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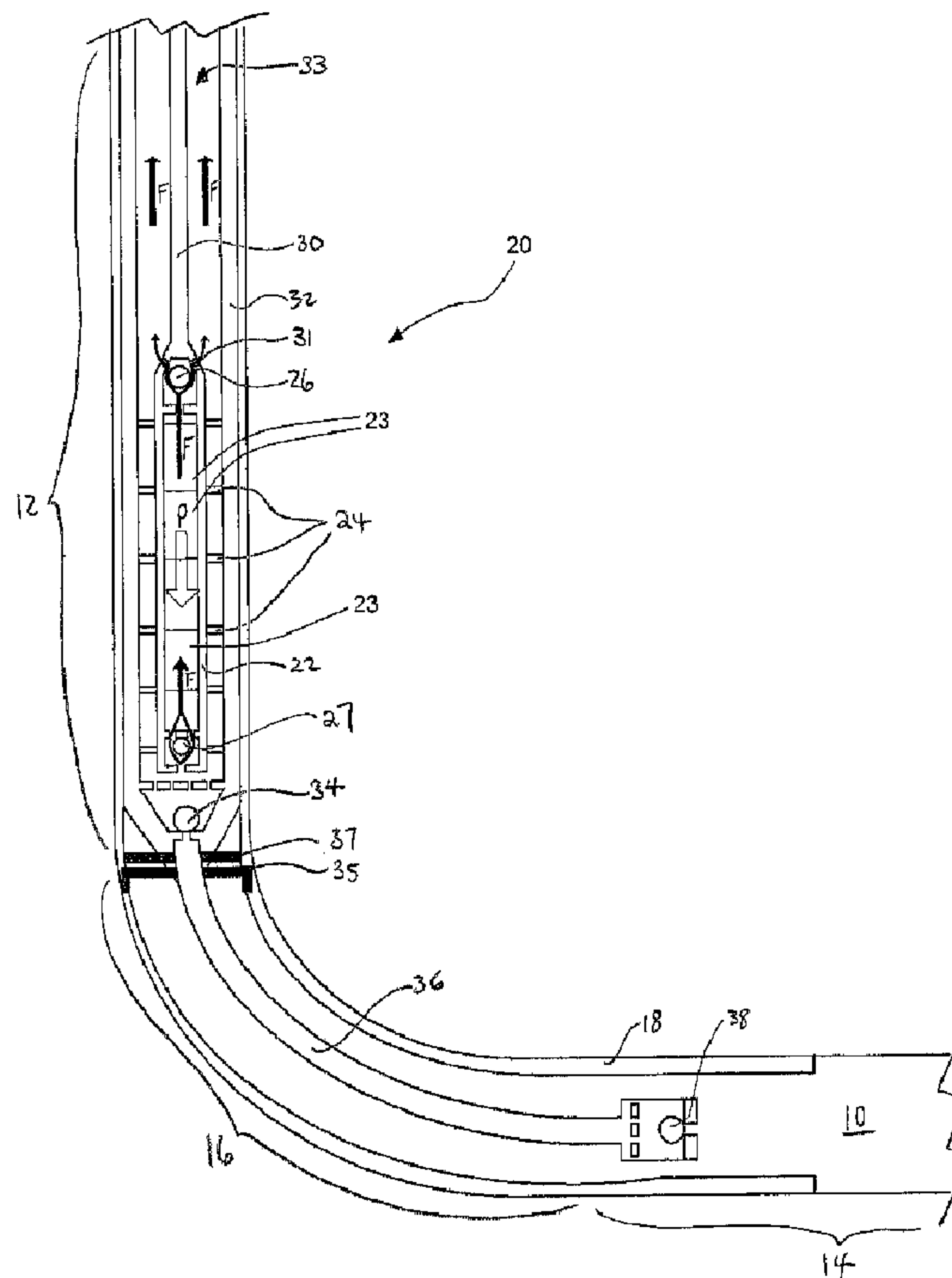
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(54) **Titre : APPAREIL DE LEVAGE DE FLUIDE DE TROU DE Puits**

(54) **Title: WELLBORE FLUID LIFT APPARATUS**



(57) **Abrégé/Abstract:**

An apparatus and a method are provided for lifting wellbore fluids from a distal section of a wellbore. The apparatus comprises a suction generator connected to a communication line having an open free end that extends into the distal section. The suction



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

generator creates suction to draw fluid from the free end of the communication line up to the proximal section. The suction generator may comprise a piston barrel with a piston disposed therein and the communication line may be a flexible tubing connected to the lower end of the piston barrel. Wellbore fluids can be drawn into the flexible tubing and up the piston barrel, through the piston, by repeated alternating upward and downward movement of the piston.

ABSTRACT

An apparatus and a method are provided for lifting wellbore fluids from a distal section of a wellbore. The apparatus comprises a suction generator connected to a
5 communication line having an open free end that extends into the distal section. The suction generator creates suction to draw fluid from the free end of the communication line up to the proximal section. The suction generator may comprise a piston barrel with a piston disposed therein and the communication line may be a flexible tubing connected to the lower end of the piston barrel. Wellbore fluids can be drawn into the flexible tubing
10 and up the piston barrel, through the piston, by repeated alternating upward and downward movement of the piston.

Wellbore Fluid Lift Apparatus**PRIORITY APPLICATION**

This application claims priority to US provisional application serial number 61/762,451, filed February 8, 2013.

5 FIELD

The invention relates to an apparatus for recovering fluids, particularly hydrocarbons, from subterranean wells, especially subterranean wells having a substantially horizontal section.

