DUAL PASSAGE DRILLING STEM HAVING SELF-CONTAINED VALVE MEANS

Filed Aug. 18, 1958

Fig. 2

Fig. 4

Fig. 5

INVENTORS
DONOVAN B. GRABLE
HUGH P. KEELER
BY WHANN & McMANIGAL
ATTORNEYS
FOR THE FIRM
This invention relates to well drilling equipment employing the method disclosed in Patent No. 2,701,122 for Method and Apparatus Employing Compressed Gas for Drilling Wells, granted February 1, 1955, and relates in particular to a sectional drilling string for use in carrying out said method.

It is an object of the invention to provide a dual-passaged drilling string having single and effective means for controlling the flow of fluids through its passages.

It is a further object of the invention to provide a dual-passaged drilling string composed of sections which are connected together in end to end relation so as to increase the length of the drilling string as the bore is deepened, said drilling string including sections which incorporate the valve means therein for controlling the flow of fluids through their passages.

It is a further object of the invention to provide a drilling string of the character set forth in the preceding paragraph having downflow and upflow passage means, upwardly closing check valve means in the downflow passage means and manually operable shutoff valve means in the upflow passage means.

A further object of the invention is to provide a dual-passaged drilling string section having at an end thereof a separable valve device which is connected to the tubular members forming the drilling string, this valve device having inner and outer tubular walls, the inner tubular wall having therein an upflow passage and the space between the inner and outer tubular walls constituting a downflow passage, there being annular check valve means for preventing upflow of fluid through said downflow passage, and thereby being a transverse valve barrel intersecting said inner tubular wall and penetrating said outer tubular wall, this barrel being ported for communication with contiguous portions of the upflow passage and having therein a ported plug for closing the upflow passage.

The invention provides a simple and effective means for closing a section at or near the upper end of the drilling string when the portion of the drilling string thereof is disconnected, so that fluids contained in said drilling string section and in the drilling string extending down therefrom, cannot escape from the lower end of the drilling string which has been assembled in the well bore.

It is a further object of the invention to provide a dual-passaged drilling string having therein a transverse shutoff valve and means for locking the shutoff valve against inadvertent operation.

Further objects and advantages of the invention may be brought out in the following part of the specification wherein many details have been described for the purpose of assuring completeness of disclosure, without intending, however, to limit the scope of the invention defined in the claims.

Referring to the accompanying drawings which are for illustrative purposes only:

FIG. 1 is a schematic view showing a well drilling string incorporating a preferred embodiment of the invention;

FIG. 2 is an enlarged fragmentary sectional view through a valve device of the drilling string and being taken as indicated by the line 2—2 of FIG. 1;

FIG. 3 is a cross section taken as indicated by the line 3—3 of FIG. 2;

FIG. 4 is a fragmentary section taken as indicated by the line 4—4 of FIG. 2; and

FIG. 5 is an elevational view showing the locking means for the shutoff valve of the device.

In FIG. 1, a dual passage drilling string 10 is shown which includes at its upper end a dual passage Kelly drive stem 11 extending through the casing head which is schematically shown as being mounted on the upper end of a well casing which is disposed in a well bore. According to the previously herein mentioned Patent No. 2,701,122, the Kelly 11 extends through a rotary table to a dual passage swivel 15 carrying a ball 16 by which the drilling string is vertically supported.

As disclosed in Patent No. 2,701,122, the drilling string 10 comprises outer pipes 17 and inner pipes 18 connected in end to end relation so as to define passages 19 and 20 extending from the swivel 15 down through the well bore to a tool, not shown, which is connected to the lower end of the drilling string 10. According to the improved drilling method as defined in theubject of the present invention, the well is drilled to the desired depth and then a Kelly drive stem 11 is lowered into the well bore, the lower end of the Kelly 11 being connected to the lower end of the drilling string 10.

