Description

The present invention relates to a valve for use in well testing, and a method of utilising said valve.

It is desirable to be able to test a petroleum formation under both static and flowing conditions. Equipment has been proposed for testing under static conditions. See, for example, U.S. Patent Specification Nos. 4,051,897 and 4,134,452 (Kingelin).

It has also been proposed to be able to open and close a by-pass valve controlling flow from the formation in such a test program. See U.S. Patent Specification No. 4,047,564 (Nix).

So far as is known the prior art does not teach a simple wireline retrievable by-pass valve which can be located in a well tubing together with an operating probe which can be manipulated to open and close a by-pass valve and which can either collect data or samples or can transmit data to the surface over a conventional electric line.

It is an aim of the present invention to provide a by-pass valve in a well string, which may be opened and closed by reciprocating a probe located in the by-pass valve, which probe is exposed to formation pressure at all times, and in which unseating of the probe returns the by-pass valve to its original condition.

Another aim is to provide a system of testing wells in which the by-pass valve of the present invention can be run in the well and seated in a locating nipple using conventional locking mandrel techniques.

Another aim is to provide a method of testing wells using a by-pass valve of the present invention which is preferably normally open in which a probe can be located and the valve opened and closed by reciprocation of the probe and in which the probe is released from the by-pass valve by an upward pull on the probe.

The present invention starts from a by-pass valve for use in well testing, said valve comprising a valve body having a seat therein, a valve member being co-operable with said seat and controlling flow through the valve body, first resilient means urging the valve member towards one of open and closed positions. Such type of a valve is for instance disclosed in US—A—4 047 564.

According to the present invention said valve is characterised by a plunger connected to said valve member to move with the valve member between the open and closed positions, the connection between the plunger and the valve member providing for movement of the plunger relative to the valve member after the valve member reaches the other of said open and closed positions, second resilient means opposing relative movement between the plunger and the valve member, and pulling means being arranged to releasably latch onto said plunger, latch release means being arranged to release said pulling means from said plunger upon movement of said plunger a selected distance in a direction towards said other position after said valve member has moved to said other position, said plunger having a flowway therethrough by-passing said valve seat, said by-pass valve being operable by a probe which is releasably locatable in said valve, the probe being adapted to be attached to a line extending to the surface.

According to a further feature of the present invention there is provided a well testing system comprising tubing with a location nipple, a locking mandrel for a probe located in said nipple, a by-pass valve according to the present invention carried by said locking mandrel, said valve having its valve member resiliently urged to one of open or closed positions, said valve member being movable to the other of the open and closed positions by raising of the probe and to said one position by the resilient means upon lowering of said probe, said probe being releasable from said valve upon upward movement a selected distance beyond that movement required to move said valve member to said other position.

Earlier own EP—A—0 024 214 falling under Art. 54(3) and (4) EPC already discloses a well testing system having a tubing with a locating nipple which comprises a by-pass valve, a locking mandrel located in said nipple, the locking mandrel receiving a transducer probe introduced into the tubing.

According to a still further feature of the present invention there is provided a method of testing a well using a tubing with a location nipple and a by-pass valve in said location nipple in which a transducer probe is introduced into the tubing and located in the by-pass valve, the method comprising the steps of alternately flowing the well and shutting down the well by raising and lowering said probe after it is located in the valve, and determining well conditions while said well is shut-down and flowing. Preferably said probe is raised a distance beyond that required to move the valve member between the open and closed positions to release the probe from the valve.

The present invention will now be further described, by way of example, with reference to the accompanying drawings, in which:—

Figure 1 is a schematic illustration partially in cross-section and partially in elevation of a well with the transducer fitting or by-pass valve according to the present invention, in place and showing the operating plunger being moved through the tubing on an electric line;

Figure 2 is a view in cross-section of the by-pass valve of this invention with the lower end of the operating plunger in engagement with the valve but not attached thereto;

Figure 3 is a view similar to Figure 2 showing the plunger to be in engagement with the by-pass valve and the by-pass valve to be in open position; and

Figure 4 is a view similar to Figures 2 and 3 with the plunger in engagement with the by-pass valve and raised to position the by-pass valve in its closed position.

Referring first to Figure 1, the well has a casing

10 which is in communication with the formation 11 through perforations 12 in the casing.

A conventional packer 13 which is preferably of the wireline type has been run in, located and set in the casing above the formation 11. If desired, the packer could be run on the tubing in the conventional manner. Using the wireline run packer 13 the tubing 14 is stabbed into the packer 13 and seals therewith through suitable annular seals (not shown) between the lower end or tailpipe of the tubing and the packer.

The tubing 14 has a conventional hanger nipple 15 therein. A conventional locking mandrel 16 is located in the nipple 15 and conventional packing 17 seals between the locking mandrel 16 and the locating nipple 15.

Depending from the locking mandrel is a transducer fitting or by-pass valve 18.

Shown above the locking mandrel is a probe 19 having a fitting 21 at its lower extremity for engaging and latching to the by-pass valve 18. The probe 19 is suspended in the well on a suitable electric line 22 which is controlled from the surface. If the probe is not sufficiently heavy to carry out the operations to be disclosed hereinafter, sufficient weights can be attached to the probe to provide the desired downward force.

