AUTOMATIC BACK-WASH PUMPING SYSTEM
RECENT TECHNOLOGICAL GAINS HAVE EVOLVED
A NEW GENERATION OF "SMART" ROD PUMPS
OFFERING DRAMATIC LIFTING COST REDUCTION

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...ABSTRACT

Patented new technology was recently introduced to the petroleum industry that reduces the lifting cost per barrel of fluid by containing the spectrum of abrasive particles that damage the rod pump. This technology includes a stainless steel membrane system with specifically tailored micron rated openings. Production operators throughout the world continue to document dramatic economic benefits when a dedicated abrasive particulate control system is used to protect the crucial tolerance of the rod pump plunger to barrel interface. Building on our 1994 Southwestern Petroleum Short Course technical presentation, "Improve The Quality of Pump Protection and Pump Performance Will Improve Automatically", we are now able to present revolutionary and proprietary sensing and actuation technology capable of "taking control" of rod pump downhole functions, dramatically increasing pump service cycle life. Scientific practice applied at the end of the prior decade to discerning the means by which abrasive particulate damage leads to pump efficiency loss and ultimate dysfunction has yielded new knowledge. With the maturing of configurational and material science regarding rod pumps in the prior two decades; technical impetus has grown to evolve a higher level approach to engineering pump longevity in abrasive pumping conditions common to today's oilfield producing environments. New knowledge has been utilized to spawn proprietary technological innovation resulting in a evolutionary integrated "smart" rod pump capable of operating for substantially extended service periods.

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The next time sand from the reservoir or frac sand bleeding back into the well kills the rod pump, wouldn't it be nice to have the pump shop repair your pump and then unitize it with the industry's new automatic back-wash rod pumping system? Wouldn't it be nice to return the new continuous pumping assembly back in the well and forget it - that is, forget it until the pump wears out or the rathole is full of sand? Well, after more than two years of concept design, engineering, patent work and testing, the time is now. A continuous pumping operation is being achieved with the automatic back-washing pumping system.

In the past, the maximum pumping cycle of the rod pump was limited to the down-hole abrasive environment of each well. Today, the pumping limits of the rod pump have been

removed from the limitations of the down-hole abrasive environment and placed back on the wear-life quality of the pump's manufactured parts. This new priority for extending the life of the rod pump has been accomplished with Stren's new patented Marathon™ BF4 Automatic Back-wash Rod Pumping System™.

The Marathon™ Pumping System is designed to keep the rod pump operating until the long term normal wear of pump components terminates the pumping operation. It will:

(1) take complete charge of the rod pumping operation,
(2) protect the pump components from the down-hole abrasive environment by back-flushing the protective membrane, and
(3) return the system to normal pumping operation upon completion of back-washing.

Not only does this allow the pump parts to wear according to their normal and useful life, the continuous pumping operation reduces the number of workover jobs and prevents the loss of production due to down time. This reduces the pumping cost per barrel of oil.

THE FIRST ENGINEERING COMPONENT

The first engineered element of the continuous operating pumping system must be the ability to protect the pump from the down-hole abrasive operating environment. This was first accomplished by the design of the PumpGard tool with the composite cartridge. This composite cartridge system protected the pump from particles of 5 micron and larger. Although it has been continuously improved up to its present form, it is limited to no more than 210 degree F bottom hole temperature, no more than about 200 barrels per day and oil no less than about 35 API gravity. This PumpGard cartridge has the ability to be removed from the mandrill and replaced with a new set of cartridges; but, composite cartridges cannot be back-washed.

THE NEXT STEP IN PROTECTING THE PUMP

The thought of automatically back-washing the PumpGard and pump while they are still in the well was still a far-off dream. However, the next step in developing the system was introduced in 1992. It was the Precision Stainless Steel cartridge. This engineered membrane is the unique application of stainless steel filament metallurgically bonded to the engineered core. With the ability to unitize the several manufactured components into one useful cartridge, the membrane became a precise continuous circular unrestricted area for the passage of fluid. The unparalleled difference in the PumpGard stainless steel membranes and the old style screens or even the perforated or slotted tubing, is the manufactured membranes continuous circular unrestricted area for the passage of fluid upon a structure of great accuracy and strength. This allows the total opening of the membrane "flow-through" area to have a ratio typically in excess of 50 to 1 to that of the opening area of the standing

valve ball and seat. When first deployed into a well, the PumpGard membrane will typically have a flow-through differential pressure across the membrane of less than one PSI.