The drilling string 10 is composed of sections which are connected in end to end relation and extend from the operating means, rotary table 23, at the top of the well bore to the bit or drilling tool in the well bore. It will be understood that most of the drilling string 10 is composed of sections referred to as "stands" which are approximately 90 feet long, for example, but at its upper end the drilling string 10 may include one or more short sections, referred to as "singles" which may be about 30 feet long and which are inserted in the drilling string between the uppermost stand of the drilling string and the lower end of the Kelly 11 as the drilling operation progresses downwardly. In FIG. 1, the drilling string 10 is shown as including a short section 52 which may be a short section or a long section depending upon the instant state of the drilling operation, for the reason that when three short sections have been inserted in the upper end of the drilling string, the drilling string is pulled up and these three short sections are replaced by a single long section or stand.

The sections S and 52 include valve devices V for preventing flow of fluid through the passages 19 and 20 of the respective sections when the upper end of the section is disconnected from the portion of the drilling string immediately above it. For example, when the drilling operation has carried the Kelly 11 downward to its fullest extent, it becomes necessary to insert another drilling string section. In order to do this it is necessary to raise the drilling string 10 so that the upper end of the section 5 is above the rotary table and then disconnect the Kelly 11 and insert an additional section between the lower end of the Kelly 11 and the upper end of the section 5. The present invention makes it possible to do this without material loss of gas from the drilling string during the time the section S is disconnected from the Kelly 11.
As shown in FIGS. 2–5, the valve V comprises outer and inner tubular walls 17' and 18', the inner tubular wall defining therein an axial passage 19' which is a continuation of the passage 19 defined by the pipes 18'. The space between the outer and inner tubular walls 17' and 18' constitutes an annular passage 20' which is a continuation of the downflow passage 20 formed between the pipes 17 and 18 of the sections of the drilling stem 10. The outer tubular wall 17' has at its lower end tool joint member 26 disposed at the upper ends of the pipes 17 and 18 of the section S, and the upper end of the tubular wall 17' is provided with tool joint box threads 27 which screw onto the threaded pin 28 of the tool joint member 29 at the lower end of the Kelly 11.

The valve V, as shown in FIG. 3, incorporates a shut-off valve manually operable to close the upflow passage 19'. This shut-off valve 30 includes a barrel 31 which extends the inner tubular wall 18' and penetrates the outer tubular wall 17' at least on one side thereof. The barrel 31 has upper and lower ports 32 and 33 establishing communication with the upflow passage 19'. The barrel 31 is provided with a ground and polished bore 34 which receives a rotatable valve plug 35 having a diametral passage 36 which connects the ports 35 and 33 when the plug 35 is in the position in which it is shown in FIG. 3. When the plug 35 is rotated through an angle of approximately 90° it will obstruct the upflow passage 19'. The valve plug 35 is held in the bore 34 by snap rings 37. The ends of the valve plug 35 are provided with engageable means such as nut-like bodies 38 for engagement by a wrench whereby the valve plug 35 may be rotated between its on and off positions. As shown in FIG. 5, lock means are provided for holding the valve plug 35 in passage closing or passage opening position. One of the nut-like bodies 38 of the plug 35 has a radial opening 39 in which a locking pin 40 is slideable so that its outer end 41 may enter either of two recesses 42 or 43 in the wall of the bore 34. A compression spring 44, in the bottom of the opening 39 urges the pin 40 outwardly, and therefore, will hold the pin end 41 in locking engagement with either of the recesses 42 or 43. The pin 40 has thereon a collar 46 to which inward force may be applied to retract the pin 40 when the valve plug is to be rotated.

As shown in FIG. 3, the valve means for closing the downflow passage 20' comprises an annular check valve 59 integral with a cylindrical sleeve 51 which is slideable on the lower portion of the inner annular wall 18' and has an O-ring seal 52 for preventing leakage through the sleeve 51. On the inner face of the outer tubular wall 17' there is a valve seat 53 for engagement by the peripheral portion of the annular check valve 59. A coil spring 54 urges the check valve 59 upwardly into engagement with the seat 53. The spring 54 is retained and held under compression by a perforated ring 55 which is threaded into the lower end of the tubular wall 17'. The upper and lower ends of the inner tubular wall 18' are connected to the inner concentric pipes 18 of the Kelly 11 and the section S by means such as disclosed in U.S. Patent No. 2,675,016 consisting of a telescoping joint wherein one of the tubular members 18 or 18' slides into the other and O-rings 56 disposed between the overlapping end portions of the members 18 and 18' prevent leakage through the connections or telescoping joints thus formed.

