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(54) **FLUID OPERATED PUMP FOR USE IN A WELLBORE**

FLÜSSIGKEIT ANGETRIEBENE PUMPE ZUR VERWENDUNG IM BOHRLOCH

POMPE À FLUIDE DESTINÉE A UN Puits DE FORAGE

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(73) Proprietor: **WEATHERFORD/LAMB, INC.**
Houston
Texas 77027 (US)

(72) Inventor: **AMANI, Mohammed**
Houston, TX 77057 (US)

(74) Representative: **Harding, Richard Patrick**
Marks & Clerk,
4220 Nash Court,
Oxford Business Park South
Oxford OX4 2RU (GB)

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EP 1 666 697 B1

Description

[0001] The present invention relates to a fluid operated pump for use in a wellbore.

[0002] Oil and gas wells include a wellbore formed in the earth to access hydrocarbon-bearing formations. Typically, a borehole is initially formed and thereafter the borehole is lined with steel pipe, or casing in order to prevent cave in and facilitate the isolation of portions of the wellbore. To complete the well, at least one area of the wellbore casing is perforated to form a fluid path for the hydrocarbons to enter the wellbore. In some instances, natural formation pressure is adequate to bring production fluid to the surface for collection. More commonly however, some form of artificial lift is necessary to retrieve the fluid.

[0003] Artificial lift methods are numerous and include various pumping arrangements. One common pump is a gas operated pump, as disclosed in US 5806598 and shown in Figure 1. Figure 1 is a sectional view of a wellbore with a gas operated pump disposed therein. The pump 30 is located adjacent perforations in the wellbore 10. The pump operates with pressured gas injected from a high pressure gas vessel 24 into a gas supply line 80 to a valve assembly 40 disposed in a body of the pump 30. The valve assembly 40 consists of an injection control valve 70 for controlling the input of gas into an accumulation chamber 34 and a vent control valve 90 for controlling the venting of valve assemblies for a gas operated pump have an internal bypass passageway 32 for injecting gas out of the chamber. The internal bypass passageway 32 must be a large enough diameter to facilitate a correct amount of gas flow from the chamber. These internal structures necessarily make the valve large and bulky. A bulky valve assembly is difficult to insert in a downhole pump because of space limitations in a wellbore and in a pump housing.

[0004] US Patent 2336683 Hatfield discloses a method and apparatus for pumping well fluid from a well utilising gas as the lifting medium. In one embodiment a valve assembly is insertable on the end of a macaroni through well tubing into a seating member, and the valve assembly is then actuable by a weight bar that is lowered through the macaroni on the end of a wireline.

[0005] It is an object of the invention to provide a fluid operated pump having an improved valve assembly and operation.

[0006] According to the present invention, there is provided a fluid operated pump for use in a wellbore, the pump comprising a housing with at least one longitudinal bore therethrough; a first fluid path formed in the housing and opening at a port into the bore for communicating a pressurized fluid from the bore to an area below the housing; and a second fluid path formed in the housing and opening at a port into the bore for communicating an exhaust fluid from an area below the housing to the exterior of the housing; characterised by a removable valve assembly axially insertable into the bore of the housing and

having ports that are constructed and arranged in an outer cylindrical valve surface to communicate with the first and second fluid paths by way of the ports opening into the cylindrical bore when the valve assembly is inserted into the bore and to selectively direct the pressurized fluid and the exhaust fluid along the first and second fluid paths; respective fluid actuating control conduits for communicating motive fluid to the valve assembly within the bore, and control valve means, actuable by the motive fluid from the control conduits, within the valve assembly for supplying (i) pressurized fluid along the first fluid path in a first control operation, and (ii) exhaust fluid along the second fluid path in a second control operation, in order to pump production fluid along the wellbore.

[0007] The provision of such a pump with a removable valve assembly and with fluid actuating control conduits for communicating motive fluid to operate the valve assembly within the bore enables particularly efficient operation of the valve assembly, whilst enabling an internal bypass passageway to be dispensed with so that the valve assembly is less bulky.

[0008] The invention also provides a method of operating a fluid operated pump within a wellbore, the method utilizing a removable valve assembly within a cylindrical bore in a housing of the pump, wherein a first fluid path in the housing opening at a port into the bore is provided for supply of pressurized fluid from the bore to an area of the pump below the housing, and a second fluid path in the housing opening at a port into the bore is provided for exhaust fluid from an area below the housing to the exterior of the housing, the method comprising lowering the valve assembly to a location in the wellbore proximate the bore in the housing; and aligning the valve assembly with the bore; characterised by the steps of axially inserting the valve assembly into the bore such that ports in an outer cylindrical valve surface communicate with the first and second fluid paths by way of ports opening into the cylindrical bore to selectively direct the pressurized fluid and the exhaust fluid along the first and second fluid paths; sealingly retaining the valve assembly in the bore during pumping of fluid by the pump; and actuating control valve means within the valve assembly, by motive fluid supplied to the valve assembly within the bore by respective fluid actuating control conduits, to supply (i) pressurized fluid along the first fluid path in a first control operation, and (ii) exhaust fluid along the second fluid path in a second control operation, in order to pump production fluid along the wellbore.

[0009] In order that the invention may be more fully understood, embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a sectional view of a prior art gas operated pump assembly in a well;

Figure 2 is a sectional view of a housing for use in a first embodiment of the invention;

Figure 3 illustrates a removable valve assembly dis-

posed on a coiled tubing string for insertion into the housing of Figure 2;

Figure 4 is a sectional view showing the removable valve assembly of Figure 3 disposed on coiled tubing and located in the bore of the housing of Figure 2; Figure 5 illustrates a removable valve assembly for a gas operated pump in accordance with an further embodiment of the invention;

Figure 6 illustrates the valve assembly of Figure 5 inserted in a housing with an alignment tool being provided to install the valve assembly in the housing; and

Figure 7 illustrates a removable valve assembly and a housing with an electrical connection means therebetween.

[0010] Figure 2 is a sectional view through a housing 200 of a gas operated pump in accordance with a preferred embodiment of the invention. The housing 200 includes two longitudinal bores 215, 225 as well as a number of internally formed motive fluid paths to operate a valve and to direct gas through the pump. More particularly the housing 200 includes an internally threaded portion 205 at its upper end for connection to a string of tubulars (not shown) and an externally threaded portion 210 at its lower end for connection to an accumulator chamber (not shown). The housing 200 has a first longitudinal bore 215 therethrough having an internally threaded portion 220 at its lower end for connection to a diptube (not shown). In use, the bore 215 serves as a conduit for production fluid pumped towards the surface of the well. The housing 200 also has a second longitudinal bore 225. An aperture 235 formed in a wall of the housing 200 provides communication between the second longitudinal bore 225 and the exterior of the housing 200. A third bore 230 provides communication between an injection port 250 in the wall of the second longitudinal bore 225 and the lower end of the housing 200 for injection of pressurized gas into the accumulation chamber (not shown).

[0011] The second longitudinal bore 225 further includes a first profile 240 and a second profile 245 formed within the bore 225 to receive a removable valve assembly (not shown) that is insertable in the upper end 255 of bore 225. In this arrangement, the profiles 240, 245 are continuous grooves and are formed to permit mating formations of the valve assembly to mate therewith as will be more fully described herebelow.

