SURFACE CONTROLLED FORMATION ISOLATION VALVE ADAPTED FOR DEPLOYMENT OF A DESIRED LENGTH OF A TOOL STRING IN A WELLBORE

BACKGROUND OF THE INVENTION

The subject matter of the present invention relates to a method and apparatus for isolating a first section of a wellbore from a second section of the wellbore, the second section being disposed below the first section in the wellbore and adjacent a formation, in order that a wellbore tool string of any desired length may be made up in the first section prior to opening a ball valve and lowering the tool string downhole into the second section of the wellbore for performing one or more wellbore operations downhole in the second section.

A prior pending application, filed by the same applicant (Dinesh R. Patel) and owned by the same assignee as that of the present invention, relates to the same field of the invention as that recited above. The prior pending application corresponds to attorney docket number 22.1185, was filed on May 10, 1996, and is entitled "Formation Isolation Valve Adapted for Building a Tool String of Any Desired Length Prior to Lowering the Tool String Downhole for Performing a Wellbore Operation". In the prior pending application to Patel, a valve is disposed in a tubing string in a similar manner as shown in figure 1 of the drawings of this application. The valve is responsive to the running of a shifting tool through a full bore of the valve for opening and closing the valve. When the valve is closed in response to the running of the shifting tool through the valve, a tool string of any desired length is built in a first section of the wellbore above the valve. When the tool

string is built, the valve is opened in response to a pressure applied to a wellbore fluid in the first section, and the tool string is run downhole through the open valve for performing wellbore operations.

When performing wellbore operations downhole, it is necessary to first make up a tool string at the surface of the wellbore prior to lowering that tool string downhole for performing the wellbore operations. In the past, the length of the tool string was limited by the maximum height of surface equipment and a longer tool string length was often desired. Therefore, when the tool string performed the wellbore operations downhole, that tool string was raised uphole and another, second tool string was made up at the surface of the wellbore. The second tool string was lowered downhole for performing additional wellbore operations. However, it is time consuming and expensive to continually make up additional tool strings at the wellbore surface, following the performance of the initial wellbore operation by the first tool string, and sequentially lower those additional tool strings downhole for performing additional wellbore operations. It would be desirable to make up one tool string having the desired length at the wellbore surface and to lower that desired tool string downhole for performing a wellbore operation during one trip into the wellbore. For example, when the tool strings include perforating guns, in the past, it was necessary to implement the following perforating procedure when perforating long length intervals of a wellbore: perforate the long length interval during multiple trips into the wellbore by making up, at the wellbore surface, a first perforating gun having a limited first length, lowering the first perforating gun downhole, perforating a formation penetrated by the wellbore, raising the first perforating gun uphole (or dropping that perforating gun to the bottom of the wellbore), making up a second perforating gun having another

second limited length at the wellbore surface, lowering the second perforating gun downhole, perforating another section of the formation, raising the second perforating gun uphole (or dropping it to a bottom of the wellbore), etc. The above referenced perforating procedure is time consuming and costly.

As a result, it became necessary to design a method and apparatus for creating a tool string, of any desired length, uphole at the surface of the wellbore, so that the tool string may be lowered downhole and wellbore operations performed downhole during only one trip into the wellbore.

U.S. Patent 5,509,481 to Huber et al discussed one method for perforating long length intervals of a formation during a single run into the wellbore. The Huber apparatus disclosed an automatic release apparatus which would disconnect one part of a long gun string from a second part of the gun string just before the perforating guns of that gun string would detonate.

Another prior pending application also discloses a method and apparatus for making up, at the wellbore surface, a tool string of any desired length prior to lowering that tool string downhole for performing a wellbore operation in the wellbore during one trip into the wellbore. In a prior pending application entitled "Completions Insertion and Retrieval Under Pressure (CIRP) Apparatus including the Snaplock Connector", having a serial number of 08/638,001 and filed on April 25, 1996 and corresponding to attorney docket number 22.1183 and corresponding to a prior filed provisional application number 60/010,500 filed January 24, 1996 (hereinafter, the "CIRP application"), a tool string of any desired length is built uphole prior to lowering that tool string downhole by first holding a first tool, having a first and a second section of a snaplock connector connected

thereto, in a deployment BOP or snaplock operator while suspending a second tool, also having a third section of the snaplock connector connected thereto, by wireline in a lubricator. The second tool is lowered down through the lubricator and through a master valve by operating a winch until the third section of the snaplock connector on the second tool connects to the second section of the snaplock connector on the first tool thereby forming a first tool string having a length which corresponds to the first tool and the second tool. The hold by the deployment BOP is released from the first tool, the first tool string is lowered, and the deployment BOP grips the second tool. The second tool also includes another first, second, and third section of a snaplock connector connected to its opposite side, the third section (called a deployment stinger) being connected to the wireline. The deployment stinger is raised uphole by operating the winch, and it is replaced by a third tool, such as a firing head, which also includes a third section of a snaplock connector. The third tool suspends by the wireline in the lubricator and it is lowered downhole and attached to the second tool being held by the deployment BOP. The hold by the deployment BOP on the second tool is released, and a resultant tool string of the desired length, consisting of the first tool, the second tool, and the third tool, is lowered downhole for the purpose of performing wellbore operations downhole during one trip into the wellbore.

However, another alternate apparatus, and corresponding method, is needed for isolating the formation downhole by means of closing a valve so that wellhead pressure can be bled off for building a long tool string uphole of any desired length and lowering that tool string downhole without a need for snubbing under wellhead pressure for the purpose of performing wellbore operations downhole during a single trip into the wellbore.

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SUMMARY OF THE INVENTION

Accordingly, it is a primary object of the present invention to provide another alternate method and apparatus for building a tool string uphole of any desired length prior to lowering that tool string downhole for the purpose of performing wellbore operations downhole during a single trip into the wellbore.

It is a further object of the present invention to provide another alternate method and apparatus for building a tool string uphole of any desired length prior to lowering that tool string downhole for the purpose of performing wellbore operations downhole during a single trip into the wellbore, the alternate apparatus including a valve disposed between an upper section and a lower section of the wellbore and adapted to open and to close, the upper section of the wellbore being isolated from the lower section of the wellbore when the valve is closed, the tool string of any desired length being built in the upper section of the wellbore when the valve is closed and the upper section of the wellbore is isolated from the lower section of the wellbore.

It is a further object of the present invention to provide another alternate method and apparatus for building a tool string uphole of any desired length prior to lowering that tool string downhole into a wellbore for the purpose of performing wellbore operations downhole during a single trip into the wellbore, the alternate apparatus including a valve disposed between an upper section and a lower section of the wellbore and adapted to open and to close, the upper section of the wellbore being isolated from the lower section of the wellbore when the valve is closed, the tool string of any desired length being built in the upper section of the

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wellbore when the valve is closed and the upper section of the wellbore is isolated from the lower section of the wellbore, the alterate apparatus further including a mandrel and piston, the valve, such as a ball valve, initially disposed in an open position adapted to be changed from the open position to a closed position when the mandrel is shifted from one position to another position, an upper chamber communicating with a gas reservoir and a valve manifold including a slow bleed valve and a fast bleed valve disposed at the wellbore surface, a lower chamber, and a gas metering orifice separating the upper chamber from the lower chamber, the mandrel being shifted in one direction and the valve changing position when a gas is delivered from the surface of the wellbore to the upper chamber thereby moving the piston and the mandrel, the mandrel shifting in an opposite direction and the valve changing position again when the gas in the upper chamber leaks from the upper chamber to the fast bleed valve at the surface, the mandrel shifting in the one direction and the valve changing position again when the gas from the surface is delivered to the upper chamber, and the mandrel not shifting in the opposite direction and the valve not changing position again when the gas in the upper chamber leaks from the upper chamber to the slow bleed valve at the surface.

