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HYDRAULIC PISTON

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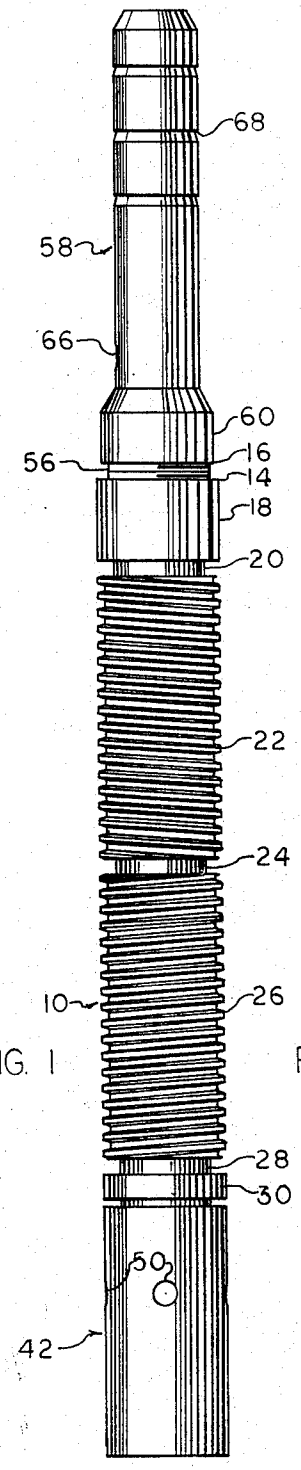


FIG. 1

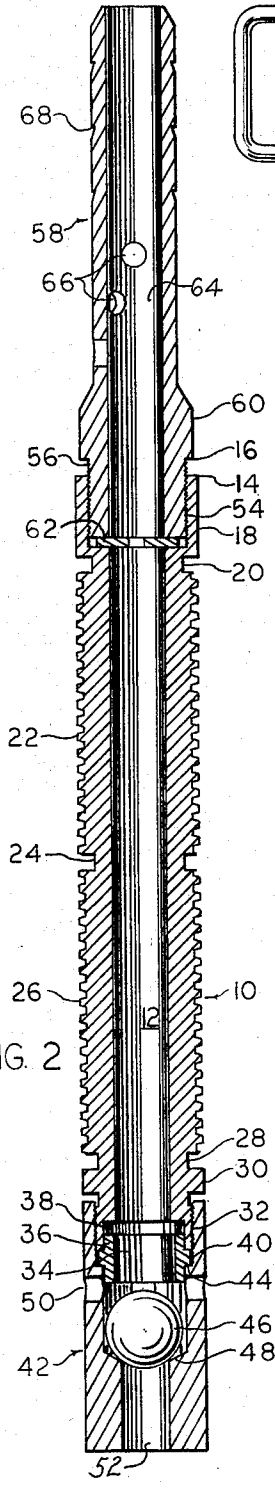


FIG. 2

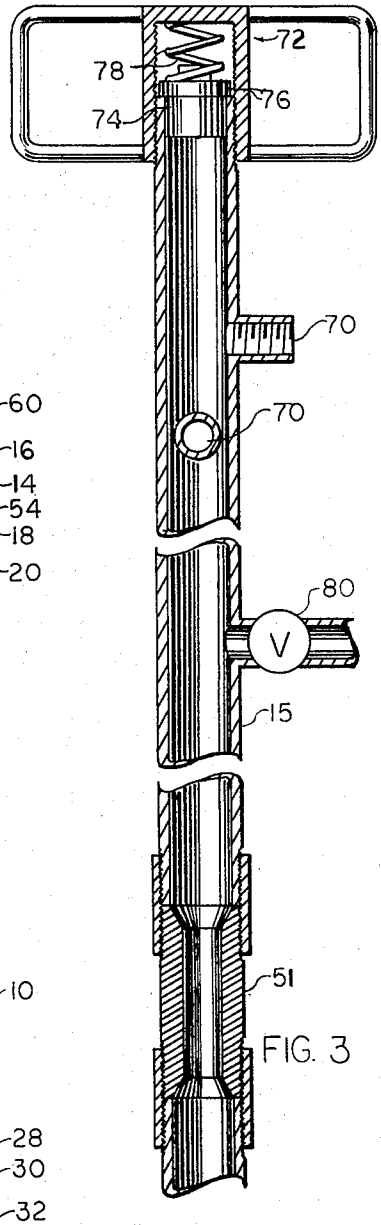


FIG. 3

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HYDRAULIC PISTON

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This invention pertains to a control hydraulic piston for use in oil wells.