In accordance with the method of this invention the by-pass valve 18 is either located in the well by wireline or run in with the tubing, it being understood that instead of using the locating nipple and locking mandrel the transducer could be provided in a joint in the tubing and run in with the tubing.

In either event, the probe 19 is run into the well and manipulated vertically to locate in the by-pass valve 18 and open and close this valve with vertical movement of the probe 19. While the valve is open the well is produced through the by-pass valve to obtain information about the formation. While the probe may be transmitting information about the formation during this time, it is also desirable that information be obtained during shut-down conditions and for this purpose the valve is closed with the probe in place and the probe is exposed to formation fluids with the well shut-down to either record or transmit to the surface information such as the build-up pressure curve for the formation. The probe is then released from the by-pass valve and retrieved from the well. Preferably, when the by-pass valve is to be run into the well, the valve is normally in the open position and when the probe 19 releases from the valve it results in the valve automatically returning to the open position. With the valve in the open position, the transducer valve can readily be engaged and removed from the well by wireline procedures as there will be little or no differential across the packing 17 while the locking mandrel is being located or retrieved. Further, there is no hydraulic lock or resistance to locating and retrieving the probe 19.

Reference is now made to Figure 2 which shows the preferred form of by-pass valve 18.

The valve includes a body made up of upper and lower body sections 23 and 24, respectively. The upper body 23 is slotted at 25 and a valve seat 26 is provided in the body 23 above the slot 25. A valve member 27 is provided, which cooperates with the valve seat 26 and controls flow through the bore 28 in the upper valve body section 23. The valve member 27 is preferably urged towards either its open or closed position, and more preferably to its open position so that the valve may be readily inserted and located in the well by wireline procedures. In the drawings valve member 27 is constantly urged toward its open position by first resilient means in the form of a spring 29 which is held in compression.

A plunger 31 is provided in the valve and reciprocates and moves with the valve member 27 between the valve open and the valve closed position. As will appear hereinbelow, force is transmitted from the spring 29 through the plunger 31 to the valve member 27 and the spring 29 constantly urges the plunger 31 downwardly to maintain the valve in the open position. When the plunger is raised the spring 29 is compressed and the valve member moves towards its closed position, as shown in Figure 4. A suitable cap 32 is provided on the lower end of the plunger 31 and the spring 29 is held between the cap and a spring guide 33 on the lower end of the lower body portion 24.

To provide for fluid tight integrity when the valve is closed a suitable seal indicated at 34 is provided between the lower body section 24 and the plunger 31.

The plunger 31 is connected to the valve member 27 by a connecting means which provides for movement of the plunger and valve member 27 together as the valve member 27 moves between the open and the closed positions. It also provides for a movement of the plunger after the valve member 27 has reached one of its open and closed positions, preferably the closed position. This additional movement provides an automatic release for a shifting means such as a shifting collet as will appear hereinafter. This connecting means includes a collet 35 which has a plurality of collet fingers 36 surrounding the plunger 31. The collet fingers also includes flange portions 36a which extend outwardly from the collet and engage within an inwardly facing circumferential groove 27a within the valve member 27. The collet 35 connects the valve member 27 to the plunger 31 so that the plunger and the valve member reciprocate with each other. Thus, the spring 29 acts through this connecting means to urge the valve member 27 towards the open position and raising of the plunger moves the valve member 27 towards the closed position in which it is in engagement with seat 26.

To provide for fluid integrity of the system when the valve 26, 27 is closed, a suitable seal indicated generally at 37 is provided on the exterior of the valve member 27 to slidably seal with the body section 23 below the seat 26. Thus, when the valve member 27 is seated the seals 34 and 37 provide for fluid tight integrity through the

bore 28 of the upper body section.

The upper ends of the collet fingers 36 reside in an external groove 31a on the plunger 31. This groove provides a downwardly facing shoulder 31b and an upwardly facing inclined surface 31c. The collet fingers 36 are contoured on their inner surfaces to be a mirror image of the groove 31a and as shown in Figure 2 fit snugly within the groove 31a in their unstressed condition.

The connecting means between the valve member 27 and the plunger 31 is such that the plunger can continue to move after the valve member has moved to its fully open or fully closed position, preferably fully closed position. To provide for such continued motion a second resilient means is provided by the spring 38 which bears against the lower end of valve member 27 and against an upwardly facing shoulder 39 in the lower body section 24 through a spring guide 41. The spring guide 41 has an out-turned lip that bears on shoulder 39 in the housing. The spring guide 41 also bears on an upwardly facing shoulder 42 on the plunger 31. The spring 38 is in compression, the engagement of the upper ends of the release collet fingers 36 with the downwardly facing shoulder 31b on the plunger 31 prevent the spring 38 from moving the valve member 27 upwardly. In other words, the spring is essentially held in compression between the downwardly facing shoulder 31b on the plunger and the upwardly facing shoulder 42 on the plunger.

