Improving the Performance of Your Sucker Rod Pump

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ADVANTAGES OF ACCESSORIES

Increase the return of your investment! Naturally, everyone is interested in doing this. The object of this paper is to discuss some recent developments of accessories which may be adapted to your present sucker rod pump which will make it better suited for the well condition. All of these accessories may be adapted to most of the convenional sucker rod pumps, and will increase their efficiency or service life, thus increasing the return on your investment.

The Oil Lubricated Plunger

The Oil Lubricated Plunger is a completely new development in rod drawn pumps. See Fig. 1. It is designed for use with stationary barrel pumps, -- either tubing or insert type. In wells where water cut is high, it will increase service life of both the barrel and the plunger. In addition, it will improve pump efficiency. This is made possible by the automatic lubricating system incorporated in the plunger assembly -- a system that provides continuous separation of clean oil in an annular flotation chamber, and permits this clean oil, instead of the usual abrasive mixture of oil, water and sand, to slip past the plunger.

The clean oil provides a continuous lubricating film between the close fitting barrel and plunger, reducing both friction and rate of wear. In addition, since crude oil has a viscosity considerably higher than water, very little fluid will pass between the plunger and barrel. This allows pump efficiency to remain high even after some wear has occured.

Operation of the Oil Lubricated Plunger is as follows: On each downstroke, a small quantity of fluid is diverted around the flow divider, into the annular passage, and back through return holes into the main flow in the center tube. On the upstroke no flow occurs, and oil remaining in the annular fluid passage rises and is trapped by its own bouyancy in the nonturbulent portion of the flotation chamber above the return holes. This operation repeats itself on each stroke of the pump, assuring a continued supply of oil to the chamber.

In addition to the improved barrel and plunger life gained by lubrication, the Oil Lubricated Plunger also reduces abrasive damage from sand entrained in the well fluid. This is because the sand, in a water, oil and sand mixture, tends to concentrate at the oil-water interface and in the water, while the oil contains a much lesser concentration.

In the Oil Lubricated Plunger, circulation of fluid through the separation chamber continuously removes the concentrated sand and water. The separated oil rises in the flotation chamber, and as it moves slowly upward, any remaining sand and water tend to settle out. By the time it passes through the ports and into the lubricating groove, the oil is essentially clean. On each stroke, a small amount of this clean oil is forced by pressure into the close fit between the barrel and plunger, lubricating the mating surfaces and sealing them from the damaging effects of water and abrasion.

An additional feature of the Oil Lubricated Plunger is the fact that the flotation chamber can be filled with grease which will supply lubrication for some initial period. Since pumps are frequently required to pump pure water for a number of hours before any oil enters the suction, this initial high pressure greasing system