In the production of oil and gas with a gas drive, the oil is brought to the surface of the ground by the gas pressure which is primarily within the same formation as the oil itself. However, a larger portion of the gas is actually cut or dissolved within the oil itself. As the well is produced, the oil and gas will string out through the tubing and therefore it will take much more gas to produce the oil, as it will cut away or separate from the oil to a certain extent; therefore the amount of gas that does break out with the oil is undesirable because the price of oil is much higher than that for gas.

Under the conservation laws it is prohibitive for an unlimited amount of gas to be burned in the field; it must be sold. However, the producing of oil from wells with high gas ratios that have no market for the gas might as well be shut in as produced on a high penalization. Therefore, putting a hydraulic piston into the tubing, allowing it to go to bottom of tubing or well by shutting off valves, will cause pressure to equalize and then, by opening valves on top, the hydraulic piston will force all fluid out of the tubing and not allow an excessive amount of gas to escape.

There is a seating nipple at the bottom of the pipe to prevent the tool from dropping out the bottom. The oil seeps into the pipe, around and through the tool. Then when the valve is opened at the top of the ground to flow the oil, the tool comes up, the tool and the oil above it, are pushed up by the gas pressure. The tool prevents the gas from bubbling up through the oil and the oil from sliding along the sides of the pipe so that a solid stream of oil is produced with substantially no gas. Of course, it will be understood that the pressures under which these operate, a slight amount of gas will be dissolved within the oil and that when the pressure is reduced, a certain amount of gas will evaporate from the oil. When the tool reaches the top of the well, the gas that has been driving the tool upward will begin to flow. Then the valve is closed, stopping production.

Previously, elaborate tools have been developed for this purpose. These tools are usually of rather complicated design. These designs do not have the ruggedness which is desired.

An object of this invention is to provide a simple, rugged hydraulic piston.

Another object is to provide a hydraulic piston which has a controlled rate of fall.

Another object of this invention is to provide a hydraulic piston which has positive and certain action.

A further object of this invention is to provide a hydraulic piston which does not permit oil or gas to escape past it.

Still further objects are to achieve the above with a device that is sturdy, simple, and reliable, yet inexpensive and easy to manufacture.

The specific nature of the invention as well as other objects, uses, and advantages thereof will clearly appear

from the following description and from the accompanying drawings, in which:

Fig. 1 is an elevation of the tool.

Fig. 2 is an axial sectional view of the tool.

Fig. 3 is an axial sectional view of the eduction tube in which the tool operates.

As seen in the accompanying drawings, one embodiment of the tool is comprised principally of three sections: the top fishing neck, the fluid seal, and the bottom cage.

The fluid seal **10** is primarily a tubular member. It has cylindrical axial bore **12**. On the upper end of the fluid seal member **10** there is external shoulder **14**. This square shoulder is of larger diameter than shoulder **16** of the fishing neck immediately above it. Therefore, the shoulder **14** will act as a paraffin scraper to remove foreign matter which may be clinging to the inside of eduction tube **15**, in which the plunger operates. The outside of the tool is .150 inch in diameter less than the inside diameter of the eduction tube within which it works. I.e., if the eduction tube is 2.450 inches I.D., the O.D. of the tool would be 2.300 inches.

Immediately below flange **18** (of which shoulder **14** is a part) is annular groove **20**. This groove is ¼-inch in width and ¼-inch in depth. Immediately below the annular groove **20** is right-handed helical flight of seals or threads **22**. These threads are basically square threads except that although they have a pitch of .250 inch, the depth of the groove is .105 inch. At the end of the right-hand flight of threads **22**, which extends about five inches, there is center annular groove **24**. This annular groove is approximately at the center of the fluid seal portion of the tool. It is also ¼-inch wide and ¼-inch deep.

Immediately below the center annular groove **24** there is a left-handed flight of helical seals or threads **26**. These are identical in shape and size to the seals **22** except for going in the opposite direction. Immediately below them is lower annular groove **28** which is of like size to the grooves **20** and **24**. Immediately below this groove is flange **30**. Below the flange the fluid seal portion is externally threaded at **32** for the attachment of the bottom cage portion.

The purpose of the right and left-handed threads are to effect a fluid seal. I.e., as the piston goes up the eduction tube, it is desirable that as little oil as possible which forms a film on the walls of the eduction tube should remain on the eduction tube. Even more important, it is desirable that no gas should bubble past the piston and mingle with the oil. I have found that the right and left-handed threads of the dimensions stated are very effective. It is important that there be both right and left handed threads. If only one set were used, the piston would tend to spiral or rotate about its axis and lose its seal. Spiralling also wears the tubing. The annular grooves aid in forming a seal. A further service of the annular grooves is that it makes the machining of the helical seals or threads easier. The machining of the threads is easier because of the grooves providing a place for the machine tool to start and stop.