[0012] Figure 3 illustrates the removable valve assembly 300 disposed on the end of a coiled tubing string 325 for insertion into the housing 200 of Figure 2. The removable valve assembly 300 includes an inlet control valve 305, a vent control valve 310, a valve stem 315 and an actuator 320. The valve stem 315 is connected to both the inlet control valve 305 and the vent control valve 310. The actuator 320 moves the valve stem 315, alternatively opening and closing the inlet control valve 305 and the vent control valve 310. When the inlet control valve 305

is in the open position, gas flows down the coiled tubing string 325 into the assembly 300 and out through a gas outlet port 330. Alternatively, when the vent control valve 310 is in the open position, gas enters a vent inlet port 340 and exits through a vent outlet port 335. A first control conduit 345 and a second control conduit 350 are housed inside the coiled tubing string 325. The first control conduit 345 and the second control conduit 350 are typically hydraulic control lines and are used to actuate the valve assembly 300. Additionally, electrical power can be transmitted through the one or more of the control conduits 345, 350 to actuate the valve assembly 300. The valve assembly 300 may include data transmitting means to transmit data, such as pressure and temperature within the pump chamber, through the control conduits 345, 350 to the surface of the wellbore. In these instances, the valve assembly 300 or the housing 200 may include sensors. The transmitting means can include fiber optic cable.

[0013] A first seal 355, second seal 360, and third seal 365 are circumferentially mounted around an external surface of the valve assembly 300. The purpose of the seals is to isolate fluid paths between the valve assembly 300 and the housing 200 (Figure 2) when the valve assembly 300 is inserted therein. The assembly 300 further includes a first key 370 and a second key 375 to secure the valve assembly 300 axially within the housing 200. The first key 370 and the second key 375 are outwardly biased and are designed to mate with the profiles in the interior surface of the housing 200 (Figure 2).

[0014] Figure 4 is a sectional view of the valve assembly 300 disposed in the housing 200. In the arrangement of Figure 4, the valve assembly 300 is shown at the end of the coiled tubing string 325 that provides a source of pressurized gas to operate the pump. The accumulator chamber 415 for collecting formation fluid is secured to the housing 200 by the externally threaded portion 210 at the lower end of the housing 200. The tubing string 405 is secured to the housing 200 at the internally threaded portion 205. A diptube 410 is secured to the housing 200 by way of the internally threaded portion 220 of the first longitudinal bore 215. A vent line 420 is secured to the housing 200 at the aperture 235 to provide a passageway for gas venting from the accumulator chamber 415.

[0015] In operation, the removable valve assembly 300 is installed at an end of the coiled tubing string 325 and the string 325 is inserted in tubing string 405 at the top of the wellbore and the valve assembly 300 is lowered on the string 325 towards the housing 200. As the valve assembly 300 reaches the housing 200, a profile means and guide orient and align the valve assembly 300 with the second longitudinal bore 225 which is offset from the center of the housing 200. Profile means and guides are well known in the art and typically include some mechanical means for orienting a device in a wellbore. After insertion into the upper end 255 of the bore 225, the valve assembly 300 is urged downwards until the first key 370

and the second key 375 of the valve assembly 300 are secured in place in the first profile 240 and the second profile 245 of the housing 200. Mating angles on the keys and profiles permit the retention of the valve in the housing 200. The first seal 355 and the second seal 360 form a barrier on the top and bottom of the injection port 250 to prevent leakage of injected gas into the accumulator chamber 415. The second seal 360 and the third seal 365 provide a barrier on the top and bottom of the aperture 235 to prevent leakage of gas exiting the vent line 420.

[0016] After such installation of the valve assembly 300 the formation fluid supplied to the accumulator chamber 415 is pumped by operation of the inlet control valve 305 and the vent control valve 310 by means of the actuator 320 in the manner already described. 7

[0017] Figure 5 is a sectional view of an alternative valve assembly 500 and Figure 6 is a sectional view of the valve assembly 500 installed in a housing 600 in accordance with a further embodiment of the invention. The housing 600 of Figure 6 includes additional fluid paths formed therein but is otherwise similar to the housing 200 of Figure 2 and the valve assembly 500 of Figure 6 includes additional fluid paths formed therein but is otherwise similar to the valve assembly 300 of Figure 3, and like reference numerals are therefore used in Figure 6 to denote similar parts in these figures. Hydraulic conduits 630, 635 are formed in the housing 600 and serve to carry hydraulic power fluid from an upper end of the housing 600 to the longitudinal bore 645 formed in the housing 600. The conduits 630, 635 intersect the bore 645 at locations ensuring that they will communicate with the valve assembly 500 after it has been installed in the bore 645 and is retained therein with the retention means described with respect to Figure 4. Also formed in the housing 600 is an internal gas line 640 providing communication between the upper end of the housing 600 and the bore 645.

[0018] By providing hydraulic conduits 630, 635 and the gas line 640 internally within the housing 600, there is no need for separate hydraulic lines or a gas supply line to remain attached at an upper end of the valve assembly 500. As illustrated in Figure 6, the valve assembly 500 is installed in the bore 645 with a selective connector or gripping tool 607 that temporarily retains the valve assembly 500 by gripping a fish neck 580 formed at the upper end of the valve assembly 500. Gripping tools typically operate mechanically with inwardly movable fingers. A kickover tool can be utilized to align the valve assembly 500 with the offset bore 645. Kickover tools and gripping tools are well known in the art. Because no rigid conduits are needed between the surface of the well and the upper end of the valve assembly 500, the assembly 500 can be inserted and removed from the housing using wireline or slick line. After completion of the pumping operation and when it is required to withdraw the valve assembly 500 from the wellbore, the valve assembly 500 can simply be retrieved from the bore 645 in

the housing 600 on the end of the wireline by exerting sufficient upward force on the wireline to overcome the sealing engagement of the valve assembly 500 within the bore 645.

[0019] Figure 7 is a sectional view of a removable valve assembly 700 in a longitudinal bore 720 of a pump housing 705 with an electrical connection therebetween. For clarity, the assembly 700 is illustrated only partially inserted into the housing 705. In the embodiment of Figure 7, the housing 705 is electrically wired with conductors 710, 715 that lead to a lower portion of the longitudinal bore 720. A contact seat 725 is located within the bore 720 and is constructed and arranged to receive an electrode 730 protruding from the lower end of the valve assembly 700. As the assembly 700 is inserted into the bore 720 and is axially located therein, the electrode 730 is seated in the contact seat 725 and an electrical connection between the housing 705 and the valve assembly 700 is made. Thereafter, the valve assembly 700 may be actuated electrically through the use of a solenoid switch 735 disposed within the valve assembly 700. As previously described, the housing includes flow paths formed therein that communicate with the valve assembly 700 and reduce the necessary bulk of the valve assembly 700. After completion of the pumping operation and when it is required to withdraw the valve assembly 700 from the wellbore, the valve assembly 700 can simply be retrieved from the bore 720 in the housing 705 on the end of the wireline.

Claims

1. A fluid operated pump for use in a wellbore, the pump comprising:

a housing (200, 600, 705) with at least one cylindrical bore (225, 645, 720) therethrough;
a first fluid path formed in the housing (200, 600, 705) and opening at a port (250) into the bore (225, 645, 720) for communicating a pressurized fluid from the bore (225, 645, 720) to an area below the housing (200, 600, 705); and
a second fluid path formed in the housing (200, 600, 705) and opening at a port (235) into the bore (225, 645, 720) for communicating an exhaust fluid from an area below the housing (200, 600, 705) to the exterior of the housing; and

characterised by a removable valve assembly (300, 500, 700) axially insertable into the bore (225, 645, 720) of the housing (200, 600, 705) and having ports (330, 335) that are constructed and arranged in an outer cylindrical valve surface to communicate with the first and second fluid paths by way of the ports (250, 235) opening into the cylindrical bore (225, 645, 720) when the valve assembly (300, 500, 700) is inserted into the bore (225, 645, 720) and to