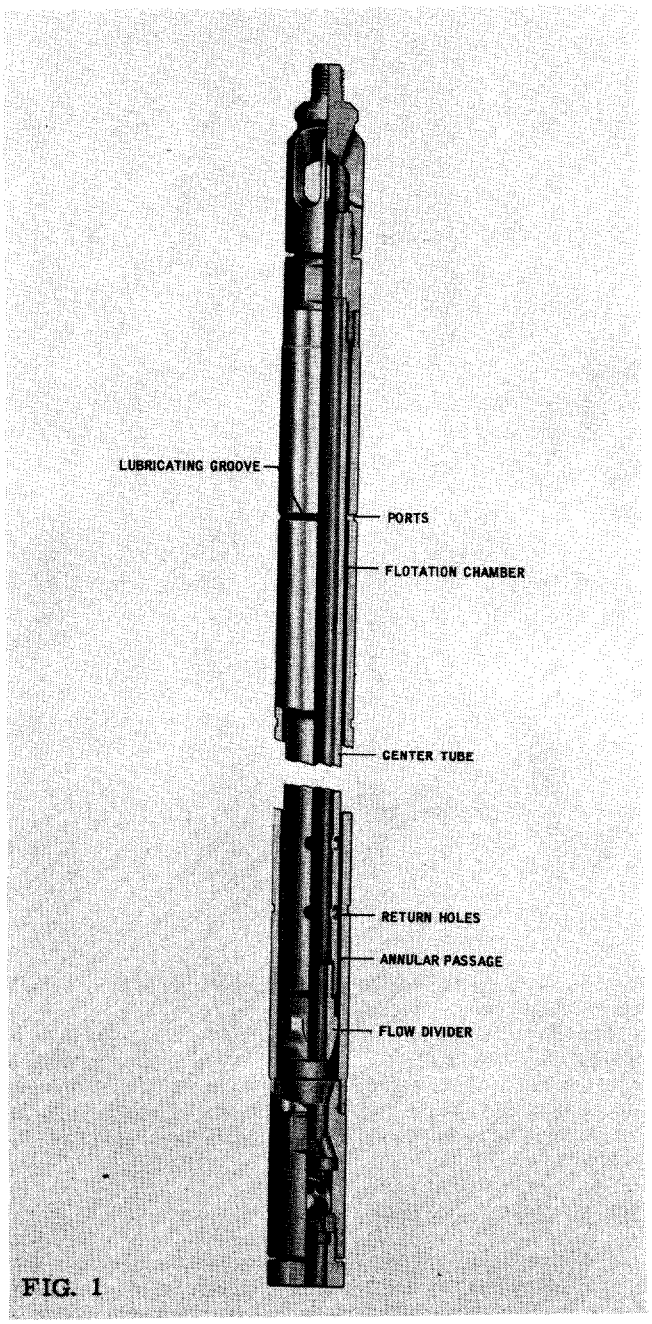

FIG. 1

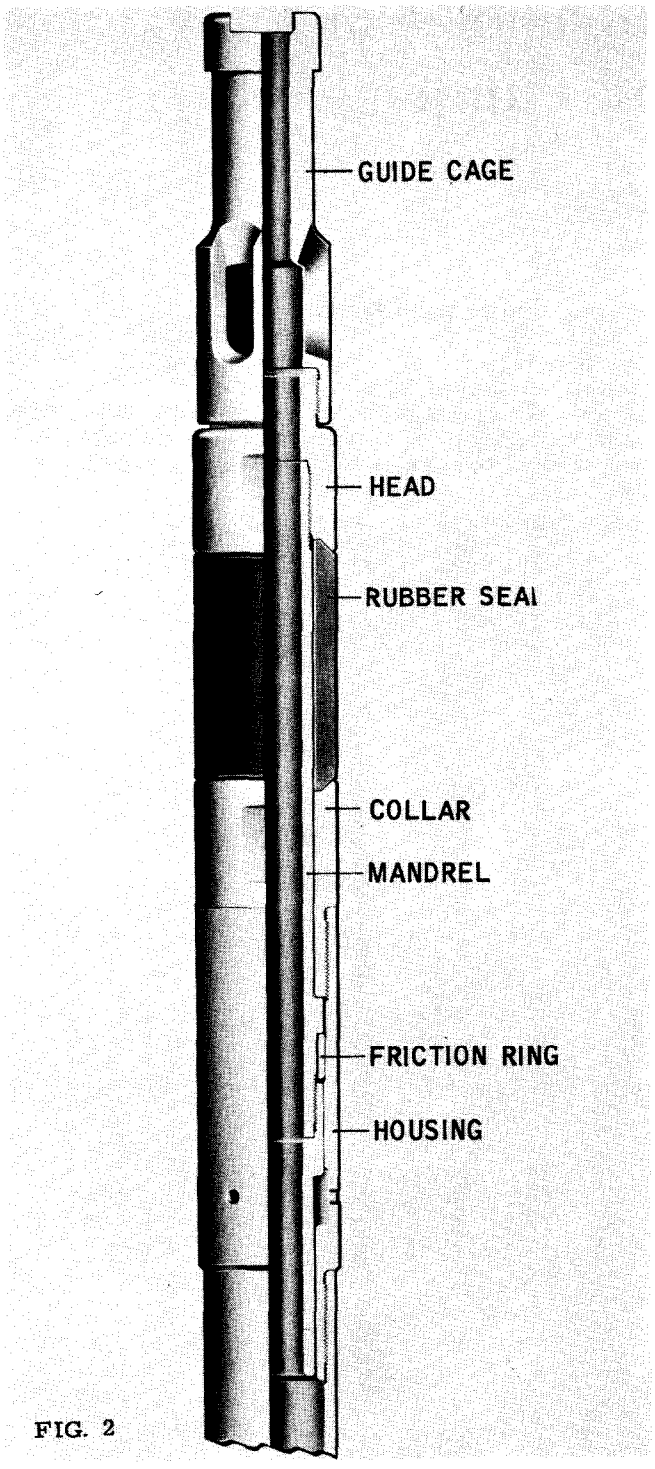

FIG. 2

may be sufficient to lubricate the pump over the critical break in period.

