Produced Water Power Fluid Conditioning Unit

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In the February, 1969 issue of the Petroleum Engineer Mr. John Scott, Executive Editor, authored an article titled, "The Revolution in Artificial Lift". In the article Mr. Scott made the following observations:

1. The number of domestic producing wells has been on a marked decline since 1961.
2. Stripper well production (10 B/D or less) now represent only 16% of the total instead of 23% in 1962.
3. Total fluid production has increased steadily each year for the past several years due to:
   a. Expanded secondary recovery operations.
   b. Higher allowables.
   c. Upgraded engineering and preplanned completions aimed at the best artificial lift methods.
4. *Artificial lift is the most important cost item in the oil industry today.*

Approximately 414,000 or 75 per cent of the artificially lifted wells are produced with sucker rod pumping systems. This artificial lift method is, naturally, where most of the emphasis is being placed by the producer who is being squeezed to trim per-barrel lifting costs a little more each year.

Nevertheless, the cost of well servicing continues to increase, due to the labor market and well-servicing equipment cost. Replacement of broken sucker rods as well as replacement of rod cut tubing contributes substantially to this cost. Producers are taking a new look at techniques, equipment and installation design of artificial lift programs. Computer programs designed especially to oversee artificial lift operations are becoming more common. Field testing of continuous sucker rod strings, and research and testing of wire line rope for operating sucker rod pumps indicate the interest and need for reducing service time and cost on rod pumping wells.

All of the above, plus the trend toward automation, has created the climate and circumstances that are bringing about "the revolution in artificial lift". In an attempt to lead this revolution, monies, engineering time and a testing program were requested and approved in April, 1969 to develop a one-well synergetic lift system to compete across-the-board with sucker rod pumping systems.

A free-type hydraulic production unit, normally associated with a central hydraulic pumping system, is used to eliminate the well-servicing cost of retrieving the subsurface pump as well as eliminating the sucker rod failures and tubing wear. In order to compete with the installation of a sucker rod pumping system for the average depth well, an economical source of fluid suitable to power the subsurface production unit had to be developed. The Power Fluid Conditioning Unit was designed and assembled to provide a solids-free fluid to power a one-well hydraulic system, and is the primary topic of this paper.

In general the Power Fluid Conditioning Unit operates as follows. (Refer to Flow Diagram - Fig. 1). Produced well fluids (oil, gas and water) enter the pressure vessel designed basically as a free water knockout. Gravity separation of water from oil and gas takes place in this pressure vessel. The volume of oil, gas and water that the well is producing will be discharged from the pressure vessel into the flow line through the back-pressure valve and on to the lease treating facilities and tank battery just as if it were coming from a sucker rod pumped well.

Water from the lower section of the pressure vessel is forced into the inlet of the cyclone separator at an optimum pressure (controlled by the back-pressure valve) to give the appropriate pressure drop across the cyclone for a particular well requirement. The solids separated by the cyclone are discharged with some of the water into the flow