- selectively direct the pressurized fluid and the exhaust fluid along the first and second fluid paths; respective fluid actuating control conduits (345, 350, 630, 635) for communicating motive fluid to the valve assembly (300, 500, 700) within the bore (225, 645, 720); and control valve means (305, 310, 320), actuable by the motive fluid from the control conduits (345, 350, 630, 635), within the valve assembly (300, 500, 700) for supplying (i) pressurized fluid along the first fluid path in a first control operation, and (ii) exhaust fluid along the second fluid path in a second control operation, in order to pump production fluid along the wellbore.
2. The pump of claim 1, wherein the area below the housing (200, 600, 705) comprises an accumulator chamber (415) for receiving production fluid to be pumped by the action of the pressurized fluid.
 3. The pump of claim 1 or 2, wherein the first fluid path further includes a path extending from the bore (225, 645, 720) to an area above the housing (200, 600, 705) for communicating the pressurized fluid from the area above the housing (200, 600, 705) to the bore (225, 645, 720).
 4. The pump of any preceding claim, further including at least one seal member (360) between the valve assembly (300, 500, 700) and the bore (225, 645, 720) for isolating the first and second fluid paths from each other.
 5. The pump of any preceding claim, further including a retention assembly (240, 245, 370, 375) between the valve assembly (300, 500, 700) and the bore (225, 645, 720) for retaining the valve assembly (300, 500, 700) in a predetermined axial position within the bore (225, 645, 720).
 6. The pump of claim 5, wherein the retention assembly includes at least one outwardly biased formation (370, 375) extending radially from an outer surface of the valve assembly (300, 500, 700) and constructed and arranged to land in a profile (240, 245) formed on an inner surface of the bore (225, 645, 720), whereby, upon insertion in the bore (225, 645, 720), the valve assembly (300, 500, 700) seats in the bore (225, 645, 720) in the predetermined axial position.
 7. The pump of claim 5 or 6, wherein the first and second fluid paths are interruptably completed when the valve assembly (300, 500, 700) is in the predetermined axial position within the bore (225, 645, 720).
 8. The pump of any preceding claim, wherein the removable valve assembly (300) includes a coiled tubing string (325) extending from an upper end thereof, the string (325) serving as a conduit for the pressurized fluid.
 9. The pump of any preceding claim, wherein the valve assembly (500, 700) is connected to a wireline by a selective connector (607) for insertion into the bore (645, 720), the valve assembly (500, 700) being subsequently releasable from the wireline by disconnection of the selective connector (607).
 10. The pump of claim 9, wherein the selective connector (607) is operable from the surface of the well.
 11. The pump of any preceding claim, further including an alignment member constructed and arranged to align the valve assembly (300, 500, 700) with the bore (225, 645, 720) prior to insertion of the valve assembly (300, 500, 700) into the bore (225, 645, 720).
 12. A method of operating a fluid operated pump within a wellbore, the method utilizing a removable valve assembly (300, 500, 700) within a cylindrical bore (225, 645, 720) in a housing (200, 600, 705) of the pump, wherein a first fluid path in the housing (200, 600, 705) opening at a port (250) into the bore (225, 645, 720) is provided for supply of pressurized fluid from the bore to an area of the pump below the housing, and a second fluid path in the housing (200, 600, 705) opening at a port (235) into the bore (225, 645, 720) is provided for exhaust fluid from an area below the housing to the exterior of the housing, the method comprising:

lowering the valve assembly to a location in the wellbore proximate the bore (225, 645, 720) in the housing (200, 600, 705); and

aligning the valve assembly (300, 500, 700) with the bore (225, 645, 720);

characterised by the steps of:

axially inserting the valve assembly (300, 500, 700) into the bore (225, 645, 720) such that ports (330, 335) in an outer cylindrical valve surface communicate with the first and second fluid paths (250, 235) by way of the ports (250, 235) opening into the cylindrical bore (225, 645, 720) to selectively direct the pressurized fluid and the exhaust fluid along the first and second fluid paths;

sealingly retaining the valve assembly (300, 500, 700) in the bore (225, 645, 720) during pumping of fluid by the pump; and

actuating control valve means (305, 310, 320) within the valve assembly (300, 500, 700), by motive fluid supplied to the valve assembly (300, 500, 700) within the bore (225, 645, 720) by respective fluid actuating control conduits (345,

350, 630, 635), to supply (i) pressurized fluid along the first fluid path in a first control operation, and (ii) exhaust fluid along the second fluid path in a second control operation, in order to pump production fluid along the wellbore.

13. The method of claim 12, wherein the motive fluid is a hydraulic fluid supplied by hydraulic control conduits (345, 350, 630, 635).

14. The method of claim 12 or 13, wherein the pumping of fluid by the pump is effected by the accumulation of production fluid to be pumped in an accumulator chamber (415) and the supply of pressurized fluid to the accumulator chamber (415) to force the production fluid along the wellbore.

Patentansprüche

1. Fluidbetätigte Pumpe zur Verwendung in einem Bohrloch, wobei die Pumpe aufweist:

ein Gehäuse (200, 600, 705) mit mindestens einer Längsbohrung (225, 645, 720) dort hindurch;

einen ersten Fluidweg, der im Gehäuse (200, 600, 705) gebildet wird und sich durch eine Mündung (250) in die Bohrung (225, 645, 720) öffnet, um eine Verbindung für ein unter Druck stehendes Fluid von der Bohrung (225, 645, 720) zu einem Bereich unterhalb des Gehäuses (200, 600, 705) herzustellen; und

einen zweiten Fluidweg, der im Gehäuse (200, 600, 705) gebildet wird und sich durch eine Mündung (235) in die Bohrung (225, 645, 720) öffnet, um eine Verbindung für ein Austrittsfluid von einem Bereich unterhalb des Gehäuses (200, 600, 705) zur Außenseite des Gehäuses herzustellen; und

dadurch gekennzeichnet, dass eine entfernbare Ventilbaugruppe (300, 500, 700), axial innerhalb der Bohrung (225, 645, 720) des Gehäuses (200, 600, 705) positioniert werden kann und Mündungen (330, 335) aufweist, die in einer äußeren zylindrischen Ventilfläche konstruiert und angeordnet sind, um mittels der Mündungen (250, 235), die in die Längsbohrung (225, 645, 720) münden wenn die Ventilbaugruppe (300, 500, 700) in die Bohrung (225, 645, 720) eingesetzt wird, eine Verbindung mit dem ersten und zweiten Fluidweg herzustellen, und um das unter Druck stehende Fluid und das Austrittsfluid selektiv längs des ersten und zweiten Fluidweges zu lenken;

jeweilige fluidbetätigbare Steuerungskanäle (345, 350, 630, 635), um eine Verbindung für ein Antriebsfluid zur Ventilbaugruppe (300, 500, 700) in der Boh-

rung (225, 645, 720) herzustellen; und Steuerungsventilmittel (305, 310, 320), die durch das Antriebsfluid von den Steuerungskanälen (345, 350, 630, 635) innerhalb der Ventilbaugruppe (300, 500, 700) angetrieben werden können, zum Zuführen vom (i) unter Druck stehenden Fluid längs des ersten Fluidweges in einem ersten Steuerungsverfahren, und (ii) Austrittsfluid längs des zweiten Fluidweges in einem zweiten Steuerungsverfahren, um Produktionsfluid längs des Bohrlochs zu pumpen.

2. Pumpe nach Anspruch 1, bei der der Bereich unterhalb des Gehäuses (200, 600, 705) eine Speicherkammer (415) für das Aufnehmen von Produktionsfluid aufweist, das durch die Wirkung des unter Druck stehenden Fluids gepumpt wird.