This release collet assembly just explained provides for the release of a pulling collet bearing against the downwardly facing shoulder 31b. Thus, if a collet be attached to the plunger and engages the downwardly facing shoulder 31b and an upward pull be placed on the pulling collet to carry the plunger upwardly beyond the point at which the valve 27 seats on seat 26, the pulling collet will be released. This action results from the continued movement of the plunger 31 upwards, the inclined shoulder 31c on the plunger riding under the collet fingers 36 forcing them outwardly to disengage the pulling collet from the shoulder 31b. The spring 38 permits this upward movement of the plunger relative to the valve member 27 after the valve member 27 is seated and, as soon as the upward pressure is removed from the plunger 31, the spring 38 returns the plunger and valve member 27 and collet 35 to the relationship shown in the drawings.

A pulling collet is provided either on the probe 19 or as a part of the valve 18. Preferably, it is a part of the valve 18 and is provided as illustrated, by the double collet 43. The collet 43 has the downwardly extending collet fingers 43a, each of which carries an upwardly facing shoulder 43b for engaging the downwardly locking shoulder 31b on the plunger 31. The engaged position is shown in Figure 3 with the valve member in the open position. The same relationship is shown in Figure 4 with the valve closed. The collet 43 has an internal annular flange 43c which engages in a groove in a shutter-valve member 44 so that as the pulling collet 43 reciprocates within the valve the shutter valve member 44 reciprocates with the pulling collet.

To engage and latch the probe 19 to the by-pass valve, the pulling collet 43 is provided with upwardly extending collet fingers 43d. These fingers reside within the groove 45 within the upper body 23 when the pulling collet is in its upper position. The bore 28 provides a land below the groove 45 and thus when the pulling collet moves downwardly, the upwardly extending collet fingers 43d are cammed inwardly. These fingers then engage within the groove 21a of latch fitting 21 and latch the probe to the pulling collet and thus to the valve 18.

In accordance with this invention means are provided for establishing fluid communication between the probe 19 and the formation, particularly when the valve 18 is closed; although in accordance with the disclosure of the preferred form, this communication is present with the valve in the open or closed position.

The plunger 31 has extending therethrough a flowway 46 which extends to the bottom extremity of the plunger. The flowway communicates with a side port 47 in the upper end of the plunger 31. Suitable seals 48 and 49 are carried on the plunger and straddle the port 47. The shutter valve member 44, which is carried by the pulling collet 43, reciprocates on the upper end of the plunger and when in the upper position shown is in contact with both seals 48 and 49 to close the passageway 46 through the plunger and prevent flow therethrough. When the pulling collet 43 is moved to its down position, as shown in Figures 3 and 4, the shutter valve member 44 uncovers the upper seals 48 and 49 to permit flow through the flowway 46.

The latch fitting 21 is provided at its lower end with a bore 51 which receives the upper end of the plunger 31, as shown in Figures 3 and 4. This bore 51 communicates with the exterior of the connector to avoid a fluid lock. The latch fitting 21 is provided with a flowway 52 to conduct fluid upwardly to the transducer within the probe 19. The flowway 52 connects with a small passageway 53, which terminates at the inwardly facing port 54. The port 54 overlies the port 47 in the plunger 31 when the probe is in engagement and attached to the by-pass valve.

In operation the wireline packer 13 will be run and set in the hole. The tubing 14 will then be run and located in the packer 13. The locking mandrel 16 with its associated transducer fitting-by-pass valve 18 may be run in place in the tubing or it may be run after the tubing has been positioned, utilizing conventional wireline techniques.

In any event with the by-pass valve 18 in place the probe 19 is run on an electric line 22 and the latch fitting 21 of the probe will move into engagement with the upper end of the plunger 31, as illustrated in Figure 2. The line is slackened off and the weight of the probe is exerted against the upper end of the shutter 44. This weight slides the shutter downwardly and cams the upper collets 43 inwardly to engage within the groove 21a on

the latch fitting 21. As the lower end of the latch fitting 21 is in abutting engagement with the upper end of the shutter 44, the upper O-rings 48 and 49 will be protected by the shutter as the transition is made in engagement of the seals 48 and 49 from the shutter to the latch fitting 21. Further downward movement of the shutter uncovers the port 47 and places the transducers (not shown) within the probe 19 in communication with the formation through the flowway 52, 53, 46 and 47.

As the pulling collet 43 moves downwardly the lower collet fingers 43 ride over the upwardly facing cam surface 60 on the plunger 31 and snap in behind the downwardly facing shoulder 31b, as shown in Figure 3. At this time the probe is attached to the by-pass valve and the valve is in position for flowing of the well through the by-pass valve to obtain information about the flowing characteristics of the well.

Flow from the well is through the bore 28 of the upper body and upwardly through the bore in the lower end 50 of the locking mandrel 16. The lower end 50 of the locking mandrel may be a short sub, as illustrated. In any event, the locking mandrel has a bore therethrough which is a continuation of the bore 55 through the sub 50 to convey well fluids through the by-pass valve and to the surface.

