto by cement.

Fitting **36** is threaded to the bottom of the washout tube **18**. The fitting **36** has an external flange **38**. This external flange has a peripheral groove which contains O ring **40** which forms a fluid tight seal against the internal face of internal flange **34**. Thus, it may be seen that there is a chamber formed between the retaining casing **22** telescoped around the washout tube **18**, defined at the top by the flange **20** and at the bottom by the internal flange **34**.

The fitting **36** also has an internal flange **42** which forms a stop for plug **44** which is shown in the drawing as formed of metal with O rings forming a seal between it and the inside of the washout tube **18**. It will be understood by those skilled in the art that it could be solid rubber. Holes **46** extend through the washout tube **18** near the bottom thereof. When the plug **44** is in the lower position resting upon internal flange **42**, the holes will be just above the top of the plug **44** in such position. Approximately opposite the holes **46** the retaining casing **22** has holes **48** providing access from within the retaining casing to within the sac **30** on the outside of the retaining casing. A short rubber tube or band **50** surrounds the holes **48** on the outside of the retaining casing **22**. It is held in place by a metal band **52**. Therefore, it may be seen that if there is pressure within the retaining casing **22**, that the pressure will push the flexible rubber tube **50** from around the holes permitting the fluid to flow. However, material cannot flow from within the sac **30** to within the retaining casing **22**. Therefore, it may be seen that rubber tube **50**

forms a check valve for the holes 48 permitting fluid to be pumped out of the chamber, but prohibiting it from returning into the chamber.

Also, with the passageway described, it may be seen that I have provided means for pumping cement from the surface of the ground to within the sac 30 outside of the retaining casing 22.

To insure that the sac 30 lies close against the retaining casing 22 while the tool is being lowered into the hole, elastic bands 54 hold the sac 30 tight.

Operation

In operation, the tool shown in FIG. 1 is attached to the tubing 14 and lowered into the well so that the tool is opposite or adjacent the interval 12 to be plugged off. The tubing 14 is empty while it is lowered into the well. After it has been lowered into the well, a predetermined, measured amount of cement is introduced into the tubing 14 and a separation plug placed on top of it, then the cement pumped down with water on top thereof. Plug 44 is forced to the bottom of the washout tube 18 to rest upon internal flange 42. Any air or water within the tubing will flow through the holes 46 into the chamber and out of the chamber through holes 48 to within the sac 30 and any air or water will pass through the semi-porous sac 30. The cement will follow the same path into the sac, but because of the nature of the fabric of which the sac is constructed, it will not leave the sac. If there is an excess of water in the cement, some of the water might be squeezed from the sac, but basically, the mixture will be retained within the sac.

After the sac 30 has been expanded to the limits of the wall 10 of the bore hole, the pressure is removed from the surface of the ground and the washout tube 18 disconnected from the retaining casing at the connection between the sub 16 and the retaining casing 22 by the J slot 26 the operation of which is well known. The tube 14 and the washout tubing 18 are raised a few inches so that there is a fluid passageway between the bottom of the washout tube 18 and the internal flange 34. Then from the top of the ground, the water is circulated between the wall 10 of the well bore and the tubing 14, down through the retaining casing 22, and back through the holes 46 into the washout tube 18, as shown by arrows in FIG. 3. Therefore, any cement within the retaining casing is washed free from the area and back through the washout tube 18 to the surface of the ground. Therefore, upon the completion of the operation, the inside of the retaining casing 22 is washed free of cement leaving an open hole through the well bore.

Normally, the retaining casing 22 remains in place and any operations (including fluid passage as in production or injection) below it are carried on through it. However, it will be understoood that if the internal diameter of the retaining casing 22 is not sufficient for the operation, it is constructed of drillable material so that it may be readily removed by drilling as is well known in the art.

Therefore, it may be seen that we have provided means for sealing off an interval in a well bore while leaving an open hole therethrough.

The term "cement" is used in its broad sense and by "cement" we mean to include not only Portland cement, but other types including liquid plastics of synthetic resins which solidify.

It will be apparent that the embodiment shown is only exemplary and that various modifications can be made in construction, materials, and arrangement within the scope of the invention as defined in the appended claims.

We claim as our invention:

1. A device for sealing off intervals in wells leaving an open hole therethrough comprising in combination:
(a) a washout tube,

(b) means for attaching the top of said washout tube to a string of tubing extending upward from the bottom of the well,
(c) a retaining casing,
(d) said retaining casing constructed of drillable material,
(e) means at the top of the retaining casing for detachably attaching the casing to the top of the washout tube,
(f) an internal flange at the bottom of the retaining casing,
(g) a seal between the bottom of the washout tube and said internal flange, thus forming a chamber between the washout tube and retaining casing,
(h) means in the washout tube for plugging the bottom of the washout tube,
(j) the washout tube having holes therethrough above the means for plugging,
(k) the retaining casing having holes therethrough,
(m) check valve means associated with the holes in retaining casing for permitting fluid to flow out of said chamber but not return, and;
(n) a sac surrounding the retaining casing to prevent dispersement of the cement thereform.

2. The invention as defined in claim 1 wherein said sac is pervious to water and weeps cement.

3. A device for sealing off intervals in wells leaving an open hole therethrough comprising in combination:
(a) a washout tube,
(b) means for attaching the top of said washout tube to a string of tubing extending upward from the bottom of the well,
(c) a retaining casing,
(d) means at the top of the retaining casing for detachably attaching the casing to the top of the washout tube,
(e) means on the bottom of the retaining casing for forming a releasable seal between the bottom of the washout tube and bottom of the retaining casing,
(f) the washout tube having holes therethrough,
(g) the retaining casing having holes therethrough,
(h) check valve means for permitting fluid to flow out of said retaining casing, but not to return, and
(j) a sac surrounding the retaining casing to prevent dispersement of cement therefrom.

4. The invention defined in claim 3 wherein said sac is pervious to water and weeps cement.

5. The method of sealing off an interval in a well bore leaving an open hole therethrough comprising
(a) lowering a retaining casing into the well adjacent the interval to be sealed off,
(b) pumping cement between the retaining casing and the well bore,
(c) preventing the cement from dispersing into the well bore by pumping it into a sac,
(d) sealing the sac to the well bore by causing a small amount of cement to ooze through the sac,
(e) preventing any cement between the retaining casing and well bore from flowing into the retaining casing, and
(f) washing the cement within the retaining casing to the surface of the ground.

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