July 24, 1962 B. F. SCHMIDT 3,045,606

RECIPROCAL PISTON OIL WELL PUMP

Filed Sept. 22, 1960

FIG. 1.

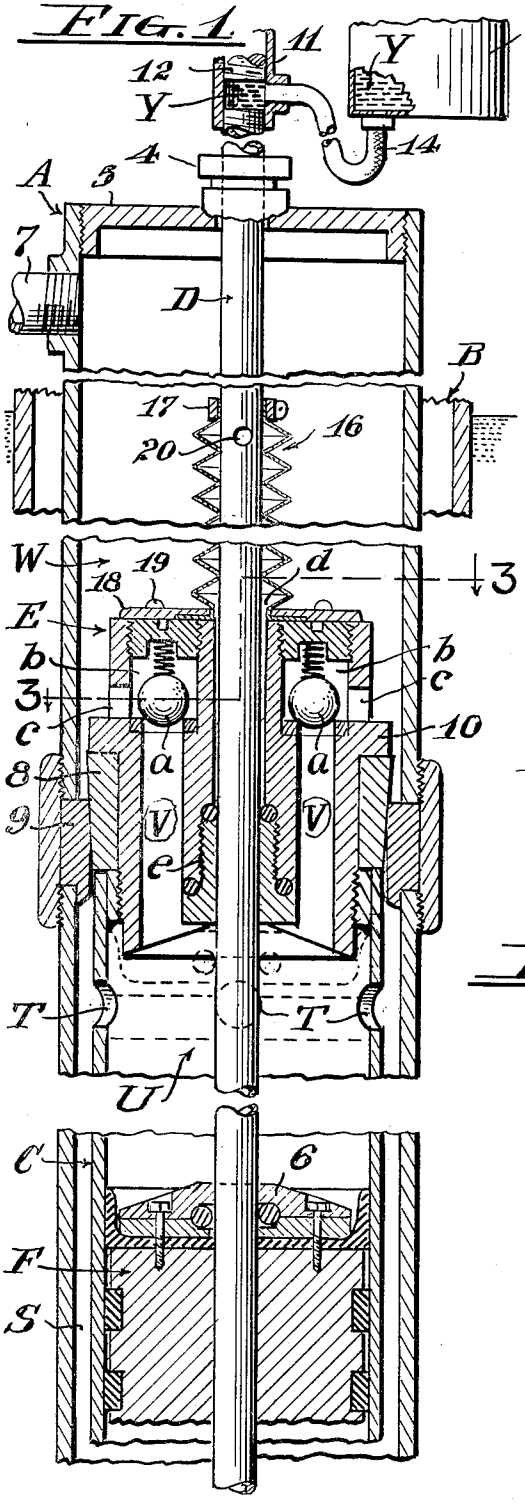


FIG. 2.

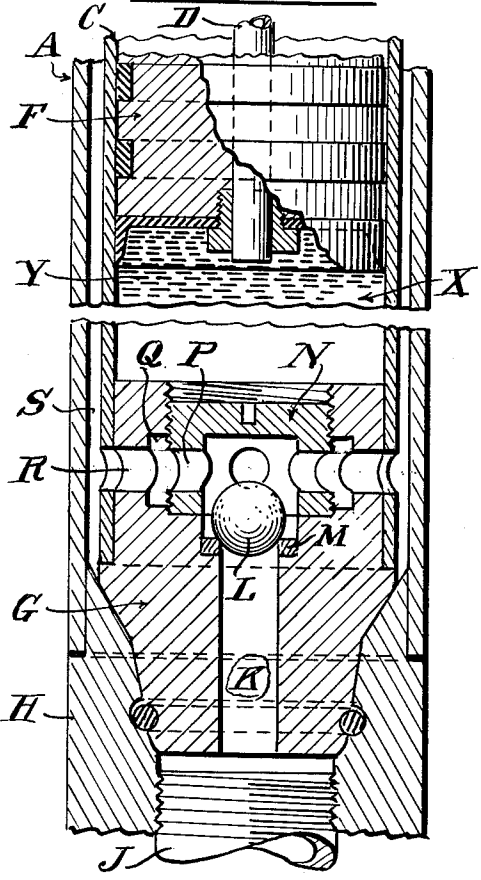
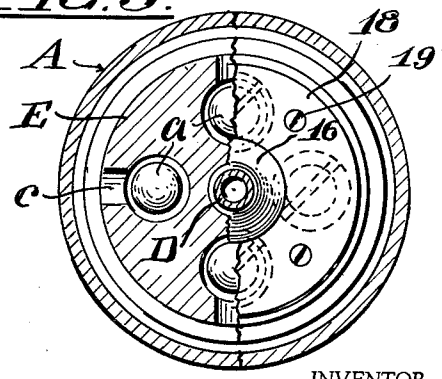


FIG. 3.



