Care and Maintenance of Long Stroke Hydraulic Pumping Units

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The long stroke hydraulic pumping unit, as we know it today, oftentimes may seem strange to the new operator, even though it has been operating successfully in parts of the oil field for the past fifteen years. Justifiably so, the hydraulic long stroke unit may at first seem unfamiliar to the new operator, since for years previous to the introduction of the long stroke hydraulic pumping unit the oil fields had known no other means of sucker rod pumping than the old familiar sight of a beam moving up and down. However, just as the rotary drilling rig has followed the cable tool rig, so has the hydraulic long stroke unit followed the beam pumping unit.

As we all know, both the rotary drilling rig and the long stroke hydraulic unit have been a result of an ever-present quest to produce oil from greater depths. Each has distinct advantages over its predecessors in obtaining oil from deep wells and, along with the benefits of these new pieces of machinery, some new maintenance problems have arisen which heretofore have been present but not especially important to the operator.

First of all, though, before we discuss problems of the long stroke hydraulic pumping units, let us briefly discuss the operation of the long stroke hydraulic pumping unit. Basically, all hydraulic long stroke units are made up of the same component parts. The hydraulic pumping unit consists essentially of four component parts:

1. The air balance tank;

2. The pump group, consisting of the main pump, the reversing valve, and the pilot valve;

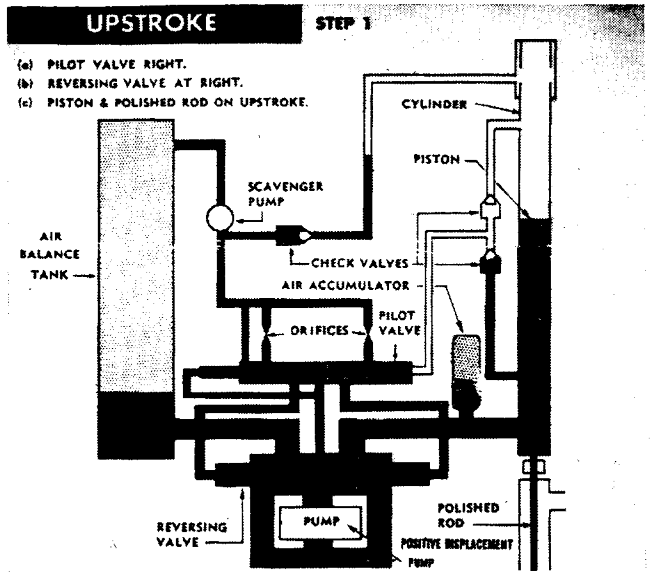
3. The cylinder assembly, consisting of the cylinder, the piston, and the polished rod;

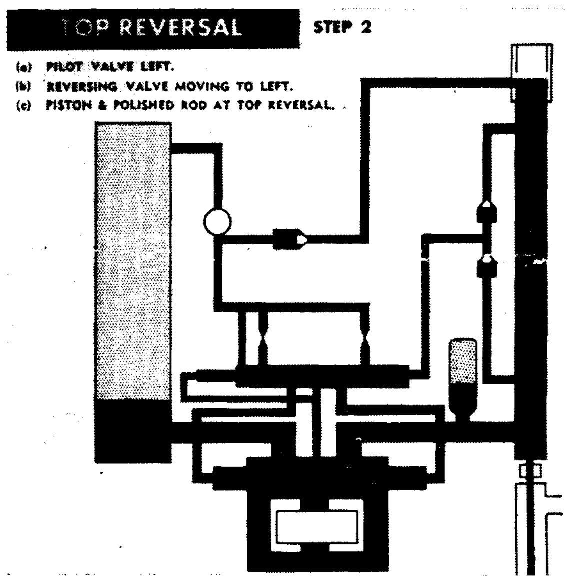
4. The drive assembly, consisting of the V-belts, the sheaves, the jack shaft, and the jack shaft bearings.

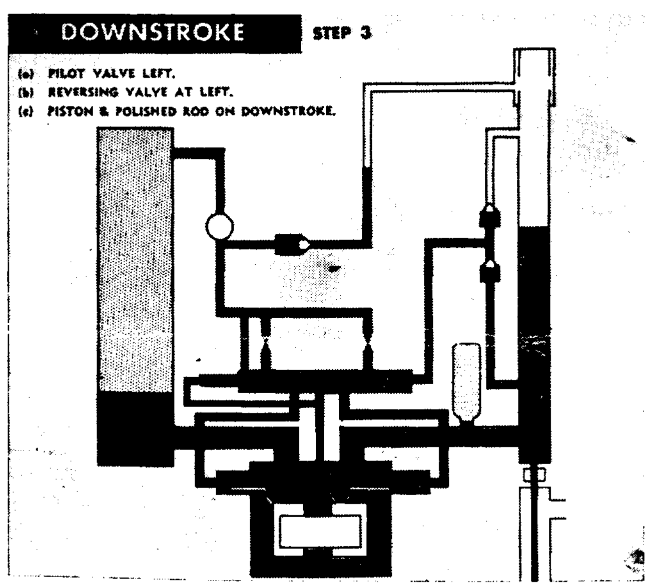
The main pump, due to the positioning of the reversing valve, takes super-charged fluid from the air balance tank and discharges it at increased pressure to the underside of the piston on the surface, and conversely takes supercharged suction fluid from underneath the piston and discharges it at increased pressure into the balance tank on the downstroke.

