



(22) Date de dépôt/Filing Date: 1997/12/09

(41) Mise à la disp. pub./Open to Public Insp.: 1998/06/10

(45) Date de délivrance/Issue Date: 2006/08/01

(30) Priorité/Priority: 1996/12/10 (US08/762,762)

(51) Cl.Int./Int.Cl. *E21B 19/00* (2006.01),
E21B 19/22 (2006.01), *E21B 33/068* (2006.01),
E21B 34/10 (2006.01)

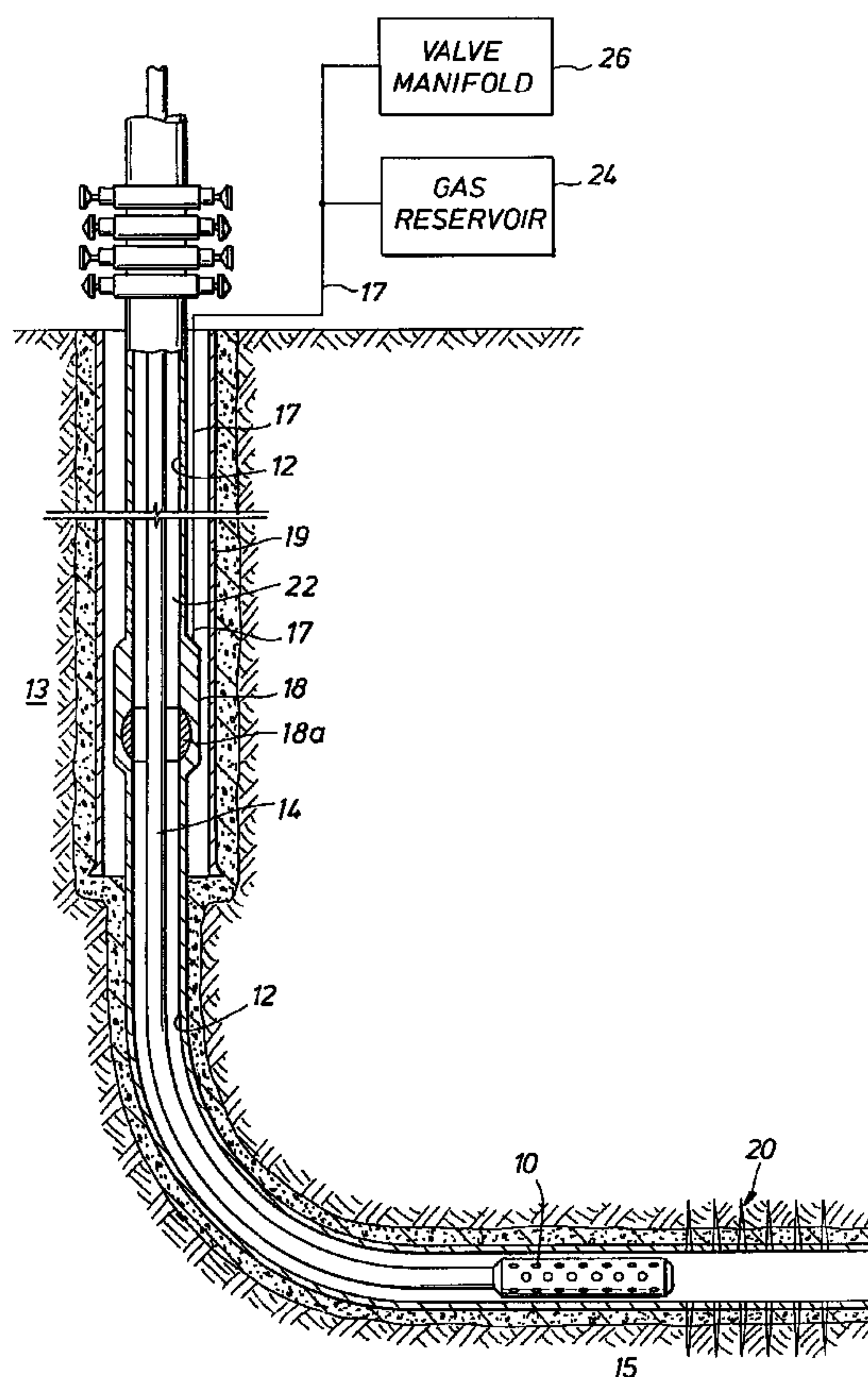
(72) Inventeurs/Inventors:
PATEL, DINESH R., US;
RYTLEWSKI, GARY L., US

(73) Propriétaire/Owner:
SCHLUMBERGER CANADA LIMITED, CA

(74) Agent: SMART & BIGGAR

(54) Titre : VANNE D'ISOLEMENT DE FORMATION SITUEE EN SURFACE ADAPTEE POUR DEPLOYER LA
LONGUEUR DESIREE D'UNE TIGE D'OUTIL DANS UN PUIT DE FORAGE

(54) Title: SURFACE CONTROLLED FORMATION ISOLATION VALVE ADAPTED FOR DEPLOYMENT OF A DESIRED
LENGTH OF A TOOL STRING IN A WELLBORE



(57) Abrégé/Abstract:

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

(57) Abrégé(suite)/Abstract(continued):

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

ABSTRACT OF THE DISCLOSURE

5 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
10 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
15 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
20 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
25 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
30 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
35 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.