BACKGROUND

- 10 Some subterranean wells have a proximal section that extends substantially vertically downward from the surface opening to a first depth in a geological formation. At the lowermost position of the proximal section begins a curved section (sometimes referred to as a "heel") that curves down towards a distal section which extends substantially horizontally across the formation at a second depth.
- 15 Generally, to recover fluids from the distal section of the well, a pump is run downhole with tubing connected to its lower end. Conventional pumps generally cannot be placed below the first depth, i.e. the point at which the well begins to curve, because moving parts in convention pumps may cause wear and damage to the casing wall if it deviates from the vertical axis of the equipment in the proximal section. Also, conventional pumps
- 20 could become wedged in the heel if it is to be installed below the proximal section of the well. The tubing then extends from the lower end of the pump through the curved section and into the distal section of the well. A large amount of suction is required to draw fluids up the tubing from the distal section because there is usually a large distance between the lower end of the proximal section and the distal section; the heel can sometimes have

radius of curvature in the magnitude of 1000 feet. In some instances, conventional pumps do not provide enough suction to draw fluids out of the distal section and up the well.

SUMMARY OF THE INVENTION

According to a broad aspect of the present invention, there is provided an apparatus for
 5 producing wellbore fluids from a well having a proximal section and a distal section, with
 a curved section therebetween, and an inner surface, the apparatus comprising: a piston
 barrel, the piston barrel being a tubular member having a first end, a second end, an outer
 surface, an inner surface defining an axial barrel bore, and an opening at or near the
 second end; a piston disposed in the barrel bore, the piston having a first end, a second
 10 end, an outer surface, an opening at or near each of the first and second ends, and an
 inner surface defining a piston chamber, at least a portion of the outer surface of the
 piston frictionally engages the inner surface of the piston barrel to substantially fluidly
 seal a first space in the barrel bore adjacent to the first end of the piston against a second
 space in the barrel bore adjacent to the second end of the piston, the piston being
 15 slideably movable axially in the barrel bore between the first end and the second end of
 the piston barrel; a flexible tubing having a first end, a second end, an outer surface, an
 opening at or near the second end, and an axial tubing bore, the first end being connected
 to the second end of the piston barrel and the inner tubing bore being in communication
 with the barrel bore via the opening of the second end of the piston barrel; a first valve
 20 having an open position allowing fluid flow between the first space and the second space
 in the barrel bore, via the openings of the first and second ends of the piston through the
 piston chamber, in the direction of the first end of the piston barrel, and a closed position
 blocking fluid communication between the first space and the second space; and a second
 valve having an open position allowing fluid flow between the opening of the second end
 25 of the flexible tubing and the second space in the barrel bore, in the direction towards the
 first end of the piston barrel, and a closed position blocking fluid flow through the
 flexible tubing in the direction towards the second end of the flexible tubing, and the first
 valve being closeable and the second valve being openable by fluid pressure differential

created by movement of the piston in the barrel bore towards the first end of the piston barrel; and the second valve being closeable and the first valve being openable by fluid pressure differential created by movement of the piston in the barrel bore towards the second end of the piston barrel.

- 5 According to another aspect of the present invention, there is provided a method for producing wellbore fluids from a wellbore having a surface opening, a proximal section, and a distal section, the method comprising: running an apparatus down the wellbore, the apparatus comprising a suction generator having a tubular member for collecting wellbore fluids therein, and a communication line connected to and in communication
10 with the tubular member, the communication line having an open free end extending into the wellbore; creating suction in the communication line to draw wellbore fluids therethrough via the open free end and into the tubular member; and collecting wellbore fluids in the tubular member.

- According to yet another broad aspect of the present invention, there is provided a
15 method for producing wellbore fluids from a wellbore having a surface opening, an inner surface, a proximal section and a distal section, the method comprising: running an apparatus into the wellbore, the apparatus comprising: a piston barrel with an upper end, a lower end, an inner axial bore and a lower opening at or near the lower end; a piston disposed in the bore, the piston being slideably movable axially inside and between the
20 upper and lower ends of the piston barrel and providing a fluid seal between an upper space above the piston in the bore and a lower space below the piston in the bore, the piston has a lower opening and an upper opening, and a fluid passage therebetween; and a flexible tubing having an upper end connected to the lower opening of the piston barrel and an open lower end, and securing the piston barrel to the inner surface of the wellbore
25 in the proximal section, with its upper end closer to the surface opening than its lower end, and with the flexible tubing extending into the wellbore below the piston barrel; moving the piston upwards towards the upper end of the piston barrel to draw wellbore fluids from the wellbore through the flexible tubing via the open lower end thereof, and

into the lower space via the lower opening of the piston barrel, while blocking fluid communication between the upper space and the lower space; and moving the piston downwards towards the lower end of the piston barrel to allow wellbore fluids in the lower space to flow into the upper space via the lower opening of the piston, the fluid
5 passage in the piston, and the upper opening of the piston, respectively, while blocking fluid communication between the open lower end of the flexible tubing and the lower space.

BRIEF DESCRIPTION OF THE DRAWINGS

Drawings are included for the purpose of illustrating certain aspects of the invention.
10 Such drawings and the description thereof are intended to facilitate understanding and should not be considered limiting of the invention. Drawings are included, in which:

FIG. 1 is a diagrammatic cross-sectional view of one possible embodiment of the invention, shown in a first position;

FIG. 2 is a diagrammatic cross-sectional view of the embodiment in FIG. 1, shown in a
15 second position; and

FIG. 3 is a diagrammatic cross-sectional view of the embodiment in FIG. 1, showing the flow of fluids.

DETAILED DESCRIPTION OF VARIOUS EMBODIMENTS

The detailed description set forth below in connection with the appended drawings is
20 intended as a description of various embodiments of the present invention and is not intended to represent the only embodiments contemplated by the inventor. The detailed description includes specific details for the purpose of providing a comprehensive understanding of the present invention. However, it will be apparent to those skilled in the art that the present invention may be practiced without these specific details.

FIGS. 1, 2, and 3 are simplified, schematic illustrations of one possible embodiment of an apparatus of the present invention for recovering fluids, especially hydrocarbons, from a subterranean well. FIGS. 1, 2, and 3 are for illustrative purposes only and are not drawn to scale. In this disclosure, "upper" or "above" generally denotes a position that is closer
5 to the well opening at the surface than "lower" or "below".

