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INFLATING PUMP FOR OIL WELL PACKERS

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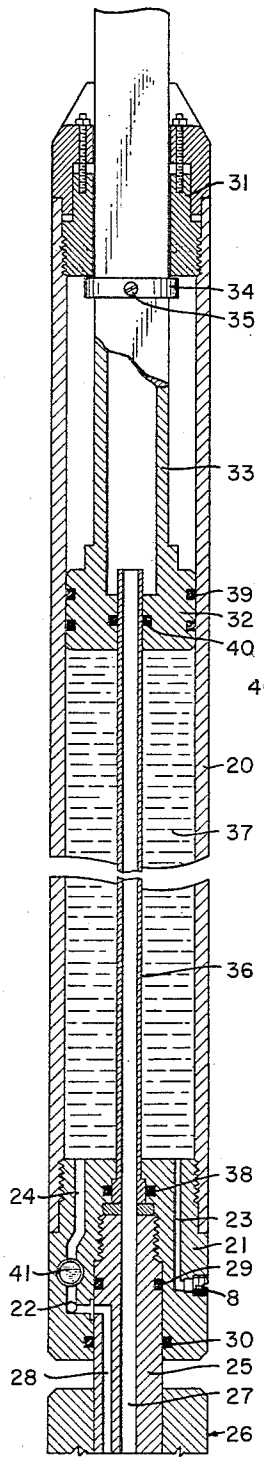

FIG. 3.

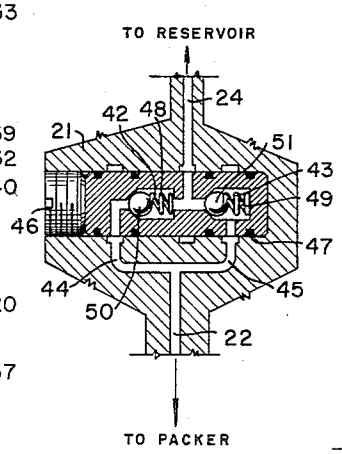

FIG. 4.

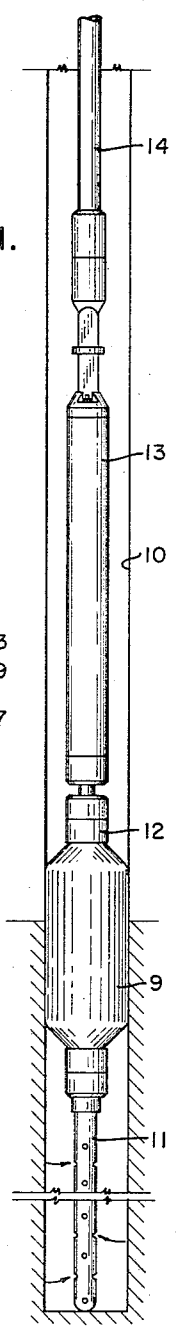

FIG. 1.

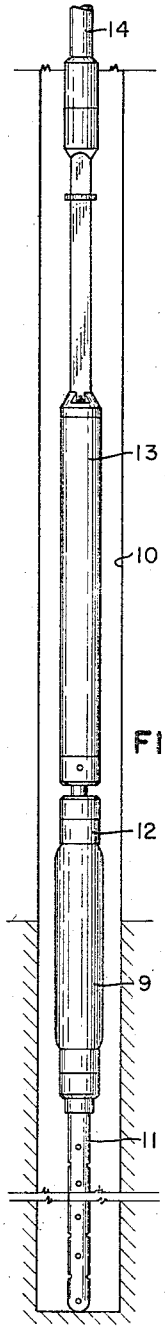

FIG. 2.

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INFLATING PUMP FOR OIL WELL PACKERS

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1 Claim. (Cl. 166—187)

This invention concerns a pump for expanding inflatable packers in a well bore. More particularly, the invention relates to a pump for inflating packers used in conducting drill stem tests or temporary well completions.

As drilling of a borehole proceeds, there are indications (such as loss of returns, etc.) which suggest the desirability of testing certain formations for oil. So-called drill stem tests are made for that purpose. Appropriate testing equipment is attached to a drill stem and lowered to the formation to be tested. A packer in the equipment is inflated to effect a seal against the wall of the borehole. Such a seal eliminates communication of the drilling fluid from the annulus above the packer surrounding the drill stem to the isolated section below. Valves in the testing apparatus are then opened by appropriate mechanisms to permit formation fluid from the isolated section to enter the empty drill stem above the packer. After a sufficient time, the valve is closed, the packer deflated, the stem removed, and the formation fluid recovered for examination and testing on the surface.