Since 1992 this stainless steel membrane has been re-designed into many devices for protecting pumps against abrasive particles. The most important factor of the stainless steel membrane is its ability to sustain the high volume and the high pressure surge of fluid required to automatically back-wash the membrane. Not just for "one" single back-washing cycle but for many back-washing cycles determined by the reservoir sand, broken frac sand, abrasive debris and other trash in the well.

THE ENGINEERING OBJECTIVE

The first thought in developing the ability to automatically back-wash the PumpGard membrane would naturally be to:

1) take complete control of the pump,
2) monitor the differential pressure across the membrane,
3) cause the system to trip the pump valves and,
4) allow the fluid in the tubing to back-flush the membrane.

Although these were important control systems that had to be engineered, some of the most demanding challenges were:

(1) to anticipate when the back-flushing operation was complete,
(2) to allow the required dwell time, (depending on the API gravity of the oil) necessary to allow the debris flushed from the membrane to gravitate into the rat-hole, then,
(3) positively return control of the pump back to the pump valves, pumping rods and pumping jack.

THE AUTOMATIC BACK-WASH SYSTEM - AND HOW IT WORKS

TAKE CONTROL OF THE PUMP. Inasmuch as the PumpGard Precision Stainless membrane (NUMBER 1), is the tool that protects the pump from abrasive damage, it is the abrasive sand and debris collected on the PumpGard membrane that triggers the automatic back-washing system cycle. When the differential pressure across the abrasive filtering PumpGard membrane reaches a pre-determined level, (NUMBER 2a & 2b) the engine piston and engine barrel activates The Marathon™ System that automatically takes control of the pumping operation such that the fluid lift is temporarily suspended.

The sensor valve now automatically actuates the engine piston to open first the (NUMBER 3) standing valve and then the (NUMBER 4) traveling valve. When both the standing valve and the traveling valves are opened, this allows the unique (NUMBER 5) all mechanically

triggering unit to permit the clean high pressure fluid above the pump barrel and in the production tubing, to flow downward and outward through the (NUMBER 1) PumpGard membrane. This action cleans the abrasive debris build-up from the membrane and directs the debris to the rathole.

DURING AUTOMATIC BACK-WASHING of the membrane, the (NUMBER 7) plunger dwell time sub-assembly takes control with a pre-calculated dwell time sequence that cleans the membrane and allows the discharged particles to begin to settle into the rat hole.

RETURNING THE MARATHON™ AUTOMATIC BACK-WASHING SYSTEM back to the pump, valves, rods and pumping jack, is controlled by the automatic actions of the differential sensor sub assembly (NUMBER 8) and engine piston, the de-activation of the plunger dwell time sub-assembly and the automatic re-seating of the traveling valve and standing valve. NUMBER 9 shows the power fluid porting of sensor valve assembly and (NUMBER 10) the engine piston power fluid filter assembly.

THE FUTURE OF ROD PUMPING

In the past, it was necessary to remove the rod pump from the well when the plunger and barrel was so scored by abrasive material that the fluid could not be pushed to the surface, or the pump is stuck. Today the Marathon™ Automatic Rod Pumping System allows,

(1) the sand and debris to be collected onto PumpGard stainless membrane,
(2) when the amount of sand and debris on the membrane creates a pre-determined flow-through differential pressure approaching blockage, the triggering sub creates an automatic back-flow of clean fluid through the PumpGard membrane and,
(3) after a dwell time period, the automatic back-washing system is de-activated and the normal pump activity is restored.

BROAD MANAGEMENT CONTROL OF THE PUMPING OPERATION

Because this sequence is (or may) be automatically repeated many times during the pumping life of the pump, it offers continuous pumping operation of the well. There are many benefits to the Marathon™ Pumping System but the most important are:

(1) better managed workover schedule of each well opposed to reacting to crisis imposed by "sand cut" pumps going down unexpectedly,
(2) less loss of production,
(3) more continuous pumping for each well,
(4) a decrease in the lifting cost per barrel of oil.

FRAC WELLS WITH HIGH PRODUCTION

Operators with wells that experience many days of lost production and changing pumps due to frac sand bleed back, have now gained control over these costs by making only one trip into the well with the complete Marathon Automatic back-wash pumping system. Reports indicate that during the clean-up period of the post frac-sand bleed-back, the automatic back-flushing system can direct the frac sand safely into the rathole. After the clean-up period is over and the well is back into full production, the automatic system can be left safely in the bottom of the well providing ongoing pump protection.