Referring to the figures, there is provided an apparatus 20 for use with a subterranean well 10. Subterranean well 10 may for example include a proximal section 12 and a distal section 14. Proximal section 12 defines a bore that extends downward from the surface to a first depth of a geological formation. Distal section 14 defines a bore that extends at an
10 angle from the proximal section into a portion of the formation containing the desired fluid. There is a curved section or heel 16 between the proximal section 12 and the distal section 14 which connects the two sections.

In one embodiment, the proximal section extends substantially vertically downward, from the surface, while the distal section extends substantially horizontally from the proximal
15 section, with curved section 16 therebetween. In alternative embodiments, the proximal and distal sections may extend at an angle to the vertical and horizontal, respectively, depending upon the characteristics of the formation through which the well bore passes and the location of the fluid source within the formation. In one embodiment, the proximal section 12 extends at an angle between 0 and 30 degrees from the vertical and
20 the distal section 14 extends at an angle between 0 and 90 degrees from the horizontal. In another embodiment, distal section 14 is substantially vertical. In yet another embodiment, the wellbore is drilled at an angle for a distance before becoming substantially horizontal. For example, the wellbore could be drilled for approximately 500 feet at about 10 degrees, increase for approximately 3000 ft to about 25 degrees, then
25 turn through a large radius to a lateral, which might begin at around 80 degrees but slowly transition to about 85 to 90 degrees, or even past 90 degrees to around 100 degrees.

From the disclosure herein, it will be apparent to the person of ordinary skill in the art that the present invention may also be used for subterranean wells with configurations other than the above-described examples.

In one embodiment, well 10 further includes a well casing 18. It may be advantageous to include casing 18 to help ensure that the diameter and structural integrity of the wellbore is maintained in sections of the formation that may be prone to caving. The casing may also help ensure that pressures in the wellbore section containing downhole equipment remain predictable and consistent. However, the present invention may also be applied to an uncased well.

Apparatus 20 generally comprises a suction generator in the proximal section, and the suction generator is connected to a communication line having an open free end that extends close to or into the distal section. The suction generator draws fluid from the free end of the communication line up to the proximal section.

In one embodiment, the suction generator of apparatus 20 has a piston comprising a piston body 22 and a plurality of piston rings 24. In a sample embodiment, the piston body 22 is made of a series of tubular segments 23. Adjacent tubular segments may be connected in various ways, including for example by threaded connection, bonding, welding, etc. The piston body 22 has an outer surface, and an inner surface that defines a chamber. In this sample embodiment, the chamber is an axial bore; however, the chamber may be of other shapes depending on the configuration of the piston body. The chamber provides a fluid passage between the upper and lower ends of the piston, thereby allowing fluid communication therebetween. The piston body is made of materials that can withstand wellbore conditions, including for example carbon steel and stainless steel.

The plurality of piston rings 24 is for sealing the interface between adjacent tubular segments. The piston rings may be made of various materials that can withstand wellbore conditions, such as high pressures and high temperatures. In one embodiment, the piston rings are made of Acrylonitrile butadiene rubber, which is resistant to abrasion, tearing,

and aging, and to oils and water. Acrylonitrile butadiene rubber may also be combined with other materials to increase its strength and its resistance to cracking upon flexure.

Each of the piston rings 24 is disposed about the outer surface of the piston body circumferentially, preferably at the junction between two adjacent segments 23, and
5 extends radially outwardly from the outer surface of the piston body. Each ring 24 provides an upper piston face and a lower piston face.

The number of piston rings on the piston body may depend on the number of tubular segments in the piston body. In one embodiment, the piston body is approximately 20 feet in length and comprises five tubular segments, each being approximately 4 feet long.
10 A piston ring is disposed about the connection between two adjacent tubular segments to provide a fluid seal therebetween. A piston ring may also be disposed near the upper end and/or lower end of the piston body. In a sample embodiment, six piston rings are disposed along the length of the piston body.

The piston body further comprises one or both of: (i) an upper traveling valve 26 and (ii)
15 a lower traveling valve 27. A traveling valve is a valve that is housed in the piston body and therefore moves with the piston body. In one embodiment, valve 26 is positioned at or near the upper end of the bore of the piston body, and valve 27 is positioned at or near the lower end of bore of the piston body. Valves 26 and 27 in piston body 22 are each a check-valve that only allows fluid flow in one direction. In a preferred embodiment,
20 valves 26 and 27, when opened, allow fluids to flow upwards towards the wellbore opening at surface.

In one embodiment, the upper end of the piston 22 is connected to the lower end of a sucker rod 30. The piston may be connected to the sucker rod by for example a flange coupling. In one embodiment, valve 26 may be incorporated into the flange coupling. The
25 sucker rod is used for moving the piston axially up and down the proximal section. The sucker rod is preferably made of materials that can withstand high stress, including for example stainless steel. In one embodiment, the upper end of the sucker rod is connected

to a land rig (not shown) at the surface of the wellbore opening, such that the upstroke and downstroke of the rig directs the respective upward and downward axial movement of the rod.

5 The suction generator of apparatus 20 further comprises a piston barrel 32 for housing the piston. The piston barrel is installed in the proximal section of the well. The piston barrel has an inner surface that defines an axial bore. The piston barrel may be made of various wellbore-suitable materials, including for example stainless steel. The piston is disposed inside the bore of the piston barrel. In a preferred embodiment, the longitudinal axis of the piston is substantially aligned with the longitudinal axis of the piston barrel.

10 The piston body 22 is sized and shaped such that its piston rings 24 frictionally engage the inner surface of the piston barrel. Preferably, the engagement between the piston rings and the barrel bore provides a fluid seal that separates any fluid above the piston from any fluid below the piston. In one embodiment, the outer circumferential edges of the piston rings of the piston body frictionally engage the inner surface of the piston barrel,
15 and at least one of the piston rings provides a fluid seal between its upper and lower piston faces.