In accordance with these and other objects of the present invention, an apparatus adapted to be disposed in a wellbore allows an operator at the wellbore surface to build a tool string uphole of any desired length prior to lowering that tool string downhole into a wellbore for the purpose of performing wellbore operations during a single trip into the wellbore. The apparatus includes a valve disposed between an upper section and a lower section of the wellbore which is adapted to open and to close. The upper section of the wellbore is isolated from the lower section of the wellbore when the valve is closed. The tool string of any desired

length is built in the upper section of the wellbore when the valve is closed and the upper section of the wellbore is isolated from the lower section of the wellbore. The apparatus further includes a mandrel and a piston, the valve, such as a ball valve, which is initially disposed in an open position and is adapted to be changed from the open position to a closed position when the mandrel is shifted from one position to another position, an upper chamber communicating with a gas reservoir and a valve manifold (including a slow bleed valve and a fast bleed valve) disposed at the wellbore surface, a lower chamber, and a gas metering orifice separating the upper chamber from the lower chamber. The mandrel is shifted in one direction and the valve changes position when a gas is delivered from the surface of the wellbore to the upper chamber thereby moving the piston and the mandrel. The mandrel shifts in an opposite direction and the valve changes position again when the gas in the upper chamber leaks from the upper chamber to the fast bleed valve at the surface. The mandrel shifts in the one direction and the valve changes position again when the gas from the surface is delivered to the upper chamber. However, the mandrel does not shift in the opposite direction and the valve does not change position again when the gas in the upper chamber leaks from the upper chamber to the slow bleed valve at the surface. The mandrel does not shift in the opposite direction because the flow rate at which the gas in the upper chamber flows through the slow bleed valve at the surface is less than the rate at which the gas in the lower chamber meters into the upper chamber via the gas metering orifice. Therefore, the gas pressure in the upper and lower chambers remain approximately equal despite the fact that the gas in the upper chamber flows upwardly through the slow bleed valve at the surface. As a result, the mandrel and piston fail to shift in either direction.

Further scope of applicability of the present invention will become apparent from the detailed description presented hereinafter. It should be understood, however, that the detailed description and the specific examples, while representing a preferred embodiment of the present invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become obvious to one skilled in the art from a reading of the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

A full understanding of the present invention will be obtained from the detailed description of the preferred embodiment presented hereinbelow, and the accompanying drawings, which are given by way of illustration only and are not intended to be limitative of the present invention, and wherein:

figure 1 illustrates a tubing string including a valve in accordance with the present invention and a coiled tubing or wireline conveyed perforating gun runnning through the full bore of the tubing string and through the valve and running downhole into a deviated wellbore, a gas reservoir and a valve manifold being disposed at a surface of the wellbore;

figure 2 illustrates a more detailed construction of the valve manifold of figure 1; and

figures 3 and 4 illustrate a more detailed construction of the valve of figure 1 in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to figure 1, a tubing string 12 having a full bore is disposed in a partially deviated wellbore consisting of a vertical wellbore 13 and a deviated wellbore 15. The tubing string 12 includes a valve 18 which is disposed in the vertical wellbore 13 portion of the partially deviated wellbore. The valve 18 includes a ball valve 18a which is rotatable between a closed position, for closing off the full bore of the tubing string 12 thereby preventing fluid communication within the tubing string 12 between the vertical wellbore 13 and the deviated wellbore 15, and an open position for opening and allowing fluid communication within the tubing string 12 between the vertical wellbore 13 and the deviated wellbore 15. In figure 1, a tubing 14, such as coiled tubing 14, having a perforating gun 10 suspending from the lower end of the coiled tubing 14, is disposed within the tubing string 12 and within both the vertical wellbore 13 and the deviated wellbore 15 of the partially deviated wellbore when the ball valve 18a is disposed in the open position. When the coiled tubing 14 is disposed within the tubing string 12 as shown in figure 1, an annulus space 22 located above the ball valve 18a is defined between the coiled tubing 14 and the tubing string 12. However, when the coiled tubing 14 is not disposed within the tubing sring 12 as shown in figure 1, a full bore space 22 is located above the ball valve 18a within the tubing string 12. As mentioned later, when the ball valve 18a is closed, this full bore space 22 can be used to build a new tool string uphole of any desired length. In the vertical wellbore 13 of figure 1, the tubing string 12 does not form part of the casing of the wellbore; however, in the deviated wellbore 15 of figure 1, the tubing string 12 forms the casing in the deviated wellbore.

In figure 1, the valve 18, which is situated downhole, is connected to a gas reservoir 24 (a nitrogen bottle 24) and a valve manifold 26, each of which are separately situated at the surface of the wellbore. A gas is stored in the gas reservoir 24, the gas flowing between the gas reservoir 24/valve manifold 26 at the wellbore surface and the valve 18 located downhole in the wellbore via a flowline 17. The flowline 17 is a one-quarter inch (1/4") pipe situated between the tubing string 12 and a casing 19 in the vertical wellbore 13 and connected between a control line 18c of the valve 18 (see figure 3) and the gas reservoir 24/valve manifold 26 situated at the surface of the wellbore. The gas reservoir 24 is really a nitrogen bottle which stores a gas, such as nitrogen, and the valve manifold 26 includes a pair of bleed valves (a slow bleed valve and a fast bleed valve) which are more particularly shown in figure 2. The gas in the gas reservoir 24 uphole communicates with the valve 18 downhole. When the gas in the gas reservoir 24 has been communicated to the valve 18, that same gas in the valve 18 can then be re-communicated back to the bleed valves of the valve manifold 26, a process which will be described in more detail below in this specification.

Referring to figure 2, the valve manifold 26 includes a slow bleed valve 26a and a fast bleed valve 26b. As the names imply, the slow bleed valve 26 will allow a gas to pass (bleed) very slowly therethrough, whereas the fast bleed valve 26b will allow a gas to pass (bleed) very rapidly therethrough. The function of these bleed valves 26a, 26b will be set forth below in the functional description of the operation of the present invention.