From FIGS. 2 and 4, it will be observed that the external diameter of the barrel 31 is less than the diameter of the tubular wall 17' so that flow spaces 57 between the barrel 31 and the wall 17' connect the upper and lower ends of the annular downflow passage 20'. The utility of the dual passage section S including the valve device V will be perceived from the following explanation. It will be understood that during the space between the operating sections having therein a valve device for preventing flow of fluid through said means, valve device comprising inner and outer tubular walls, the space between said tubular walls constituting a downflow passage and the interior of said inner tubular wall being an upflow passage, said annular upwardly closing check valve for said downflow passage, a transversely positioned plug valve in said valve device for closing said upflow passage, and means exposed to the exterior of said outer tubular wall for manually operating said plug valve to prevent upward flow therefore through said passages means, said valve device comprising inner and outer tubular walls, the space between said tubular walls constituting an upflow passage 20' which is a continuation of the downflow passage 20 formed between the pipes 17 and 18 of the sections of the drilling stem 10. The outer tubular wall 17' has at its lower end tool joint member 26 disposed at the upper ends of the pipes 17 and 18 of the section S, and the upper end of the tubular wall 17' is provided with tool joint box threads 27 which screw onto the threaded pin 28 of the tool joint member 29 at the lower end of the Kelly 11.

In order to flow through the annular passage 20' of the valve V, the downwardly moving fluid displaces the check valve 50 downwardly. When disconnection of the Kelly bar from the remainder of the drilling string is required, the string 10 is rotated so as to close the passage 19' which constitutes a portion of the passage 19, the check valve 50 preventing upward flow of fluid through the passage 20', when the lower end of the Kelly 11 is disconnected from the upper end of the valve device V of the section S.

To lubricate the plug 35 so that it may be rotated under operating conditions, means are provided for the application of grease under high pressure to the confronting surfaces of the barrel 31 and the plug 35. As shown in FIGS. 3, 4, and 5, grease fittings 60 are disposed in recesses in the ends of the plug 35 from which axial passages 61 lead inwardly to connect with radial passages 62 which are placed at an angle of substantially 90° to the axis of the transverse passage 36 of the plug 35, and which communicate with grease distribution channels 63 in the face of the plug 35 at the ends of the radial passages 62, as shown by dotted lines in FIGS. 3 and 4, making it possible to force a thin layer of grease into position between the confronting surfaces of the barrel 31 and the plug 35.

The invention also includes means selectively operable to maintain the valve of the downflow passage 20 open so that under an alternative condition of operation the flow through the dual passage section S may be reversed. That is to say, fluid may be fed down through the central passage 19–19' and returned to the surface through the passage 20–20'. In the form of the invention disclosed, screws 70, FIGS. 3 and 5, are threaded diagonally through the wall 18' of the valve device V in such positions that their lower ends will be directed downwardly toward the peripheral lip 71 of the check valve 50. By rotation thereof the screws 70 may be advanced downwardly so that their lower ends will engage the peripheral lip 71 and force the valve 50 downwardly so that it will be in an open position of the valve seat 53 and the screw 70 then hold the valve 50 in open position so that fluid may flow in reverse direction, or upwardly, through the annular passage 20' which is normally the downflow passage of the device.

We claim:

1. In a tool operating string comprising a plurality of sections connected in end to end relation so as to extend from an operating means at the top of a bore to a tool in the bore, said string, including said sections, having downflow and upflow passage means from end to end thereof: at least one of said sections having therein a valve device for preventing flow of fluid through said passage means, said valve device comprising inner and outer tubular walls, the space between said tubular walls constituting a downflow passage and the interior of said inner tubular wall being an upflow passage, an annular upwardly closing check valve for said downflow passage, a transversely positioned plug valve in said valve device for closing said upflow passage, and means exposed to the exterior of said outer tubular wall for manually operating said plug valve to prevent upward flow thereof.