While the piston is shown in the Figures as a generally tubular member, the piston may be of other shapes, as long as a portion of its outer surface is capable of frictionally engaging the inner surface of the piston barrel and providing a fluid seal between the
20 space in the barrel bore above the piston and the space in the barrel bore below the piston.

The piston is slidably movable axially inside the piston barrel. The piston may be moved upwards by pulling the piston in the direction of wellbore opening, for example by way of the upward movement of the sucker rod connected thereto on the upstroke of the land rig, with a force that is at least sufficient to overcome the friction between the piston and
25 the piston barrel. The piston may be moved downwards by pushing the piston in the direction of the distal section, for example by way of the downward movement of the sucker rod connected thereto on the downstroke of the land rig, with a force that is at

least sufficient to overcome the friction between the piston and the piston barrel. When the apparatus is in operation, the force that is required to move the piston also takes into account the weight of the fluids drawn into the apparatus and the negative pressures generated downhole by the displacement of the fluids, as described in more detail below.

- 5 The lower end of piston body 22 has an opening such that its inner bore is communicable with the space in the piston barrel bore below piston body 22. In a further embodiment, where piston body 22 includes valve 27, fluids inside the piston barrel can only flow into piston body 22 from the piston body's lower opening when valve 27 is open, as described in more detail hereinbelow.
- 10 An annulus 33 is formed above the piston between the inner surface of piston barrel 32 and the outer surface of sucker rod 30. The piston body 22 includes ports 31 at or near its upper end and ports 31 are in communication with annulus 33. When valve 26 is in an open position, as described in more detail hereinbelow, fluid inside the piston body 22 can flow into annulus 33 through ports 31. The plurality of piston rings 24 on the piston
- 15 body 22 provide a fluid seal between the annulus 33 and the space below the piston inside the piston barrel 32. When valves 26, 27 are open, fluid can flow through the inside of the piston body, via the opening in the lower end of the piston body, the chamber, and ports 31, respectively, and vice versa.

The piston barrel 32 includes a standing valve 34 at or near its lower end. A standing
 20 valve is a valve that remains stationary during the pumping cycle (i.e. the alternating upward and downward movement of the piston). The valve 34 may be a check-valve that allows fluid flow in only one direction. Preferably, valve 34 allows fluid to flow into, but not out of, the piston barrel.

In one embodiment, the communication line in communication with the suction generator
 25 is a flexible tubing. In a sample embodiment as illustrated in the Figures, the lower end of the piston barrel is connected to a tubing hanger 35 at the upper end of the flexible tubing 36. In a further embodiment, the lower end of the piston barrel is also connected to a

hold-down seal assembly 37 outfitted with a seating nipple and positioned above the tubing hanger 35. A flange may be used to couple the hold-down seal assembly 37 to the tubing hanger 35. Preferably, the hold-down seal assembly provides a fluid seal in the annulus defined by the inner surface of the well and the outer surface of the piston barrel
5 near the second end or the outer surface of the flexible tubing near the first end, such that fluid can only flow through the seal assembly 37 via the inner bore of tubing 36.

Tubing 36 may be made of various materials including for example a flexible composite polymer-coated woven steel or carbon fiber cloth. Tubing 36 has an inner bore that is in communication with the piston barrel bore, when standing valve 34 is opened. Tubing 36
10 may further include a standing valve 38 at or near its lower end. In one embodiment, valve 38 is a check-valve that allows fluid flow in only one direction. Preferably, valve 38 allows fluid to flow into, but not out of, tubing 36. In one embodiment, apparatus 20 includes one or both of valve 34 and valve 38.

The apparatus may be configured to help prevent certain solids and/or fluids from
15 entering the piston barrel. For example, a screen and/or screening material may be included at the inlet of valve 38 to filter out any undesirable solids, such as sand and silt. In a further embodiment, valve 38 may be configured to restrict the flow of any undesirable fluids, including for example water and carbon dioxide. In a further embodiment, any one of the valves 26, 27, 34 may include a screen to filter out
20 undesirable solids and/or may be configured to restrict the flow of undesirable fluids.

In the illustrated embodiment, the lower end of piston barrel 32 is positioned near the lower end of the proximal section 12. However, piston barrel 32, with the piston disposed therein, may be positioned anywhere along the length of the proximal section. In the illustrated embodiment, valve 38 is positioned above the lower end of casing 18, which
25 may help prevent any damage that can be caused by the apparatus 20 to the formation along the wellbore or any damage to valve 38 or tubing 36.

When the apparatus 20 is run into the wellbore, piston body 22, piston barrel 32 and tubing 36 may be may be filled with fluid, such as for example water or gas. Filling the apparatus with fluid may prevent the apparatus from collapsing under wellbore pressures during deployment.

- 5 In a sample embodiment, apparatus 20 operates in the following manner. Initially, the piston is at a lower position at or near the lower end of the piston barrel. Piston barrel 32 may include a shoulder or the like near its lower end inside the bore to help prevent the piston from moving lower than a certain point inside the piston barrel. In another embodiment, the piston barrel bore may a sufficient length to accommodate a range of motion equivalent to the stroke length of the land rig such that the movement of the piston is restricted at a certain point at or near the lower end of the piston barrel. The piston may be placed and maintained in the lower position when the apparatus is run downhole. Alternatively, once the apparatus is set downhole, the piston may be put in the lower position by exerting a downward force on the sucker rod through the rig, thereby pushing the piston downwards until the piston reaches the lower position.

If the apparatus is filled with fluid during deployment, the downward movement of the piston increases the fluid pressure in the space below the piston inside the piston barrel, until the pressure is sufficient to open lower valve 27 of the piston body 22. With valve 27 opened, fluid in the piston barrel below the piston is permitted to flow into the chamber in piston body 22 via its lower opening, thereby increasing fluid pressure in piston body 22. When the increase in pressure inside piston body 22 is sufficient to open valve 26, fluid inside piston body 22 is allowed to flow into annulus 33 via ports 31.

