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FLUID PUMP CONSTRUCTION

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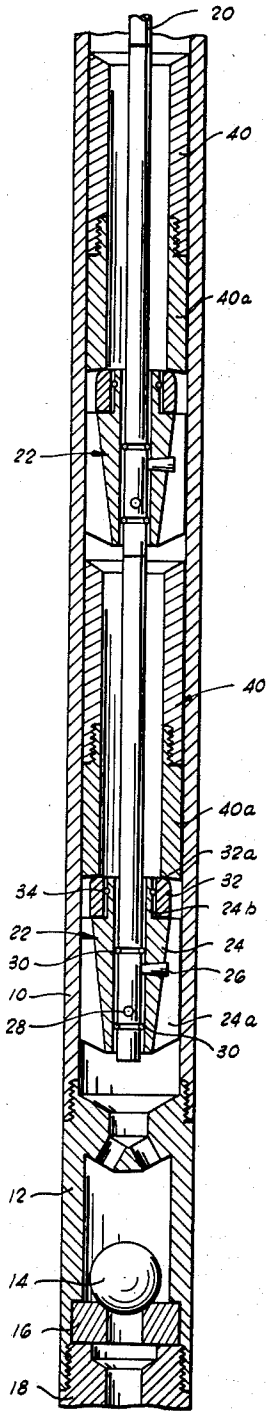


FIG. 1

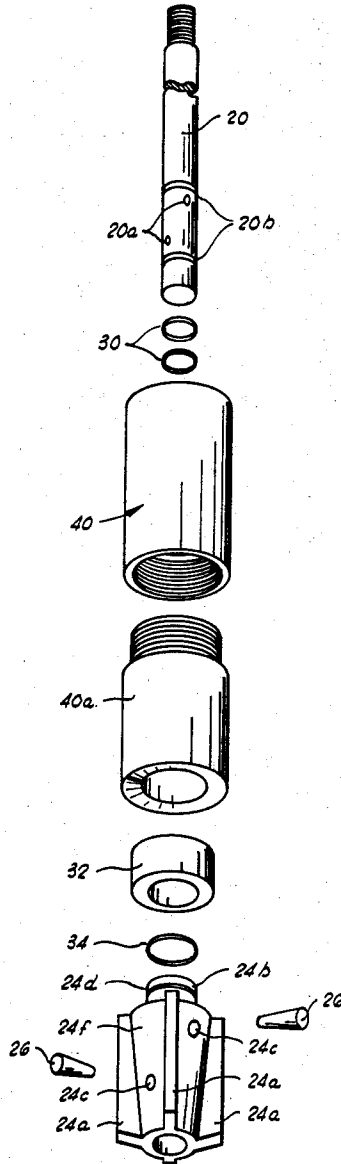


FIG. 2

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FLUID PUMP CONSTRUCTION

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The present invention relates to improvements in reciprocating pumps, and more particularly, but not by way of limitation, to improvements in fluid pumps adapted to be used in the lower part of an oil well, such as the type of pump disclosed in U.S. Patent No. 2,933,050, issued to L. S. Crowl et al. on April 19, 1960 and assigned to the assignee of this invention.

Pumps of the general type described in U.S. Patent No. 2,933,050 use the conventional working barrel with a standing valve in the bottom to prevent the escape of fluid which has once entered the barrel. The reciprocating plunger positioned in the working barrel includes a plurality of vertically aligned heads spaced apart and interconnected by connecting rods. Each head has passage means at its periphery to pass fluid by the head. A sleeve is located between each two adjacent heads and has a central fluid passage between the sleeve and the connecting rod which it encircles. Each sleeve forms a sliding, fluid seal fit at its periphery with the working barrel. On the upstroke of the plunger, each sleeve is forced downwardly against the adjacent lower head by friction with the working barrel. The lower end of the sleeve is so constructed as to mate with a seating surface machined on the upper end of the adjacent lower head to form an annular fluid seal which prevents fluid within the sleeve and thereabove from passing downwardly through the sleeve and past the periphery of the head. Therefore, on the upstroke of the plunger, each sleeve and the adjacent lower head forms a traveling valve which is closed to lift all fluid above the seating surfaces. On the downstroke of the plunger, the standing valve in the bottom of the barrel is closed, and each sleeve separates from the adjacent lower head due to friction with the working barrel. Fluid can then pass by the periphery of each head into and through the sleeve immediately thereabove preparatory to the next upstroke or working stroke. The reciprocation of the plunger therefore gives a lift-type pumping action.