When employing an inflatable type packer, it is desirable to know the safe inflate capacity of the packer. Because of unknown washouts, etc., the diameter of the borehole may be larger than the diameter to which the packer is capable of expanding. In such instances, the packer may be damaged or may burst from over-inflation. In present systems in which are used mud pumps employing well drilling muds as the packer expanding fluids, over inflation, with resulting damage to the packer, may occur.

Also, the caliper of the well bore at the packer seal location is desired. For example, in a drill stem test the diameter of the borehole at the packer location gives an indication of (1) the type formation being tested and (2) how good a seal the packer is capable of effecting at that location.

Therefore, an object of this invention is to provide a pump for well packers wherein the pump is limited to a safe packer inflate capacity. Additionally, as object of the present invention is to provide a pump for well packers wherein the diameter of the well bore at the packer set location may be measured quickly and easily.

Briefly, the invention comprises a pump for inflating a packer comprising a cylinder connected to said packer, said packer including first and second passageways and said cylinder fluidly communicating with said first passageway, a movable hollow plunger provided with a piston arranged in said cylinder and adapted to connect to a tubing string exterior of said cylinder, guide means arranged on said cylinder adapted to guide said plunger, and a pipe arranged in said cylinder and extending through said piston adapted to fluidly communicate the interior of said plunger and said second passageway.

The above objects of the invention and other objects will be apparent from a description of the invention taken in conjunction with the drawings wherein:

Fig. 1 is an elevational view of the apparatus of the invention connected to a packer arranged in a borehole and showing the equipment in packer inflated position;

Fig. 2 is a view similar to Fig. 1 showing the equipment in packer deflated position;

Fig. 3 is a elevational view, partly in section, of the pump of the present invention; and

Fig. 4 is an enlarged view of the valving arrangement of Fig. 1.

In Figs. 1 and 2 is shown a borehole **10** in which is arranged a perforated tail pipe **11** positioned on the bottom of borehole **10** and connected to a packer section **12** provided with an inflatable packer element **9** and which, in turn, is connected to a pump section **13**. A tubing string **14** is connected to the upper end of pump section **13**.

Pump section **13** (Fig. 3) includes a cylinder **20** to which is connected at its lower end a cylinder sub or closure member **21**. Closure member **21** is formed to provide fluid passageways **22**, **23**, and **24**. A mandrel **25** which forms part of a packer assembly, generally designated **26**, is connected to closure member **21**. Mandrel **25** is formed to provide a fluid passageway **28** which fluidly communicates passageway **22** and the interior of packer **9** (not shown) and a fluid passageway **27** which extends through packer section **12**. Suitable sealing means **29** and **30** are arranged on mandrel **25** and closure member **21**, respectively, for sealing off the annulus between mandrel **25** and closure member **21** above and below the connection between passageway **22** and passageway **28**.

A guide head **31** is connected to the upper end of cylinder **20**. A piston **32** to which is connected a hollow plunger **33** is slidably arranged in cylinder **20**. Plunger **33** extends through guide head **31** and connects to tubing string **14**. A stop ring **34** is secured to plunger **33** by means of screw **35**. The interior surface of plunger **33** is circular and the exterior surface thereof is square, as shown in Figs. 1 and 2 more clearly. The interior of guide head **31** is also formed square thereby providing a keyway in guide head **31**, which prevents rotation of plunger **33** with relation to cylinder **20**. This structure is desirable for operation of certain standard test tools which require rotary motion for operation. When using such a tool, torque is applied to the drill stem at the well surface in order to close valves in the tool after entry of formation fluids into the drill stem above. An anchor shoe at the very end of the drill stem holds the lower end of the stem anchored as the torque is applied. If the pump described herein is used above the packer, the keyway arrangement mentioned above is necessary to prevent rotation of plunger **33** during application of the torque.

A pipe or stringer **36** fluidly communicating with passageway **27** is secured to closure member **21** and extends through piston **32** into the interior of plunger **33**. Packer inflating fluid **37** is contained in cylinder **20**. Passageway **23**, provided at one end with a plug **8**, is employed for filling cylinder **20** with fluid **37**. Sealing means **38** is arranged in closure member **21** adapted to seal off the annulus between pipe **36** and closure member **21**. Also, sealing means **39** are arranged on piston **32** adapted to seal off the annulus between piston **32** and the interior wall of cylinder **20** and sealing means **40** is arranged on piston **32** adapted to seal off the annulus between piston **32** and the exterior wall of pipe **36**.