DYNAMOMETER INPUT

Not only is the ABS4 Automatic Back-Wash system designed to take charge of the pumping system, it will establish the basis for the factual data input of each well's information management program. Each pumping change in the down hole pumping operation gives a definite data set that tells the story of that change. But, most importantly, as the time for each automatic back-wash cycle changes, longer or shorter, the data print will identify a change in the sand content relationship to fluid. As these changes are monitored, the management of production is simplified.

THE ROD PUMP HAS BEEN ENHANCED

For many years the "simple rod pump" has been identified as the work horse tool of the enhanced oil producing industry. Then came water flood, fracing, CO_2 enhanced recovery, and other methods that, although they produced more oil, the enhanced producing rate often reduced the life of the rod pump. As this cycle continued, many screens were used to help the pump survive abrasive damage. Although the PumpGard has proved to be successful in extending the service life of the pump, it too, must generally be pulled and serviced with the pump.

Today, the Marathon™ Automatic Pumping System gives the rod pump the ability to automatically purge itself of debris built up on the PumpGard membrane and then re-activate itself. This is automatically accomplished without people working the pumping jack, the pumping rods or without the use of a workover rig.

In the oil business, profits go to those who perform the best. This has long been true, in land deals geology, drilling, services, and producing the oil. This new automatic back-wash tool technology gives the oil producer a pro-active tool that monitors down hole demands and automatically triggers the back-washing cycles, to provide the solution as needed. The automatic back-wash system allows pumping cost to be more competitive.

When each oil company matches the cost per barrel of oil pumped, with the performance life of the rod pump, it is important to focus, not only on the down hole automatic back-wash

system, but an understanding how the continuous pumping system will enhance the total production.

Although comprehensive information management is a relatively new production tool, the automatic back-wash system, along with a computer program dedicated to pumping and production data, is providing management with real time information.

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Author's Biography

ROY N. MOORE

Vice President of Stren, he was formerly with Reed Tool Company for 40 years and retired as Director of World Market Development. He was contract manager for two major drilling companies and owned his own international trading company. Roy has visited most all the mining and petroleum producing areas of the world and has worldwide marketing experience.

KENNETH J. SCHMITT

A Founder and the President of Stren, he has extensive background in both the Petro-Chemical and Petroleum Production Industries. A recognized authority on innovative producing technologies, Mr. Schmitt is a published author and holds several patents in this field. He is a member of the Institute of Electrical and Electronic Engineers and other professional affiliations.