The Oil Lubricated Plunger is available for use in pumps with bores of 1-1/2 inches, 1-3/4 inches, 2 inches, 2-1/4 inches, 2-1/2 inches, 2-3/4 inches, 3-1/4 inches, and 3-3/4 inches. Standard practice, depending on the pump setting depth, will determine the length of the plunger.

The Automatic Top Seal

The Automatic Top Seal is an important accessory to a stationary barrel bottom anchor pump. See Fig. 2. When the pump is seated, the rubber is expanded automatically by the weight of the sucker rods. The expanded rubber stabilizes the top of the pump and seals the annulus to prevent sand or other foreign material from settling behind the pump.

It has long been recognized that a stationary barrel bottom anchor pump has better suction characteristics than a traveling barrel pump, and can be safely operated at a greater depth than a top anchored pump. However, the long annulus between the stationary barrel and the tubing string makes a natural sand trap; if this annulus becomes filled with sand, it is rarely possible to unseat the pump with the sucker rod string. By sealing the annulus at the top of the pump, the Automatic Top Seal prevents sand from settling and makes the stationary barrel bottom anchor pump as safe to run as a top anchor or traveling barrel pump.

The increasing use of long stroke hydraulic pumping units has made necessary the demand for excessively long downwell pumps and good production practice dictates these pumps be stationary barrel, bottom anchored. The use of the Automatic Top Seal eliminates the necessity of fabricating a pump jacket to be used for seating and protecting the bottom anchored pump. The Automatic Top Seal, when affixed to the top of the pump, will provide the desired protective pump jacket without the cost of a tubing job.

The Automatic Top Seal works effectively in conjunction with an insert pump anchor where a seating nipple or shoe is not provided. In the event of a faulty seating nipple or shoe, the use of the Automatic Top Seal with an insert pump anchor is an ideal solution to eliminate the need of pulling tubing.

The Automatic Top Seal is mechanical in operation, and may be affixed to the majority of stationary barrel bottom anchor pumps. Its use on your present pump could increase the return on your investment by eliminating costly stripping or tubing jobs.

The Ration Compound Pack-Off Assembly

The Ratio compound Pack-Off Assembly, when adapted to an insert pump, is designed to overcome low efficiencies in wells where foamy oil or high gas-oil ratios are prevalent. See Fig. 3. Its addition to a pump is especially suitable when producing from under a packer where no provision for gas separation is available.

The Ratio Compound Pack-Off Assembly consists of an accurately ground hollow polished rod stroking throuth a short pack-off barrel with a valve at the top of the hollow polished rod. The bottom of the hollow polished rod is connected to the top of the pump plunger and the bottom of the short pack-off barrel connects to the top of the pump barrel, thereby converting a conventional pump to a Ratio Compound.

The functional principle employed by the Ratio Compound pump is as follows: On the upstroke, fluid enters the pump in the normal manner. At the beginning of the down-stroke, the top valve closes, and the pressure is reduced in the annular area above the plunger while the pressure is increased in the full area below the plunger.

This leads to the unique feature of the Ratio Compound pump -- the fact that the intermediate traveling valve will open immediately at the start of the down-stroke, even in a gassy oil. By contrast, in a conventional pump, operating at 25 per cent efficiency, nearly three-quarters of the stroke will be completed, merely compressing gas, before the traveling valve ever opens.