72196-13

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

BACKGROUND OF THE INVENTION

5 This 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
10 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.

 U.S. Patent No. 5,810,087, owned by the same
15 assignee as that of the present application, relates to the
same field of the invention as that recited above. In this
prior patent, 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
20 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.

5

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
10 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
15 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
20 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
25 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
30 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
35 dropping that perforating gun to the bottom of the wellbore), making up a second perforating gun having another

72196-13

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
5 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
10 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
15 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.

20 U.S. Patent No. 5,848,646 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 this patent,
25 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
5 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
10 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
15 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
20 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
25 tool, is lowered downhole for the purpose of performing
wellbore operations downhole during one trip into the
wellbore.

However, another alternate apparatus, and corresponding
30 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
35 purpose of performing wellbore operations downhole during a
single trip into the wellbore.

SUMMARY OF THE INVENTION

Accordingly, it is a primary object of the present invention
5 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.

10

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
15 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
20 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.

25

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
30 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
35 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, the alternate apparatus further including a mandrel and piston, the valve, such as a ball valve, initially
5 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
10 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
15 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
20 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.

25 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
30 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
35 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
5 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
10 (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
15 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
20 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
25 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
30 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
35 direction.

72196-13

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.

The invention may be summarized according to one aspect as apparatus adapted for building a tool string of a desired length for downhole operations 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 of the wellbore, 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.

According to another aspect the invention provides 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 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 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

72196-13

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
5 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
10 the movement of said mandrel in said direction opposite to said one direction.

According to another aspect the invention provides a system adapted for use in connection with wellbore operations, comprising: an outer housing; a mandrel enclosed
15 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
20 the piston; and a valve manifold and a flowline interconnecting said valve manifold to said first chamber.

According to another aspect the invention provides a method of building a tool string for performing downhole operations in the wellbore, comprising: providing a first
25 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
30 valve by moving the medium from a medium reservoir through

72196-13

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
5 operation in the lower section of said wellbore.

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
10 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
15 tubing or wireline conveyed perforating gun running 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;

20 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 string 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.

35

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
5 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
10 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.
15 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
20 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
25 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.
30 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,
35 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:

5 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
10 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
15 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.

20

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
25 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
30 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
35 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
5 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
10 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.

72196-13

CLAIMS:

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

5 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 of the wellbore, the valve adapted to be opened to allow said tool string to be lowered from said upper
10 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
15 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
20 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
25 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

72196-13

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,

5 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
10 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
15 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
20 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
25 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

72196-13

through said flowline and through said fast bleed valve when said fast bleed valve is connected to said flowline.

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 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 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.

9. 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.

10. The apparatus of claim 9, further comprising a metering orifice coupled between the first and second chambers.

72196-13

11. The apparatus of claim 10, 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
5 adapted to release pressure at a faster rate than the metering orifice.

12. The apparatus of claim 11, further comprising a piston defined between the first and second chambers and adapted to operate the valve.

10 13. The apparatus of claim 12, wherein the piston is adapted to move by differential pressure between the first and second chambers.

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

15 15. 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 a first chamber of the valve;

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

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

25 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;

72196-13

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
5 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
10 to the movement of said mandrel in said direction opposite to said one direction.

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

an outer housing;

15 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
20 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.

17. The system of claim 16, further comprising:

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

72196-13

18. The system of claim 17, wherein said valve manifold comprises a fast bleed valve and a slow bleed valve,

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

19. A method of building a tool string for performing downhole operations in the wellbore, comprising:

providing a first valve between an upper section
10 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;