When the piston is at the lower position, for example as shown in FIG. 1 and FIG. 3, apparatus 20 will be referred to herein as being in the "empty position," wherein apparatus 20 is ready to draw fluids from the distal section of the wellbore. From the empty position, the piston is moved upwards by applying an upward force on the sucker rod, for example via the land rig.

Referring to FIG. 2, the direction of movement of the piston is indicated by an arrow "P". In a sample embodiment, the upward force required to move the piston is approximately the sum of: a) the weight of the traveling parts of the apparatus (e.g. the piston and the sucker rod), b) the force required to overcome friction between the piston rings and the piston barrel bore, c) the force to overcome the pressure differential between the barrel bore, tubing bore and distal section, d) the weight of the fluid column drawn into the apparatus, and e) the force to overcome the negative pressure generated downhole by the displacement of fluids in the distal section.

The upward motion of the piston creates negative pressure (also referred to as suction) below the piston in the piston barrel, thereby opening standing valves 34 and 38. There may also be negative pressure in the chamber in the piston body 22 resulting from the upward movement. The negative pressure below the piston in the piston barrel and/or the negative pressure in the chamber cause at least one of valves 26 and 27 to close. With valve 38 opened, the suction generated by the continued upward movement of the piston draws fluids in the distal section near valve 38 into tubing 36. The flow direction of wellbore fluids from the distal section during the upward stroke of the piston is indicated by arrows "F". As the piston continues to move upwards, fluids from the distal section are drawn into piston barrel 32 via tubing 36 through open valve 34.

The piston may continue to move upwards until it is at an upper position, which may be at or near the upper end of the piston barrel. The piston barrel may be of a length equal to or greater than the stroke length of the land rig to prevent the piston from moving above a certain point inside the piston barrel bore. In another embodiment, the piston barrel bore may have a reduced diameter at or near its upper end such that the movement of the piston is restricted at a certain point at or near the upper end of the bore.

When the piston is at its upper position, with wellbore fluids occupying at least a portion of the space therebelow, the piston will be referred to herein as being in a "filled position." The volume of wellbore fluids that can be collected in the piston barrel

depends at least on the average diameter of the piston barrel bore and the distance between the piston's upper and lower positions.

The wellbore fluids in the space below the piston when the apparatus is in the filled position may be removed in various ways. In one sample embodiment, as shown in FIG. 3, the wellbore fluids may be removed by moving the piston down, for example by exerting a downward force on the sucker rod, towards the lower end of the piston barrel. The magnitude of downward force required to move the piston is approximately the force of the weight of the sucker rod assembly in addition to the downstroke force exerted by the land rig. The downward force is generally proportional to the size of the rig required to draw fluids from various depths. The direction of movement of the piston is indicated by the arrow "P".

As the piston moves downward in the piston barrel, the fluid pressure in the space below the piston in piston barrel 32 increases, thereby closing at least one of valves 34 and 38. The increase in fluid pressure below the piston also opens valve 27. With valve 27 opened, and as the piston moves downward, the wellbore fluids in piston barrel 32 below the piston flow up through valve 27 into the chamber of the piston body 22 via its lower opening. As wellbore fluids flow into the chamber, the fluid pressure in the chamber increases and opens valve 26. With valve 26 open, fluids in the chamber then flow into annulus 33 via ports 31. Therefore, when valves 26 and 27 are both open, fluids below the piston in the piston barrel can flow up to annulus 33 through the chamber of the piston body. The flow direction of the wellbore fluids during the downward stroke of the piston is indicated by arrows "F" in FIG. 3. With at least one of valves 34 and 38 closed, the wellbore fluids in the piston barrel are restricted from flowing back into the wellbore during the downward stroke of the piston. The wellbore fluids may continue to flow up annulus 33 as the piston reaches the lower position, at which point the apparatus returns to the empty position at the end of the downstroke of the land rig.

From the empty position, the piston is pulled up to again open valves 34 and 38, while closing valves 26 and 27, to draw wellbore fluids through the tubing 36 and into the

piston barrel below the piston, as described above. As the piston moves up, the fluids in annulus 33 is also pushed upwards towards the upper end of the piston barrel, since the piston fluidly seals the spaces above and below it in the piston barrel. Valves 26 and 27 are also closed during the upward movement of the piston, thereby preventing the fluids
5 in annulus 33 from flowing back to the space below the piston. Accordingly, the wellbore fluids in annulus 33 are lifted to (or close to) surface by the upward movement of the piston and can then be collected therefrom.

Accordingly, more fluids may be drawn out of the distal section of the wellbore and transported upwards by repeatedly moving the piston up and down between the empty
10 position and the filled position, as described above.

A method is provided herein for producing wellbore fluids from a well having a proximal section and a distal section, with a curved section therebetween. The method comprises: running an apparatus into the wellbore, the apparatus comprising: a piston barrel with an upper end, a lower end, an inner axial bore and a lower opening at or near the lower end;
15 a piston disposed in the bore, the piston being slideably movable axially inside and between the upper and lower ends of the piston barrel and providing a fluid seal between an upper space above the piston in the bore and a lower space below the piston in the bore, the piston has a lower opening and an upper opening; and a flexible tubing having an upper end connected to the lower opening of the piston barrel and a lower end having
20 an opening, and securing the piston barrel to the inner surface of the wellbore in the proximal section, with its upper end closer to the wellbore opening at surface than its lower end, and with the flexible tubing extending into the wellbore below the piston barrel; moving the piston upwards towards the upper end of the piston barrel to draw wellbore fluids from the wellbore through the flexible tubing via the opening in the lower
25 end thereof, and into the lower space via the lower opening of the piston barrel, while blocking fluid communication between the upper space and the lower space; and moving the piston downwards towards the lower end of the piston barrel to allow wellbore fluids in the lower space to flow into the upper space via the lower opening of the piston, the

piston chamber, and the upper opening of the piston, while blocking fluid communication between the opening in the lower end of the flexible tubing and the lower space.

