The Lease Pumper's Handbook

CHAPTER 8

HYDRAULIC LIFT

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Section A

INTRODUCTION TO HYDRAULIC LIFT

A-1. Principles of Hydraulic Lift.

Hydraulic lift is a system where a liquid, usually crude oil, is pumped downhole under high pressure to operate a reciprocating pump or a jet pump. This is a very flexible pumping system and can be used to produce low- to high-volume wells. This system is capable of producing a higher volume of fluid than the mechanical lift pump.

Hydraulic lift uses a triplex plunger style pump (Figure 1) and pumps oil or water under very high pressure. The pump pressure is usually between 2,000-5,000 pounds per square inch (PSI) and pushes the liquid to the wellhead and downhole to operate the pump.

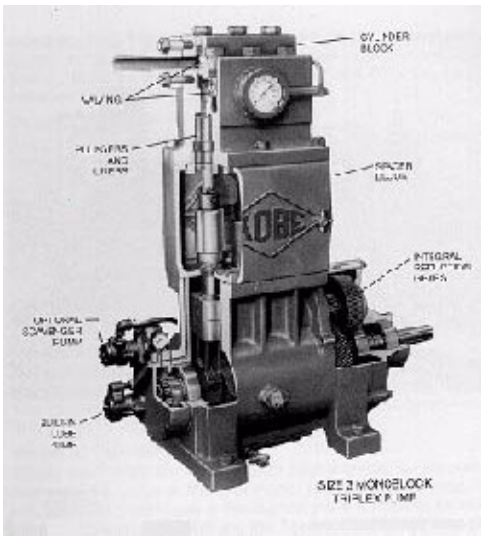

Figure1. A high-pressure central triplex.
(courtesy of Trico Industries, Inc.)

When liquid reaches the bottom of the well, it enters the top of the hydraulically operated reciprocating pump (Figure 2). The reciprocating action of the pump will pull new oil from the annular space and combine it with the power oil. It is then forced back to the surface and through the flow line to the tank battery.

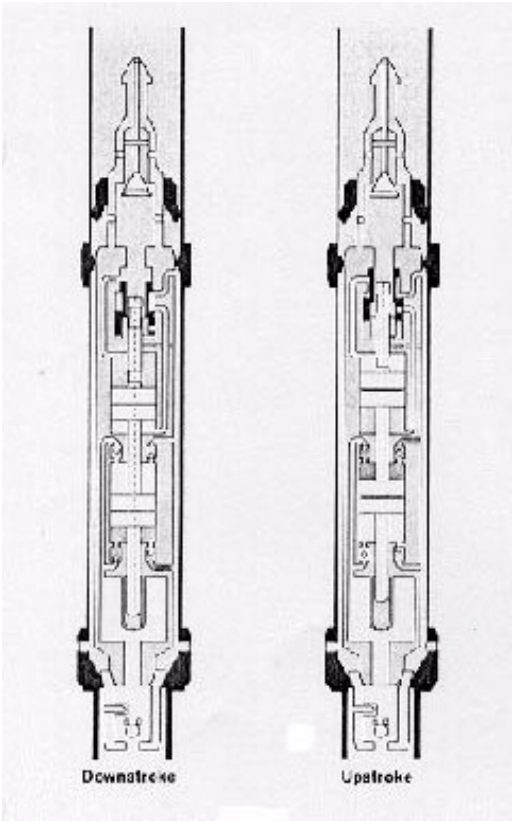

Figure2. Illustration of the downstroke and the upstroke of a hydraulic pump.
(courtesy of Trico Industries, Inc.)

The required power oil or produced water is reclaimed and reused to continue operating the wells. As an illustration, for each three barrels of liquid pumped down hole, five barrels will be produced back to the surface. The additional oil produced represents new production and is treated and sold The pump produces oil on both the upstroke and the downstroke, or 100 percent of the time. The pump stroke speed is easily adjustable by turning a valve.

A-2. Designing and Installing Hydraulic Lift Systems at the Wellhead.

The hydraulic lift system can be installed in any of several different ways in placing the liquid under pressure and in wellhead and downhole arrangements. These include:

- Fixed insert.
- Fixed casing.
- Free parallel.
- Free casing.
- Jet pump.
- Commingled power fluids.
- Closed power fluid.

