NEW GAS VENT PUMP™ SUCKER ROD PUMP FOR GAS LOCKING AND GAS INTERFERENCE CONDITIONS

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ABSTRACT AND SCOPE

The Harbison-Fischer patent pending Gas Vent Pump™ utilizes an unprecedented concept in sucker rod pumping - the division of two functions of the plunger. Two physically separate parts of the pump are utilized so that on the upstroke there is fluid lifting and on the downstroke compressing in the compression chamber. This division of functions allows the plunger to separate gas from the fluid/gas mixture in the compression chamber during the upstroke and downstroke.

INTRODUCTION

Leon Brown, a producing well owner and long-time operator located in Masterson, Texas, invented this concept. He experimented with the concept of gas separation with a sucker rod pump for over two years and eventually perfected the method that will be covered by this paper.

BACKGROUND

Slippage: Sucker rod pumps with metal plungers and barrels experience leakage, commonly called "slippage", past the plunger during the upstroke of normal, API style pumps. Although slippage causes a minor amount of inefficiency in the pump, slippage is necessary to provide lubrication between the plunger and barrel, and to wash particulates from the barrel/plunger interface. The rules of thumb for optimal clearance between the plunger and barrel are:

(1) About 2% of the produced fluid should slip by the plunger and barrel to insure adequate lubrication. This amount should be increased if lack-of-lubrication indications are seen on the plunger or barrel. These indications are normally galling between the plunger and barrel, or heat indications such as dark colored areas. A formula for estimating slippage can be found in a paper presented at the 2000 Southwestern Petroleum Short Course (SWPSC) titled, "Fluid Slippage in Down-hole Sucker Rod Pumps."[1]
(2) Enough clearance should be specified to allow particulates to pass between the plunger and barrel without causing the plunger to hang up in the barrel.

Gas Locking: Sucker rod pumps can experience gas locking when the gas/fluid ratio is sufficiently high such that the compressible gas in the compression chamber prevents the plunger from producing enough pressure on the downstroke to open the traveling valve. Other forms of gas locking can also occur and are described in a paper presented at the 2004 SWPSC[2]. Gas locking causes sucker rod pumps to produce little or no production and the remedy is normally to lower the sucker rod string until the traveling parts of the pump hit the stationary parts resulting in a "tag" which produces a mechanical shock to the pump which can break a gas lock. Tagging of a pump has been used as a diagnostic tool but many pumps are left tagging to keep the pump operating in gas lock conditions. This can cause damage to the sucker rod pump, sucker rod string and tubing. Thus, if a pump can overcome gas locking an operator can save repairs and troubleshooting.

Gas Interference: Gas interference occurs when gas takes the place of fluid in the compression chamber of a sucker rod pump. The pump continues to operate and pumps fluid and gas on each stroke, but at a reduced efficiency since gas is taking the place of fluid in the compression chamber. If a well operator can separate the gas from the fluid before it enters the compression chamber then the effect of gas interference will be minimized and the apparent efficiency of the sucker rod pump will be higher since more fluid will be in the compression chamber during each stroke of the pump. Gas separators constructed from tubing and installed below the sucker rod pump are in general use in the oil patch but their success has been inconsistent.

THEORY

The Harbison-Fischer Gas Vent Pump™: The new Gas Vent Pump™ is constructed in a top hold-down or tubing pump configuration. See figure A. It utilizes two plungers either connected by a short coupling or a hollow tube, depending on the length of the pump, and two barrels connected by a coupling with vent holes, or one barrel with vent holes in the barrel. A single standing valve is used at the bottom of the barrel and two traveling valves are used, one above the two plungers and one below.

On the upstroke the fluid is lifted as with a standard sucker rod pump. When the plungers approach the top of the stroke, the bottom of the lower plunger moves above the vent holes and allows gas to pass out of the compression chamber into the mud anchor or casing/tubing annulus.

On the downstroke the lower plunger passes and seals off the vent holes as it compresses the fluid/gas mixture in the compression chamber. As the pressure starts to rise, gas is free to pass between the plunger and barrel and exit the vent holes. When the plunger hits the fluid it forms a fluid seal between the plunger and barrel, the pressure rises rapidly, and the traveling valves open and allow fluid to pass through the plungers as with a normal pump.

FIELD TESTS

At this time the Gas Vent Pump™ has been tested in shallow wells with low fluid production and high gas fluid ratios. The well depths are about 2,000'. Several operators in the Texas panhandle area are now using the pumps. Other applications are being considered that will place the Gas Vent Pump™ in deeper wells with greater fluid and gas production.

SUMMARY

Several things were learned during the two years of prototype testing:

Consistent Pump Operation: In all installations the Gas Vent Pump™ dramatically changed the pumping experience for the well operator from tagging the standard API pump and performing troubleshooting tests to the consistent production of fluid and gas without gas locking and producing less gas up the tubing.

Reduced Pumping Speeds: In most of the installations the pumping speed was reduced while the liquid and gas production rate was maintained at the same rate. This was due to the elimination of much of the gas from the compression chamber of the pump.