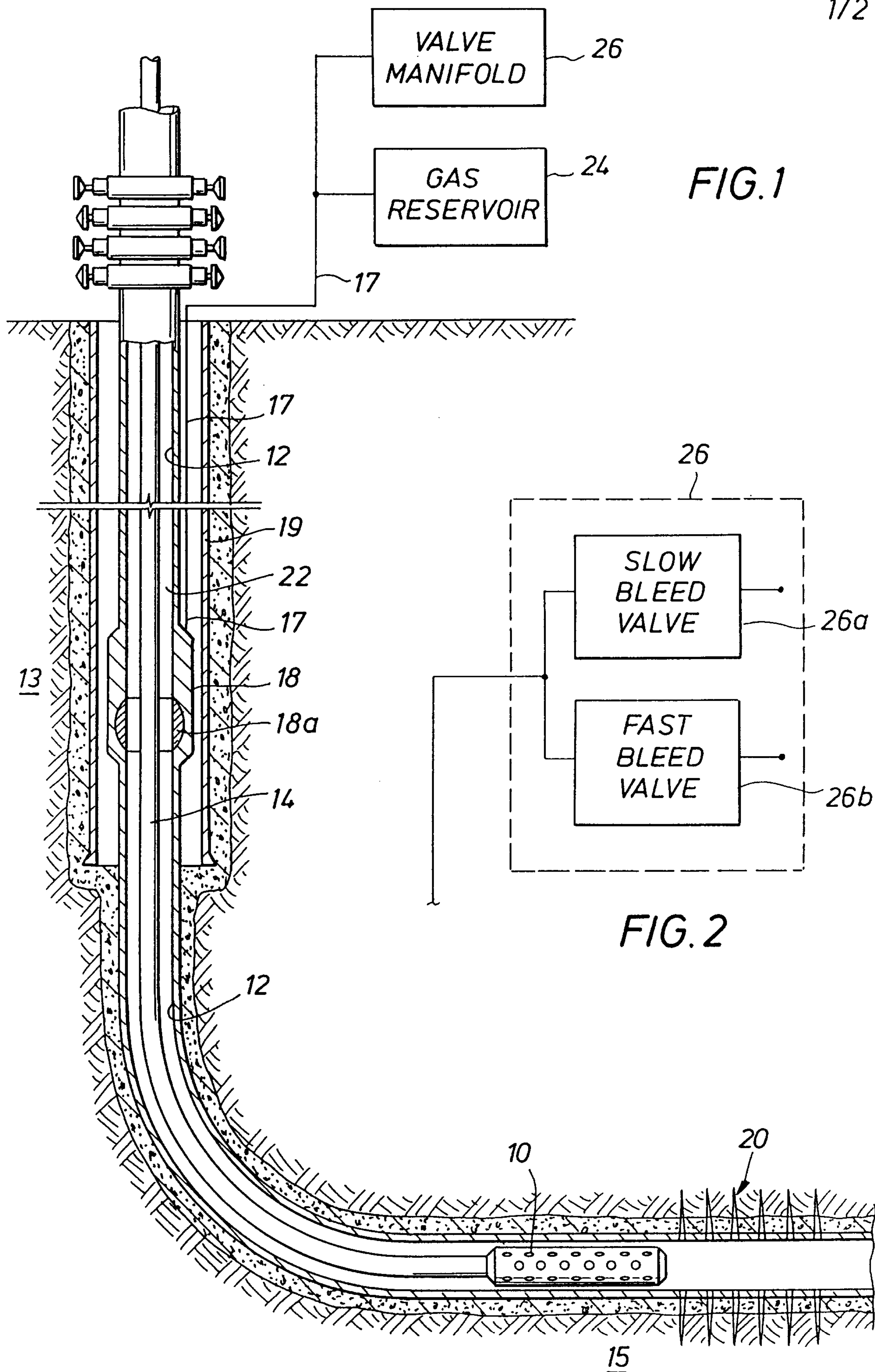
15 opening the first valve by moving the medium from a medium reservoir through the flowline into the first valve;

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

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

20. The method of claim 19, further comprising the steps of:

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



2/2

FIG. 3

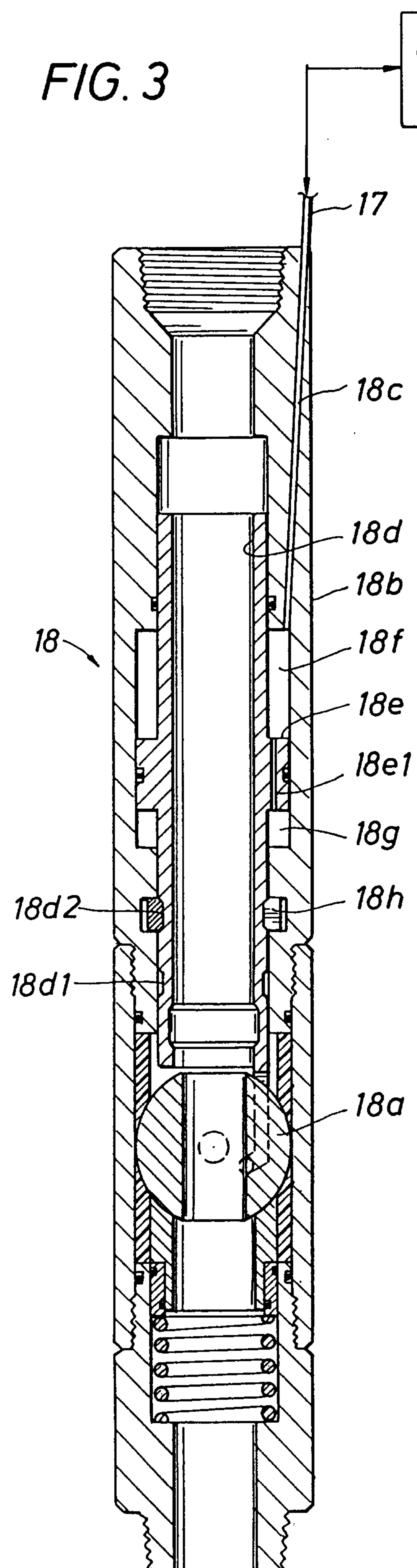
GAS RESERVOIR 24/
VALVE MANIFOLD 26

FIG. 4

