April 27, 1948. O. L. FURSE 2,440,506

SUBSURFACE CHOKE

Filed Dec. 27, 1943

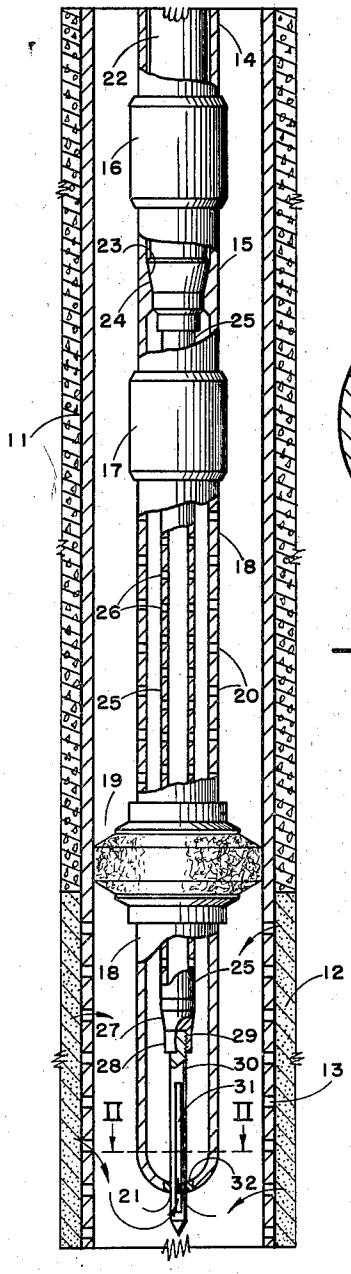


FIG. 1.

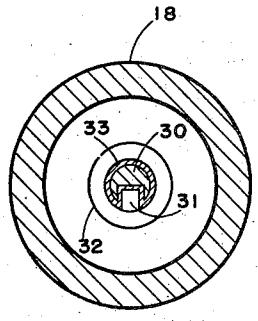


FIG. 2.

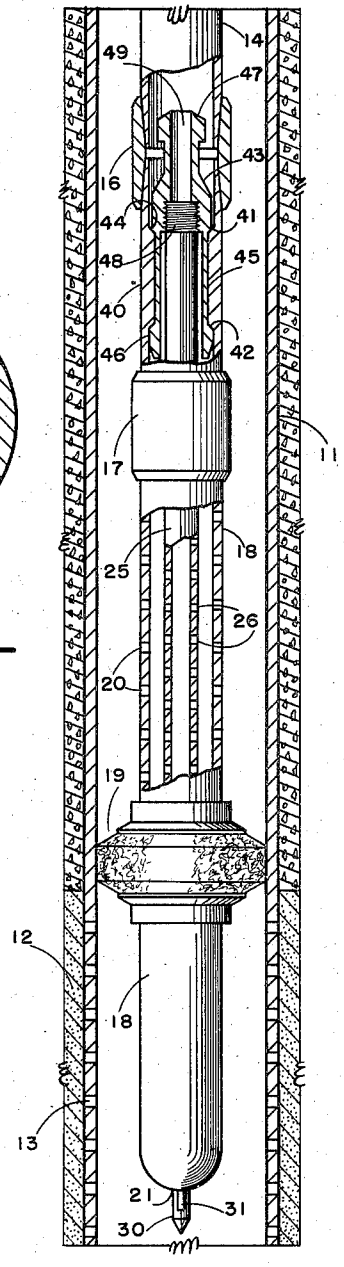


FIG. 3.

Oliver L. Furse INVENTOR.

BY

J. G. McKean

ATTORNEY.

Patented Apr. 27, 1948 2,440,506

UNITED STATES PATENT OFFICE

2,440,506

SUBSURFACE CHOKE

Oliver L. Furse, Overton, Tex., assignor to Standard Oil Development Company, a corporation of Delaware

Application December 27, 1943, Serial No. 515,748

5 Claims. (Cl. 166—2)

1

The present invention is directed to an arrangement providing a restricted opening or choke to control the flow of fluid in a well.