The previous description of the disclosed embodiments is provided to enable any person skilled in the art to make or use the present invention. Various modifications to those
5 embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments without departing from the spirit or scope of the invention. Thus, the present invention is not intended to be limited to the embodiments shown herein, but is to be accorded the full scope consistent with the claims, wherein reference to an element in the singular, such as by use of the
10 article "a" or "an" is not intended to mean "one and only one" unless specifically so stated, but rather "one or more". All structural and functional equivalents to the elements of the various embodiments described throughout the disclosure that are known or later come to be known to those of ordinary skill in the art are intended to be encompassed by the elements of the claims. Moreover, nothing disclosed herein is intended to be
15 dedicated to the public regardless of whether such disclosure is explicitly recited in the claims. For US patent properties, it is noted that no claim element is to be construed under the provisions of 35 USC 112, sixth paragraph, unless the element is expressly recited using the phrase "means for" or "step for".

Claims:

1. An apparatus for producing wellbore fluids from a well having a proximal section and a distal section, with a curved section therebetween, and an inner surface, the apparatus comprising:
 - 5 a piston barrel, the piston barrel being a tubular member having a first end, a second end, an outer surface, an inner surface defining an axial barrel bore, and an opening at or near the second end;
 - a piston disposed in the barrel bore, the piston having a first end, a second end, an outer surface, an opening at or near each of the first and second ends, and an inner
 - 10 surface defining a piston chamber, at least a portion of the outer surface of the piston frictionally engages the inner surface of the piston barrel to substantially fluidly seal a first space in the barrel bore adjacent to the first end of the piston against a second space in the barrel bore adjacent to the second end of the piston, the piston being slideably movable axially in the barrel bore between the first end
 - 15 and the second end of the piston barrel;
 - a flexible tubing having a first end, a second end, an outer surface, an opening at or near the second end, and an axial tubing bore, the first end being connected to the second end of the piston barrel and the inner tubing bore being in communication with the barrel bore via the opening of the second end of the
 - 20 piston barrel;
 - a first valve having an open position allowing fluid flow between the second space and the first space in the barrel bore, via the openings of the first and second ends of the piston through the piston chamber, in the direction of the first end of the piston barrel, and a closed position blocking fluid communication
 - 25 between the first space and the second space; and
 - a second valve having an open position allowing fluid flow between the opening of the second end of the flexible tubing and the second space in the barrel bore, in the direction towards the first end of the piston barrel, and a closed position blocking fluid flow through the flexible tubing in the direction towards the second

- end of the flexible tubing, and
the first valve being closeable and the second valve being openable by fluid
pressure differential created by movement of the piston in the barrel bore towards
the first end of the piston barrel; and
5 the second valve being closeable and the first valve being openable by fluid
pressure differential created by movement of the piston in the barrel bore towards
the second end of the piston barrel.
2. The apparatus of claim 1, further comprising a sucker rod having a first end and a
second end, the second end of the sucker rod being connected to the first end of
10 the piston for moving the piston axially within the barrel bore, and the first end of
the sucker rod being connectable to a land rig associated with the well.
3. The apparatus of claim 2, wherein the piston barrel is positionable in and affixable
to the proximal section of the well, with the second end of the piston barrel at or
near the upper end of the curved section, and wherein the flexible tubing is
15 extendable through the curved section, with the second end of the flexible tubing
extending into the distal section.
4. The apparatus of claim 1, wherein the outer surface of the piston comprises a
plurality of piston rings for frictionally engaging the inner surface of the piston
barrel.
- 20 5. The apparatus of claim 3, further comprising a tubing hanger connected to one or
both of the second end of the piston barrel and the first end of the flexible tubing,
the tubing hanger being securable to the inner surface of the well.
6. The apparatus of claim 6 further comprising a hold-down seal assembly coupled
to the tubing hanger.
- 25 7. The apparatus of claim 1, wherein one or both of the first valve and the second
valve comprise a screen for filtering out undesirable solids.

8. The apparatus of claim 1, wherein one or both of the first valve and the second valve are configured to restrict the flow of undesirable fluids.
9. The apparatus of claim 1, wherein the first valve is situated near the opening of the first end of the piston.
- 5 10. The apparatus of claim 1, wherein the first valve is situated near the opening of the second end of the piston.
11. The apparatus of claim 1, wherein the first valve is situated in the piston chamber.
12. The apparatus of claim 1, wherein the second valve is situated near the opening of the second end of the piston barrel.
- 10 13. The apparatus of claim 1, wherein the second valve is situated near the opening of the second end of the flexible tubing.
14. The apparatus of claim 1, wherein the second valve is situated in the tubing bore.
15. A method for producing wellbore fluids from a wellbore having a surface opening, a proximal section, and a distal section, the method comprising:
15 running an apparatus down the wellbore, the apparatus comprising a suction generator having a tubular member for collecting wellbore fluids therein, and a communication line connected to and in communication with the tubular member, the communication line having an open free end extending into the wellbore;
creating suction in the communication line to draw wellbore fluids therethrough
20 via the open free end and into the tubular member; and
collecting wellbore fluids in the tubular member.
16. The method of claim 15, wherein the suction generator further comprises a piston housed in the tubular member, the piston providing a fluid seal between an upper space above the piston in the tubular member and a lower space below the piston

in the tubular member, and wherein suction is created by moving the piston upwards towards the surface opening.

17. The method of claim 16 further comprising moving wellbore fluids from the lower space to the upper space.

5 18. The method of claim 15, further comprising increasing fluid pressure in the tubular member to block fluid flow through the communication line.

19. The method of claim 17, further comprising increasing fluid pressure in the lower space by moving the piston downwards, and wherein the increase in fluid pressure blocks fluid flow through the communication line and moves wellbore fluids from
10 the lower space to the upper space.