A valve seat **34** fits against the lower surface of the fluid seal portion **10** of the tool. A portion of the seat **36** fits within an internal annular notch **38**. A centrally located annular flange **40** of seat **34** fits against the top of the bottom cage and lower surface of the fluid seal member. The seat is held in place by the cage proper or retainer **42** which has internal threads to mate with threads **32**. It likewise has an internal notch **44** to fit against the flange **40** to hold the seat in place. The cage contains spherical valve or ball **46** so that when there is pressure on the bottom of the tool, the ball will seat against the valve seat effectively closing any fluid passage through the annular

bore of the tool. When the ball is in the lower position resting on retainer 48, an upward fluid passage is provided by four holes 50, which are located radially through the cage immediately below the valve seat 34. However, if the tool is resting on its seating nipple 51 at the bottom of the well, the retainer 48 acts as a valve seat and prevents any flow of oil down through the cage 32. As the cage forms a seal with the seating nipple, no liquid may pass downward by the tool. In this manner the tool acts as a standing valve. When the ball is in lower position resting on its retainer, there is a very large opening for the flow of oil through the holes 50, the valve seat 34 and on up through axial bore 12. The bottom of the cage has an axial bore 52 extending therethrough and in communication to the rest of the tool. Also, there is two or three inches of space from the retainer 48 to the bottom of the tool. This provides a certain leeway so that the sole working portion of the tool (the ball valve) is not too badly battered should the tool drop to the bottom of the well. The purpose of having the bottom of the tool open is so that it is unnecessary to have any mechanical or external means to close the ball when the tool starts up. With the bottom of the tool open, the blast of gas will automatically close the ball valve.

The top of the fluid portion 10 has internal threads 54 which mate with the threads 56 on the bottom of the fishing neck 58. Flange 60 is immediately above the threads 56, which has been mentioned previously and is of less diameter than the diameter of the shoulder 14. Orifice plate 62 rests upon an internal shoulder between the fluid seal portion and the fishing neck. The purpose of this orifice plate is to control the rate of fall.

The fishing neck itself is a tubular member which has an axial bore 64 therethrough. There are three radial holes 66 therethrough. The purpose of these holes is if it is necessary to fish tool and thereby the upper opening is closed, these holes will provide a fluid passage so that the tool does not act as a swab. On the upper portion of the tool there are notches 68 so that a grappling instrument may be attached to the tool if it is necessary to do so. The fishing neck is about seven inches from top to the paraffin scraping shoulder 14. It is necessary to have ample room so that the paraffin which may be scraped from the side of the eduction tube will not cover the top opening and thus change the fall characteristics of the tool.

Fig. 3 includes an illustration of the top of the joint of the eduction tube which is known as the lubricator although it does not lubricate anything. Essentially it is a tube with nipples 70 for the attachment of gauges and other instruments. However, on the top there is threaded to the eduction tube a cap 72. Within the cap is a bumper block 74 having an annular flange 76 which rests upon the top of the tube. A spring 78 extends from the top of the cap to the bumper block.

Operation

The well may be operated from single valve 80 located in a branch from the eduction tube below a point the tool would be located when in the top position. Assuming that the tool were in the bottom of the well with a slug of petroleum above it and the valve at the top of the eduction tube were open, the gas in the well would force the petroleum and tool upward. The tool will find the division point between the petroleum on top and the gas below it. The pressure on the bottom of the tool is greater than the pressure on top. Therefore, the ball valve 46 will be held against the seat 34. This prohibits any gas from bubbling up through the center of the tool. The seals on the outside of the tool will prevent any gas from bubbling up around the outside of the tool. Thus the tool will form effective partition between the liquid above and the gas below. Also it has been found with the use of this tool that the water will separate.

When all of the liquid has passed through the valve 80, the gas and momentum will carry the tool on up into the lubricator. At this time the valve 80 is closed, preventing any loss of gas which is needed to drive the rest of petroleum from the ground. This valve can be closed either manually or by some mechanism which is responsive to time, pressure, or the passage of the tool past any point near the top of the tube.

When the valve 80 is closed, the tool will fall to the bottom of the well. The rate of the fall to the bottom of the well is controlled by the size of the orifice in the orifice plate 62. The smaller the orifice, the more resistance there is to passage of gas through the tool as it falls and, therefore, the slower the fall.

When the valve 80 is open and the tool is traveling up the tube, the following forces will act on the tool. The gravity will be acting downward on the tool and the frictional forces due to the viscosity of the oil between the tube and the tool will be a downward force on the tool. There will be an upward force on the tool which will be the pressure differential. With the valve 80 open at the top there will be very little pressure at the top of the well and there will be the great gas pressure at the bottom of the well. The force exerted by the differential pressure will be greater than the downward gravity therefore the tool will move upward. When the tool is above the valve 80, it will be held there by the rush of gas and other fluids through the eduction tube and into the branch containing the valve 80. When the tool is above the valve 80, there will be sufficient gas leak between the tool and the tube so that the pressure is equalized above and below the tool and the ball 46 will drop from its seat 34.