The increased efficiency of the Ration Compound pump is brought about both by elimination of gas lock from the compounding action of the two valve controlled

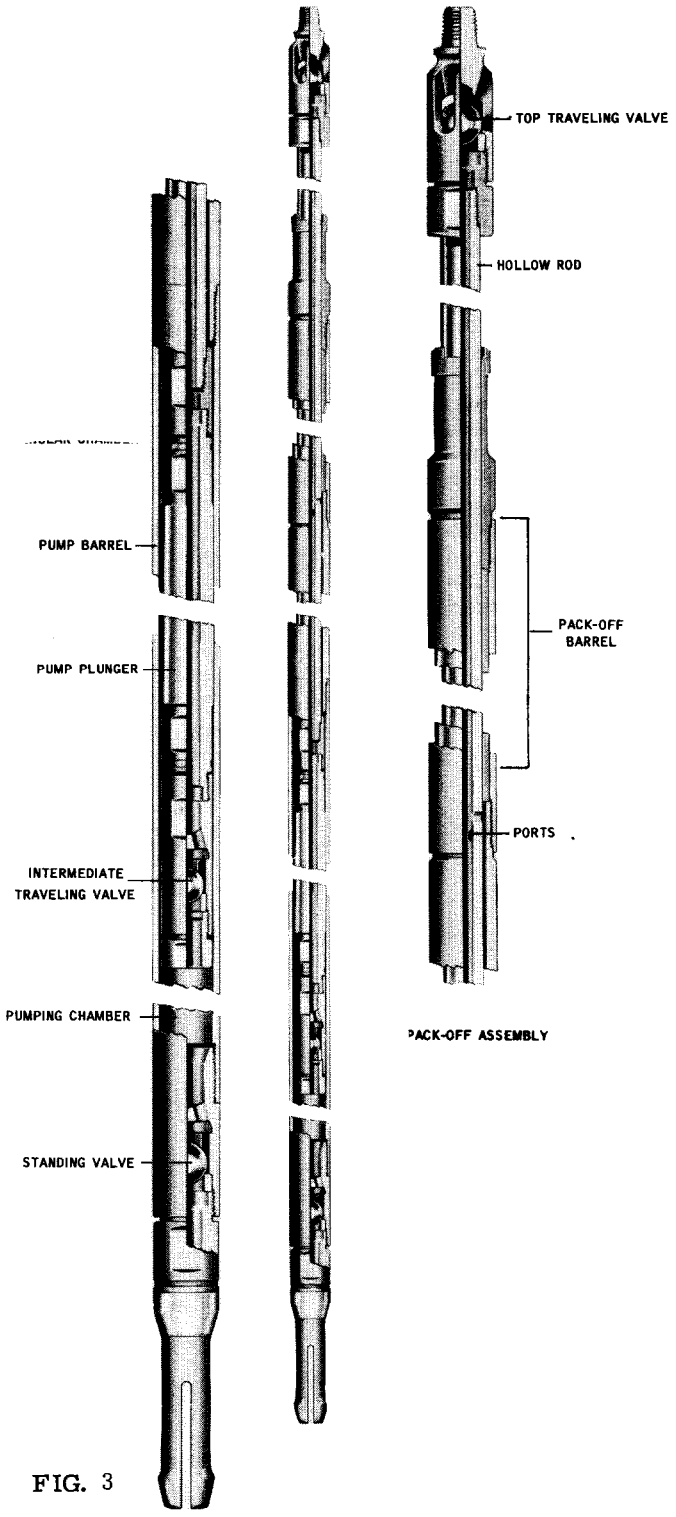

FIG. 3

chambers, and by the more efficient transfer of fluid and gas from the pumping chamber to the annular chamber during the downstroke. This permits the standing valve to open promptly at the beginning of the upstroke, allowing more complete filling of the pump chamber with the mixture of oil and gas that will be drawn into the pump suction.

In a low efficiency range, the Ratio Compound will have no gas or fluid pound, but rather will actually exert a pull down force, reducing load range on the rods, torque on the unit, and horsepower requirements of the prime mover.

While commendable results have been obtained with Ration Compound pumps replacing pumps that have operated at 60 or 70 per cent efficiency, the greatest improvement is in wells operating in the extremely low efficiency range.

The Ratio Compound Pack-Off Assemblies are available for standard insert pumps with bores of 1-1/16 inches, 1-1/4 inches, 1-1/2 inches, 1-3/4 inches and 2 inches. This design is also available for 1 inch bore pumps to be run in 1-1/4 inch tubing.