At the present time it is customary to complete wells by running a string of tubing inside the casing so that the production from the well will flow up the string of tubing. The present invention is adapted to be arranged at the lower end of a string of tubing in either a pumping well or a well flowing under its own pressure.

Other objects and advantages of the present invention will be seen from a reading of the following description taken in conjunction with the drawing, in which:

Fig. 1 is an elevation partly in section of the lower portion of a pumping well equipped with an embodiment of the present invention;

Fig. 2 is a section taken along II—II of Fig. 1; and

Fig. 3 is an elevation partly in section of the lower portion of a well capable of flowing under its own pressure and provided with another embodiment of the present invention.

Turning now specifically to the drawing, and first to the device shown in Figs. 1 and 2, a borehole lined with a casing 11 penetrates a petroleum producing formation 12 with suitable perforations 13 adjacent the producing formation to allow the flow of fluid into the bore of the well. Within the casing is suspended a string of tubing 14 having a seating nipple 15 secured to the lower end thereof by suitable means such as coupling 16, and secured to the lower end of the seating nipple by suitable means such as coupling 17 is tubing 18. A packing means 19 is mounted on the lower portion of tubing 18 to close the annulus between the tubing 18 and the casing.

The portion of the tubing 18 above packer 19 is pierced by a plurality of perforations 20. The lower portion of tubing 18 is without perforations and has its end closed, with the exception of a single axial opening 21. Within the string of tubing 14 is an insert pump 22 having its lower end provided with a tapering seat 23, which rests on a corresponding tapering seat 24 of the seating nipple. As is generally known to the art, insert pumps include a body arranged to be supported on a seat and a plunger adapted to be reciprocated and attached to a string of rods, and the pump may be placed in position by lowering it by means of the rods and may be removed to the surface by drawing it upwardly by means of the string of rods. The construction of insert pumps is well known to the art and hence the showing in detail of the mechanism of

2

pump 22 and a showing of the string of rods is omitted from the drawing in order to keep it as simple as possible.

Secured to the lower end of the body of pump 22 is downwardly extending tubing 25 provided with a plurality of perforations 26. The tubing member 25 is in the form of a perforated tubular body having its lower end closed by means of a suitable closure or plug 27. Closure 27 is provided with a downwardly extending circular shoulder or bushing 28, and secured thereto by readily engageable and disengageable means such as mating screw threads 29 is a downwardly extending rod 30, whose axis lies on a prolongation of the axis of pump anchor 25. The rod 30 preferably is constructed with a uniform diameter throughout its length and of such a size that it makes a sliding but snug fit with the opening 21. The length of rod 30 is selected so that its lower end extends below tubing nipple 18 when the insert pump 22 is resting upon its seat. A longitudinally extending slot 31 extends upwardly from the lower end of rod 30. This slot is of such length as to insure an opportunity for the liquid to enter it at a point below the lower end of tubing 18 and to leave it at a point within the body of tubing 18. The area of slot 31 defines the size of the choke or restriction through which fluid is forced to flow from the producing formation into the lower portion of tubing 18, and will be selected in accordance with the characteristics of the field and the well to which it is applied. If the area of the slot installed in a well is not satisfactory, the insert pump with the attached pump anchor and rod 30 may be readily withdrawn to the surface, another rod 30 with a different size slot 31 substituted for the original rod 30, and the insert pump with the attached pump anchor and substituted rod 30 lowered back into position. In order to resist better the abrasion caused by the flow of fluid through the restrictions into the tubing 18, it is preferred to surround the opening 21 with an abrasion resisting annulus 32, formed, for example, of Haystellite, and similarly it is preferred to provide rod 30 with an abrasion resisting coating 33, which also may be Haystellite.