INVENTOR.

Benjamin F. Schmidt

BY

R. S. Berry

Att'y.

United States Patent Office 3,045,606 Patented July 24, 1962

3,045,606

RECIPROCAL PISTON OIL WELL PUMP

Benjamin F. Schmidt, 450 Fairview Ave., Sierra Madre, Calif.

Filed Sept. 22, 1960, Ser. No. 57,676
7 Claims. (Cl. 103—155)

This invention relates to a single acting reciprocal piston oil well pump of the inserted barrel type in which a piston rod and pump thereon are utilized in lowering a pump barrel in a pump tube within a well casing and in removing the pump barrel therefrom as well as effecting operation of the pump; the invention particularly pertaining to and having its primary object to provide a construction whereby the piston works between a confined body of lubricating oil beneath its lower end and a body of crude oil being pumped above its upper end and in such manner as to at least substantially equalize pressures on opposite ends of the piston and thereby obviate the use of heavy counter-balance, and whereby the pumping load is solely that of lifting the sucker rod and piston plus some friction.

Another object is to provide a piston pump for oil wells wherein the crude oil being pumped is prevented from being brought into contact with the lower end of the pump piston and is flowed solely in and out of the pump barrel above the pump piston.

Another object is to provide a construction whereby the sucker-rod is protected against the abrasive action of sand accumulated on the upper end of the pump barrel through which the sucker-rod is extended and reciprocated.

With the foregoing objects in view together with such other objects and advantages as may subsequently appear, the invention resides in the parts and in the combination, construction and arrangement of parts hereinafter described and claimed, and as illustrated by way of example in the accompanying drawing in which:

FIG. 1 is a view in vertical section partly in elevation of the upper portion of the pump;

FIG. 2 is a similar view of the lower portion of the pump; and

FIG. 3 is a horizontal section and plan view as seen on the line 3—3 of FIG. 1.

Referring to the drawings more specifically A indicates generally a length of cylindrical pump tubing and B designates a well casing into which the tubing A extends substantially throughout the length thereof and C denotes a cylindrical pump barrel removably positioned in the lower portion of the pump tubing A.

A sucker-rod D extends through a packing gland 4 on the upper end 5 of the pump tubing A and through a cap E screwed into and projecting above the upper end of the pump barrel C and constituting the upper end of the latter. The lower end portion of the sucker-rod D extends through a piston F which is rigidly but detachably affixed to the sucker-rod; a bumper block 6 on the upper end of the piston F being adapted to be disposed in abutting relation to the lower end of the cap E to afford a support for the pump barrel C in lowering it into the tubing A and removing it therefrom in a customary manner.

The lower end of the pump-barrel C is fitted with a tapered closure plug G adapted to seat on and conform to a correspondingly contoured inner periphery of a coupling H extending from the lower end of the tubing A, as shown in FIG. 2. The coupling H connects with an intake pipe J opening in a suitable manner to the crude oil deposited in the lower end portion of the well casing B, the upper end of the pipe J being open and presented to the lower end of an intake passage K extending upwardly through the plug G which passage is fitted intermediate its ends with an upwardly opening ball foot valve L normally abutting a seat M.

The valve L is arranged in a cage N mounted in the upper end of the plug G which cage has side openings P leading to a channel Q in the plug G from which extends openings R leading laterally through the plug G and side wall of the pump barrel C to the exterior of the latter.

The pump barrel has an external diameter sufficiently less than the internal diameter of the pump tubing A to provide a crude oil conducting space S between the pump tubing A and the pump barrel C extending around the circumference and along substantially the length of the latter. The upper end portion of the pump barrel C has apertures T forming passages between the space S and the pump chamber U interiorly of the pump barrel above the piston F.

The cap E has a plurality of passages V leading vertically therethrough, which passages open at their lower ends to the pump chamber U and have their upper ends normally closed by spring pressed ball valves *a* enclosed in valve chambers *b* having side outlets *c* leading to an oil conducting chamber W constituting the interior of the upper end portion of the tubing A commonly known as the productive tubing from the upper part of which leads an outlet fitted with a discharge pipe 7.

The cap E is snugly encompassed by a sleeve 8 which has a longitudinally tapered outer periphery converging to its lower end which sleeve is adapted to seat on an annulus 9 fixed on the pump tubing A, the annulus 9 having its inner perimeter tapered to conform to the taper of the sleeve 8. The cap E has a peripheral flange 10 which abuts the upper end of the sleeve 8 the other end of which abuts the upper end of the pump tubing A. The abutting sleeve 8 and annulus 9 form a seal separating the space S around the pump barrel C from the chamber W in the tubing A leading from above the upper end of the pump barrel.