Bottom Discharge Valve

A Bottom Discharge Valve is an accessory to a rod pump. See Fig. 4. It is most frequently used on stationary barrel bottom anchor, or three tube pumps; but it can also be run on travel barrel pumps where gas is no problem, and the standing valve can be run at the

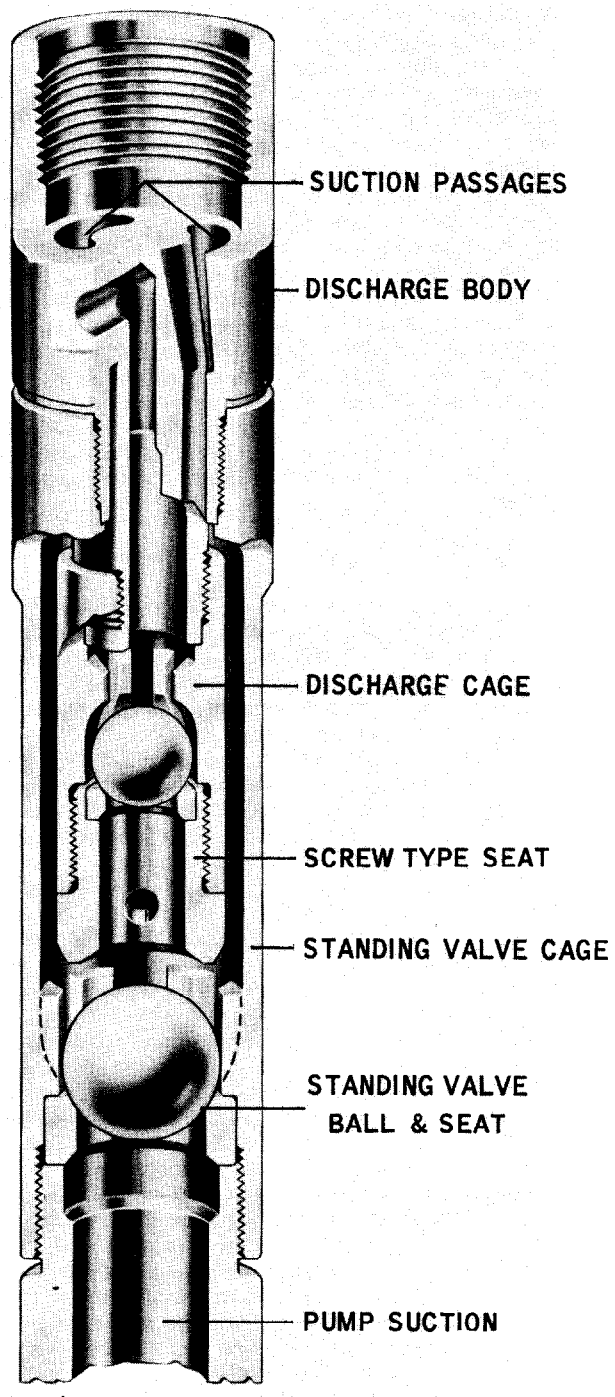

FIG. 4

BOTTOM DISCHARGE VALVE

hold-down.

The operation of a pump with a bottom discharge valve is identical to that of a conventional pump. On every downstroke, however, a portion of the fluid is discharged at a point immediately above the hold-down, while the balance of the fluid is displaced through the traveling valve in the conventional manner.

The most important application of the bottom discharge valve is in sandy wells where it is important to maintain an upward movement of fluid from the hold-down to the top of the pump to continuously flush out any sand that might otherwise settle in the annulus between the pump and the tubing. This greatly reduces the hazard of a stuck pump and thereby reduces the possibility of a "wet job".

In the case of the three tube pump, the bottom discharge valve serves a double function. As described above, it does reduce the hazard of a pump becoming sanded in, but in addition, it continuously supplies lubrication to the outside traveling and standing tubes. Where no bottom discharge is provided, it is mainly water (and some sand) that settles around the pump.

A bottom discharge valve keeps this annulus filled with production fluid and keeps any produced sand moving up the annulus instead of settling. Since the produced fluid contains oil, it is a better lubricant than the water that would otherwise be lubricating the tubes. For this reason, a bottom pump discharge valve used in conjunction with a three tube pump increases pump live as well as giving additional protection against sanding-in.