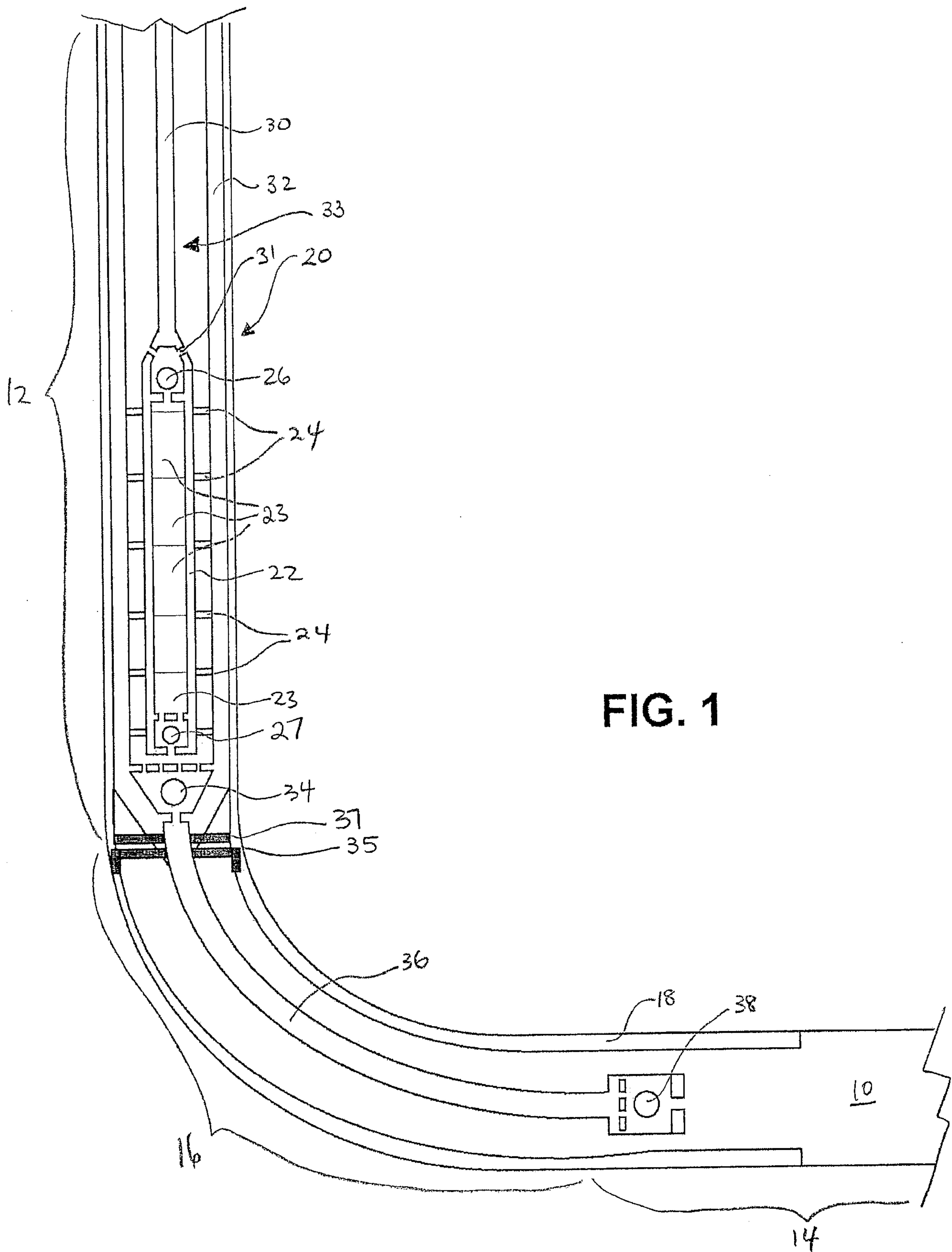
20. The method of claim 16, further comprising lifting wellbore fluids in the upper space towards the surface opening by upward movement of the piston.

21. A method for producing wellbore fluids from a wellbore having a surface opening, an inner surface, a proximal section, and a distal section, the method
15 comprising:
running an apparatus into the wellbore, the apparatus comprising:
a piston barrel with an upper end, a lower end, an inner axial bore and a lower opening at or near the lower end; a piston disposed in the bore, the piston being slideably movable axially inside and between the upper and lower ends of the
20 piston barrel and providing a fluid seal between an upper space above the piston in the bore and a lower space below the piston in the bore, the piston has a lower opening and an upper opening, and a fluid passage therebetween; and a flexible tubing having an upper end connected to the lower opening of the piston barrel and an open lower end, and
25 securing the piston barrel to the inner surface of the wellbore in the proximal section, with its upper end closer to the surface opening than its lower end, and with the flexible tubing extending into the wellbore below the piston barrel;

- moving the piston upwards towards the upper end of the piston barrel to draw wellbore fluids from the wellbore through the flexible tubing via the open lower end thereof, and into the lower space via the lower opening of the piston barrel, while blocking fluid communication between the upper space and the lower space; and
- moving the piston downwards towards the lower end of the piston barrel to allow wellbore fluids in the lower space to flow into the upper space via the lower opening of the piston, the fluid passage in the piston, and the upper opening of the piston, respectively, while blocking fluid communication between the open lower end of the flexible tubing and the lower space.
22. The method of claim 21 wherein the apparatus further comprises a sucker rod connected to an upper end of the piston, and the method further comprising pulling the sucker rod in the direction from the lower end to the upper end of the piston barrel to move the piston upwards, and pushing the sucker rod in the direction from the upper end to the lower end of the piston barrel to move the piston downwards.
23. The method of claim 22 wherein the sucker rod is connected to a land rig, and an upstroke of the land rig pulls the sucker rod and a downstroke of the land rig pushes the sucker rod.
24. The method of claim 21 wherein the open lower end of the flexible tubing extends into the distal section of the wellbore.
25. The method of claim 21 wherein the apparatus comprises a valve in the piston, and opening the valve allows fluids in the lower space to flow into the upper space, and closing the valve blocks fluid communication between the upper space and the lower space, and wherein the upward movement of the piston closes the valve and the downward movement of the piston opens the valve.