The operation of the device shown in Figs. 1 and 2 will be self-evident to a worker skilled in the art. Fluid from producing formation 12 passes through casing perforations 13 and thence through groove 31 into the lower portion of tubing 18. If the pump is in operation, the fluid passes upwardly in the annulus between the tubing 18 and tubing 25 and through perforations

26 into tubing 25 and then upwardly into insert pump 22. If the pump is not in operation, the fluid will flow from the annulus defined by tubing 18 and tubing 25 outwardly through perforations 20 into the reservoir defined by the well casing 11 and the tubing 18 above packer 19. After fluid has been stored in this reservoir and pumping is begun, the liquid will be withdrawn from said reservoir whenever the fluid is pumped out of the well faster than the amount passing through slot 31.

The other embodiment of the present invention, shown in Fig. 3 is adapted for use in wells having sufficient formation pressure to force the fluid to the surface without pumping. In this embodiment the well is provided with a casing 11 penetrating through producing formation 12 and having perforations 13 adjacent thereto, as does the embodiment of Figs. 1 and 2. Within the casing is arranged a string of tubing 14, also corresponding to that of Figs. 1 and 2. Secured to the lower end of tubing 14 by suitable means, such as coupling 16, is anchor shoe 40, provided with an upper inwardly tapering seat 41 and a lower inwardly tapering seat 42. Secured to the lower end of the anchor shoe by coupling 17, is tubing 18, corresponding to that shown in Figs. 1 and 2, and provided with perforations 20, and packer 19, and having an opening 21 at the lower end thereof.

A body 43, commonly designated as a pipe anchor, and adapted for longitudinal movement along tubing 14 defines an inwardly tapering seat 44, and is arranged within the tubing string with seat 44 resting on seat 41 of the anchor shoe. Body 43 is constructed with downwardly depending arms 45. An outwardly projecting lug or shoulder 46 is provided on the lower end of each arm 45. The arms extend downwardly a sufficient length to insure the positioning of projections 46 at least below tapering seat 42 when the upper seat 44 of the body 43 rests on seat 41 of the anchor shoe. The upper portion of body 43 is shaped to form a head 47 arranged for cooperation with a grappling device, not shown, to allow the withdrawal of the anchor body upwardly through the bore of the tubing.

Secured to body 43 by means of screw threads 48 is tubing 25, provided with perforations 26 and corresponding to the tubing 25 of Figs. 1 and 2. To the lower end of tubing 25 is attached rod 30, in which is arranged longitudinal groove 31 and which corresponds in all details with corresponding rod 30 of Figs. 1 and 2. The opening 21 in the lower end of this member is preferably provided with an abrasion resisting annulus 32, and the rod is preferably given an abrasive resisting coating 33. Body 43 is provided with a passage 49 which communicates with the passage defined by member 25, and allows the discharge of fluid, entering 25 by means of perforations 26, into the tubing at a point above the body seat 44. The portion of the device including body 43, tube 25 and rod 30 of Fig. 3 may be placed in position or removed by means of a wire line and without manipulation of the tubing. The body may be secured to the end of a wire line provided with conventional attaching means and jars and lowered through the tubing until projections 46 come in contact with seat 41. The body may then be driven downwardly by the jars until seat 44 rests on seat 41 and the projections 46 are below seat 42. The attaching means may then be released from body 43 and withdrawn with the jars to the surface. When it is desired to withdraw body 43, tubing 25 and rod 30 from the well, a grappling tool may be secured to the end of a wire line, lowered into the well and engaged with head 47 and sufficient strain then put on the wire line to release the body 43 from anchor shoe 40, and the assembly may then be withdrawn to the surface. The use of a wire line in connection with jars and grappling means is conventional to the art, and hence these devices have not been illustrated in the drawing. It will be evident that the hold-down device retains the assembly in position against the effective well pressure when it is assembled as shown in Fig. 3, and allows the assembly to be readily removed and replaced at the convenience of the operator.

The dimensions and proportions of the device of the present invention may be varied over a wide range and satisfactory results obtained. I accordingly do not intend to be restricted to any specific dimensions or proportions. However, by way of illustration, it may be stated that a satisfactory assembly has been found to include a perforated tubing 25 of 1" or 1¼" in diameter and a rod 30 of ½" or ⅝" in diameter when the well is provided with tubing ranging in diameter from 2" to 3". These dimensions, and particularly the diameter of rod 30, may of course be increased or diminished as desired.