3. Pumpe nach Anspruch 1 oder 2, bei der der erste Fluidweg ferner einen Weg umfasst, der sich von der Bohrung (225, 645, 720) zu einem Bereich oberhalb des Gehäuses (200, 600, 705) erstreckt, um eine Verbindung für das unter Druck stehende Fluid vom Bereich oberhalb des Gehäuses (200, 600, 705) zur Bohrung (225, 645, 720) herzustellen.

4. Pumpe nach einem der vorhergehenden Ansprüche, die außerdem mindestens ein Dichtungselement (360) zwischen der Ventilbaugruppe (300, 500, 700) und der Bohrung (225, 645, 720) für das Trennen des ersten und zweiten Fluidweges voneinander umfasst.

5. Pumpe nach einem der vorhergehenden Ansprüche, die außerdem eine Arretierbaugruppe (240, 245, 370, 375) zwischen der Ventilbaugruppe (300, 500, 700) und der Bohrung (225, 645, 720) für das Halten der Ventilbaugruppe (300, 500, 700) in einer vorgegebenen axialen Position innerhalb der Bohrung (225, 645, 720) umfasst.

6. Pumpe nach Anspruch 5, bei der die Arretierbaugruppe mindestens eine nach außen gerichtete Ausbildung (370, 375) umfasst, die sich radial von einer Außenfläche der Ventilbaugruppe (300, 500, 700) erstreckt und konstruiert und angeordnet ist, um auf einem Profil (240, 245) zu landen, das auf einer Innenfläche der Bohrung (225, 645, 720) gebildet wird, wobei beim Einsetzen in die Bohrung (225, 645, 720) die Ventilbaugruppe (300, 500, 700) in der Bohrung (225, 645, 720) in der vorgegebenen axialen Position aufsitzt.

7. Pumpe nach Anspruch 5 oder 6, bei der der erste und zweite Fluidweg unterbrechbar komplettiert werden, wenn sich die Ventilbaugruppe (300, 500, 700) in der vorgegebenen axialen Position innerhalb der Bohrung (225, 645, 720) befindet.

8. Pumpe nach einem der vorhergehenden Ansprüche, bei der die abnehmbare Ventilbaugruppe (300) eine gewundene Fördertour (325) aufweist, die sich von einem oberen Ende davon erstreckt, wobei die Tour (325) als einen Kanal für das unter Druck stehende Fluid dient. 5
9. Pumpe nach einem der vorhergehenden Ansprüche, bei der die Ventilbaugruppe (500, 700) mit einem Drahtseil mittels eines selektiven Verbinders (607) für das Einsetzen in die Bohrung (645, 720) verbunden wird, wobei die Ventilbaugruppe (500, 700) vom Drahtseil durch Trennung des selektiven Verbinders (607) später trennbar ist. 10
10. Pumpe nach Anspruch 9, bei der der selektive Verbinder (607) von der Erdoberfläche des Bohrloches betätigbar ist. 15
11. Pumpe nach einem der vorhergehenden Ansprüche, die außerdem ein Ausrichtungselement umfasst, das konstruiert und angeordnet ist, um die Ventilbaugruppe (300, 500, 700) mit der Bohrung (225, 645, 720) vor dem Einsetzen der Ventilbaugruppe (300, 500, 700) in die Bohrung (225, 645, 720) auszurichten. 20
12. Verfahren zum Betätigen einer fluidbetätigten Pumpe innerhalb eines Bohrloches, wobei das Verfahren eine entfernbare Ventilbaugruppe (300, 500, 700) innerhalb einer Längsbohrung (225, 645, 720) in einem Gehäuse (200, 600, 705) der Pumpe nutzt, wobei ein erster Fluidweg im Gehäuse (200, 600, 705), der sich über eine Mündung (250) in die Bohrung (225, 645, 720) öffnet, für die Zuführung des unter Druck stehenden Fluids von der Bohrung zu einem Bereich der Pumpe unterhalb des Gehäuses vorhanden ist, und wobei ein zweiter Fluidweg im Gehäuse (200, 600, 705), der sich über eine Mündung (235) in die Bohrung (225, 645, 720) öffnet, für ein Austrittsfluid von einem Bereich unterhalb des Gehäuses zur Außenseite des Gehäuses vorhanden ist, wobei das Verfahren die folgenden Schritte aufweist: 30
- Absenken der Ventilbaugruppe an eine Stelle im Bohrloch in unmittelbarer Nähe der Bohrung (225, 645, 720) im Gehäuse (200, 600, 705); und Ausrichten der Ventilbaugruppe (300, 500, 700) mit der Bohrung (225, 645, 720); 35
- durch die folgenden Schritte **gekennzeichnet**:
- axiales Einsetzen der Ventilbaugruppe (300, 500, 700) in die Bohrung (225, 645, 720), so dass die Mündungen (330, 335) in einer äußeren zylindrischen Ventilfläche mit dem ersten und zweiten Fluidweg (250, 235) mittels der 40

Mündungen (250, 235) in Verbindung stehen, die sich in die Längsbohrung (225, 645, 720) öffnen, um das unter Druck stehende Fluid und das Austrittsfluid selektiv längs des ersten und zweiten Fluidweges zu lenken; abdichtendes Festhalten der Ventilbaugruppe (300, 500, 700) in der Bohrung (225, 645, 720) während des Pumpens des Fluids mittels der Pumpe; und Betätigen der Steuerungsventilmittel (305, 310, 320) innerhalb der Ventilbaugruppe (300, 500, 700) mittels Antriebsfluids, das der Ventilbaugruppe (300, 500, 700) innerhalb der Bohrung (225, 645, 720) durch jeweilige fluidbetätigbare Steuerungskanäle (345, 350, 630, 635) zugeführt wird, zum Zuführen vom (i) unter Druck stehenden Fluid längs des ersten Fluidweges in einem ersten Steuerungsverfahren, und (ii) Austrittsfluid längs des zweiten Fluidweges in einem zweiten Steuerungsverfahren, um Produktionsfluid längs des Bohrloches zu pumpen.

13. Verfahren nach Anspruch 12, bei dem das Antriebsfluid ein Hydraulikfluid ist, das von der hydraulischen Steuerleitungseinrichtung (345, 350, 630, 635) zugeführt wird.

14. Verfahren nach einem der Ansprüche 12 oder 13, bei dem das Pumpen des Fluids mittels der Pumpe durch das Speichern des zu pumpenden Produktionsfluids in einer Speicherkammer (415) und die Zuführung des unter Druck stehenden Fluids zur Speicherkammer (415) bewirkt wird, um das Produktionsfluid längs des Bohrloches zu treiben.

Revendications

1. Pompe actionnée par un fluide, destinée à être utilisée dans un puits de forage, la pompe comprenant :

un carter (200, 600, 705) comportant au moins un alésage longitudinal (225, 645, 720) le traversant ;
une première trajectoire de fluide formée dans le carter (200, 600, 705) et ouverte au niveau d'un orifice (250) vers l'alésage (225, 645, 720) en vue de transférer un fluide sous pression de l'alésage (225, 645, 720) vers une zone située au-dessous du carter (200, 600, 705) ; et
une deuxième trajectoire de fluide formée dans le carter (200, 600, 705) et ouverte au niveau d'un port (235) vers l'alésage (225, 645, 720) pour transférer un fluide d'échappement d'une zone située au-dessous du carter (200, 600, 705) vers l'extérieur du carter ; et