This chapter covers the **fixed insert** and the **free parallel** pump, plus a brief review of the **jet pump**.

A-3. The Insert Pump.

When the first well on the lease is designed to operate by hydraulic lift, the operator must decide if it is to be operated downhole by a fixed insert or a free parallel system. The actual pump is the same regardless of the system selected, but major changes are made in how the two strings of moveable pipe are installed and in the wellhead selected.

With the insert design, the pump is attached to the bottom of a small string of tubing, possibly ¾ inch, and is lowered into the hole inside the 2-3/8-inch tubing. A metal-to-metal seat on the bottom of the pump seats against the tubing seating nipple. The weight of the small string holds the seat in place. A packer is not used so the gas is produced up through the annulus, just as with the mechanical pumping well. It is then commingled back with the power and produced fluids at the wellhead and enters the flow line.

Since the hydraulic pump is lowered into the well on the bottom of a small string of upset tubing, a pulling unit is required to pull this small string to change the pump in the well.

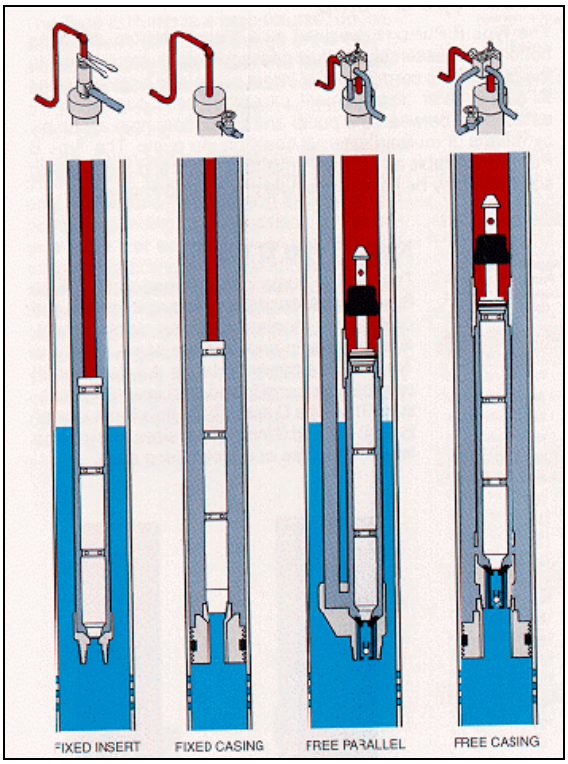

Figure 3. Hydraulic pump designs, including a fixed insert design (left) and a free parallel pump (third from left).
(courtesy of Trico Industries, Inc.)

Occasionally the pump may collect debris or *trash* (any solid objects are referred to as trash) under the pump seat and production will lessen or cease. Even the column of fluid inside the 2-3/8-inch tubing may be lost back into the formation. A lift piston can be attached above the top of the wellhead so that power oil may be diverted in under this piston to be able to raise and drop the small tubing string and pump to reseat the pump. This will remove the trash, and the pump will begin to operate normally again. This action by the pumper may be necessary many times in the life of a pump.

The pumping wellhead valve is designed so that a quarter turn of the valve handle changes both valve openings to the correct position to achieve this action. Changing it back will restore it to the standard producing position and allow the pump and small string of tubing to drop back to the bottom and re-seat.

A-4. The Free Parallel Pump.

With the free parallel pump system, a small string of tubing is strapped to the outside of the tubing string and both strings of pipe are lowered into the hole at the same time. After the two strings of pipe have been lowered into the hole and the wellhead installed, a plug or cap can be removed from the wellhead and the pump dropped free-fall into the tubing.

When the hydraulic valve is opened for the power fluid to flow into the well, the power fluid will carry the pump to the bottom. As soon as it seats in the seating nipple, it will begin to pump.

The power fluid and the produced fluids will flow over at the bottom of the tubing string and be produced to the surface through the small string of pipe that was attached to the outside of the tubing. The natural gas that is being produced will travel to the surface through the annulus space, will be commingled back with the power fluid and produced fluids as it leaves the wellhead and will flow to the tank battery just as it would with any pumping well.

One of the leading advantages of the free pump over the fixed or insert pump is that no well servicing unit is needed to change the pump. It can be pumped to the surface by switching one valve on the wellhead and can be changed by one person. After the pump has been pumped to the surface, a catcher mechanism will secure the pump and a small hoist can be used to lift it out of the hole.