Having fully described the preferred embodiments of the present invention, what I desire to claim is:

1. An assembly adapted to be secured to the lower end of a string of tubing and arranged in a well, said assembly comprising, in combination, a tubular first member with the inner wall of its upper end defining a seat, its lower end closed except for an axial circular port of smaller diameter than said seat, said first member being adapted to have its upper end secured to the lower end of the string of tubing, a second member adapted to be slidably inserted into and withdrawn from the first member and including a medial perforated tubular body portion of smaller diameter than the minimum diameter of the seat, an upper portion of said second member defining a central passage and having an exterior surface shaped to cooperate with said seat to make a fluid tight seal, and a lower solid rod portion of slightly less diameter than said axial port in the first member and making a close fit therewith, said rod portion being provided with a longitudinal groove, the second member having such a length that when inserted in the first member with its upper portion in contact with said seat the rod portion projects through the axial port with said longitudinal groove extending above and below the wall defining said port.

2. A device adapted to be placed in a well provided with a casing and a string of tubing and comprising, in combination, a first member including a seating nipple adapted to be secured to the lower end of a string of tubing and to provide support for a pump, a first tubular body having an upper portion perforated said body having its lower portion closed with the exception of an axial opening, the upper end of said body being secured to the lower end of said seating nipple, a packer mounted on said first tubular body at a point below said perforations and above said axial opening to seal the annular space between said casing and said tubular body, a second member adapted to be slidably inserted into and withdrawn from the first member and including a second tubular body of substantially less diameter than the first tubular body and arranged to

have its upper end secured to a pump supported by the seating nipple, the longitudinal axis of said second tubular body coinciding with the longitudinal axis of the first tubular body, said second tubular body being provided with a plurality of perforations, a downwardly depending solid rod secured to the lower end of said second tubular body with the longitudinal axis of said rod coinciding with the longitudinal axis of the second tubular body, said rod being of such length as to extend through the axial opening of the first tubular body when the second tubular body is secured to a pump supported by the seating nipple and making a close fit with the central opening and said rod being provided with a longitudinally extending groove to provide a passage from the exterior of the lower end of the first tubular member into the interior thereof.

3. A device in accordance with claim 2 in which the lower end of the first tubular member is provided with an abrasion resisting annulus insert with the opening of the annulus defining the axial opening and in which at least the lower portion of the rod is provided with a wear resisting surface.

4. A device adapted for use in a well provided with a casing and a string of tubing and comprising, in combination, a first member including an anchor shoe adapted to be secured to the lower end of said string of tubing, a first tubular body with its upper end secured to the lower end of said anchor shoe and having an upper portion provided with a plurality of perforations and a lower portion closed with the exception of an axial opening, a packer mounted on said first tubular body at a point below said perforations but above said opening to seal the annular space between said body and said casing, a second member adapted to be slidably inserted into and

withdrawn from the first member and including a pipe anchor seated within said anchor shoe and adapted to be placed in position within the anchor shoe and to be removed therefrom by means of a wire line, a second tubular member of substantially less diameter than the first tubular member and having its upper end secured to said pipe anchor and depending downwardly with its longitudinal axis coinciding with the longitudinal axis of the first tubular member, a solid rod secured to the lower end of the second tubular member and with its longitudinal axis coinciding with the longitudinal axis of said second tubular member, said rod extending through the opening in said first tubular member, and making a close fit with said opening as it passes therethrough and being provided with a longitudinally extending groove to allow the flow of fluid through the opening defined by said groove and the wall of the first tubular member.

5. A device in accordance with claim 4 in which a wear resisting annulus is secured to the lower end of the first tubular member and the opening through said annulus is said axial opening and the surface of at least the lower portion of the cylindrical body is provided with an abrasion resisting coating.

OLIVER L. FURSE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,800,144	Johnson	Apr. 7, 1931
1,977,915	Mowry	Oct. 23, 1934
2,152,980	Svadlenak	Apr. 4, 1939