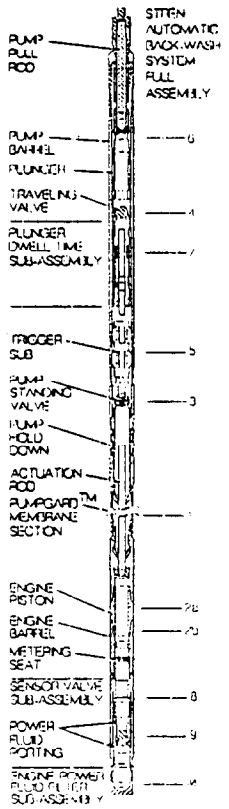

Figure 1 - Stren Automatic Back-Wash System
Full Assembly

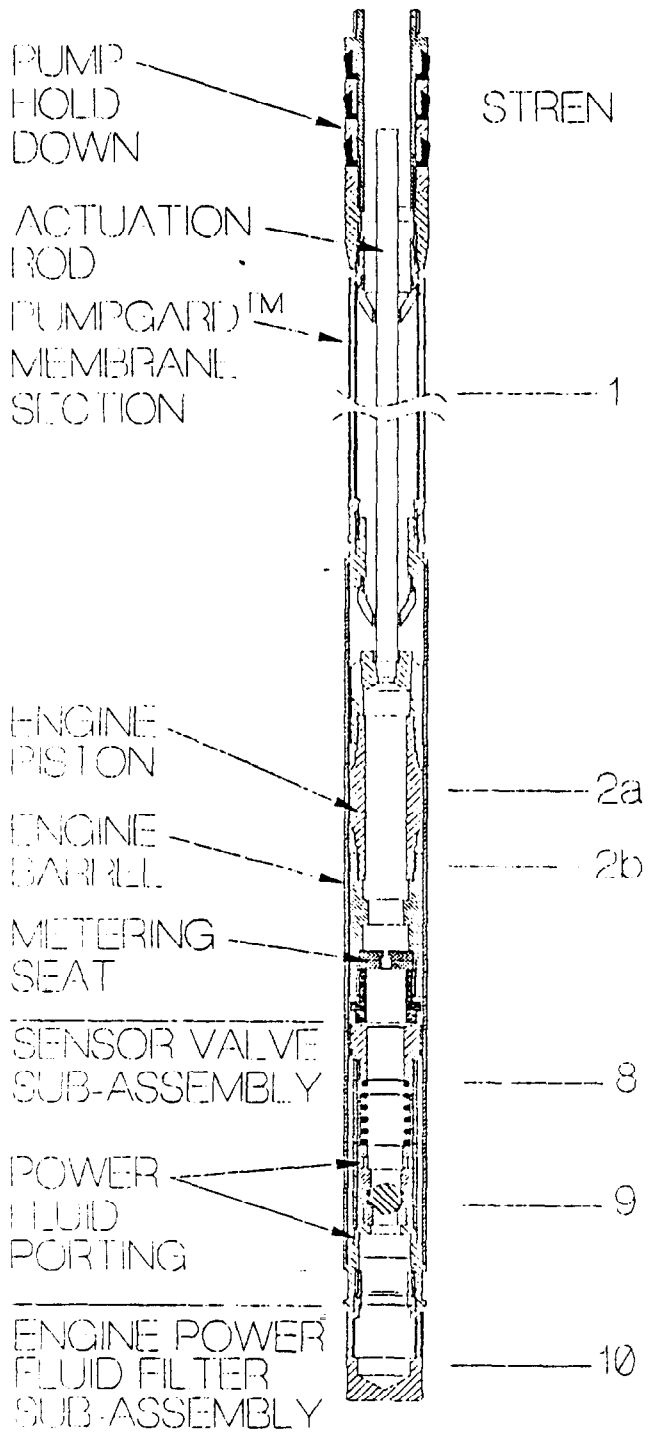

Figure 2 - Stren Automatic Back-Wash System
Bottom Section

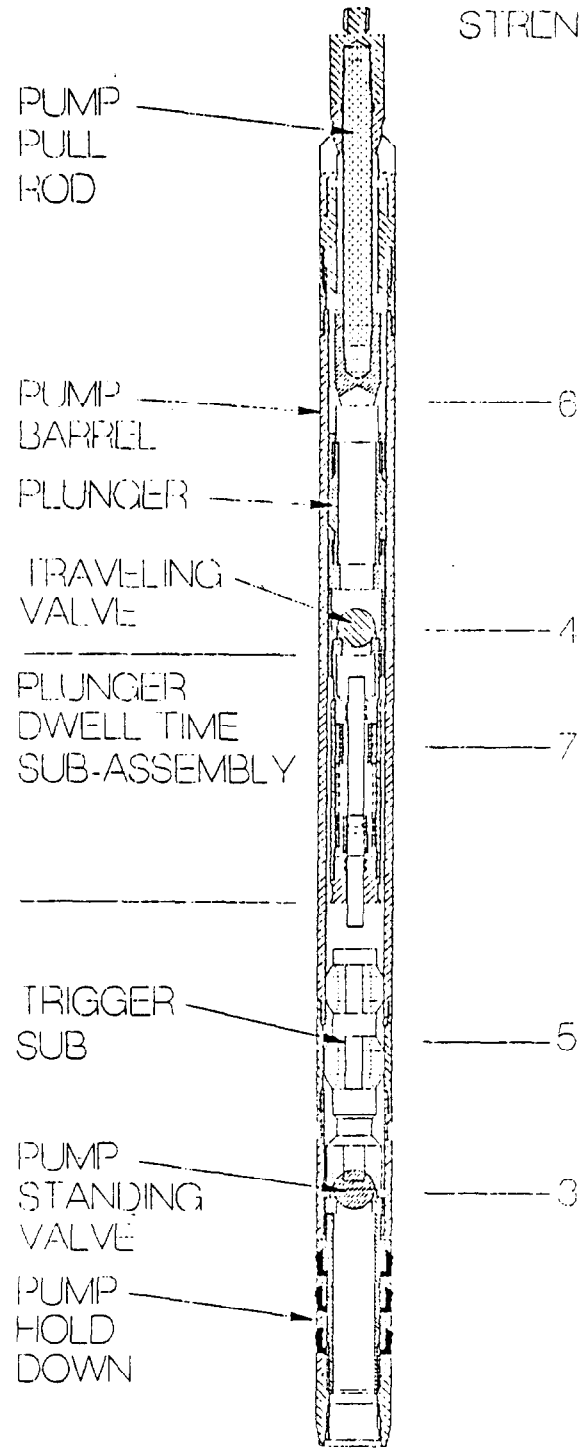

Figure 3 - Stren Automatic Back-Wash System
Top Section