In operation, referring to figure 1, the ball valve 18a is open and the perforating gun 10 with associated coiled tubing 14 is situated in the wellbore as shown in figure 1, the perforating gun 10 perforating the formation penetrated

by the deviated wellbore 15 thereby forming a plurality of perforations 20 in the deviated wellbore 15. When the perforating gun 10 has perforated the deviated wellbore 15, the coiled tubing 14 and the perforating gun 10 are raised uphole until the perforating gun 10 passes through the ball valve 18a of the valve 18, at which point, the perforating gun 10 and associated coiled tubing 14 are located above the valve 18 within the tubing string 12 in the vertical wellbore 13. The ball valve 18a is then closed. When the ball valve 18a is closed, the perforating gun 10 is raised uphole to a surface of the wellbore, leaving empty the full bore space 22 which is located above the closed ball valve 18a within the tubing string 12. A new tool string of any desired length (the length of the new tool string being limited only by the distance between the ball valve 18a and the wellbore surface) may then be built within the full bore space 22. When the new tool string is built within the full bore space 22, the ball valve 18a is reopened, and the new tool string is lowered downhole for the purpose of performing other wellbore operations downhole.

Referring to figures 3 and 4, a detailed construction of the valve 18 of the present invention is illustrated.

In figures 3 and 4, the valve 18 of the present invention, adapted for deploying a desired length of a tool string in a wellbore, includes an outer housing 18b. The outer housing 18b further includes an open port 18c, otherwise known as a control line 18c, which is connected to the flowline 17, the one-quarter inch pipe 17 that is connected to the gas reservoir 24 and the valve manifold 26 at the surface of the wellbore. The gas in the gas reservoir 24 can communicate with the control line 18c of the valve 18 via the flowline pipe 17, and the gas in the valve 18 can communicate with the bleed valves 26a, 26b of the valve manifold 26 via the control line 18c of the valve 18 and the flowline pipe 17.

The valve 18 of figures 3 and 4 further include a mandrel 18d connected to the ball valve 18a and enclosed by the outer housing 18b. The mandrel 18d is further connected to a piston 18e, and the piston 18e separates an upper gas chamber 18f from a lower gas chamber 18g. The upper gas chamber 18f is defined by the mandrel 18d, an upper part of the piston 18e and the outer housing 18b, whereas the lower gas chamber 18g is defined by the mandrel 18d, a lower part of the piston 18e, and the outer housing 18b. The piston 18e includes a gas metering orifice 18e1 disposed through the axial center of the piston 18e. The gas metering orifice 18e1 allows a gas, such as nitrogen, from the gas reservoir 24, to be metered slowly between the upper gas chamber 18f and the lower gas chamber 18g, for reasons which will be described later in this specification. A spring biased ratchet 18h is biased inwardly by a spring, as shown in figures 3 and 4, the ratchet 18h adapted to be received in one of two detents 18d1 and 18d2 in the mandrel 18d, the detents 18d1, 18d2 each being a groove which is carved into the mandrel 18d and which is adapted to receive the ratchet 18h.

A functional description of the operation of the surface controlled formation isolation valve of the present invention, adapted for deploying a desired length of a tool string in a wellbore, will be set forth in the following paragraphs with reference to figures 1 through 4 of the drawings.

The perforating gun 10 of figure 1 perforates the formation 15 and produces a plurality of perforations 20 in the formation 15. An operator at the wellbore surface of figure 1 raises the coiled tubing 14 uphole. Since the perforating gun 10 is connected to the coiled tubing 14, the perforating gun 10 also is raised uphole in figure 1. Since the ball valve 18a of the valve 18 is open, the perforating gun 10

will pass through the full bore center of the valve 18. When the perforating gun 10 is removed from the full bore space 22 of the vertical wellbore 13, the valve 18 must now be closed so that a tool string of desired length may be built inside the full bore space 22 which is situated above the closed ball valve 18a in the vertical wellbore 13.

In order to close the ball valve 18a, referring to figures 1, 2, and 3, assume that the gas pressure within the upper gas chamber 18f is equal to the gas pressure within the lower gas chamber 18g. The gas present in the upper gas chamber 18f is allowed to flow through the control line 18c, through the flowline pipe 17, and into the valve manifold 26 of figure 1 for the purpose of closing the ball valve 18a. In the valve manifold 26, the gas flows into the fast bleed valve 26b of figure 2. As a result, the gas will flow from the upper gas chamber 18f, through flowline 17, and through the fast bleed valve 26b at a rate which is faster than the rate at which the gas in the lower gas chamber 18g can meter through the gas metering orifice 18e1 into the upper gas chamber 18f. Therefore, the gas pressure inside the upper gas chamber 18f will be less than the gas pressure inside the lower gas chamber 18g and, as a result, the piston 18e and the mandrel 18d move upwardly in figure 3. The ball valve 18a closes. Eventually, the gas pressure inside the upper gas chamber 18f and the lower gas chamber 18g falls to a value which is approximately equal to zero. The closed ball valve 18a is shown in figure 4.

With the ball valve 18a closed, another, new tool string of desired length is built inside the full bore space 22 located above the closed ball valve 18a in figure 1.

When the new tool string is built in the full bore space 22, the ball valve 18a must now be re-opened so that the new tool string can be lowered downhole, from its current

location in the full bore space 22, for the purpose of performing a new wellbore operation downhole.

The ball valve 18a is re-opened in the following manner: referring to figures 1 and 4, a gas, such as Nitrogen, from the gas reservoir 24, is forced to flow from the reservoir 24, through the flowline pipe 17, through the control line 18c in figure 3, and into the upper gas chamber 18f. The gas is exerted against the piston 18e, and it begins to meter slowly through the gas metering orifice 18e1 into the lower gas chamber 18g. However, since there is no gas within the lower gas chamber 18g, the piston 18e moves downwardly in figure 4 which, in turn, moves the mandrel 18d downwardly and which re-opens the ball valve 18a, as shown in figure 3. Eventually, the gas in the upper gas chamber 18f flows through the metering orifice 18e1 into the lower gas chamber 18g. As a result, when the ball valve 18a is re-opened, the gas pressure in the upper gas chamber 18f equals the gas pressure in the lower gas chamber 18g.

At this point, now that the ball valve 18a is reopened, the new tool string can be lowered downhole, from its current location in the full bore space 22, and through the ball valve 18a, for the ultimate purpose of performing a new wellbore operation downhole.

In figures 1, 2 and 3, the gas in the lower gas chamber 18g of figure 3 can flow into the upper gas chamber 18f, and the gas in the upper gas chamber 18f in figure 3 can flow through the flow line pipe 17 and into valve manifold 26 without reclosing the ball valve 18a as previously recited. To accomplish this without reclosing the ball valve 18a, in figure 3, the gas in the upper gas chamber 18f will flow into the flowline pipe 17, and into the slow bleed valve 26a of the valve manifold 26 of figure 2 (the gas does not flow into the fast bleed valve 26b). As a result, since the gas

flows into the slow bleed valve 26a, the rate at which the gas flows from the upper gas chamber 18f and through the slow bleed valve 26a is lower than the rate at which the gas in the lower gas chamber 18g flows through the gas metering orifice 18e1 and into the upper gas chamber 18f.

The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

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WE CLAIM:

1. Apparatus adapted for building a tool string uphole of any desired length prior to lowering said tool string downhole into a wellbore for performing wellbore operations downhole in said wellbore, comprising:

an upper section of said wellbore;

a lower section of said wellbore; and

a valve disposed between said upper section and said lower section and adapted to be opened and closed,

said tool string adapted to be built in said upper section when said valve is closed, said tool string adapted to be lowered from said upper section, through said valve, and into said lower section when said valve is open, said tool string adapted to perform said wellbore operation downhole when said valve is closed.