26. The method of claim 21 wherein the apparatus comprises a valve at or near the lower end of the piston barrel, and opening the valve allows wellbore fluids in the wellbore to flow through the flexible tubing via the open lower end thereof, and into the lower space via the lower opening of the piston barrel, and closing the valve blocks fluid communication between the open lower end of the flexible tubing and the lower space, and wherein the upward movement of the piston opens the valve and the downward movement of the piston closes the valve.
27. The method of claim 21 wherein the apparatus comprises a valve in the flexible tubing, and opening the valve allows wellbore fluids in the wellbore to flow through the flexible tubing via the opening in the lower end thereof, and into the lower space via the lower opening of the piston barrel, and closing the valve blocks fluid communication between the opening in the lower end of the flexible tubing and the lower space, and wherein the upward movement of the piston opens the valve and the downward movement of the piston closes the valve.
28. The method of claim 21, further comprising lifting wellbore fluids in the upper space towards the surface opening by upward movement of the piston.
29. The method of claim 21, wherein the steps of moving the piston upwards and moving the piston downwards are repeated alternately.
30. The method of claim 21, further comprising filtering out undesirable solids in the wellbore fluids flowing into the lower space from the wellbore.
31. The method of claim 21, further comprising restricting the flow of undesirable fluids into the lower space from the wellbore.
32. The method of claim 21, wherein the upper end of the flexible tubing is connected to a tubing hanger, and further comprising securing the tubing hanger to the inner surface of the wellbore.

33. The method of claim 21, further comprising providing a fluid seal in the annulus defined by the inner surface of the wellbore and the piston barrel near the lower end thereof or the flexible tubing near the upper end thereof.



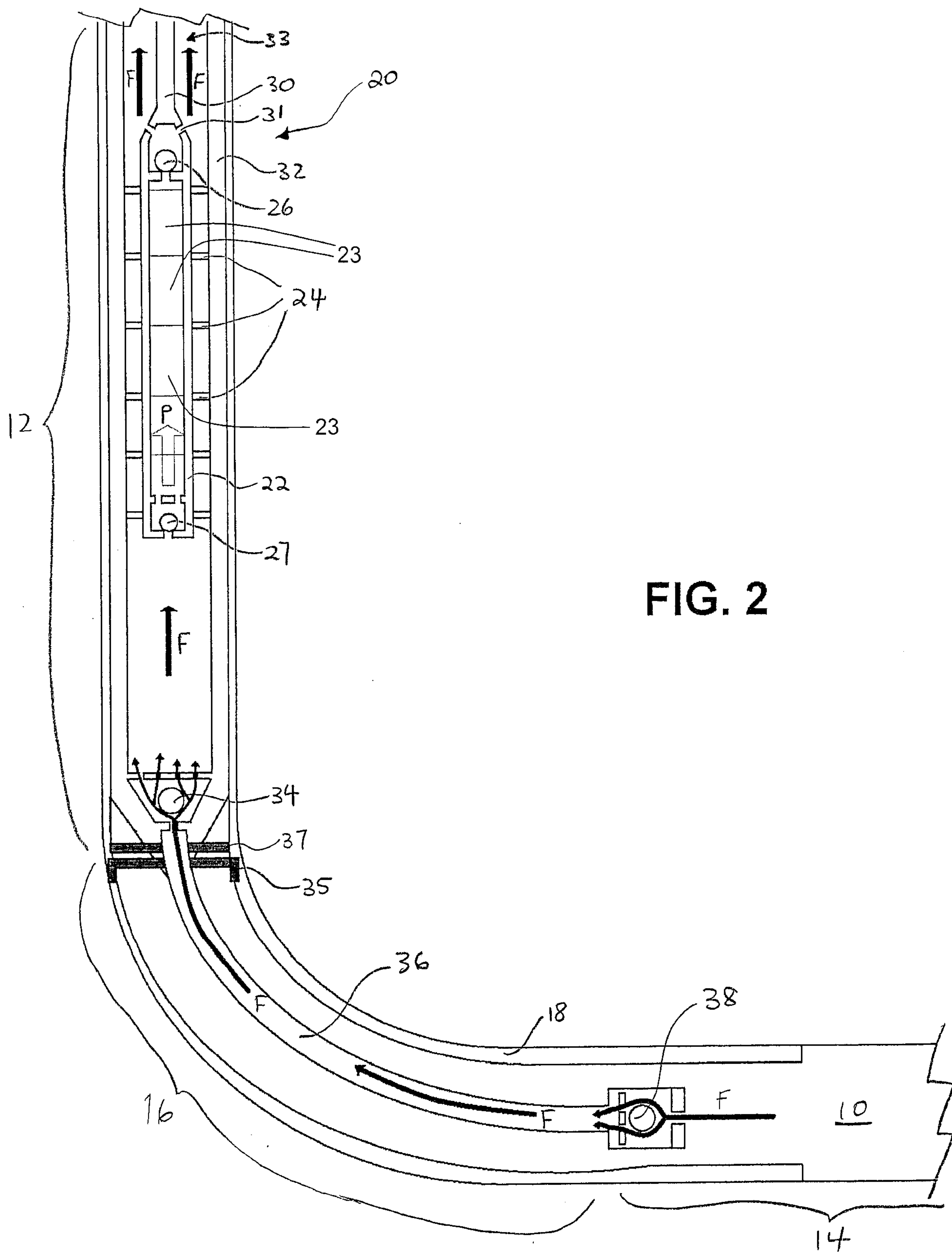


FIG. 2