While the pump described in the patent previously mentioned constitutes a great advance in the art and has many advantages over the pumps previously used, various difficulties have been encountered in finding a construction which was economical to build and economical to maintain in operating condition.

Therefore, the object of the present invention is to provide a plunger for a fluid pump of the type described which is more economical to construct, more economical to operate, and more economical to maintain.

Another object of the present invention is to provide a head for a fluid pump plunger of the type described which is more economical to make and maintain.

Another object of the present invention is to provide a head means for a fluid pump plunger of the type described which is provided with a replaceable, hardened seating surface.

Another object of the present invention is to provide a head means for a fluid pump plunger of the type described which is constructed to easily receive and retain a replaceable, hardened seating surface.

Another object of the present invention is to provide a head means for a fluid pump plunger of the type described which can be assembled and disassembled without any special tools.

Another object of the present invention is to provide a

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sleeve means for a fluid pump plunger having a replaceable, hardened seating surface on the lower end thereof, which is therefore more economical to make and maintain.

Still another object of the present invention is to provide a means for providing both an annular fluid seal between a replaceable seat and a head body and for securing the replaceable seat to the head body.

Still another object of the present invention is to provide a head means for a fluid pump plunger of the type described which does not require precision of construction in that the seating surface is laterally displaceable relative to the head body and connecting rod to properly mate and seat with the adjacent sleeve.

Additional objects and advantages of the present invention will be obvious to those skilled in the art from the following detailed description and drawings wherein:

FIGURE 1 is a longitudinal cross-sectional view of a pump assembly constructed in accordance with the present invention.

FIGURE 2 is an exploded perspective view of a portion of the plunger of the pump shown in FIG. 1.

Referring now to the drawings, a suitable conventional working barrel 10 threadingly receives a standing valve cage 12 in the bottom thereof. A standing valve ball 14 and seat 16 are retained in the cage 12 by a seating nipple 18. The seating nipple 18 may have the conventional hold-down cups on the bottom thereof or any other suitable means of holding the working barrel stationary, but for convenience this structure is not shown. A rod means 20 is connected at its upper end in some conventional manner to a rod string extending to the surface of the ground and reciprocated by some suitable means such as a pumping jack.

The rod means 20 interconnects a pair of head means indicated generally at 22. It is to be understood that any number of head means can be carried by the rod 20 above the two shown, only two being shown for convenience of illustration. Each head means 22 is comprised of a body 24 which encircles the rod 20. Each body 24 has a frusto-conical portion 24f which is tapered toward the bottom thereof so that the diameter of the conical portion is less at the bottom than at the top. Four projecting ribs 24a radiate from the frusto-conical portion and slidably engage the working barrel to guide and maintain the head means and rod 20 in proper alignment. Fluid can readily pass by the body 24 through the passageways bounded by the ribs 24a, the frusto-conical portion 24f and the working barrel 10. An annular shoulder portion 24b projects upwardly from the frusto-conical portion of body 24 and also surrounds the rod 20. The outer diameter of the shoulder 24b is substantially less than the adjacent larger diameter of the frusto-conical portion of the body. The body 24 has a pair of tapered bores 24c disposed at right angles. Tapered pins 26 pass through the bores 24c into registering bores 28 in the rod 20 to secure the body 24 against longitudinal slippage on the rod 20. A pair of circumferential grooves 29b are provided on the rod 20 on each side of the bores 28. The grooves receive O-ring seals 30 which provide a circumferential sealing means between the body 24 and the rod 20 to prevent fluid passage therebetween.