In carrying out the invention at least the portion of the sucker-rod extending into the pump tubing A, when the piston F is in its lowermost position, together with a portion then projecting above the upper end 5 of the pump tubing A, is tubular, and opens at its lower end into the chamber X in the pump barrel C beneath the lower end of the piston F. The chamber X is characterized by being enclosed by the side wall of the pump barrel, the plug G on the lower end of the pump barrel, and the lower end of the piston F; the chamber X opening only to the lower end of the tubular sucker-rod D and being designed to be maintained filled with a body of lubricating oil Y as will presently be described. The upper end of this tubular length of the sucker rod connects with and opens to the lower end of a coupling 11 to the upper end of which connects a solid length of rod 12 for connection with a walking beam or other means for actuating the sucker rod.

An elongated flexible conduit 14 leads from the coupling 11 and opens to a tank 15 located above and adjacent the upper end of the sucker-rod, which tank is in open communication with the chamber X below the piston F through the conduit 14 and sucker-rod D whereby on supplying the tank with a sufficient quantity of the lubricating oil Y, such oil will be delivered to the chamber X to fill the latter as well as the sucker-rod and thereby establishing a counter-balancing column of oil in the latter. The body of oil Y in the chamber X is displaced by downward movement of the piston whereby a portion of the oil Y will then be caused to return through the sucker-rod D into the tank 15.

As a means for protecting the sucker-rod D from abrasion due to collection of sand around the sucker-rod on the upper end of the cap E, an elongated bellows 16 is positioned around the portion of the sucker-rod projecting above the cap E in the chamber D and has its upper end closed and affixed to the sucker-rod by a collar 17

and has its lower end closed and affixed to the upper end of the cap E by a sealing plate **18** attached to the latter as by screws **19** and bearing on the lower end of the bellows. As a means for permitting bodily expansion and contraction of the bellows **16** the sucker-rod D has an orifice **20** therein which opens to the interior of the bellows to afford free passage of oil between the interiors of the sucker-rod and bellows, expansion of the bellows acting to draw oil from the sucker-rod into the bellows and contraction of the bellows effecting discharge of the oil from the bellows into the sucker-rod. A clearance space *d* is afforded between the sucker-rod D and the major portion of the length of the cap E the upper end of which space opens to the interior of the bellows **16** and accordingly is occupied by lubricating oil delivered from the bellows. The lower end of the space *d* is closed by a packing gland *e* encompassing the sucker-rod D and affixed to the lower end of the cap C.

The bellows being arranged in the chamber W is encompassed by crude oil being pumped and accordingly expansion and contraction of the bellows and consequent displacement of the surrounding body of oil serves to augment pumping action of the pump.

Assuming the pump piston F to be in its lowermost position as indicated in FIG. 2 the operation will be as follows: lubricating oil previously displaced by downward movement of the piston will have been restored in part to the tank **15**, and crude oil will have been inducted from the well past the foot valve L and delivered through the space S and passages T into the chamber U of the pump barrel above the piston. On upstroke of the piston F the crude oil thereabove will be delivered through the cap E past the valves *a* and into the pump chamber W thereby displacing a portion of the crude oil then contained therein and directing such portion toward discharge through the pipe **7**. This upward movement of the pump piston effects induction into the chamber X beneath the pump piston of lubricating oil Y from the tank **15** which oil will completely fill the chamber X as well as the interior of the sucker-rod D and bellows **16**. Downstroke of the pump piston, will act as before stated to induct crude oil from the well past the foot valve L into the pump barrel and return the displaced lubricating oil to or toward the tank **15**.

From the foregoing it will be seen that the piston F will have imposed on its upper end the load of the column of crude oil extending therefrom to the point of discharge at the top of the well, and at the same time will have upward pressure imposed on its lower end by the column of lubricating oil leading from the tank **15**. The ends of the piston being of equal areas and the columns of the crude oil and the lubricating oil imposed thereon being of at least substantially corresponding heights, the pressures on opposite ends of the pump piston will be balanced or nearly so.

By this arrangement the power required to operate the pump is only that which is necessary to lift the load of the sucker-rod and piston plus resistances occasioned by friction.

An oil of heavy specific gravity can be used in the hollow sucker-rod to increase the lifting power of the hollow sucker-rod, and in some instances water may be employed instead of oil, or an extra heavy oil having a specific gravity greater than that of water and not miscible in water can be used in the lower portion of the tube and the remainder of the column of liquid consist of water which on account of its low viscosity would move in the hollow sucker-rod without drag.

As a means for increasing hydraulic pressure beneath the piston, the tank **15** may be pressurized or it may be elevated to suitable height as in an oil well derrick to attain the desired pressure.

While a specific embodiment of the invention has been shown and described, the invention is not limited to the exact details of construction set forth, the invention embracing such changes, modifications and equivalents of the parts and their formation and arrangement as come within the purview of the appended claims.