When the pump becomes unseated on the bottom due to trash, the same valve can be used to kick the pump up the hole and clear the trash. The valve is then turned back to its original position to allow the pump to reseat. This action may be necessary many times in the life of the pump before it must go to the repair shop.

A-5. The Jet Pump.

Jet action is achieved by the use of a venturi tube, which is cone shaped narrowing of the flow path. This causes an increased flow rate of the fluid, which creates a low-pressure area that draws fluids to it.

The jet pump (Figure 4) offers several advantages over the fixed and free pump in special situations. It has been installed in many offshore wells where space is at a premium, and one triplex unit can support the need for power oil to several wells. Jet pumps can also be used in horizontal completions and with continuous coiled tubing.

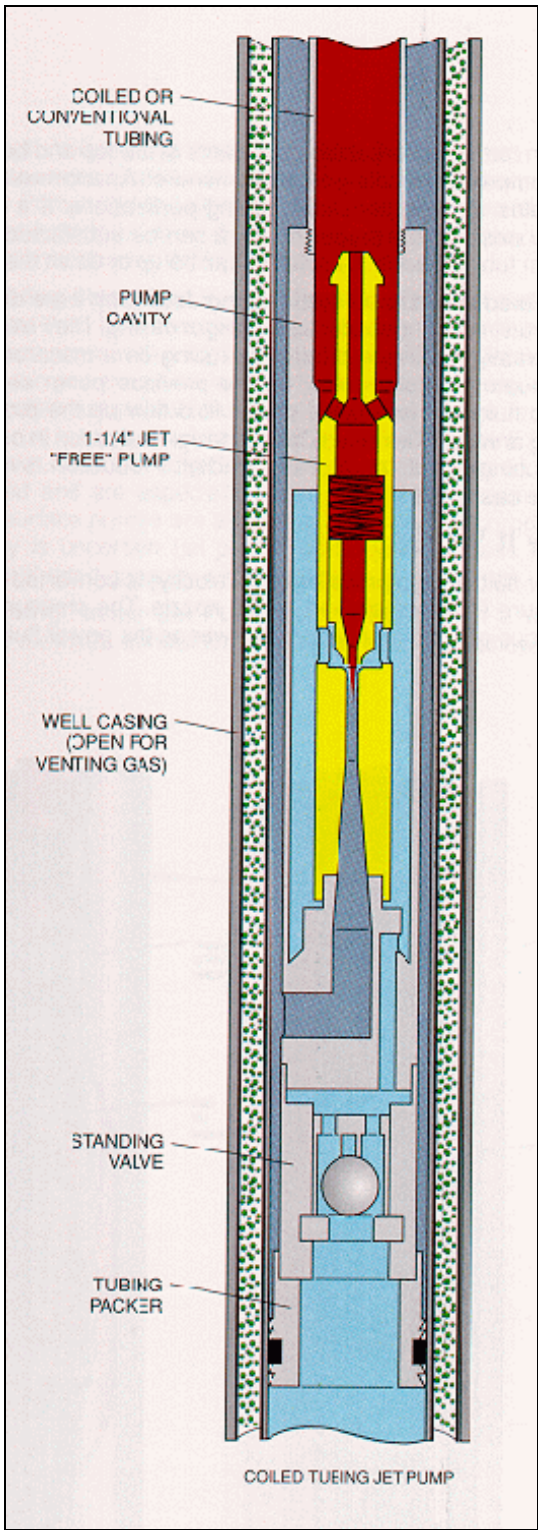

Figure 4. Components of a jet pump.
(courtesy of Trico Industries, Inc.)

A-6. Advantages and Disadvantages of Hydraulic Lift.

Advantages. There are some advantages over other high production systems by using hydraulic lift. One of them is the ease in changing the volume of fluid being pumped. A wide range of crosshead plungers and liners are available to change the volume of power fluid pumped.

Another advantage includes the high volume of production that the pump will handle each day. With the free pump, the lease pumper or a field technician can also change the pump without the need for calling out a well servicing crew and unit.

Disadvantages. Some of the disadvantages may be problems in maintaining a satisfactory supply of clean power fluid, downtime due to equipment failure, and the complexity of the operations. Multiple tubing strings are also needed as well as hydraulic power lines.