A sleeve-shaped ring seat 32 encircles the upstanding annular shoulder 24b and the rod 20. The ring seat 32 is preferably either fabricated of a very hard and durable metal with a spherical seating surface 32a formed on the upper face thereof, or of a softer metal with a process hardened spherical seating surface 32a. The spherical seating surface 32a is preferred over a planar or conical seating surface because it insures proper mating between the conical surface of the sleeve seating surface (hereafter described) even though the axes of the ring seat and

sleeve means (hereafter described) are angularly misaligned. Also, the spherical surface results in a greatly reduced contact area between the spherical seating surface 32a and the sleeve thereby reducing the possibility that a particle of sand will be trapped between the two mating surfaces. A particle of sand may hold the seating surfaces apart, causing a fluid jet or wash which will erode and wear the seat beyond usefulness.

The annular shoulder 24b of the body 24 has an annular groove around the outer periphery thereof which receives an O-ring seal 34. The O-ring seal 34 provides an annular seal between the ring seat 32 and the annular shoulder 24b to prevent fluid passage therebetween. The combination of the groove 24d and the resilient O-ring seal 34 also serves as a retainer to keep the ring seat 32 in position around the shoulder 24b and retain it there against the force of fluid rushing by the periphery of the ring seat 32 on the downstroke of the plunger. The ring seat 32 has an external diameter less than the internal diameter of the working barrel to permit fluid to flow past the head means 22 by flowing between the longitudinal ribs 24a, as previously explained, and past the periphery of the ring seat 32.

A sleeve 40 is positioned around the rod 20 between each pair of head means 22 and has an external cylindrical surface of a diameter to provide a sliding, substantially fluid-tight seal with the working barrel 10. A sleeve insert 40a is threadedly connected to the lower end of the main body portion of the sleeve 40 and has an external surface of a diameter corresponding to that of the sleeve 40. The internal diameter of the sleeve insert 40a at the lower end thereof must be less than the external diameter of the ring seat 32, and the lower face of the sleeve insert 40a is formed to mate with the upper face of the ring seat 32 to form an annular fluid seal between the two members. The sleeve insert 40a is preferably fabricated of a hard metal to withstand both frictional wear and direct pounding. The sleeve insert 40a is also preferably of sufficient length to constitute a guide for the entire sleeve means comprised of sleeve 40 and sleeve insert 40a. In this manner the hardened metal of the insert 42 will maintain the upper part of the sleeve 40 which is fabricated of a softer metal in proper alignment and reduce the wear of the upper sleeve 40.

The pumping operation of the pump described above is like that of the pump described in the U.S. patent previously mentioned. Assume that fluid has entered the working barrel 10 through the standing valve 14—16 and has passed upwardly through the plunger. As the rod 20 moves upwardly on the working stroke, each sleeve means 40—40a is forced downwardly relative to the rod 20 against the respective ring seat 32 by friction with the working barrel 10. The lower surface of the insert 40a mates with the seating surface 32a of the ring seat 32 and provides an annular seal between the head means 32 and the sleeve 40 to prevent fluid passing from inside the sleeve outwardly by the periphery of the head means 22. As previously mentioned, each sleeve means 40 forms a peripheral fluid seal with the working barrel 10. Therefore, fluid above and within each sleeve 40 cannot pass downwardly by the sleeve and head means and is lifted. As the rod 20, head means 22 and sleeve means 40 are raised upwardly, fluid is drawn into the working barrel 10 through the standing valve 14—16. As the rod 20 is then lowered on the return stroke, friction between each sleeve means 40 and the working valve 10 separates each sleeve means from the respective ring seat 32. Fluid will then pass by the periphery of each head means, pass between the ring seat 32 and the seating surface of the sleeve insert 40a, pass up through the internal bore of the sleeve 40, and by the periphery of the next higher head means and so on preparatory to the next upstroke of the plunger.

From the foregoing description it will be noted that no special tools are required to replace worn parts of the plunger assembly. Therefore, the parts can readily be replaced in a matter of minutes at the well site and

the plunger assembly returned to operation in the bottom of the well. Beginning at the lower end of the plunger assembly, the pins 26 are removed from the bores 24c. The body 24 can then readily be removed from the rod 20 because only the friction between the resilient O-ring seals 30 and the body 24 holds the body on the rod. When the body 24 is removed from the rod, the ring seat 32 is readily removed from the annular shoulder 24b against the frictional resistance of the resilient ring seal 34 and replaced. Of course, the sleeve means 40 can then readily be removed from the rod 20 and replaced. Each successive head means 22 and sleeve means 40 can be slipped off the end of the rod means 20.