A valve assembly **41**, shown more clearly in Fig. 4, is arranged in passageway **22**. Passageway **24** fluidly communicates with two oppositely disposed check valves **42** and **43**, which, in turn, fluidly communicate with fluid passageway **22** via conduits or branch passageways **44** and **45**, respectively. A plug **46** is arranged in closure member **21** for facilitating positioning and removal of valve elements **42** and **43**. Sealing means **47** are provided for sealing off the various flow passages. Check valves **42** and **43** include spring members **48** and **49**, respectively, and ball members **50** and **51**, respectively. Spring

member **43** is of sufficient strength to prevent movement of fluid from cylinder **37** through fluid passageway **24** to fluid passageways **45** and **22** when the piston is in the upper position as shown in Figs. 2 and 3. The various sealing means **29**, **30**, **38**, **39**, **40** and **47** may be suitably O-ring seals.

Operation

The apparatus is lowered in borehole **10** with packer **9** in deflated position until tail pipe **11** engages the bottom of borehole **10**. Then the usual setting down of weight upon drill string **14** against the bottom of the borehole causes plunger **33** to move downwardly within cylinder **20**. Packer inflating fluid **37** is thereby forced by piston **32** downwardly through fluid passageway **24**, valve **43**, passageway **45**, passageway **22**, and passageway **28** to the interior of packer **9** and the packer is expanded outwardly against the walls of the borehole, as shown in Fig. 1. The inflating pressure inside the packer is controlled directly in proportion to the weight put on the drill string.

When the packer has expanded into sealing engagement with the borehole wall the formation fluids move through the perforations in tail pipe **11** through passageway **27**, through the interior of pipe **36** and through the interior of plunger **33** into drill pipe **14** and thence to the surface of the earth.

Lifting of weight from the drill string permits the packer to deflate as plunger **33** is withdrawn upwardly to recover the inflate fluid back into cylinder **20**. Thus, when weight is released from drill string **14**, piston **32** moves upwardly until stop member **34** engages the lower side of guide head **31**. Fluid within packer **9** moves upwardly through passageway **28**, passageway **22**, passageway **44**, valve member **42**, and passageway **24** into the interior of cylinder **20**.

As readily seen the present invention has two distinct advantages over present packer pumps. First, the stroke of the inflating pump and therefore the available fluid is limited to a safe inflate capacity of the packers. Second, the stroke of the inflating pump is directly proportional to the inflate diameter of the packer. Therefore, by measuring the downward travel of drill string **14** at the surface of the earth after tail pipe **11** has touched the bottom of the borehole, and making a correction for known stretch in the drill pipe **14**, the stroke of the inflating pump in the hole is determined. Knowing the relationship of the pump stroke to the packer diameter furnishes an accurate caliper of the well bore at the packer seat location.

Having fully described the nature, objects, and operation of our invention, we claim:

A pumping system for use in well bores comprising a cylinder adapted to contain a predetermined amount of fluid; a closure member arranged on one end of said

cylinder and provided with a first passageway; a packer assembly connected to said closure member and provided with an inflatable element and second and third passageways, said third passageway fluidly communicating said first passageway and the interior of said inflatable element, said second passageway extending through said packer assembly; a movable hollow plunger adapted to be connected to a tubing string exterior of said cylinder at one end and provided with a piston at the other end thereof movable from an upper to a lower position and vice versa within said cylinder; a guide member arranged on the other end of said cylinder cooperating with the exterior surface of said plunger to form a keyway; a stationary pipe connected to said closure member and extending through said piston adapted to fluidly communicate the interior of said plunger and said second passageway; sealing means on said piston adapted to sealingly engage the interior surface of said cylinder and the exterior surface of said pipe; stop means on said plunger adapted to engage said guide member to limit movement of said plunger in an upward direction; and valve means including two branch passageways, said valve means being adapted to retain packer inflate fluid in said cylinder when said cylinder is in said upper position, said valve means fluidly communicating said cylinder and the interior of said inflatable element via said first and third passageways and one of said branch passageways and being adapted to close off fluid communication thru said other branch passageway when said piston moves downwardly from said upper to said lower position, said valve means being adapted to permit release of packer inflate fluid from the interior of said inflatable element to said cylinder via said first and third passageways and the other of said branch passageways and being adapted to close off fluid communication thru said one branch passageway when said piston moves upwardly from said lower to said upper position; the predetermined amount of fluid adapted to be contained in said cylinder providing a safe inflate capacity for said inflatable element and the length of travel of said plunger being measurably related to the inflate diameter of said inflatable element.

References Cited in the file of this patent

UNITED STATES PATENTS

31,567	Spooner	Feb. 26, 1861
882,416	Pitner	Mar. 17, 1908
1,850,218	Thomas	Mar. 22, 1932
2,222,750	Litoff	Nov. 26, 1940
2,231,282	Norris	Feb. 11, 1941
2,232,199	Bold	Feb. 18, 1941
2,715,444	Fewel	Aug. 16, 1955
2,778,431	Lynes	Jan. 22, 1957