caractérisée par un assemblage de soupape amo-

- vible (300, 500, 700) insérable axialement dans l'alésage (225, 645, 720) du carter (200, 600, 705) et comportant des orifices (330, 335) construits et agencés dans une surface externe cylindrique de la soupape en vue d'une communication avec les première et deuxième trajectoires de fluide par l'intermédiaire des orifices (250, 235) ouverts vers l'alésage longitudinal (225, 645, 720) lorsque l'assemblage de soupape (300, 500, 700) est inséré dans l'alésage (225, 645, 720), et pour diriger sélectivement le fluide sous pression et le fluide d'échappement le long des première et deuxième trajectoires de fluide ;
des conduites de commande d'actionnement par fluide respectives (345, 350, 630, 635) en vue de transférer un fluide moteur à l'assemblage de soupape (300, 500, 700) dans l'alésage (225, 645, 720) ;
et
des moyens de soupape de commande (305, 310, 320), actionnable par le fluide moteur des conduites de commande (345, 350, 630, 635) dans l'assemblage de soupape (300, 500, 700) en vue de fournir
(i) un fluide sous pression le long de la première trajectoire de fluide dans une première opération de commande et (ii) du fluide d'échappement le long de la deuxième trajectoire de fluide dans une deuxième opération de commande afin de pomper le fluide de production le long du puits de forage.
2. Pompe selon la revendication 1, dans laquelle la zone située au-dessous du carter (200, 600, 705) comprend une chambre d'accumulation (415) pour recevoir le fluide de production devant être pompé par l'action du fluide sous pression.
 3. Pompe selon les revendications 1 ou 2, dans laquelle la première trajectoire de fluide englobe en outre une trajectoire s'étendant à partir de l'alésage (225, 645, 720) vers une zone située au-dessus du carter (200, 600, 705), pour transférer le fluide sous pression de la zone située au-dessus du carter (200, 600, 705) vers l'alésage (225, 645, 720).
 4. Pompe selon l'une quelconque des revendications précédentes, englobant en outre au moins un élément de joint (360) entre l'assemblage de soupape (300, 500, 700) et l'alésage (225, 645, 720) pour isoler les première et deuxième trajectoires de fluide l'une de l'autre.
 5. Pompe selon l'une quelconque des revendications précédentes, englobant en outre un assemblage de retenue (240, 245, 370, 375) entre l'assemblage de soupape (300, 500, 700) et l'alésage (225, 645, 720) pour retenir l'assemblage de soupape (300, 500, 700) dans une position axiale prédéterminée dans l'alésage (225, 645, 720).
 6. Pompe selon la revendication 5, dans laquelle l'assemblage de retenue englobe au moins une structure poussée vers l'extérieur (370, 375), s'étendant radialement à partir d'une surface externe de l'assemblage de soupape (300, 500, 700) et construite et agencée de sorte à être positionnée dans un profil (240, 245) formé sur une surface interne de l'alésage (225, 645, 720), l'assemblage de soupape (300, 500, 700) étant ainsi agencé dans l'alésage (225, 645, 720) dans une position axiale prédéterminée lors de l'insertion dans l'alésage (225, 645, 720).
 7. Pompe selon les revendications 5 ou 6, dans laquelle les première et deuxième trajectoires de fluide sont complétées par interruption lorsque l'assemblage de soupape (300, 500, 700) se trouve dans la position axiale prédéterminée dans l'alésage (225, 645, 720).
 8. Pompe selon l'une quelconque des revendications précédentes, dans laquelle l'assemblage de soupape amovible (300) englobe une colonne de tubes spiralée (325) s'étendant à partir d'une extrémité supérieure de celui-ci, la colonne (325) servant de conduite pour le fluide sous pression.
 9. Pompe selon l'une quelconque des revendications précédentes, dans laquelle l'assemblage de soupape (500, 700) est connecté au câble métallique par un connecteur sélectif (607) en vue de l'insertion dans l'alésage (645, 720), l'assemblage de soupape (500, 700) pouvant ensuite être dégagé du câble métallique par suite de la déconnexion du connecteur sélectif (607).
 10. Pompe selon la revendication 9, dans laquelle le connecteur sélectif (607) peut être actionné à partir de la surface du puits.
 11. Pompe selon l'une quelconque des revendications précédentes, englobant en outre un élément d'alignement construit et agencé de sorte à aligner l'assemblage de soupape (300, 500, 700) avec l'alésage (225, 645, 720) avant l'insertion de l'assemblage de soupape (300, 500, 700) dans l'alésage (225, 645, 720).
 12. Procédé d'actionnement d'une pompe actionnée par un fluide dans un puits de forage, le procédé utilisant un assemblage de soupape amovible (300, 500, 700) dans un alésage longitudinal (225, 645, 720) dans un carter (200, 600, 705) de la pompe, une première trajectoire de fluide dans le carter (200, 600, 705) ouverte au niveau d'un orifice (250) vers l'alésage (225, 645, 720) étant destinée à amener le fluide sous pression de l'alésage vers une zone de la pompe située au-dessous du carter, et une deuxième trajectoire de fluide dans le carter (200, 600, 705) ouverte au niveau d'un orifice (235) vers

l'alésage (225, 645, 720) servant à transférer un fluide d'échappement d'une zone située au-dessous du carter vers l'extérieur du carter, le procédé comprenant les étapes ci-dessous :

5

descente de l'assemblage de soupape dans un emplacement dans le puits de forage proche de l'alésage (225, 645, 720) dans le carter (200, 600, 705) ; et

alignement de l'assemblage de soupape (300, 500, 700) avec l'alésage (225, 645, 720), 10

caractérisé par les étapes suivantes :

insertion axiale de l'assemblage de soupape (300, 500, 700) dans l'alésage (225, 645, 720) de sorte que les orifices (330, 335) dans une surface externe cylindrique de la soupape communiquent avec les première et deuxième trajectoires de fluide (250, 235) par l'intermédiaire des orifices (250, 235) s'ouvrant vers l'alésage longitudinal (225, 645, 720) pour diriger sélectivement le fluide sous pression et le fluide d'échappement le long des première et deuxième trajectoires de fluide; 15 20 25

retenue étanche de l'assemblage de soupape (300, 500, 700) dans l'alésage (225, 645, 720) au cours du pompage du fluide par la pompe ; et actionnement des moyens de commande de soupape (305, 310, 320) dans l'assemblage de soupape (300, 500, 700) par le fluide moteur fourni à l'assemblage de soupape (300, 500, 700) dans l'alésage (225, 645, 720) par les conduites de commande d'actionnement par fluide respectives (345, 350, 630, 635), pour fournir (i) du fluide sous pression le long de la première trajectoire de fluide dans une première opération de commande, et (ii) du fluide d'échappement le long de la deuxième trajectoire de fluide dans une deuxième opération de commande, afin de pomper le fluide de production le long du puits de forage. 30 35 40

13. Procédé selon la revendication 12, dans lequel le fluide moteur est constitué par un fluide hydraulique amené par des conduites de commande hydraulique (345, 350, 630, 635). 45

14. Procédé selon les revendications 12 ou 13, dans lequel le pompage du fluide par la pompe est effectué par l'accumulation du fluide de production devant être pompé dans une chambre d'accumulation (415) et l'approvisionnement de fluide sous pression vers la chambre d'accumulation (415) pour entraîner le fluide de production le long du puits de forage. 50 55