2. The apparatus of claim 1, further comprising:

further apparatus including a valve manifold and a gas reservoir; and

a flowline interconnecting said further apparatus to said valve.

3. The apparatus of claim 2, wherein said gas reservoir includes a gas, said valve manifold including a slow bleed valve and a fast bleed valve, said gas in said gas reservoir adapted to flow from said gas reservoir through said flowline and into said valve.

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4. The apparatus of claim 3, wherein said valve comprises an outer housing, a mandrel enclosed by said outer housing and defining a full bore within said valve, and a piston attached to an outer side of said mandrel, said piston including a metering orifice disposed longitudinally therethrough, said mandrel and said piston being longitudinally movable within said housing,

said mandrel and said piston defining an upper chamber within said housing disposed between said mandrel and said housing and one side of said piston, said upper chamber communicating with said flowline, said flowline communicating with said slow bleed valve and said fast bleed valve of said further apparatus and said gas reservoir of said further apparatus,

said mandrel and said piston defining a lower chamber within said housing disposed between said mandrel and said housing and the other side of said piston.

5. The apparatus of claim 4, wherein said valve further comprises closure means attached to said mandrel for opening said full bore of said valve when said mandrel is disposed in one longitudinal position within said valve and closing said full bore of said valve when said mandrel is disposed in another longitudinal position within said valve.

6. The apparatus of claim 5, wherein said gas in said gas reservoir flows through said flowing and into said upper chamber of said valve, a pressure of said gas in said upper chamber exerting against said one side of said piston, said gas in said upper chamber metering through said metering orifice into said lower chamber and said mandrel moving longitudinally in one direction when said pressure of said gas is exerted against said one side of said piston, said closure means closing said full bore of said valve when said

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mandrel moves in said one direction, said tool string adapted to be built in said upper section when said closure means closes said full bore of said valve.

7. The apparatus of claim 6, wherein said gas in said lower chamber exerts a pressure against the other side of said piston, said gas metering from said lower chamber through said metering orifice and into said upper chamber, said mandrel moving in a direction opposite to said one direction, and said gas flowing from said upper chamber through said flowline and through said fast bleed valve when said fast bleed valve is connected to said flowline,

said closure means reopens said full bore of said valve when said mandrel moves in said direction opposite to said one direction.

8. The apparatus of claim 7, wherein said tool string in said upper section is adapted to move downhole from said upper section through the reopened closure means and into said lower section when said closure means reopens said full bore of said valve.

9. The apparatus of claim 8, wherein said gas in said gas reservoir flows through said flowline and into said upper chamber when said tool moved from said upper section of said wellbore through the reopened closure means and into said lower section of said wellbore, said gas in said upper chamber metering from said upper chamber through said metering orifice and into said lower chamber, said gas in said upper chamber moving said mandrel in said one direction,
said closure means reclosing said full bore of said valve when said mandrel moves in said one direction, said tool string in said lower section adapted to perform said wellbore operations downhole in said lower section of said

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wellbore when said closure means recloses said full bore of said valve.

10. A method of operating a valve in a wellbore, comprising the steps of:

moving a medium from a medium reservoir through a flowline and into an upper chamber of the valve;

exerting a pressure by the medium against a piston of the valve and moving a mandrel in one direction in response thereto;

metering the medium from the upper chamber through a metering orifice in the piston and into a lower chamber of the valve;

operating said valve by changing a state of the valve from a first state to a second state in response to the movement of said mandrel in said one direction;

exerting a pressure by the medium in said lower chamber against said piston;

metering said medium from said lower chamber through said metering orifice into said upper chamber through said flowline and through a fast bleed valve;

moving said mandrel in a direction opposite to said one direction; and

operating said valve by changing said state of the valve from said second state to said first state in response to the movement of said mandrel in said direction opposite to said one direction.

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11. A system adapted for use in connection with wellbore operations, comprising:

an outer housing;

a mandrel enclosed by the outer housing and movable longitudinally within said outer housing;

a piston on said mandrel and a metering orifice longitudinally disposed through said piston,

said mandrel and said housing defining an upper chamber between the mandrel and the housing and one side of said piston,

said mandrel and said housing defining a lower chamber between the mandrel and the housing and the other side of said piston; and

a valve manifold and a flowline interconnecting said valve manifold to said upper chamber.

12. The system of claim 11, further comprising:

a reservoir, said flowline interconnecting said reservoir to said upper chamber.

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13. The system of claim 12, wherein said valve manifold comprises a fast bleed valve and a slow bleed valve,

said fast bleed valve adapted to be interconnected to said upper chamber via said flowline when said slow bleed valve is not interconnected to said upper chamber,

said slow bleed valve adapted to be interconnected to said upper chamber via said flowline when said fast bleed valve is not interconnected to said upper chamber.

14. A method of building a tool string uphole of a desired length prior to lowering said tool string downhole into a wellbore for performing wellbore operations in the wellbore, comprising the steps of:

closing a valve located between an upper section of the wellbore and a lower section of the wellbore by moving a medium from a medium reservoir through a flowline and into the valve;

building said tool string in said upper section of the wellbore when the valve is closed;

reopening the valve by bleeding the medium from the valve through the flowline and through a fast bleed valve;

moving said tool string from said upper section through the reopened valve and into the lower section of the wellbore; and

reclosing the valve by moving said medium from said medium reservoir through said flowline and into said valve,

the tool string performing a wellbore operation in the lower section of said wellbore.

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15. The method of claim 14, further comprising the steps of:

reopening the valve by bleeding the medium from the valve through the flowline and through said fast bleed valve; and

moving the tool string uphole from the lower section through the reopened valve and into the upper section of the wellbore.

16. The method of claim 14, further comprising the steps of:

maintaining the valve closed by bleeding the medium from the valve through the flowline and through a slow bleed valve.

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ABSTRACT OF THE DISCLOSURE

SURFACE CONTROLLED FORMATION ISOLATION VALVE ADAPTED FOR DEPLOYMENT OF A DESIRED LENGTH OF A TOOL STRING IN A WELLBORE

A method and apparatus is disclosed for building a tool string uphole of any desired length prior to lowering that tool string downhole into a wellbore for the purpose of performing wellbore operations downhole during a single trip into the wellbore. The apparatus includes a valve disposed between an upper section and a lower section of the wellbore and adapted to open and to close, the upper section of the wellbore being isolated from the lower section of the wellbore when the valve is closed. The tool string of any desired length is built in the upper section of the wellbore when the valve is closed and the upper section of the wellbore is isolated from the lower section of the wellbore. The apparatus also includes a mandrel and piston, the valve being initially disposed in an open position and adapted to be changed from the open position to a closed position when the mandrel is shifted from one position to another position. An upper chamber communicates with a gas reservoir and a valve manifold at the surface. The manifold includes a slow bleed valve and a fast bleed valve disposed at the wellbore surface. A gas metering orifice separates the upper chamber from a lower chamber. The mandrel is shifted in one direction and the valve changes position when a gas is delivered from the surface of the wellbore to the upper chamber thereby moving the piston and the mandrel, the mandrel shifting in an opposite direction and the valve changing position again when the gas in the upper chamber leaks from the upper chamber to the fast bleed valve at the surface. The mandrel shifts in the one direction and the valve changes position again when the gas from the surface is delivered to the upper chamber. However, the mandrel does not shift in the opposite direction and the valve does not change position again when the gas in the upper chamber

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leaks from the upper chamber to the slow bleed valve at the surface.