The bottom discharge valve also finds application on high volume pumps for the same reasons described above. In addition, by providing a second outlet for fluid, it reduces the pressure drop across the plunger and actually permits freer plunger travel and a longer net stroke.

The Insert Pump Anchor

The Insert Pump Anchor is a combination pack-off and anchoring device that permits a pump to be set at any desired point in the tubing string when a shoe or seating nipple has not been provided. See Fig. 5. The anchor further permits raising or lowering and resetting the pump without pulling tubing.

There are various designs of Insert Pump Anchors available to the operator. We will describe the operation of the vertical setting type, since it will operate on any insert pump without any modification being necessary, such as providing a clutch within the pump.

The vertical setting is made possible by the slot pattern which is milled into the body of the anchor. When running the anchor, the dowel pin of the slip cage assembly remains in the running slot until the desired setting point is reached. Then an upward movement of the anchor body in excess of the length of the running slot will cause the lower slot to transfer the dowel pin to the setting slot.

When the rods are lowered, the slips will set before the pin reaches the end of the longer slot. If it is desired to reset the pin in the running position, this can be done by again raising and lowering the rods.

The pack-off seal between the anchor and tubing string is effected by a compression type rubber sleeve. When the anchor is set, the slips are expanded by the split cone to a point where they contact and seize the inside of the tubing string. As additional weight is placed on the anchor through the pump and the sucker rod string, the anchor body moves down and compresses the rubber until it makes an initial seal with the tubing.

At this point, internal wickers on the split cone grip the anchor body and, by wedging action with the slips, maintain the rubber sleeve in the compressed position. The weight of the rods can now be removed from the anchor and it will stay in place while the pump is put on production.

The principle advantages of the vertical setting Insert Pump Anchor are that it may be set with vertical motion only, which in turn eliminates the necessity of providing a clutch arrangement on the pump. With vertical motion, the anchor can be readily set in crooked or directionally drilled wells. The split cone and compression type pack-off provide a positive seal, even in worn or pitted tubing. The Insert Pump Anchor can be set and reset during installation without damaging the packing element, and does not require the use of a shear pin. The unique, internally wickered, split cone, provides a positive hold-down force while fluid is being lifted to the surface, or when the well flows trhough the pump.

One or more of the accessories we have discussed here, when applied properly, can assist the production personnel in improving the performance of sucker rod pumps, thereby increasing the return on their investment.

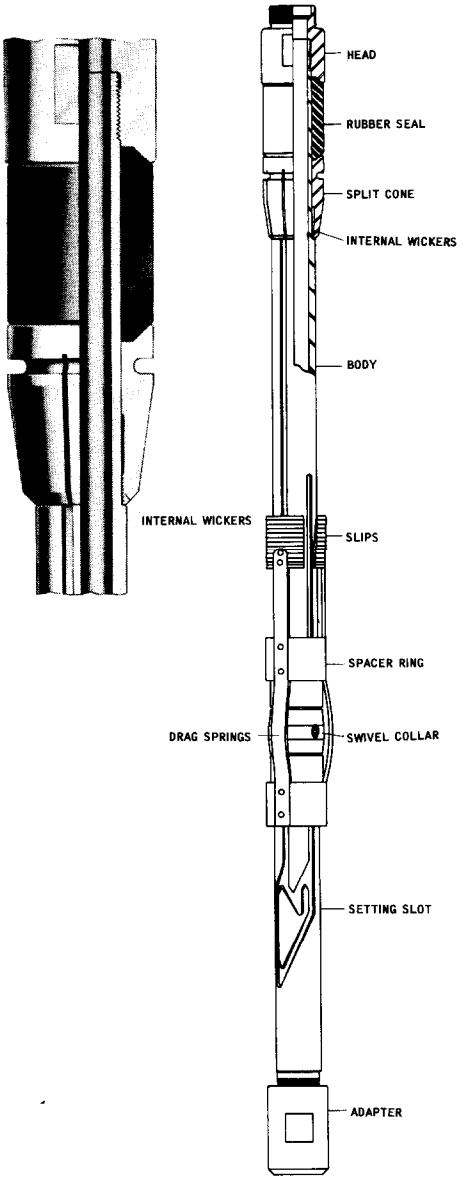

FIG. 5 INSERT PUMP ANCHOR