To reassemble the plunger device, the sleeve 40 is slipped onto the rod 20. O-ring seal 34 is placed in the groove 24d of the body 24 and a ring seat 32 forced over the O-ring seal 34 around the upstanding shoulder 24b. O-ring seals 30 are placed in the grooves 20b on the rod 20, and the body 24 is forced over the O-rings until the tapered bores 24c are aligned with the bores 28 in the rod. Tapered pins 26 are then driven into the aligned bores to secure the head means in place. Each successive head means 22 can be assembled on the rod 20 in like manner.

It will be appreciated that the rod 20 can be made of any number of links, preferably of uniform lengths, screwed together. No special care need be taken with the surfaces of these rods 20 and therefore conventional pipe wrenches can be used to screw the rods together at the well site. In this manner a plunger of any desired length can be assembled as desired at the well site.

The upper surface of the conical body 24 is preferably flat. Also, the bottom surface of the ring seat 32 is preferably flat. Then the resilient annular O-ring seal 34 between the ring seat 32 and the upstanding annular shoulder 24b will permit the ring seat 32 to adjust laterally or transversely of the rod 20 so the seating surface 32a will properly mate with the seating surface of the sleeve insert 40a. This eliminates the necessity for precise alignment of the upstanding shoulder 24b to insure that the ring seat 32 will properly mate with the seating surface of the sleeve insert 40a. Therefore, it will be seen that the O-ring seal 34 serves three distinct functions. The resilient seal 34 serves to prevent fluid passage between the ring seat 32 and annular shoulder 24b and body 24. The combination of the O-ring seal 34 and the groove 24b serves to anchor the ring seat 32 in position against the force of fluid rushing past the periphery of the ring seat. As mentioned, the O-ring seal 34 also permits lateral displacement of the ring seat to insure proper mating with the seating surface of the sleeve insert 40a.

From the above description it will be apparent that a pump construction has been described which is more economical to construct because a smaller quantity of expensive hard metal is required and because the methods required to construct the parts are simplified and therefore more economical. A pump constructed in accordance with the present invention is more economical to operate because it has a longer life due to limited use of more costly metals and due to special features of construction. The pump construction is more economical to maintain because it is readily repaired without special tools and by unskilled personnel at the well site; and, the only portions of the pump which are subjected to excessive wear are readily replaceable without replacing the other parts of the pump.

Having thus described a particular embodiment of my invention, it is understood that various changes can be made in the particular embodiment described without departing from the spirit and scope of my invention as defined by the appended claims.

I claim:

1. In a subsurface fluid pump for an oil well having a tubular barrel, a standing valve in the lower end of the barrel, a plurality of vertically spaced head means in

the barrel, rod means interconnecting said head means and maintaining said head means in spaced relation, each head means having means at the periphery thereof to pass fluid thereby, sleeve means in the barrel around the rod means and between each two adjacent head means, said sleeve means having a length less than the distance between the two adjacent head means and having an outer diameter of a size to provide a sliding, substantially fluid seal fit with the barrel and having an internal diameter greater than said rod means to provide a longitudinal fluid passage therethrough, said sleeve means being moved into cooperative engagement with the adjacent lower head means on the upstroke to form a fluid seal with the head means and prevent the downward flow of fluid thereby and being moved away from the adjacent lower head means on the downstroke to permit fluid to pass by each said head means and through each said sleeve means whereby a pumping action will be attained; the improvement wherein each head means is comprised of a body connected to the rod means, and a ring seat on top of the body and around the rod means, said ring seat being readily separable from the body and having an outer diameter less than the internal diameter of the barrel to provide a passage for fluid to pass therebetween, said outer diameter being greater than the internal diameter of the adjacent sleeve means whereby the ring seat will mate with the lower end of the sleeve means to form an annular fluid seal therebetween.