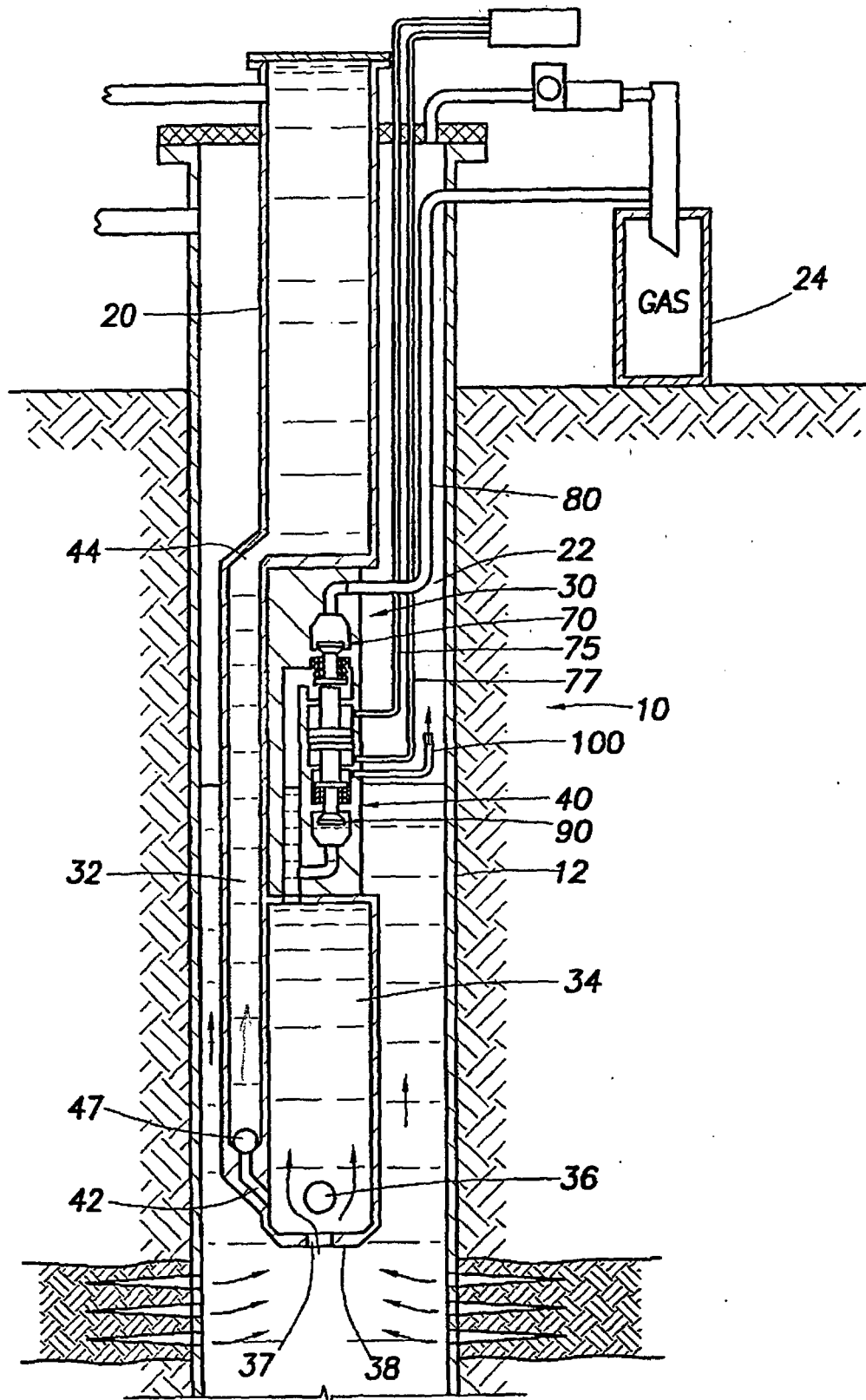
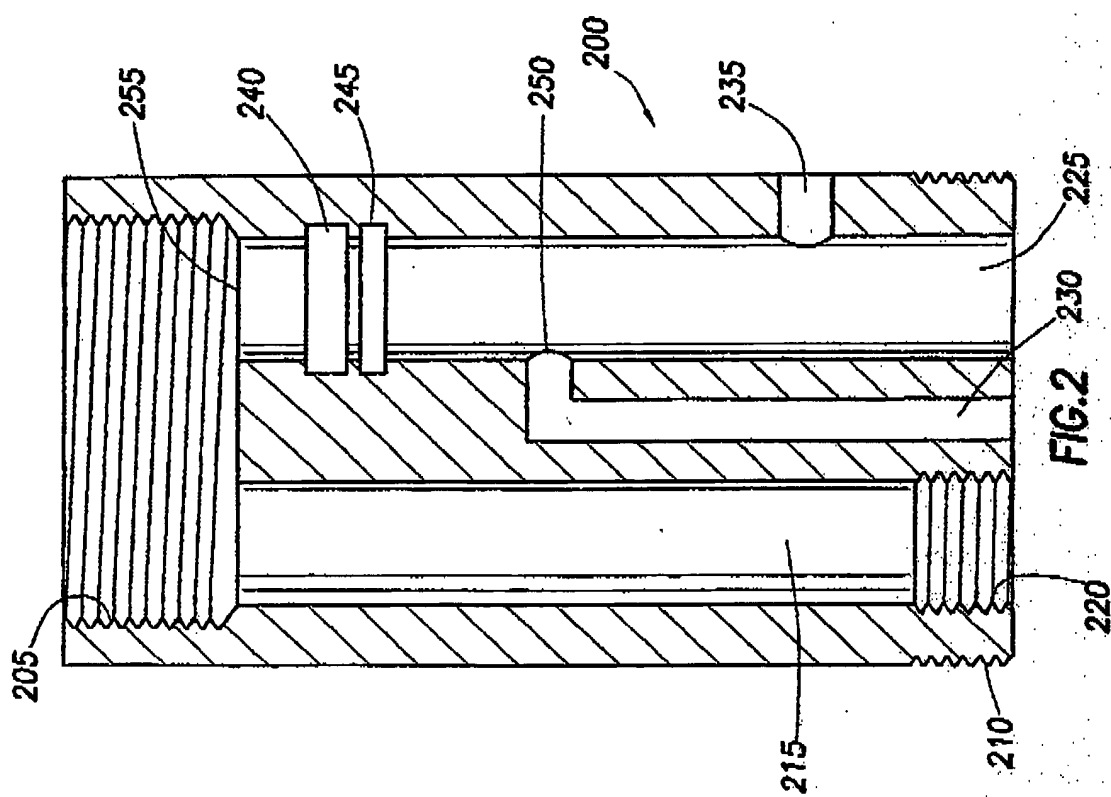
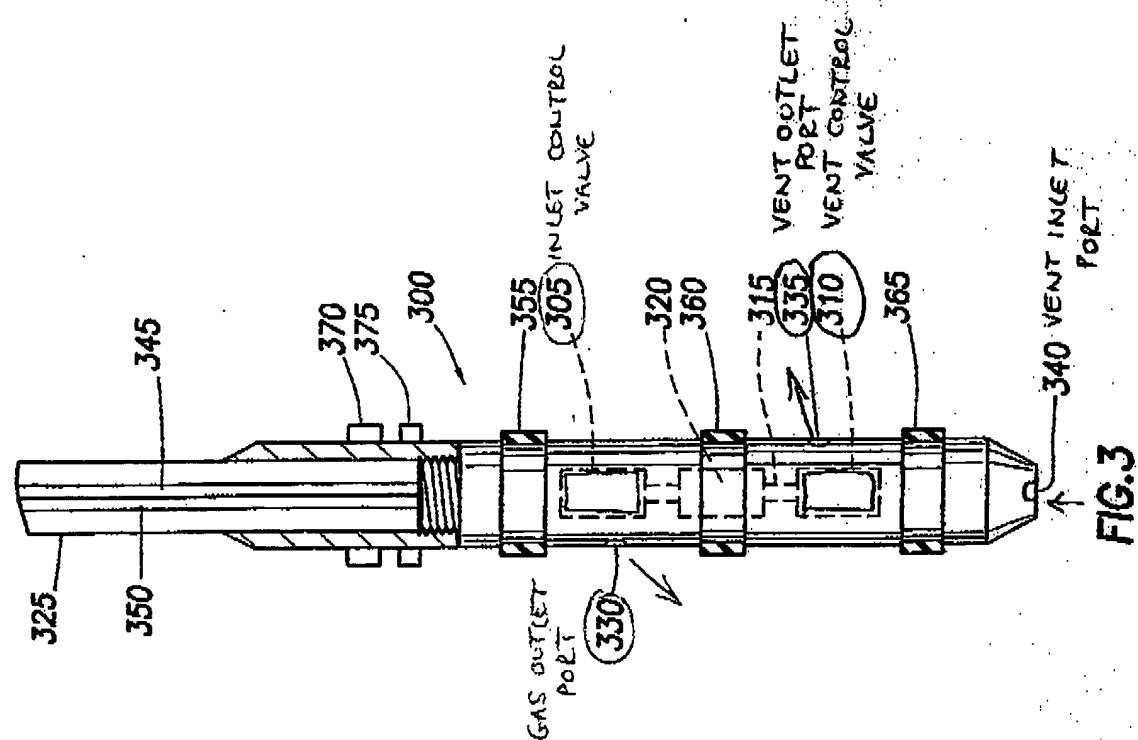