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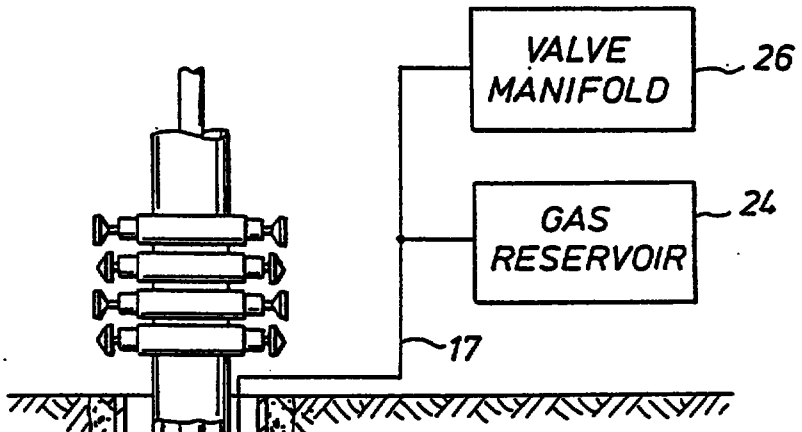

VALVE MANIFOLD
26
GAS RESERVOIR
24
17

FIG.1

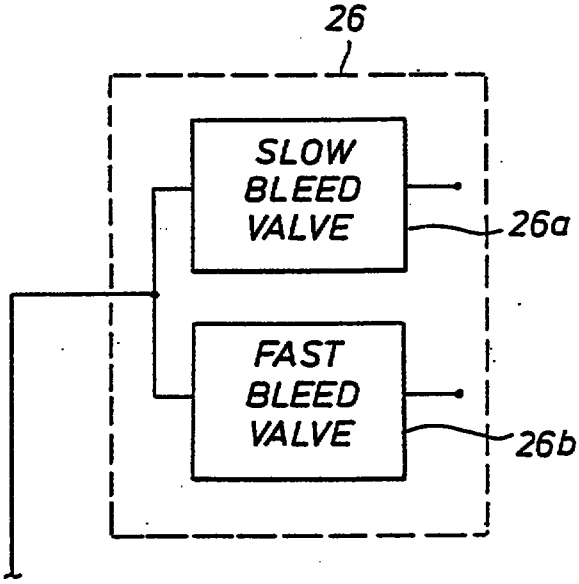

26
SLOW BLEED VALVE
26a
FAST BLEED VALVE
26b

FIG.2

17
12
19
22
17
13
18
18a
14
12
10
20
15

FIG. 3

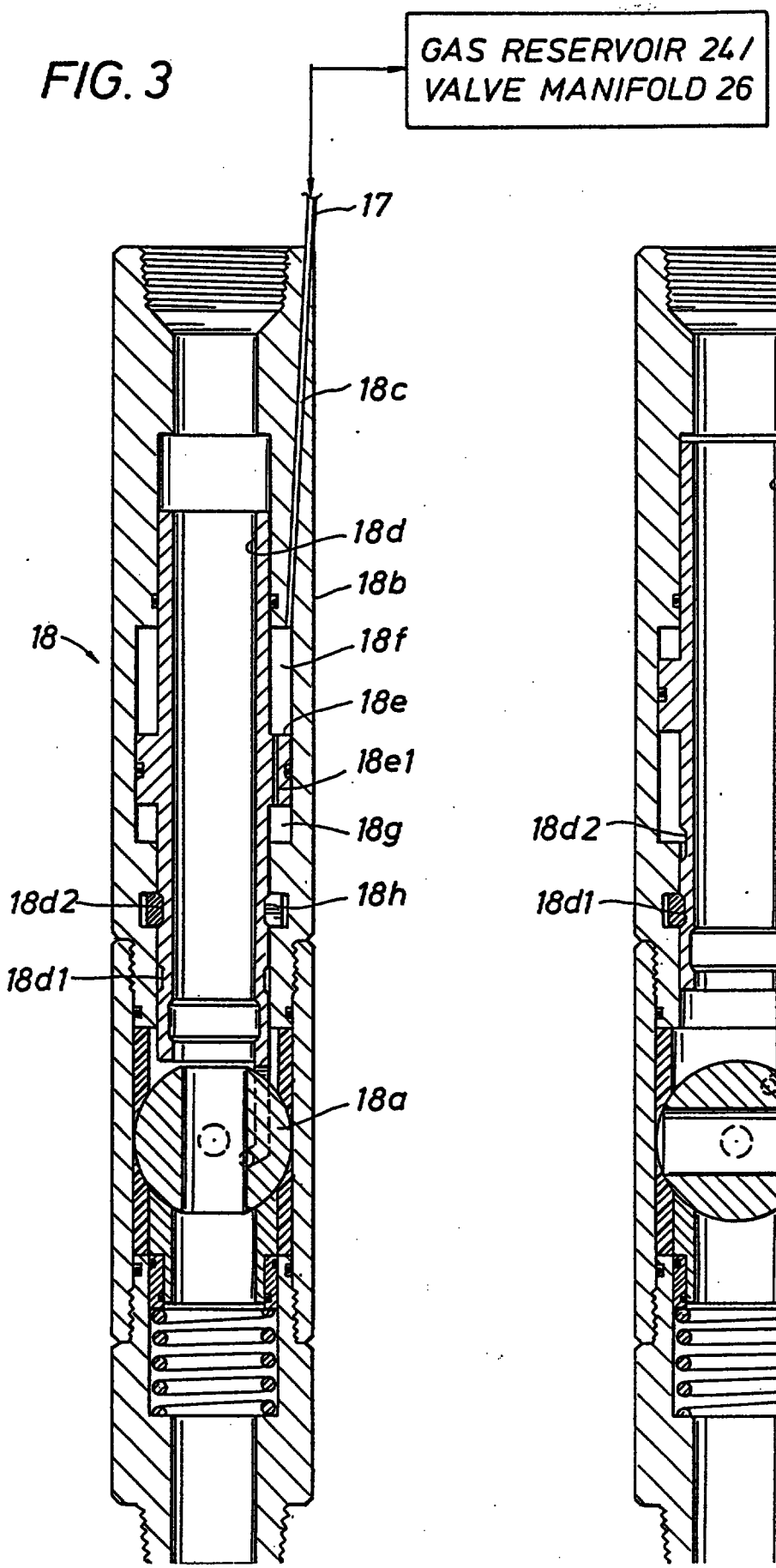

GAS RESERVOIR 24/
VALVE MANIFOLD 26
17
18c
18d
18b
18
18f
18e
18e1
18g
18d2
18h
18d1
18a

FIG. 4

17
18c
18d
18b
18f
18e
18e1
18g
18d2
18d1
18h
18a

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ABSTRACT OF THE DISCLOSURE

SURFACE CONTROLLED FORMATION ISOLATION VALVE ADAPTED FOR DEPLOYMENT OF A DESIRED LENGTH OF A TOOL STRING IN A WELLBORE

A method and apparatus is disclosed for building a desired length of tool string uphole prior to lowering that tool string downhole into a wellbore for performing wellbore operations downhole during a single trip into the wellbore. The apparatus includes a valve disposed between an upper and lower section of the wellbore. The upper wellbore section is isolated from the lower wellbore section when the valve is closed. The tool string is built in the upper section of the wellbore when the valve is closed. The valve is adapted to be opened or closed when a valve mandrel is shifted from one position to another position. The mandrel shifts in one direction when a gas is delivered to an upper chamber, and in an opposite direction when the gas leaks through the fast bleed valve but not if the gas leaks through the slow bleed valve.