2. In a tool operating string comprising a plurality of sections connected in end to end relation so as to extend from an operating means at the top of a bore to a tool in the bore, said string, including said sections, having downflow and upflow passage means from end to end thereof: at least one of said sections having therein a valve device for preventing flow of fluid through said passage means, said valve device comprising inner and outer tubular walls, the space between said tubular walls constituting a downflow passage and the interior of said inner tubular wall being an upflow passage, an annular upwardly closing check valve for said downflow passage, a transversely positioned plug valve in said valve device for closing said upflow passage, and means exposed to the exterior of said outer tubular wall for manually operating said plug valve to prevent upward flow thereof.
stifiting a downflow passage and the interior of said inner tubular wall being an upflow passage, an annular upwardly closing check valve for said downflow passage, a transversely positioned plug valve in said valve device for closing said upflow passage, means exposed to the exterior of said outer tubular wall for manually operating said plug valve to prevent upward flow therethrough, and releasable means for locking said plug valve against operation.

3. In a tool operating string comprising a plurality of sections connected in end to end relation so as to extend from an operating means at the top of a bore to a tool in the bore, said string, including said sections, having downflow and upflow passage means from end to end thereof: at least one of said sections having therein a valve device for preventing flow of fluid through said passage means, said valve device comprising inner and outer tubular walls, the space between said tubular walls constituting a downflow passage and the interior of said inner tubular wall being an upflow passage, an annular upwardly closing check valve for said downflow passage, a transverse barrel of smaller diameter than said outer tubular wall intersecting said inner tubular wall and penetrating said outer tubular wall, said barrel being ported so as to communicate with the contiguous portions of said inner tubular wall, a ported plug in said barrel rotatable between positions opening and closing said upflow passage defined by said inner tubular wall, and means exposed in an end of said barrel operable to rotate said plug between said passage opening and closing positions thereof.

4. A device as defined in claim 3 having means forming passages for directing a lubricant into position between the confronting surfaces of said barrel and said plug.

5. In a sectional tool operating string adapted to be extended from an operating means at the top of a bore to a tool adapted to be operated in the bore, said string having downflow and upflow passages from end to end thereof: a string section having downflow and upflow passage means from end to end thereof, a check valve in said downflow passage means, a shutoff valve in said upflow passage means for preventing flow of fluids through the passage means thereof when the section is disconnected from the portion of said string above it, and means operative to positively hold said check valve in open position.

6. In a tool operating string comprising a plurality of sections connected in end to end relation so as to extend from an operating means at the top of a bore to a tool in the bore, said string, including said sections, having downflow and upflow passage means from end to end thereof: at least one of said sections having therein a valve device for preventing flow of fluid through said passage means, said valve device comprising inner and outer tubular walls, the space between said tubular walls constituting a downflow passage and the interior of said inner tubular wall being an upflow passage, an annular upwardly closing check valve for said downflow passage, a transverse barrel of smaller diameter than said outer tubular wall intersecting said inner tubular wall and penetrating said outer tubular wall, said barrel being ported so as to communicate with the contiguous portions of said inner tubular wall, a ported plug in said barrel rotatable between positions opening and closing said upflow passage defined by said inner tubular wall, means exposed in an end of said barrel operable to rotate said plug between said passage opening and closing positions thereof, and screw means threaded through said outer tubular wall selectively operable to hold said check valve in open position.

References Cited in the file of this patent

UNITED STATES PATENTS

1,146,284 Sanders July 13, 1915
1,400,962 Leonard June 19, 1921
1,674,955 Nixon et al. Sept. 24, 1928
1,781,049 Brinton Nov. 11, 1930
2,247,023 Humason et al. June 24, 1941
2,522,444 Grable Sept. 12, 1950
2,565,742 Sailer Aug. 28, 1951
2,649,769 Kaiser Aug. 25, 1953
2,701,122 Grable Feb. 1, 1955
2,798,561 True July 9, 1957
2,831,503 Argo Aug. 22, 1958