2. In a subsurface fluid pump for an oil well having a tubular barrel, a standing valve in the lower end of the barrel, a plurality of vertically spaced head means in the barrel, rod means interconnecting said head means and maintaining said head means in spaced relation, each head means having means at the periphery thereof to pass fluid thereby, sleeve means in the barrel around the rod means and between each two adjacent head means, said sleeve means having a length less than the distance between the two adjacent head means and having an outer diameter of a size to provide a sliding, substantially fluid seal fit with the barrel and having an internal diameter greater than said rod means to provide a longitudinal fluid passage therethrough, said sleeve means being moved into cooperative engagement with the adjacent lower head means on the upstroke to form a fluid seal with the head means and prevent the downward flow of fluid thereby and being moved away from the adjacent lower head means on the downstroke to permit fluid to pass by each said head means and through each said sleeve means whereby a pumping action will be attained; the improvement wherein each head means is comprised of a body connected to the rod means, a ring seat on top of the body and around the rod means, said ring seat being fabricated of a material having a greater hardness than said body and being readily separable from said body, said ring seat having an outer diameter less than the internal diameter of said barrel to provide a passage for fluid to pass therebetween and greater than the internal diameter of the adjacent sleeve means whereby said ring seat will mate with the lower end of the adjacent sleeve means to form an annular fluid seal therebetween.

3. In a subsurface fluid pump for an oil well having a tubular barrel, a standing valve in the lower end of the barrel, a plurality of vertically spaced head means in the barrel, rod means interconnecting said head means and maintaining said head means in spaced relation, each head means having means at the periphery thereof to pass fluid thereby, sleeve means in the barrel around the rod means and between each two adjacent head means, said sleeve means having a length less than the distance between the two adjacent head means and having an outer diameter of a size to provide a sliding, substantially fluid seal fit with the barrel and having an internal diameter greater than said rod means to provide a longitudinal fluid passage therethrough, said sleeve means being moved into cooperative engagement with the adja-

cent lower head means on the upstroke to form a fluid seal with the head means and prevent the downward flow of fluid thereby and being moved away from the adjacent lower head means on the downstroke to permit fluid to pass by each said head means and through each said sleeve means whereby a pumping action will be attained; the improvement wherein each head means is comprised of a body connected to the rod means, a ring seat on top of the body and around the rod means, an O-ring seal between the ring seat and the body to provide an annular fluid seal therebetween, said ring seat having an outer diameter less than the internal diameter of said barrel to provide a passage for fluid to pass therebetween and greater than the internal diameter of the adjacent sleeve means, said ring seat having a hardened seating surface adapted to mate with the lower end of the adjacent sleeve means to form an annular fluid seal therebetween.

4. In a subsurface fluid pump for an oil well having a tubular barrel, a standing valve in the lower end of the barrel, a plurality of vertically spaced head means in the barrel, rod means interconnecting said head means and maintaining said head means in spaced relation, each head means having means at the periphery thereof to pass fluid thereby, sleeve means in the barrel around the rod means and between each two adjacent head means, said sleeve means having a length less than the distance between the two adjacent head means and having an outer diameter of a size to provide a sliding, substantially fluid seal fit with the barrel and having an internal diameter greater than said rod means to provide a longitudinal fluid passage therethrough, said sleeve means being moved into cooperative engagement with the adjacent lower head means on the upstroke to form a fluid seal with the head means and prevent the downward flow of fluid thereby and being moved away from the adjacent lower head means on the downstroke to permit fluid to pass by each said head means and through each said sleeve means whereby a pumping action will be attained; the improvement wherein each head means is comprised of a body connected to the rod means, said body having an upwardly extending annular shoulder portion of reduced diameter around said rod means, a ring seat around said annular shoulder portion and readily separable therefrom, annular sealing means between said ring seat and said body to prevent fluid passage therebetween, said ring seat having an outer diameter less than the internal diameter of said barrel and greater than the internal diameter of said sleeve means and having a hardened seating surface adapted to mate with the lower end of said sleeve means to form an annular fluid seal therebetween.