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ABSTRACT OF THE DISCLOSURE

SURFACE CONTROLLED FORMATION ISOLATION VALVE ADAPTED FOR DEPLOYMENT OF A DESIRED LENGTH OF A TOOL STRING IN A WELLBORE

A method and apparatus is disclosed for building a desired length of tool string uphole prior to lowering that tool string downhole into a wellbore for performing wellbore operations downhole during a single trip into the wellbore. The apparatus includes a valve disposed between an upper and lower section of the wellbore. The upper wellbore section is isolated from the lower wellbore section when the valve is closed. The tool string is built in the upper section of the wellbore when the valve is closed. The valve is adapted to be opened or closed when a valve mandrel is shifted from one position to another position. The mandrel shifts in one direction when a gas is delivered to an upper chamber, and in an opposite direction when the gas leaks through the fast bleed valve but not if the gas leaks through the slow bleed valve.

(FIG. 1)

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1. (Amended) Apparatus adapted for building a tool string of a desired length [~~uphole of any desired length prior to lowering said tool string downhole into a wellbore~~] for [~~performing wellbore operations~~] downhole operations in [~~said~~] a wellbore, comprising:

[~~an upper section of said wellbore;~~

~~a lower section of said wellbore; and~~]

a valve disposed between [~~said~~] an upper section and [~~said~~] a lower section [~~and~~] of the wellbore, the valve adapted to be [~~opened and~~] closed[,] to allow said tool string [~~adapted~~] to be built in said upper section [~~when said valve is closed~~], the valve adapted to be opened to allow said tool string [~~adapted~~] to be lowered from said upper section, through said valve, and into said lower section [~~when said valve is open, said tool string adapted to perform said wellbore operation downhole when said valve is closed~~]; and

a controller adapted to open and close the valve, the controller including a valve manifold, a gas reservoir, and a flowline interconnecting the valve manifold to said valve.

3. (Amended) The apparatus of claim [~~2~~] 1, wherein said gas reservoir includes a gas, said valve manifold including a slow bleed valve and a fast bleed valve, said gas in said gas reservoir adapted to flow from said gas reservoir through said flowline and into said valve.

4. (Amended) The apparatus of claim 3, wherein said valve comprises an outer housing, a mandrel enclosed by said outer housing and defining a full bore within said valve, and a piston attached to an outer side of said mandrel, said piston including a metering orifice disposed longitudinally therethrough, said mandrel and said piston being longitudinally movable within said housing,

said mandrel and said piston defining [~~an upper~~] a first chamber within said housing disposed between said mandrel and said housing and one side of said piston, [~~said upper chamber communicating with said flowline,~~] said flowline communicating with said slow bleed valve and said fast bleed valve of said [~~further apparatus~~] controller and said gas reservoir of said controller [~~further apparatus~~],

said mandrel and said piston defining [~~a lower~~] a second chamber within said housing disposed between said mandrel and said housing and the other side of said piston.

6. (Amended) The apparatus of claim 5, wherein said gas in said gas reservoir flows through said [~~flowing~~] flowline and into said [~~upper~~] first chamber of said valve, a pressure of said gas in said [~~upper~~] first chamber exerting against said one side of said piston, said gas in said [~~upper~~] first chamber metering through said metering orifice into said [~~lower~~] second chamber and said mandrel

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moving longitudinally in one direction when said pressure of said gas is exerted against said one side of said piston, said closure means closing said full bore of said valve when said mandrel moves in said one direction[~~, said tool string adapted to be built in said upper section when said closure means closes said full bore of said valve~~].

7. (Amended) The apparatus of claim 6, wherein said gas in said [~~lower~~] second chamber exerts a pressure against the other side of said piston, said gas metering from said [~~lower~~] second chamber through said metering orifice and into said [~~upper~~] first chamber, said mandrel moving in a direction opposite to said one direction, and said gas flowing from said [~~upper~~] first chamber through said flowline and through said fast bleed valve when said fast bleed valve is connected to said flowline,

said closure means reopens said full bore of said valve when said mandrel moves in said direction opposite to said one direction.

9. (Amended) The apparatus of claim 8, wherein said gas in said gas reservoir flows through said flowline and into said [~~upper~~] first chamber when said tool is moved from said upper section of said wellbore through the reopened closure means and into said lower section of said wellbore, said gas in said [~~upper~~] first chamber metering from said [~~upper~~] first chamber through said metering orifice and into said [~~lower~~] second chamber, said gas in said [~~upper~~] first chamber moving said mandrel in said one direction,

said closure means reclosing said full bore of said valve when said mandrel moves in said one direction, said tool string in said lower section adapted to perform said wellbore operations downhole in said lower section of said wellbore when said closure means recloses said full bore of said valve.

10. (Amended) A method of operating a valve in a wellbore, comprising [~~the steps of~~]:

moving a medium from a medium reservoir through a flowline and into [~~an upper~~] a first chamber of the valve;

exerting a pressure by the medium against a piston of the valve and moving a mandrel in one direction in response thereto;

metering the medium from the [~~upper~~] first chamber through a metering orifice in the piston and into a [~~lower~~] second chamber of the valve;

operating said valve by changing a state of the valve from a first state to a second state in response to the movement of said mandrel in said one direction;

exerting a pressure by the medium in said [~~lower~~] second chamber against said piston;

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metering said medium from said ~~[lower]~~ second chamber through said metering orifice into said ~~[upper]~~ first chamber through said flowline and through a fast bleed valve;

moving said mandrel in a direction opposite to said one direction; and

operating said valve by changing said state of the valve from said second state to said first state in response to the movement of said mandrel in said direction opposite to said one direction.

11. (Amended) A system adapted for use in connection with wellbore operations, comprising:

an outer housing;

a mandrel enclosed by the outer housing and movable longitudinally within said outer housing;

a piston on said mandrel and a metering orifice longitudinally disposed through said piston~~[,]~~;

said mandrel and said housing defining ~~[an upper]~~ a first chamber on one side of the piston ~~[between the mandrel and the housing and one side of said piston,]~~ and a second chamber on another side of the piston; and

~~[said mandrel and said housing defining a lower chamber between the mandrel and the housing and the other side of said piston; and]~~

a valve manifold and a flowline interconnecting said valve manifold to said ~~[upper]~~ first chamber.