FIG. 1



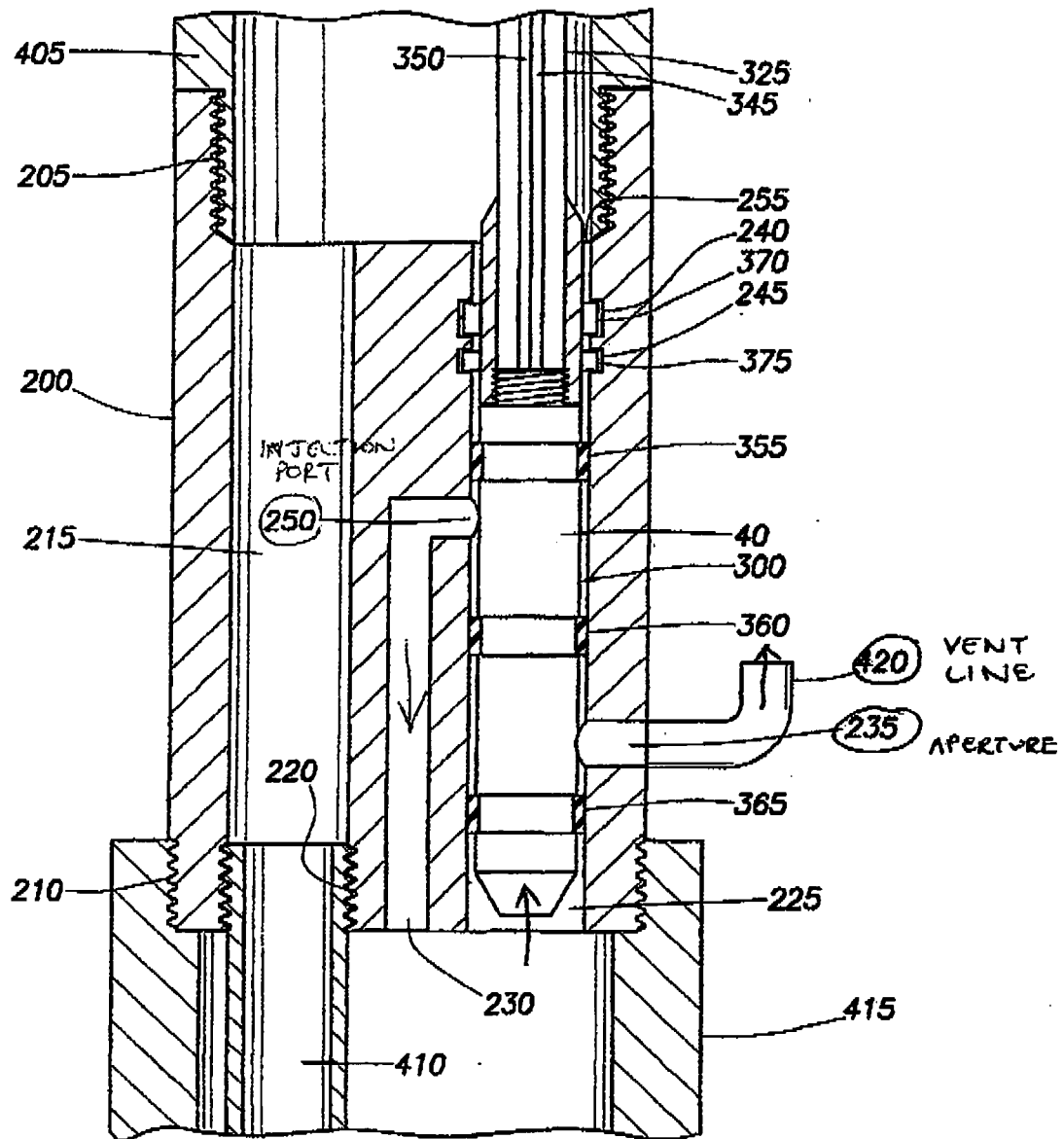


FIG. 4

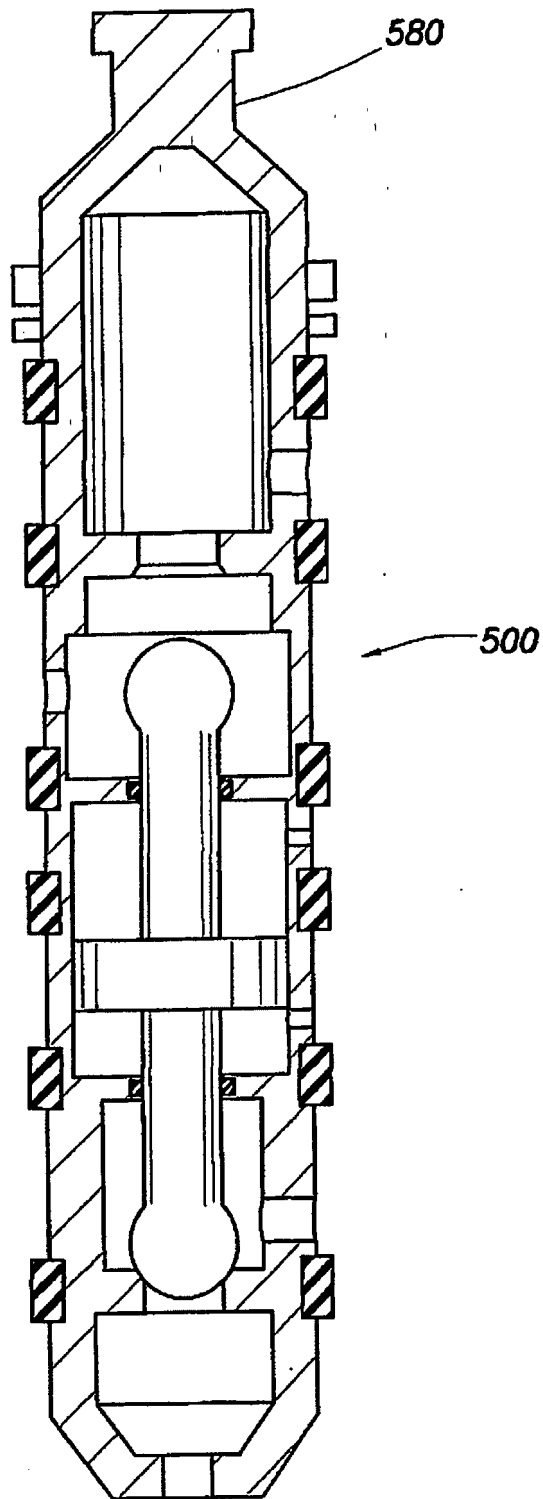


FIG.5

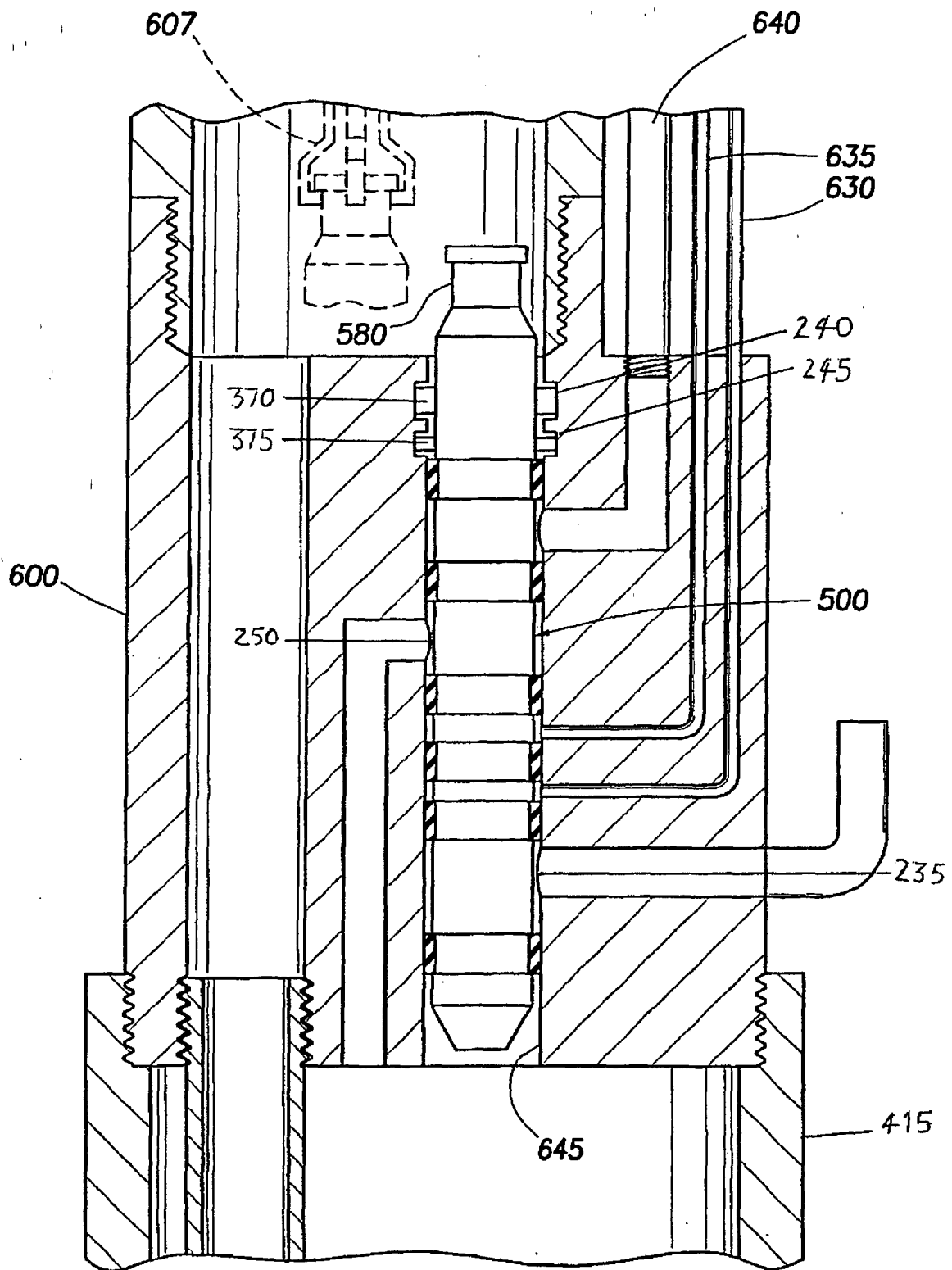