5. In a subsurface fluid pump for an oil well having a tubular barrel, a standing valve in the lower end of the barrel, a plurality of vertically spaced head means in the barrel, rod means interconnecting said head means and maintaining said head means in spaced relation, each head means having means at the periphery thereof to pass fluid thereby, sleeve means in the barrel around the rod means and between each two adjacent head means, said sleeve means having a length less than the distance between the two adjacent head means and having an outer diameter of a size to provide a sliding, substantially fluid seal fit with the barrel and having an internal diameter greater than said rod means to provide a longitudinal fluid passage therethrough, said sleeve means being moved into cooperative engagement with the adjacent lower head means on the upstroke to form a fluid seal with the head means and prevent the downward flow of fluid thereby and being moved away from the adjacent lower head means on the downstroke to permit fluid to pass by each said head means and through each said sleeve means whereby a pumping action will be attained; the improvement wherein each head means is comprised of a body encircling said rod means, pin means holding said body against longitudinal slippage on said rod means, annular sealing means between said body and said rod means to prevent fluid passage therebetween, a ring seat on top of said body

and around the rod means, said ring seat being readily separable from said body, said ring seat having an outer diameter less than the diameter of the barrel to provide a passage for fluid to pass therebetween and greater than the internal diameter of the adjacent sleeve means whereby the ring seat will mate with the lower end of the adjacent sleeve means to form an annular fluid seal therebetween.

6. In a subsurface fluid pump for an oil well having a tubular barrel, a standing valve in the lower end of the barrel, a plurality of vertically spaced head means in the barrel, rod means interconnecting said head means and maintaining said head means in spaced relation, each head means having means at the periphery thereof to pass fluid thereby, sleeve means in the barrel around the rod means and between each two adjacent head means, said sleeve means having a length less than the distance between the two adjacent head means and having an outer diameter of a size to provide a sliding, substantially fluid seal fit with the barrel and having an internal diameter greater than said rod means to provide a longitudinal fluid passage therethrough, said sleeve means being moved into cooperative engagement with the adjacent lower head means on the upstroke to form a fluid seal with the head means and prevent the downward flow of fluid thereby and being moved away from the adjacent lower head means on the downstroke to permit fluid to pass by each said head means and through each said sleeve means whereby a pumping action will be attained; the improvement wherein each head means is comprised of a body encircling said rod means, pin means holding said body against longitudinal slippage on said rod means, annular sealing means between said body and said rod means to prevent fluid passage therebetween, said body having an annular shoulder portion of reduced diameter extending upwardly around said rod means, a ring seat around said annular shoulder portion, annular sealing means between said ring seat and said annular shoulder portion to prevent fluid passage therebetween, said ring seat having an outer diameter less than the internal diameter of said barrel and greater than the internal diameter of the adjacent sleeve means whereby the ring seat will mate with the lower end of the adjacent sleeve means to form an annular fluid seal therebetween.

7. In a subsurface fluid pump for an oil well having a

tubular barrel, a standing valve in the lower end of the barrel, a plurality of vertically spaced head means in the barrel, rod means interconnecting said head means and maintaining said head means in spaced relation, each head means having means at the periphery thereof to pass fluid thereby, sleeve means in the barrel around the rod means and between each two adjacent head means, said sleeve means having a length less than the distance between the two adjacent head means and having an outer diameter of a size to provide a sliding, substantially fluid seal fit with the barrel and having an internal diameter greater than said rod means to provide a longitudinal fluid passage therethrough, said sleeve means being moved into cooperative engagement with the adjacent lower head means on the upstroke to form a fluid seal with the head means and prevent the downward flow of fluid thereby and being moved away from the adjacent lower head means on the downstroke to permit fluid to pass by each said head means and through each said sleeve means whereby a pumping action will be attained; the improvement wherein each head means is comprised of a body encircling said rod means, pin means holding said body against longitudinal slippage on said rod means, annular sealing means between said body and said rod means to prevent fluid passage therebetween, said body having an annular shoulder portion of reduced diameter extending upwardly from said body and around said rod means, a ring seat around said annular shoulder portion, annular sealing means between said ring seat and said annular shoulder portion to prevent fluid passage therebetween, said ring seat having an outer diameter less than the internal diameter of said barrel to provide a fluid passage therebetween and greater than the internal diameter of the adjacent sleeve means, said ring seat having a hardened seating surface adapted to mate with the lower end of the adjacent sleeve means to form an annular fluid seal therebetween.

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