The unit is counterbalanced by adjusting the pressure in the air balance tank to balance the weight of sucker rod plus one-half the well fluid load. The main pump then acts on a constant work cycle, doing only enough work to boost the supercharged suction pressure through a differential equal to one-half the fluid load on both the upstroke and the downstroke.

The stroke reversals are hydraulically controlled at both the top and bottom by use of a pilot operated reversing valve, the speed of which is regulated by orifice controls to produce soft drive reversals. A schematic drawing of the operation of a long stroke hydraulic pumping unit may be seen in the following diagrams:

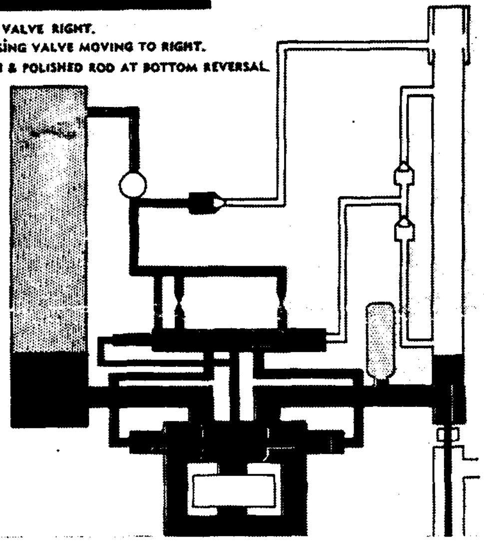






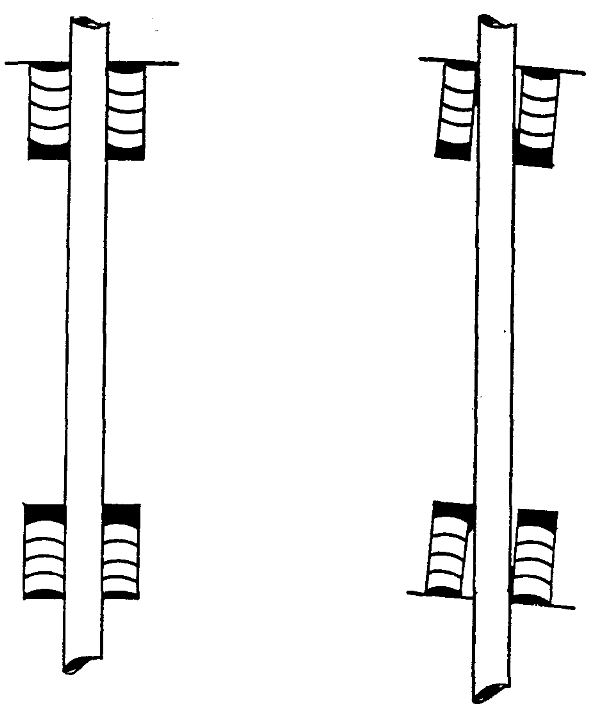
BOTTOM REVERSAL STEP 4

(a) PILOT VALVE RIGHT.
(b) REVERSING VALVE MOVING TO RIGHT.
(c) PISTON & POLISHED ROD AT BOTTOM REVERSAL.



One of the first and most important points concerning the hydraulic pumping unit and its care is the polished rod alignment with the well and the well head stuffing box. Since most hydraulic pumping units use highly refined oils as power fluids it is important that leakage be kept at a minimum to reduce operating costs.

Polished rod packing, through polished rod misalignment, can be a source of oil leakage and oftentimes is. This leakage can be eliminated if the problem is thoroughly understood when installing the hydraulic unit. Misalignment allows only a small portion of the polished rod to make contact with the packing, whereas proper alignment allows the entire stack of polished rod packing to seal around the polished rod. This is illustrated in the diagram below, No. 1 showing proper alignment and No. 2 showing misalignment exaggerated somewhat:



No. 1 **No. 2**

Referring to the above diagram it can be seen that polished rod alignment is very important to reduce not only polished rod packing wear and resulting leakage, but also accelerated mechanical wear on the polished rod itself.

In line with the foregoing problem, the foundation of the hydraulic long stroke pumping unit for best service should be level. If the foundation of the hydraulic unit is level and the skid channels are well grouted polished rod alignment with the well may be accomplished with a minimum of effort and at the same time insure vertical movement of the rod, thus eliminating any slide wear on the polished rod packing glands or on the main power piston.

The third and equally important point in reducing oil leakage at the polished rod packing gland is to be certain that the polished rod is kept smooth. There are three important factors which contribute to the success attained in keeping the polished rod smooth. They are as follows:

1. Whenever possible, a Monel or non-corrosive polished rod should be initially installed in the equipment. Monel, being a corrosion resistant metal, remains smooth when in contact with a corrosive well fluid, whereas steel in a corrosive well will etch and soon render the polished rod packing inoperative and ineffective.
2. The exposed portion of the polished rod should be covered to protect the rod and packing from blowing sand which tends to accelerate wear on the packing as well as on the rod.
3. Again it is imperative that the rod be properly aligned with the well bore.