12. (Amended) The system of claim 11, further comprising:

a reservoir, said flowline interconnecting said reservoir to said ~~[upper]~~ first chamber.

13. (Amended) The system of claim 12, wherein said valve manifold comprises a fast bleed valve and a slow bleed valve,

one of said fast bleed valve and slow bleed valve adapted to be selectively interconnected to said ~~[upper]~~ first chamber via said flowline ~~[when said slow bleed valve is not interconnected to said upper chamber,~~

~~said slow bleed valve adapted to be interconnected to said upper chamber via said flowline when said fast bleed valve is not interconnected to said upper chamber].~~

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14. (Amended) A method of building a tool string [~~uphole of a desired length prior to lowering said tool string downhole into a wellbore~~] for performing [~~wellbore~~] downhole operations in the wellbore, comprising [~~the steps of~~]:

providing a first valve between an upper section and a lower section of the wellbore;

closing [~~a~~] the first valve [~~located between an upper section of the wellbore and a lower section of the wellbore~~] by moving a medium from the first valve [~~a medium reservoir~~] through a flowline [~~and~~] into [~~the~~] a fast bleed valve;

building said tool string in said upper section of the wellbore when the first valve is closed;

[~~reopening~~] opening the first valve by [~~bleeding~~] moving the medium from [~~the valve~~] a medium reservoir through the flowline [~~and through a fast bleed~~] into the first valve;

moving said tool string from said upper section through the [~~reopened~~] first valve and into the lower section of the wellbore when the first valve is open; and

[~~reclosing the valve by moving said medium from said medium reservoir through said flowline and into said valve.~~]

operating the tool string [~~performing~~] to perform a wellbore operation in the lower section of said wellbore.

16. (Amended) The method of claim 14, further comprising [~~the steps of~~]:

maintaining the first valve open [~~closed~~] by bleeding the medium from the first valve through the flowline and through a slow bleed valve.

17. The apparatus of claim 1, wherein the valve includes a first and a second chamber, the first chamber in communication with the flowline to develop a differential pressure between the first and second chambers to actuate the valve.

18. The apparatus of claim 17, further comprising a metering orifice coupled between the first and second chambers.

19. The apparatus of claim 18, wherein the valve manifold includes a slow bleed valve and a fast bleed valve, the slow bleed valve adapted to release pressure at a slower rate than the metering orifice, and the fast bleed valve adapted to release pressure at a faster rate than the metering orifice.

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20. The apparatus of claim 19, further comprising a piston defined between the first and second chambers and adapted to operate the valve.

21. The apparatus of claim 20, wherein the piston is adapted to move by differential pressure between the first and second chambers.

22. The apparatus of claim 1, wherein the valve includes a ball valve.

23. An assembly for use with a well, comprising:

an isolation valve; and

a controller adapted to actuate the isolation valve, the controller including a reservoir containing a medium, a fast bleed valve, a slow bleed valve, and a flowline coupled to the isolation valve through which medium is applied to or removed from the isolation valve to actuate the isolation valve.

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CLAIMS

1. Apparatus adapted for building a tool string of a desired length for downhole in a wellbore, comprising:

a valve disposed between an upper section and a lower section of the wellbore, the valve adapted to be closed to allow said tool string to be built in said upper section, the valve adapted to be opened to allow said tool string to be lowered from said upper section, through said valve, and into said lower section; and

a controller adapted to open and close the valve, the controller including a valve manifold, a gas reservoir, and a flowline interconnecting the valve manifold to said valve.

2. The apparatus of claim 1, wherein said gas reservoir includes a gas, said valve manifold including a slow bleed valve and a fast bleed valve, said gas in said gas reservoir adapted to flow from said gas reservoir through said flowline and into said valve.

3. The apparatus of claim 2, wherein said valve comprises an outer housing, a mandrel enclosed by said outer housing and defining a full bore within said valve, and a piston attached to an outer side of said mandrel, said piston including a metering orifice disposed longitudinally therethrough, said mandrel and said piston being longitudinally movable within said housing,

said mandrel and said piston defining a first chamber within said housing disposed between said mandrel and said housing and one side of said piston, said flowline communicating with said slow bleed valve and said fast bleed valve of said controller and said gas reservoir of said controller,

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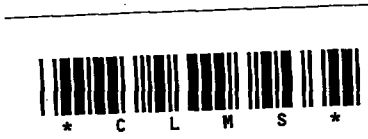
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said mandrel and said piston defining a second chamber within said housing disposed between said mandrel and said housing and the other side of said piston.

4. The apparatus of claim 3, wherein said valve further comprises closure means attached to said mandrel for opening said full bore of said valve when said mandrel is disposed in one longitudinal position within said valve and closing said full bore of said valve when said mandrel is disposed in another longitudinal position within said valve.

5. The apparatus of claim 4, wherein said gas in said gas reservoir flows through said flowline and into said first chamber of said valve, a pressure of said gas in said first chamber exerting against said one side of said piston, said gas in said first chamber metering through said metering orifice into said second chamber and said mandrel moving longitudinally in one direction when said pressure of said gas is exerted against said one side of said piston, said closure means closing said full bore of said valve when said mandrel moves in said one direction.

6. The apparatus of claim 5, wherein said gas in said second chamber exerts a pressure against the other side of said piston, said gas metering from said second chamber through said metering orifice and into said first chamber, said mandrel moving in a direction opposite to said one direction, and said gas flowing from said first chamber through said flowline and through said fast bleed valve when said fast bleed valve is connected to said flowline,



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said closure means reopens said full bore of said valve when said mandrel moves in said direction opposite to said one direction.

7. The apparatus of claim 6, wherein said tool string in said upper section is adapted to move downhole from said upper section through the reopened closure means and into said lower section when said closure means reopens said full bore of said valve.

8. The apparatus of claim 7, wherein said gas in said gas reservoir flows through said flowline and into said first chamber when said tool is moved from said upper section of said wellbore through the reopened closure means and into said lower section of said wellbore, said gas in said first chamber metering from said first chamber through said metering orifice and into said second chamber, said gas in said first chamber moving said mandrel in one said direction,

said closure means recessing said full bore of said valve when said mandrel moves in said one direction, said tool string in said lower section adapted to perform said wellbore operations downhole in said lower section of said wellbore when said closure means recloses said full bore of said valve.

9. A method of operating a valve in a wellbore, comprising:

moving a medium from a medium reservoir through a flowline and into a first chamber of the valve;

exerting a pressure by the medium against a piston of the valve and moving a mandrel in one direction in response thereto;

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metering the medium from the first chamber through a metering orifice in the piston and into a second chamber of the valve;

operating said valve by changing a state of the valve from a first state to a second state in response to the movement of said mandrel in said one direction;

exerting a pressure by the medium in said second chamber against said piston;

metering said medium from said second chamber through said metering orifice into said first chamber through said flowline and through a fast bleed valve;

moving said mandrel in a direction opposite to said one direction; and

operating said valve by changing said state of the valve from said second state to said first state in response to the movement of said mandrel in said direction opposite to said one direction.