Elimination of Gas Locking: Gas locking was eliminated in all installations, normally at lower pumping speeds. Some of the installations were pumped at higher pumping rates and thus produced more gas up the tubing but without gas locking.

Efficiency: An increase in pump efficiency was noted for most of the installations, probably due to elimination of gas from the compression chamber.

REFERENCES

(1) "Fluid Slippage in Down-Hole Rod-Drawn Oil Well Pumps," by John Patterson, ARCO, Jim Curfew ARCO Permian, Mike Brock ARCO Permian, Dennis Braaten, ARCO Permian, Jeff Dittman, ARCO, Benny Williams, Harbison-Fischer, Southwest Petroleum Short Course, 2000, pp 117-148.

(2) "Success In Overcoming Gas Locking Problems Update of Two years of Field Applications for the Harbison-Fischer Down-Hole Sucker Rod Variable Slippage Pump® (VSP®)," by Benny J. Williams, Harbison-Fischer, Southwest Petroleum Short Course, 2004, pp 185-190.

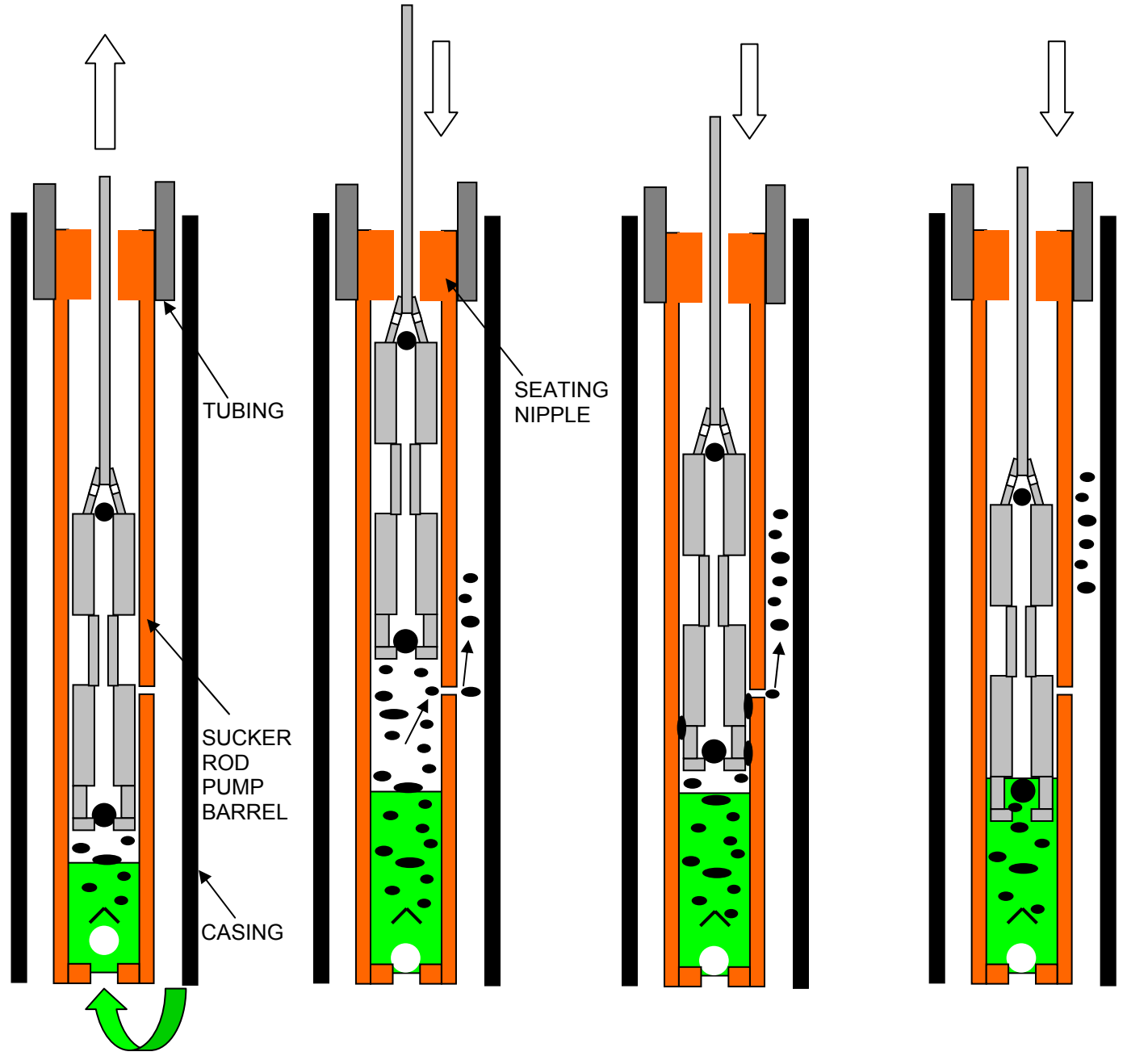

Figure A - Harbison-Fischer Gas Vent Pump™