When it is desired to shut-down the well and obtain well information, such as a pressure build-up curve, the electric line is raised to place sufficient upward force on the line to raise the probe 19 and the pulling collet 43 upwardly to the position shown in Figure 4 in which the valve member 27 is seated against seat 26 to prevent flow through the by-pass valve and thus shut-down the formation.

The well may be maintained in a shut-down condition with the by-pass valve closed for as long as desired to obtain bottom hole information through the flowway through the probe by the media of the transducer within the probe 19.

Upon completion of testing it is desirable to equalize pressure across the valve to prevent blowing the probe up the hole when the by-pass opens. The well is thus shut-down at the surface and tension on the line 22 is slackened off to open the valve and equalize pressure across the probe. Then the probe is released from the by-pass valve by an upward pull on the wireline. As an upward pull is exerted the spring 38 is compressed permitting the plunger 31 to move upwardly relative to the release collet 35 to spread the upper collet fingers 36. As these collet fingers spread they force the lower collet fingers 43a of the pulling collet 43 to expand until they release the probe 31. Upon release of the probe the resilient spring 29 returns the valve member 27 to the valve open position and as spring 38 expands to its limited length the plunger is returned to the position shown in Figure 2 in which the collet fingers 36 are in engagement with the downwardly facing shoulder 31b on the probe 31.

Upward movement of the release collet 43 moves the upwardly facing collet fingers 43d on collet 43 into the groove 45 where they expand and disengage the latch fitting 21 on the probe 19. As the collet 43 moves upwardly with the latch fitting 21 the shutter valve member 44 moves up to cover O-ring 48 and protect the O-ring as the latch fitting 21 is disengaged.

After the probe is removed from the well the locking mandrel 16 may be removed with conventional wireline techniques and thereafter further operations of conventional nature may be carried out in the well.

Claims

1. A by-pass valve (18) for use in well testing, said valve comprising a valve body (23, 24) having a seat (26) therein, a valve member (27) being co-operable with said seat (26) and controlling flow through the valve body (23, 24), first resilient means (29) urging the valve member (27) towards one of open and closed positions, characterised by a plunger (31) connected to said valve member (27) to move with the valve member (27) between the open and closed positions, the connection between the plunger (31) and the valve member (27) providing for movement of the plunger (31) relative to the valve member (27) after the valve member (27) reaches the other of said open and closed positions, second resilient means (38) opposing relative movement between the plunger (31) and the valve member (27), and pulling means (43) being arranged to releasably latch onto said plunger (31), latch release means (36) being arranged to release said pulling means (43) from said plunger (31) upon movement of said plunger (31) a selected distance in a direction towards said other position after said valve member (27) has moved to said other position, said plunger (31) having a flowway (46) therethrough by-passing said valve seat (26), said by-pass valve (18) being operable by a probe (19) which is releasably locatable in said valve, the probe (19) being adapted to be attached to a line (22) extending to the surface.

2. A valve as claimed in claim 1, characterised in that said flowway (46) opens into the side wall of said plunger (31) at its upper end, seal means (48, 49) straddling said flowway opening (47) and being protected by a shutter (44) carried by said pulling means (43).

3. A valve as claimed in claim 1 or 2, characterised by inwardly facing dogs (43d) on said pulling means (43) which latch on to said probe (19) when the probe (19) pushes said pulling means (43) downwardly.

4. A valve according to any of the preceding claims, characterised by an annular groove (31a) in the external wall of the plunger (31) providing an upwardly facing inclined surface (31c) and a downwardly facing stop shoulder (31b), a release collet (36) located in the groove (31a) and attached to said valve member (27), being urged by the second resilient means (38) towards said stop shoulder (31b), said second resilient means (38) yielding upon continued movement of said

the latch fitting 21. As the lower end of the latch fitting 21 is in abutting engagement with the upper end of the shutter 44, the upper O-rings 48 and 49 will be protected by the shutter as the transition is made in engagement of the seals 48 and 49 from the shutter to the latch fitting 21. Further downward movement of the shutter uncovers the port 47 and places the transducers (not shown) within the probe 19 in communication with the formation through the flowway 52, 53, 46 and 47.

As the pulling collet 43 moves downwardly the lower collet fingers 43 ride over the upwardly facing cam surface 60 on the plunger 31 and snap in behind the downwardly facing shoulder 31b, as shown in Figure 3. At this time the probe is attached to the by-pass valve and the valve is in position for flowing of the well through the by-pass valve to obtain information about the flowing characteristics of the well.

Flow from the well is through the bore 28 of the upper body and upwardly through the bore in the lower end 50 of the locking mandrel 16. The lower end 50 of the locking mandrel may be a short sub, as illustrated. In any event, the locking mandrel has a bore therethrough which is a continuation of the bore 55 through the sub 50 to convey well fluids through the by-pass valve and to the surface.

When it is desired to shut-down the well and obtain well information, such as a pressure build-up curve, the electric line is raised to place sufficient upward force on the line to raise the probe 19 and the pulling collet 43 upwardly to the position shown in Figure 4 in which the valve member 27 is seated against seat 26 to prevent flow through the by-pass valve and thus shut-down the formation.