10. A system adapted for use in connection with wellbore operations, comprising:

an outer housing;

a mandrel enclosed by the outer housing and movable longitudinally within said outer housing;

a piston on said mandrel and a metering orifice longitudinally disposed through said piston;

said mandrel and said housing defining a first chamber on one side of the piston and a second chamber on another side of the piston; and

a valve manifold and a flowline interconnecting said valve manifold to said first chamber.

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11. The system of claim 10, further comprising:

a reservoir, said flowline interconnecting said reservoir to said first chamber.

12. The system of claim 11, wherein said valve manifold comprises a fast bleed valve and a slow bleed valve,

one of said fast bleed valve and slow bleed valve adapted to be selectively interconnected to said first chamber via said flowline.

13. A method of building a toolstring for performing downhole operations in the wellbore, comprising:

providing a first valve between an upper section and a lower section of the wellbore,

closing the first valve by moving a medium from the first valve through a flowline into a fast bleed valve;

building said tool string in said upper section of the wellbore when the first valve is closed;

opening the first valve by moving the medium from a medium reservoir through the flowline into the first valve;

moving said tool string from said upper section through the first valve and into the lower section of the wellbore when the first valve is open; and

operating the tool string to perform a wellbore operation in the lower section of said wellbore.

14. The method of claim 13, further comprising:

maintaining the first valve open by bleeding the medium from the first valve through the flowline and through a slow bleed valve.

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15. The apparatus of claim 1, wherein the valve includes a first and a second chamber, the first chamber in communication with the flowline to develop a differential pressure between the first and second chambers to actuate the valve.

16. The apparatus of claim 15, further comprising a metering orifice coupled between the first and second chambers.

17. The apparatus of claim 16, wherein the valve manifold includes a slow bleed valve and a fast bleed valve, the slow bleed valve adapted to release pressure at a slower rate than the metering orifice, and the fast bleed valve adapted to release pressure at a faster rate than the metering orifice.

18. The apparatus of claim 17, further comprising a piston defined between the first and second chambers and adapted to operate the valve.

19. The apparatus of claim 18, wherein the piston is adapted to move by differential pressure between the first and second chambers.

20. The apparatus of claim 1, wherein the valve includes a ball valve.

21. An assembly for use with a well, comprising:
an isolation valve; and

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a controller adapted to actuate the isolation valve, the controller including a reservoir containing a medium, a fast bleed valve, a slow bleed valve, and a flowline coupled to the isolation valve through which medium is applied to or removed from the isolation valve to actuate the isolation valve.

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SUMMARY OF THE INVENTION

In accordance with the invention, there is provided an apparatus adapted for building a tool string of a desired length for downhole in a wellbore, comprising:

a valve disposed between an upper section and a lower section of the wellbore, the valve adapted to be closed to allow said tool string to be built in said upper section, the valve adapted to be opened to allow said tool string to be lowered from said upper section, through said valve, and into said lower section; and

a controller adapted to open and close the valve, the controller including a valve manifold, a gas reservoir, and a flowline interconnecting the valve manifold to said valve.

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In another aspect, there is provided a method of building a toolstring for performing downhole operations in the wellbore, comprising:

providing a first valve between an upper section and a lower section of the wellbore,

closing the first valve by moving a medium from the first valve through a flowline into a fast bleed valve;

building said tool string in said upper section of the wellbore when the first valve is closed;

opening the first valve by moving the medium from a medium reservoir through the flowline into the first valve;

moving said tool string from said upper section through the first valve and into the lower section of the wellbore when the first valve is open; and

operating the tool string to perform a wellbore operation in the lower section of said wellbore.

In accordance with these and other objects of the present invention, an apparatus adapted to be disposed in a wellbore allows an operator at the wellbore surface to build a tool string uphole of any desired length prior to lowering that tool string downhole into a wellbore for the purpose of performing wellbore operations during a single trip into the wellbore. The apparatus includes a valve disposed between an upper section and a lower section of the wellbore which is adapted to open and to close. The upper section of the wellbore is isolated from the lower section of the wellbore when the valve is closed. The tool string of any desired

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said closure means reopens said full bore of said valve when said mandrel moves in said direction opposite to said one direction.

7. The apparatus of claim 6, wherein said tool string in said upper section is adapted to move downhole from said upper section through the reopened closure means and into said lower section when said closure means reopens said full bore of said valve.

8. The apparatus of claim 7, wherein said gas in said gas reservoir flows through said flowline and into said first chamber when said tool is moved from said upper section of said wellbore through the reopened closure means and into said lower section of said wellbore, said gas in said first chamber metering from said first chamber through said metering orifice and into said second chamber, said gas in said first chamber moving said mandrel in one said direction,

said closure means recessing said full bore of said valve when said mandrel moves in said one direction, said tool string in said lower section adapted to perform said wellbore operations downhole in said lower section of said wellbore when said closure means recloses said full bore of said valve.

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9. A method of building a toolstring for performing downhole operations in the wellbore, comprising:

providing a first valve between an upper section and a lower section of the wellbore,

closing the first valve by moving a medium from the first valve through a flowline into a fast bleed valve;

building said tool string in said upper section of the wellbore when the first valve is closed;

opening the first valve by moving the medium from a medium reservoir through the flowline into the first valve;

moving said tool string from said upper section through the first valve and into the lower section of the wellbore when the first valve is open; and

operating the tool string to perform a wellbore operation in the lower section of said wellbore.

10 The method of claim 9, further comprising:

maintaining the first valve open by bleeding the medium from the first valve through the flowline and through a slow bleed valve.

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11. The apparatus of claim 1, wherein the valve includes a first and a second chamber, the first chamber in communication with the flowline to develop a differential pressure between the first and second chambers to actuate the valve.

12. The apparatus of claim 11, further comprising a metering orifice coupled between the first and second chambers.

13. The apparatus of claim 12, wherein the valve manifold includes a slow bleed valve and a fast bleed valve, the slow bleed valve adapted to release pressure at a slower rate than the metering orifice, and the fast bleed valve adapted to release pressure at a faster rate than the metering orifice.

14. The apparatus of claim 13, further comprising a piston defined between the first and second chambers and adapted to operate the valve.

15. The apparatus of claim 14, wherein the piston is adapted to move by differential pressure between the first and second chambers.

16. The apparatus of claim 1, wherein the valve includes a ball valve.

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ABSTRACT OF THE DISCLOSURE

SURFACE CONTROLLED FORMATION ISOLATION VALVE ADAPTED FOR DEPLOYMENT OF A DESIRED LENGTH OF A TOOL STRING IN A WELLBORE

A method and apparatus is disclosed for building a desired length of tool string uphole prior to lowering that tool string downhole into a wellbore for performing wellbore operations downhole during a single trip into the wellbore. The apparatus includes a valve disposed between an upper and lower section of the wellbore. The upper wellbore section is isolated from the lower wellbore section when the valve is closed. The tool string is built in the upper section of the wellbore when the valve is closed. The valve is adapted to be opened or closed when a valve mandrel is shifted from one position to another position. The mandrel shifts in one direction when a gas is delivered to an upper chamber, and in an opposite direction when the gas leaks through the fast bleed valve but not if the gas leaks through the slow bleed valve.

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