FIG.6

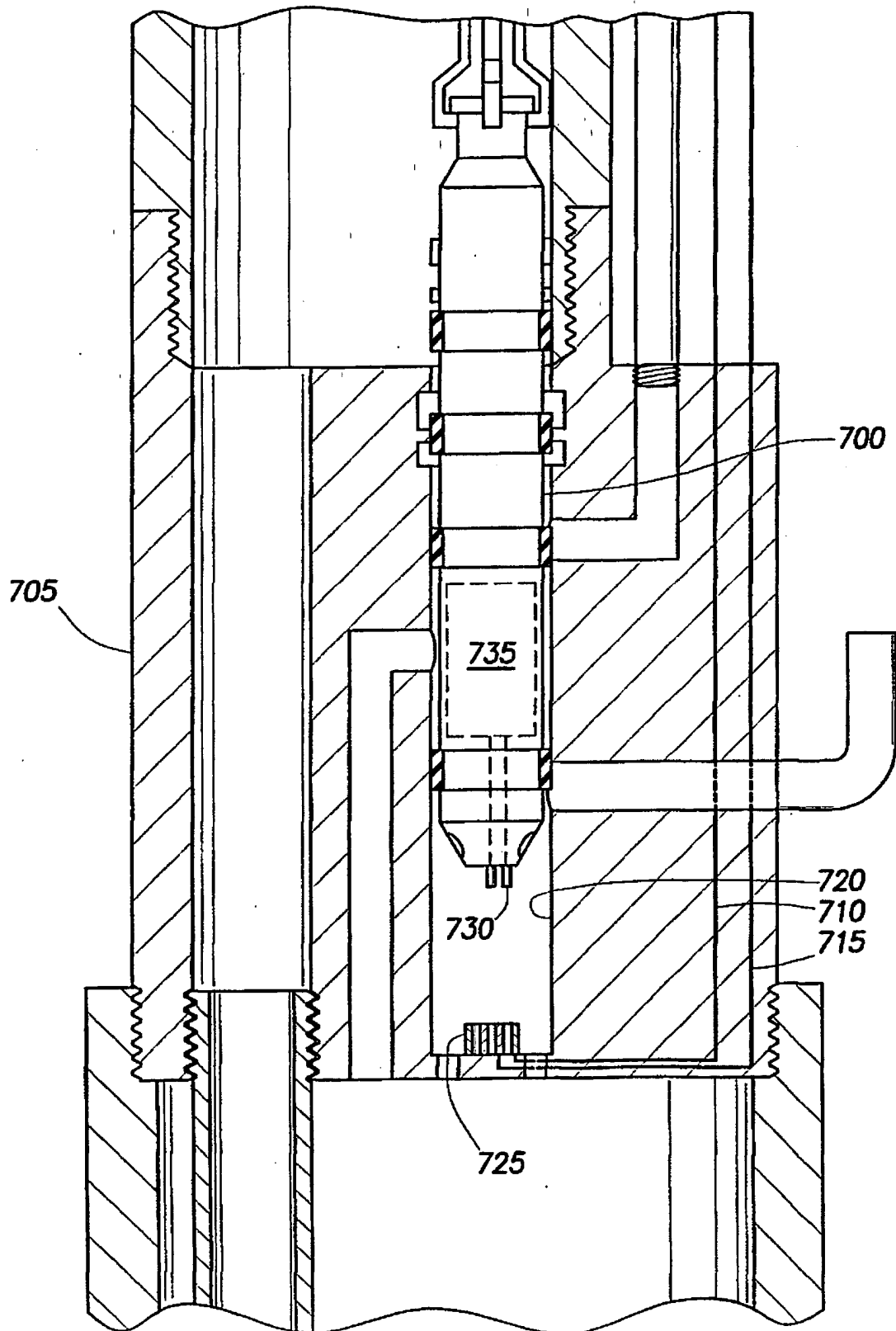


FIG. 7

REFERENCES CITED IN THE DESCRIPTION

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