The well may be maintained in a shut-down condition with the by-pass valve closed for as long as desired to obtain bottom hole information through the flowway through the probe by the media of the transducer within the probe 19.

Upon completion of testing it is desirable to equalize pressure across the valve to prevent blowing the probe up the hole when the by-pass opens. The well is thus shut-down at the surface and tension on the line 22 is slackened off to open the valve and equalize pressure across the probe. Then the probe is released from the by-pass valve by an upward pull on the wireline. As an upward pull is exerted the spring 38 is compressed permitting the plunger 31 to move upwardly relative to the release collet 35 to spread the upper collet fingers 36. As these collet fingers spread they force the lower collet fingers 43a of the pulling collet 43 to expand until they release the probe 31. Upon release of the probe the resilient spring 29 returns the valve member 27 to the valve open position and as spring 38 expands to its limited length the plunger is returned to the position shown in Figure 2 in which the collet fingers 36 are in engagement with the downwardly facing shoulder 31b on the probe 31.

Upward movement of the release collet 43 moves the upwardly facing collet fingers 43d on collet 43 into the groove 45 where they expand and disengage the latch fitting 21 on the probe 19. As the collet 43 moves upwardly with the latch fitting 21 the shutter valve member 44 moves up to cover O-ring 48 and protect the O-ring as the latch fitting 21 is disengaged.

After the probe is removed from the well the locking mandrel 16 may be removed with conventional wireline techniques and thereafter further operations of conventional nature may be carried out in the well.

Claims

1. A by-pass valve (18) for use in well testing, said valve comprising a valve body (23, 24) having a seat (26) therein, a valve member (27) being co-operable with said seat (26) and controlling flow through the valve body (23, 24), first resilient means (29) urging the valve member (27) towards one of open and closed positions, characterised by a plunger (31) connected to said valve member (27) to move with the valve member (27) between the open and closed positions, the connection between the plunger (31) and the valve member (27) providing for movement of the plunger (31) relative to the valve member (27) after the valve member (27) reaches the other of said open and closed positions, second resilient means (38) opposing relative movement between the plunger (31) and the valve member (27), and pulling means (43) being arranged to releasably latch onto said plunger (31), latch release means (36) being arranged to release said pulling means (43) from said plunger (31) upon movement of said plunger (31) a selected distance in a direction towards said other position after said valve member (27) has moved to said other position, said plunger (31) having a flowway (46) therethrough by-passing said valve seat (26), said by-pass valve (18) being operable by a probe (19) which is releasably locatable in said valve, the probe (19) being adapted to be attached to a line (22) extending to the surface.

2. A valve as claimed in claim 1, characterised in that said flowway (46) opens into the side wall of said plunger (31) at its upper end, seal means (48, 49) straddling said flowway opening (47) and being protected by a shutter (44) carried by said pulling means (43).

3. A valve as claimed in claim 1 or 2, characterised by inwardly facing dogs (43d) on said pulling means (43) which latch on to said probe (19) when the probe (19) pushes said pulling means (43) downwardly.

4. A valve according to any of the preceding claims, characterised by an annular groove (31a) in the external wall of the plunger (31) providing an upwardly facing inclined surface (31c) and a downwardly facing stop shoulder (31b), a release collet (36) located in the groove (31a) and attached to said valve member (27), being urged by the second resilient means (38) towards said stop shoulder (31b), said second resilient means (38) yielding upon continued movement of said

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plunger (31) a selected distance in a direction towards the other of said open and closed positions after said valve member (27) has moved to said other position, to permit the release collet (36) to expand as it moves over the said inclined surface (31c).

5. A valve as claimed in claim 4, in combination with a pulling collet (43) adapted to engage said stop shoulder (31b) and overlie said release collet (36) and to be disengaged from said stop shoulder (31b) upon expansion of said release collet (36).

6. A valve as claimed in any one of the preceding claims characterised in that said probe (19) is in fluid communication with said plunger flowway (46), said valve member (27) is reciprocated by raising and lowering said probe (19), and said probe (19) is releasable from said valve upon upward movement a selected distance beyond that movement required to reach said other position.

7. A well testing system comprising a tubing (14) with a location nipple (15), a locking mandrel (16) located in said nipple (15), a by-pass valve (18) according to claim 1 carried by said locking mandrel (16), said valve (18) having its valve member (27) resiliently urged to one of open or closed positions, said valve member (27) being movable to the other of the open and closed positions by raising of the probe (19) and to said one position by the resilient means (29) upon lowering of said probe (19), said probe (19) being releasable from said valve (18) upon upward movement a selected distance beyond that movement required to move said valve member (27) to said other position.

8. A method of testing a well using a tubing (14) with a location nipple (15) and a by-pass valve (18) in said location nipple (15), in which a transducer probe (19) is introduced into the tubing (14) and located in the by-pass valve (18), the method comprising the steps of alternately flowing the well and shutting down the well by raising and lowering said probe (19) after it is located in the valve (18), determining well conditions while said well is shut-down and flowing, and raising said probe (19) a distance beyond that required to move the valve member (27) between the open and closed positions to release the probe (19) from the valve (18).