Of course, it should go without saying leakage in general whenever it appears should be eliminated. Once oil leakage is controlled, air leakage is usually of lesser importance since fittings are generally checked during the initial installation, and if any leakage is encountered is stopped at that time. However, should air leakage become apparent due to continued loss of pressure, the air make-up system and air system should be checked for leakage or malfunctions.

Preventive maintenance in the form of periodic inspection should be made on the following items to insure operation from the long stroke hydraulic pumping unit:

1. **Proper Oil Level**—The oil level in the sump tank as well as in the balance tank should be checked weekly to be certain a sufficient amount of oil is in the system at all times. Proper oil levels prevent equipment shutdowns and save down time. Even though some systems have automatic oil level controls for the main system, it is still necessary to check the sump tank to be certain there is oil present so that the oil make-up may function properly.
2. **Air Pressure**—Air pressure in the system should be checked weekly to be certain a sufficient amount of air pressure is carried in the system for a balanced operation. If the pressure in the system is low a quick survey should be made to be certain the air make-up system is working, also that there are no leaks which have developed during the previous week's operation.
3. **Bearings**—Bearings on the drive system should be checked and lubricated if necessary. Bearing temperatures should be low enough so that the bearings may be touched without burning your hand. Specifically, they should be about 140 degrees F.
4. **V-Belts**—V-Belt tension should be checked visually to be certain belts are not too loose or too tight. Belts which are too tight often cause bearings to overheat. Loose belts oftentimes jump their grooves and as a result are cut and destroyed.
5. **Polished Rod Packing** — Polished rod packing should be checked for leakage. If leakage is excessive and packing cannot be tightened **by hand** the packing should be replaced.

6. **General Inspection**—A general inspection should be made of the entire unit to be certain the unit is free from leaks. This should not take a great deal of time but just a quick general observance of the unit.

7. **Power Oil**—The general condition of the power oil should be observed—that is, the color of the power oil should be noted. If it is exceedingly dark it is probable that the filter should be changed in the power oil filter. These filters should be changed approximately every four to six months.

The aforegoing items, when checked periodically, will aid in an efficient and satisfactory operation of the long stroke unit but, nevertheless, sometimes down hole trouble develops which operators should be able to analyze with a minimum of difficulty. This analyzation may be made easily if the operator understands the hydraulic circuit. In order to aid the operator in understanding common down hole difficulties we will cover two of the more common problems. The first to be considered is:

1. **Parted Sucker Rods Or Split Tubing** — Parted sucker rods or a split joint of tubing are very similar as far as surface indications on a hydraulic unit are concerned and may be determined by the following method:

A. Check the balance tank pressure to be certain it is normal, that is, what it has been operating at normally.

B. Start the unit and if the engine or prime mover labors on the downstroke and races on the upstroke it is indicative of either a rod part or a split joint of tubing. Production or well fluid produced should also be checked. If the unit can be operated the cylinder pressure should be checked. If it is considerably lower than that encountered during normal operations, it indicates that part of the well load has been lost. This in turn would indicate either a parted rod or a split joint of tubing.

2. **Stuck Bottom Hole Pump**—A stuck bottom hole pump may be determined by again first checking the balance tank pressure to be certain it is proper. Then, by operating the unit, check the cylinder pressure when the unit is started. If the cylinder pressure on the upstroke is excessively above the normal operating pressure, it would indicate that the bottom hole pump is stuck. It is also well to operate the unit, if possible, and check to determine if any well fluid is being produced. If no well fluid is being produced under the aforegoing tests it is safe to assume the bottom hole pump is stuck.

Other surface or subsurface problems encountered with individual hydraulic pumping units which are peculiar to that pumping unit will not be discussed at this time. However, these problems should be referred to the manufacturer for his specific recommendations.

As manufacturers, we realize it is important that our machinery be reliable and of high quality workmanship. However, it is more important that you, the customer and operator, understand and be satisfied with the equipment to insure continued progress. We are always happy to receive constructive criticism suggestions and questions concerning our equipment, which will ultimately bring about a more efficient and simplified piece of oil field machinery.

REFERENCES

1. **Practical Petroleum Engineer's Handbook**
   Zaba & Doherty, 3rd Edition, 1949
2. **Hydraulically Pumping Dual Completions**
   T. E. Horton, World Oil, October, 1952
3. **How to Pump Deep Dual Completions Alternately**
   J. R. Hatfield, World Oil, January, 1953
4. **Pumping Dually Completed Wells**
   Temple P. Hoffer, Petroleum Engineer, Sept., 1947
5. **Dual Pumps In The Velma Area**
   L. P. Holsapple, Petroleum Engineer, Dec., 1953
6. **Factors Affecting Dual Pump Installations**
   J. A. Queen, Petroleum Engineer, Dec., 1953
7. **Dual Completion Equipment And Practices**
   M. C. Turner, Paper No. 851-28-H, A.P.I., Mid-Continent District, Production Division, Spring Meeting, 1954