I claim:

1. In an oil well pump; a length of tubing having an oil inlet at its lower end and an outlet at its upper end; a pump barrel in said pump tubing; a piston in said barrel; said pump barrel having a closed cap at its upper end; said closed cap having a sucker rod receiving opening therethrough; said tubing and said barrel defining therebetween an annular oil conducting space; a reciprocable sucker rod extending through said opening in said cap, connected to said piston and operable for reciprocating said piston to thereby effect an intake of crude oil through said inlet, the passage of crude oil through said space and the discharge of crude oil through said outlet; said barrel and said piston defining beneath said piston a variable capacity enclosed chamber; the variability of said chamber being caused by the reciprocation of said piston relative to said barrel; said sucker rod being tubular and extending through said piston with its lower end open at all times to said chamber; a tank adjacent the upper end of said pump tubing open at all times to the interior of said tubular sucker rod; and a body of lubricating oil contained in said tank filling said sucker rod and said chamber.

2. The structure called for in claim 1 in which a hollow bellows encompassing said sucker rod has a lower end in sealed connection with said cap and has an upper end sealed to said sucker rod; and said sucker rod having an opening leading into the interior of said hollow bellows.

3. The structure set forth in claim 1 including means providing a foot valve controlled passage connecting said annular space to said crude oil inlet; said pump barrel having openings leading from above the piston to said oil conducting space; said cap having passage means extending therethrough to pass crude oil from said barrel into said tubing above said cap; and normally closed upwardly opening check valve means operable in said passage means.

4. In an oil well pump, a length of pump tubing having lower and upper ends with a valved inlet at its lower end and a crude oil discharge outlet at its upper end; a pump barrel closed at its upper end mounted within said tubing; a piston reciprocal in said barrel; port means for intaking crude oil from said inlet into said barrel above said piston in response to reciprocation of said piston; valve means at said closed end of said barrel for discharging crude oil from above the piston to said pump tubing; said barrel having a closed variable capacity chamber beneath said piston; the variability of said chamber being responsive to reciprocation of said piston; a tubular sucker rod extending through said closed upper end of said barrel and joined to said piston; said sucker rod being operable to reciprocate said piston and having its lower end open at all times to said chamber; and a source of supply of lubricating oil at all times in communication with the interior of said sucker rod at the upper end portion of said sucker rod to maintain a body of said lubricating oil in said chamber and sucker rod, thereby counterbalancing the load of crude oil imposed on said piston.

5. An oil well pump including: a pump barrel closed at its upper end; a piston reciprocal in said barrel; port means including a port in said barrel for conducting crude oil to the interior of said barrel above said piston; valved means for passing crude oil from said closed upper end of said barrel on the up-stroke of said piston; means defining a closed chamber of variable capacity in said barrel beneath said piston; the variability of said chamber being caused by reciprocation of said piston; a tubular sucker rod extending through said closed end of said barrel and connected to said piston and extended through said piston so that an open lower end of the sucker rod is at all times open to said chamber; and a source of supply of lubricating oil at all times in communication with the interior of said sucker rod and filling said sucker rod and said cham-

ber to compensate for the load of crude oil imposed on said piston.

6. An oil well pump including: a pump barrel closed at its upper end; a piston operable in said barrel; means operable for introducing crude oil in and out of said barrel above said piston; a closed variable capacity chamber in said barrel beneath said piston; the variability of said chamber being responsive to reciprocation of said piston; means for reciprocating said piston including a tubular sucker rod extending through said closed end of said barrel and connected with said piston so that the interior of said sucker rod is at all times in direct communication with the interior of said closed chamber; and a source of supply of a heavy liquid at all times operable to maintain a body of said heavy liquid throughout said sucker rod and in said chamber to counterbalance the crude oil load imposed on said piston.

7. An oil well pump including: a pump barrel closed at its upper end; a piston in said barrel; means affording the flow of crude oil from a side of said barrel into the interior of said barrel above said piston; means for reciprocating said piston including a hollow sucker rod extending through said closed upper end and connected to said piston; means providing a closed variable capacity chamber in said barrel below said piston and in which the variable capacity is responsive to reciprocation of said piston; valved means at said closed upper end of said barrel operable responsive to a stroke of the piston to discharge crude oil upwardly from said barrel; said sucker rod being tubular and having its lower end open at all times to said chamber; and means connected with the upper portion of said sucker rod operable at all times to maintain said rod and chamber filled with a substance which will counterbalance the crude oil load on said piston.

References Cited in the file of this patent

UNITED STATES PATENTS

205,120	Moreau	June 18, 1878
1,900,588	Scott	Mar. 7, 1933
2,149,040	Binder et al.	Feb. 28, 1939
2,319,749	Salnikov	May 18, 1943