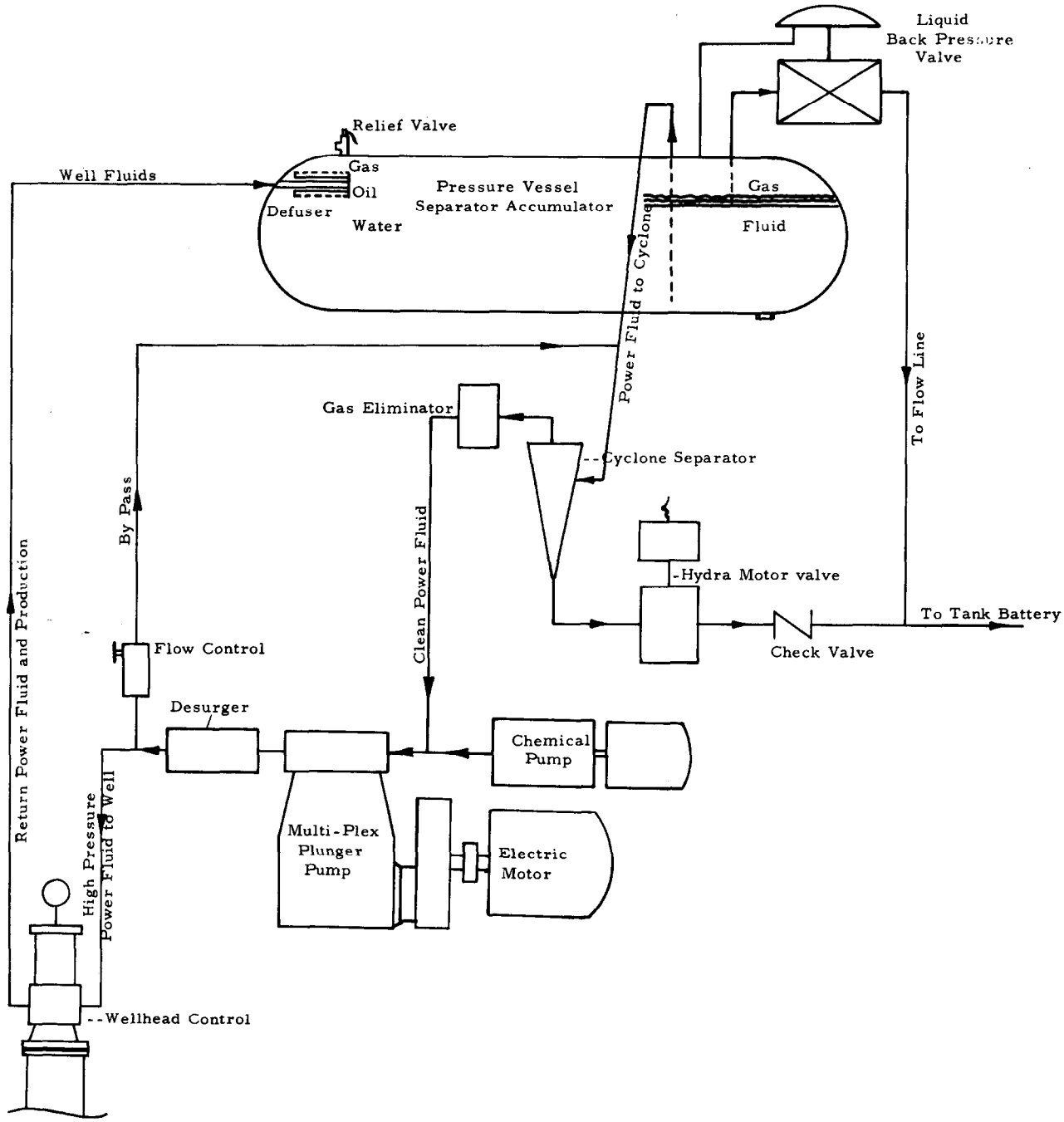

FIGURE 1

FLOW DIAGRAM — POWER FLUID CONDITIONING UNIT

line and join the production for the trip to the tank battery.

The clean water is discharged out of the upper end of the cyclone through the gas eliminator into the suction manifold of the pressure pump. Appropriate chemical is injected into the suction of the pressure pump by the chemical pump. The high pressure water is discharged from the power fluid outlet and down the well to operate the subsurface production unit.

The speed of the subsurface unit is controlled by the constant flow control valve that is bypassing unused power fluid back into the pressure pump supply line upstream of the cyclone separator and gas eliminator. The output of the pressure pump is constant, due to the speed of the electric motor, so the amount of bypassed fluid controls the amount sent to the well, maintaining the desired strokes per minute on the subsurface pump.

There has been a total of six Power Fluid Conditioning Units placed in operation in various areas at the time this paper was written (November, 1970). The original unit was designed as a 25-hp lift system to compete in producing the average depth pumping well of 50-400 BFPD from 1500-4000 ft in depth. Normally, this type of well is automatically considered for sucker rod pumping. This original unit was completed in December of 1969 and all of the preinstallation tests were completed in Houston, Texas, by mid January, 1970. On January 20, 1970, the unit was installed on a well for field test which was already being produced with a hydraulic power oil central system. The test well, located in South Texas near San Antonio, was 5100 ft deep and produced approximately 100 BFPD. After eight months' operation on the test well, during which time some modifications of various elements were made, the unit was moved to a well that was being pumped with sucker rods. This well had a history of rod parts and tubing leaks with corresponding high well-servicing costs. At this writing it is still producing at a rate of approximately 150 BFPD.

The other five Power Fluid Conditioning Units are 100-hp lift systems producing from 400-1000 BFPD from 6000-10,000 ft in depth. One is located in Wyoming and the other four are in the West Texas - New Mexico area. See Fig. 2.

The advantages of using the free-type hydraulic pump concept should attract the cost-conscious producer because it eliminates the well-servicing cost associated with a sucker rod pumping system, plus eliminating (1) the inventory of power oil, (2) power oil tank, (3) high-pressure power oil lines, (4) fire hazard, and (5) additional treating facilities necessary at the central battery of a hydraulic system. This one well lift system can be tailored to fit the requirement of the well with a maximum flexibility for producing rates or well changes.

The concept of conditioning produced water at the well site to be used as power fluid for a single well lift system is a safe, flexible and economical method of producing an oil well. It merits consideration when a well requires artificial lift.

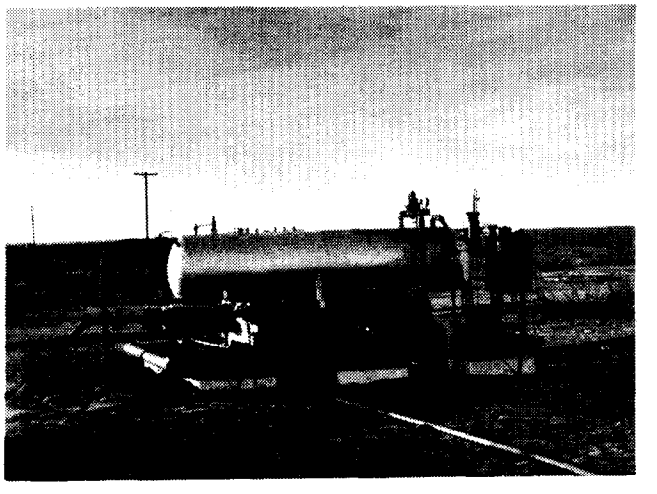

FIGURE 2

100 HP P.F.C.U. — WEST TEXAS AREA