However, when the valve 80 is closed, there will no longer be a flow of fluids within the eduction tube. A static condition will be reached because there will be no place for gas to escape. With the valve 80 closed, the top of the eduction tube will be entirely closed. At this time the force of gravity will pull downward on the tool. There will be a pressure differential above and below the tool due to the orifice in plate 62. If the tool is moving down within the tube, the pressure differential will not be great enough to overcome the weight or gravitational forces acting upon the ball valve 46. Therefore the ball 46 will drop from its seat 34 and be held by the retainer. The gas will primarily flow around the cage 42 through the holes 50 up through the orifice 62. With no liquid in the well there will be no appreciable seal between the outside of the tool and the tube. Therefore there will be a certain amount of gas leakage between the tool and the tube.

When the tool hits the surface of liquid which has accumulated in the eduction tube during the trip up, the fluid coming in the bottom axial bore 64 will cause the ball to seat momentarily. However, after the ball has once seated and the tool stopped, the ball valve will open again and the tool will continue to sink on down to the bottom of the well.

As may be seen, there is no necessity for any special valve operating mechanism for the tool either at the top of the well or at the bottom. Although the tool may be traveling at a considerable speed when it reaches the top, it has only one moving part and no delicate parts. All that is necessary is the short bumper block in the top of the eduction tube. Nothing more is needed than the seating nipple 51 at the bottom of the eduction tube. Generally, the tool will be going quite slowly through the liquid at the very bottom. However, even if the bottom of the hole is dry, the orifice will slow the tool down to reasonable speed and no damage is done if it falls against the seating nipple in the bottom of the tube.

After the tool reaches the bottom, it remains there until a sufficient slug of petroleum has again accumulated above it to justify another trip up. During this time the tool acts as a standing valve to prevent any downward flow should the pressure above it exceed the pressure below it. When another trip up is desired, the valve at the top of the eduction tube may be opened manually or by a mechanism

responsive to time or otherwise. While the tool is at the bottom of the well, the flow of petroleum will be through the bore **52**, bouncing the valve up from seat **48**; also, the tool may rise from the nipple **51** to allow the oil to pass through radial holes **50** and on up through the tube. Thus, as may be seen, there is provided a large opening for the petroleum to flow into the eduction tube before the tool starts up again.

It will be apparent that the embodiment shown is only exemplary and that various modifications can be made on construction, materials, and arrangement within the scope of the invention as defined in the appended claims.

I claim as my invention:

1. A hydraulic piston comprising an elongated tubular fishing neck which has notches thereon for engagement of a grapple, a circular annular flange on the outside of the piston beneath said fishing neck which presents a right angle to the axis of said piston for scraping paraffin, a cylindrical fluid seal immediately below said shoulder, said seal comprising the two sets of square helical threads which turn in opposite direction from one another, an annular square groove on either side of each set of threads, an axial bore extending from one end of the piston to the other, an orifice within said bore to restrict the passage of fluid through the bore, a valve seat in the bore, a ball valve beneath the valve seat, and a cage to retain the ball within the piston, said cage having radial holes therethrough immediately below the valve seat.

2. The invention as defined in claim 1 wherein said annular square groove is about twice as deep and wide as said threads.

3. The invention as defined in claim 1 with the addition of a second valve seat in said bore beneath said radial holes.

4. In a hydraulic piston having an elongated tubular cylindrical body, said body having an axial bore therethrough, a valve seat co-axial with the body, and a valve below said seat; the improvement comprising: a set of right-handed square helical seals on the outside of said body integral with said body, a set of left-handed square helical seals on the outside of said body integral with said body, and an annular square groove on either side of each set of seals, said body being fluid tight through the extent of the right and left hand helical seals.

5. The invention as defined in claim 4 wherein said annular square groove is about twice as deep and wide as said seal.

6. In an eduction tube having a seating nipple therein, said seating nipple being of less inside diameter than said eduction tube, an improved hydraulic piston comprising: an elongated tubular cylindrical body, said body having an axial bore therethrough, means on the outer surface of said body for forming a partition between liquid and gas, a valve seat attached to the body, a retainer attached to the body below the valve seat, a spherical valve within said retainer, said retainer having an opening co-axial with the body on the bottom of the retainer whereby the valve is closed by a greater pressure on bottom than top, said valve seat being below said means for forming a partition, and a second valve seat below said spherical valve, said retainer having an outer surface correlative to the upper surface of said seating nipple so that they form a seal therebetween, and said retainer having radial holes therethrough between said valve seats.

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