9. A method as claimed in claim 8, in which prior to releasing the probe (19) from the valve (18) the well is shut-down at the surface and the by-pass valve (18) is opened to equalize pressure across the probe (19).

10. A method of testing a well using a tubing (14) with a location nipple (15) and a by-pass valve (18) in said location nipple (15), in which a transducer probe (19) is introduced into the tubing (14) and located in the by-pass valve (18), the method comprising the steps of alternately flowing the well and shutting down the well by raising and lowering said probe (19) after it is located on the valve (18), and determining well conditions while said well is shut down and flowing.

11. A method as claimed in claim 10, in which said conditions are monitored continuously while said probe (19) is engaged in the by-pass valve (18).

12. A method as claimed in claim 10, in which prior to releasing said probe (19) from the by-pass valve (18), the well is shut down at the surface and the by-pass valve is opened to equalize pressure across the probe (19).

Patentansprüche

1. Nebenstromventil (18) zur Verwendung bei der Untersuchung eines Bohrloches mit einem Ventilkörper (23, 24), in welchem ein Sitz (26) vorgesehen ist, mit einem Ventilelement (27), das mit dem Sitz (26) zusammenwirken kann und den Strom durch den Ventilkörper (23, 24) steuert, und mit einer ersten elastischen Einrichtung (29), die das Ventilelement (27) in die eine Stellung drückt, entweder die Offenstellung oder die Schließstellung, gekennzeichnet durch einen Stößel (31), der mit dem Ventilelement (27) für eine Bewegung damit zwischen der Offenstellung und der Schließstellung verbunden ist, wobei die Verbindung zwischen dem Stößel (31) und dem Ventilelement (27) für die Bewegung des Stößels (31) relativ zum Ventilelement (27) sorgt, nachdem das Ventilelement (27) die andere Stellung, nämlich die Schließstellung bzw. Offenstellung erreicht hat, durch eine zweite elastische Einrichtung (38), die der Relativbewegung zwischen dem Stößel (31) und dem Ventilelement (27) entgegenwirkt, und eine Zugeinrichtung (43), die für ein lösbares Einschnappen auf dem Stößel (31) angeordnet ist, und durch eine Freigabeeinrichtung (36) für das Einschnappen, die so angeordnet ist, daß die Zugeinrichtung (43) vom Stößel (31) bei Bewegung des Stößels (31) um eine ausgewählte Entfernung in einer Richtung zu der anderen Stellung freigegeben wird, nachdem sich das Ventilelement (27) zur anderen Stellung bewegt hat, wobei der Stößel (31) einen durchgehenden Strömungsweg (46) aufweist, der den Ventilsitz (26) umgeht, und wobei das Nebenstromventil (18) von einer Sonde (19) betätigbar ist, die in dem Ventil lösbar positionierbar und an einer sich zur Oberfläche erstreckenden Leine (22) befestigbar ist.

2. Ventil nach Anspruch 1, dadurch gekennzeichnet, daß der Strömungsweg (46) in die Seitenwand des Stößels (31) an seinem oberen Ende mündet, wobei seitlich von der Strömungswegöffnung (47) Dichtungseinrichtungen (48, 49) sitzen und von einer Abdeckung (44) geschützt werden, die von der Zugeinrichtung (43) getragen wird.

3. Ventil nach Anspruch 1 oder 2, gekennzeichnet durch nach innen weisende Klinken (43d) an der Zugeinrichtung (43), welche auf der Sonde (19) einschnappen, wenn die Sonde (19) die Zugeinrichtung (43) nach unten drückt.

4. Ventil nach einem der vorhergehenden Ansprüche, gekennzeichnet durch eine Ringnut (31a) in der Außenwand des Stößels (31), die eine nach

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oben weisende geneigte Fläche (31c) und eine nach unten weisende Anschlagschulter (31b) hat, und durch eine Freigabeklemmhülse (36), die in der Nut (31a) angeordnet ist, am Ventilelement (27) befestigt ist und durch die zweite elastische Einrichtung (38) gegen die Anschlagschulter (31b) gedrückt wird, wobei die zweite elastische Einrichtung (38) bei fortgesetzter Bewegung des Stößels (31) um eine ausgewählte Entfernung in eine Richtung zu der anderen Stellung, entweder der Schließstellung oder der Offenstellung, nachgibt, nachdem das Ventilelement (27) sich zu der anderen Stellung bewegt hat, wodurch die Freigabeklemmhülse (36) sich ausdehnen kann, wenn sie sich über die geneigte Fläche (31c) bewegt.

5. Ventil nach Anspruch 4 in Kombination mit einer Zugklemmhülse (43), die mit der Anschlagschulter (31b) in Eingriff bringbar ist, über der Freigabeklemmhülse (36) liegt und aus dem Eingriff an der Anschlagschulter (31b) bei Ausdehnung der Freigabeklemmhülse (36) lösbar ist.

6. Ventil nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Sonde (19) in Fluidverbindung mit dem Stößelströmungsweg (46) steht, daß das Ventilelement (27) durch Anheben und Absenken der Sonde (19) hin- und herbewegbar ist, und daß die Sonde (19) vom Ventil bei einer Aufwärtsbewegung über eine ausgewählte Entfernung jenseits der Bewegung freisetzbar ist, die für das Erreichen der anderen Stellung erforderlich ist.

7. Bohrlochprüfsystem, welches eine Berohrung (14) mit einem Positionieransatz (15), einem Arretierdorn (16), der in dem Ansatz (15) angeordnet ist, und ein Nebenstromventil (18) nach Anspruch 1 aufweist, das von dem Arretierdorn (16) getragen wird, wobei das Ventil (18) mit seinem Ventilelement (27) elastisch in die Offenstellung oder Schließstellung gedrückt wird, das Ventilelement (27) in die andere Stellung, nämlich die Schließstellung bzw. Offenstellung durch Anheben der Sonde (19) und die eine Stellung durch die elastische Einrichtung (29) bei Absenken der Sonde (19) bewegbar ist und die Sonde (19) von dem Ventil (18) bei einer Aufwärtsbewegung um eine ausgewählte Entfernung über die Bewegung hinaus lösbar ist, die erforderlich ist, um das Ventilelement (27) in die andere Stellung zu bewegen.

8. Verfahren zur Untersuchung eines Bohrlochs unter Verwendung einer Berohrung (14) mit einem Positionieransatz (15) und einem Nebenstromventil (18) in dem Positionieransatz (15), bei welchem eine Wandlersonde (19) in die Berohrung (14) eingeführt und in dem Nebenstromventil (18) positioniert wird, wobei das Verfahren die Schritte umfaßt, nämlich abwechselnd das Bohrloch zu fluten und außer Betrieb zu setzen, indem die Sonde (19) angehoben und abgesenkt wird, nachdem sie in dem Ventil (18) positioniert worden ist, daß die Bohrlochzustände bestimmt werden, während das Bohrloch abgestellt und durchströmt ist und daß die Sonde (19) um eine Entfernung über die Entfernung hinaus angehoben wird, die erforderlich ist, um das Ventilelement (27) zwischen der Offenstellung und der Schließstellung zu bewegen, um die Sonde (19) vom Ventil (18) zu lösen.

9. Verfahren nach Anspruch 8, bei welchem vor der Freigabe der Sonde (19) vom Ventil (18) das Bohrloch an der Oberfläche stillgesetzt wird und das Nebenstromventil (18) geöffnet wird, um den Druck über der Sonde (19) auszugleichen.

10. Verfahren zur Untersuchung eines Bohrlochs unter Verwendung einer Berohrung (14) mit einem Positionieransatz (15) und einem Nebenstromventil (18) in dem Positionieransatz (15), bei welchem eine Wandlersonde (19) in die Berohrung (14) eingeführt und in dem Nebenstromventil (18) positioniert wird, wobei das Verfahren die Schritte aufweist, daß das Bohrloch abwechselnd durchströmt und stillgesetzt wird, indem die Sonde (19) angehoben und abgesenkt wird, nachdem sie an dem Ventil (18) positioniert worden ist, und daß die Bohrlochzustände bestimmt werden, während das Bohrloch stillgelegt ist und durchströmt wird.

11. Verfahren nach Anspruch 10, dadurch gekennzeichnet, daß die Zustände fortlaufend überwacht werden, während die Sonde (19) in Eingriff mit dem Nebenstromventil (18) gebracht wird.

12. Verfahren nach Anspruch 10, bei welchem vor der Freigabe der Sonde (19) von dem Nebenstromventil (18) das Bohrloch an der Oberfläche stillgelegt und das Nebenstromventil geöffnet wird, um den Druck über der Sonde (19) auszugleichen.

Revendications

1. Vanne de dérivation (18) pour utilisation dans les essais de puits, ladite vanne comprenant un corps de vanne (23, 24) ayant un siège à l'intérieur, un obturateur (27) pouvant coopérer avec ledit siège (26) et commandant l'écoulement à travers le corps de vanne (23, 24), un premier moyen élastique (29) rappelant l'obturateur (27) vers l'une des positions ouverte ou fermée, caractérisée par un plongeur (31) relié audit obturateur (27) pour se déplacer avec l'obturateur (27) entre les positions ouverte et fermée, le raccord entre le plongeur (31) et l'obturateur (27) permettant le déplacement du plongeur (31) par rapport à l'obturateur (27) après que l'obturateur (27) a atteint l'autre desdites positions ouverte ou fermée, un second moyen élastique (38) s'opposant au mouvement relatif entre le plongeur (31) et l'obturateur (27), et un moyen de traction (43) étant disposé pour bloquer ledit plongeur (31) de manière libérable, un moyen de déverrouillage (36) étant disposé pour libérer ledit moyen de traction (43) dudit plongeur (31) dès que ledit plongeur (31) se déplace d'une distance prédéterminée dans la direction de ladite autre position après que ledit obturateur (27) s'est déplacé vers ladite autre position, ledit plongeur (31) présentant un conduit d'écoulement (46) le traversant et mettant ledit siège de vanne (26) en dérivation, ladite vanne de dérivation (18) pouvant être

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actionnée par une sonde (19) qui peut être logée dans ladite vanne de manière à pouvoir être libérée, la sonde (19) étant adaptée pour être raccordée à un câble (22) se prolongeant jusqu'à la surface.

2. Vanne selon la revendication 1, dans laquelle ledit conduit d'écoulement (46) débouche dans la paroi latérale dudit plongeur (31) à son extrémité supérieure, des garnitures d'étanchéité (48, 49) étant à cheval sur ladite ouverture (47) du conduit d'écoulement, et étant protégé par une vanne d'obturation (44) portée par ledit moyen de traction (43).

3. Vanne de dérivation selon l'une des revendications 1 ou 2, caractérisée par des griffes (43d) tournées vers l'intérieur sur ledit moyen de traction (43) qui se verrouille à ladite sonde (19) quand la sonde (19) pousse vers le bas ledit moyen de traction (43).

4. Vanne de dérivation selon l'une des revendications précédentes, caractérisée par une gorge annulaire (31a) dans la paroi extérieure du plongeur (31) procurant une face inclinée vers le haut (31c) et une butée (31b) tournée vers le bas, un collet de dégagement (36) logé dans la gorge (31a) et fixé audit obturateur (27), étant rappelé par le second moyen élastique (38) vers ladite butée (31b), ledit second moyen élastique (38) cèdant au déplacement continu dudit plongeur (31) d'une distance déterminée dans la direction opposée à celle desdites positions ouverte ou fermée après que l'obturateur (27) s'est déplacé vers ladite autre position pour permettre au collet de dégagement (36) de s'ouvrir à mesure qu'il se déplace au-dessus de ladite surface inclinée (31c).

5. Vanne selon la revendication 4, associée à un collet de traction (43) disposé pour se mettre en prise avec ladite butée (31b) et recouvrir ledit collet de dégagement (36) et pour être dégagé de ladite butée (31c) dès l'ouverture dudit collet de dégagement (36).

6. Vanne selon l'une des revendications précédentes, caractérisée par le fait que ladite sonde (19) est en contact par le fluide avec ledit conduit d'écoulement (46) du plongeur, ledit obturateur (27) effectue un mouvement de va-et-vient de par le soulèvement et l'abaissement de ladite sonde (19), et ladite sonde (19) est libérable de ladite vanne dès le déplacement ascendant d'une distance déterminée au-delà du mouvement nécessaire pour atteindre ladite autre position.

7. Dispositif d'essai de puits comprenant un tube (14) muni d'un manchon de positionnement (15), un mandrin de verrouillage (16) logé dans ledit manchon (15), une vanne de dérivation (18) selon la revendication 1 portée par ledit mandrin de verrouillage (16), ladite vanne ayant son obturateur (27) rappelé élastiquement vers l'une des positions ouverte ou fermée, ledit obturateur étant déplaçable vers l'autre des positions ouverte et fermée par le soulèvement de la sonde (19), et vers ladite première position par le moyen élastique (29) dès l'abaissement de ladite sonde (19), ladite sonde (19) étant dégageable de ladite vanne (18) par le déplacement ascendant d'une distance déterminée au-delà de celle nécessaire pour déplacer ledit obturateur (27) vers ladite autre position.

8. Procédé pour tester des puits utilisant un tube (14) muni d'un manchon de positionnement (15) et d'une vanne de dérivation (18) dans ledit manchon de positionnement (15), dans lequel une sonde transductrice (19) est introduite dans le tube (14) et logée dans la vanne de dérivation (18), le procédé comprenant les étapes consistant soit à laisser produire le puits soit à le fermer en élevant ou en abaissant ladite sonde (19) après qu'elle est logée dans la vanne (18), déterminant l'état du puits quand ledit puits est fermé ou ouvert, et élevant ladite sonde (19) d'une distance au-delà de celle nécessaire à déplacer l'obturateur (27) entre les positions ouverte et fermée pour dégager la sonde (19) de la vanne (18).

9. Procédé selon la revendication 8 dans lequel avant de libérer la sonde (19) de la vanne (18) le puits est fermé en surface et la vanne de dérivation (18) est ouverte pour égaliser la pression à travers la sonde (19).

10. Procédé pour tester un puits utilisant un tube (14) muni d'un manchon de positionnement (15) et une vanne de dérivation (18) dans ledit manchon de positionnement (15), dans lequel une sonde transductrice (19) est introduite dans le tube (14) et logée dans la vanne de dérivation (18), le procédé comprenant les étapes consistant soit à laisser produire le puits soit à le fermer en élevant ou en abaissant ladite sonde (19) après qu'elle est logée sur la vanne (18), et déterminant l'état du puits pendant que ledit puits est fermé ou produit.

11. Procédé selon la revendication 10, dans lequel ledit état (du puits) est continuellement surveillé pendant que ladite sonde (19) est en prise dans la vanne de dérivation (18).

12. Procédé selon la revendication 10, dans lequel, avant de libérer ladite sonde (19) de la vanne de dérivation, le puits est fermé à la surface et la vanne de dérivation est ouverte pour équilibrer la pression à travers la sonde (19).

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