AUTOMATION OF PUMPING UNITS WITH GAS ENGINES

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ABSTRACT

Finding effective, low cost prime movers for pumping units can be hard to acquire in today's market of deregulated electricity. The inability to adequately start and stop gas engines has always been a problem area. With the cost of electricity increasing, and the ability to operate wells when you want decreasing, the producer will have to take peak usage and availability of that electricity into consideration for their production cycles. The day may come when the electricity may dictate when the well operates and not the producer.

This paper will introduce a completely new air actuated clutch design, and review several applications that have been used successfully in automating pumping units with gas engines. This new air clutch design for gas engines also teams with P.O.C.'s, and telemetry to give the producer the ability to better manage their pumping cycles, saving time, money, and driving down repair and maintenance costs.

INTRODUCTION

Although automation itself is not a new process in the production of gas and oil fields, the ability to automate the pumping cycles of beam pumping units that have gas engines is. This paper will discuss a new design of clutch that will enable operators and attendees of the Short Course with another option to automate where previously there was no effective option.

The new clutch design has been in field operations since August of '99. Since that time the clutch has gone through several slight modifications, each time enhancing it for better and more efficient operations. The new clutch design is operated by either gas or air pressure, which can be obtained through several mediums.

The intent of this paper is to present new technology for operators of pumping units driven by gas engines, the ability to reduce down time, automate remote wells, and save on the overall maintenance of their pumping units through effective production methods.

HISTORY OF AUTOMATION

Since the very beginning of automation, oil producers have known that pumping wells 24 hours a day is not necessary, nor efficient to operations. From putting wells on timers to the current pump off controllers that are available, automation has been around for a number of years. There is plenty of data on the advantages of automation, the benefits of reduced runtimes for units, the reduction of rod, pump, & tubing failures, and the list goes on.

Very simply, automation exists because it is a better way to produce the fluid to surface and save wear and tear on the equipment, thereby extending the life of the equipment. However, to date there has not been an effective or proven method to automate gas operated pumping units. The main hindrance **to** the automation process for these units has been the clutch.

The automation process has seen great changes over the years. Electric pin timers offered the ability to pick when and how long the operator wanted to run the unit. This was better than running all the time, but relied upon the operators knowledge, abilities, and commitment to increasing production while decreasing costs. Timing the units "just right" to coincide with the well pumping off didn't happen and still doesn't happen, so the wells would spend some of that valuable producing time in a pumped off state. It wasn't until the advent of dynamometers and studying the effects of "fluid pound", that operators soon realized the damage fluid pound causes. Rod buckling, shock tremors, reduced pump efficiency, just to name a few. Due to the effects of fluid pound operators began to see an increase in downtime due to rod parts, holes in the tubing, etc. So the next part of the process began to appear, the introduction of pump off controllers(P.O.C.'s). Now in almost every oil field or gas field pump off controllers are used to automate most all of the beam pumping units, except one. Gas operated pumping units.

HISTORY OF GAS ENGINES

From the beginning gas engines have been a part of the pumping process. A natural fuel source made the gas engine economical, easy to get, and a low cost, in most cases free until taxes. Still in many fields today gas engines are the prime mover of choice because of the afore mentioned reasons and the high cost of running power to the locations or the remoteness of the location.

In order to automate the gas engine itself one has to consider starting it with load. In most cases the engine will not turn over with load already applied. So the clutch becomes an important part of the gas engine. The clutch allows the operator to start the engine out of gear, and then when the engine has reached running levels, the clutch is then engaged and the unit goes online. Due to this reason the majority of gas engines simply run 24 hours a day every day. With reserves depleting and natural production declines, it would safe to say that most of the pumping units do not need to operate 24 hours a day. This brings us to the point of automation and the gas engine.

The arca of automation and the gas engine has to begin at the clutch level. Starting and stopping the gas engine is not yet a realistic method in automation, however we can leave the gas engine running and simply engage and disengage the clutch. This would require the clutch to be able to spend ample time disengaged and freely engage when needed.

Current clutches and previous designs of automating the current style of clutch have not been effective. This is due to the friction of the metal moving parts within the clutch heating up and swelling during the disengage time and not being able to freely engage. Adjustments have also needed to be made in order to keep the clutch aligned properly. There are and have been several designs that use hydraulics to operate a “ram” mounted to the existing clutch arm. These have had limited success.

NEW CLUTCH DESIGN

The new design of the air clutch makes installation and operation easy, effective, and versatile with any timer or P.O.C. Parts include the flywheel plate, which is mounted directly to the drive ring of the engine. The clutch assembly, which when mounted, surrounds the hub of the flywheel plate. The bell housing lines up the clutch assembly and the flywheel plate. The bell housing is mounted in the same location as existing clutches. The core of the clutch consists of an air bladder which is lined with friction pads. These friction pads are made of brake shoe type material. Using gas or air, the clutch bladder is inflated causing the friction pads to constrict onto the hub of the flywheel plate there by engaging the unit. By releasing the gas or air pressure, the bladder deflates, allowing the friction pads to loose contact with the flywheel plate thus disengaging the unit. The manual air valve is in line with the gas or air supply and allows the operator to manually engage and disengage the clutch. This allows manual operations for testing, dynamometer work, or what ever the operator needs to stop the unit for. The engine does not stop running while the clutch is disengaged, and there are no parts rubbing together while clutch is disengaged. In between the air valve and the clutch is a solenoid valve, which allows the clutch to be controlled by a timer and/or a controller. When the P.O.C. detects the pump in a pumped off state the controller send an electrical pulse to the latching solenoid valve which in turn releases the gas pressure from the bladder disengaging the unit.

By engaging of the unit with equal pressure on the entire surface of the flywheel plate hub, there is a smooth transfer of power. The unit takes off when enough friction is applied to move the load of the pumping unit. That pressure remains until released so there is a constant contact between the friction pads and the flywheel plate. With the flywheel plate and the clutch there is sufficient clearance between the two so that there is no contact during the units downtime or while the clutch is disengaged. This allows for unlimited periods of downtime with no harmful effects to the clutch.

CASE STUDY

San Juan Basin, Four Comers Area, Farmington, New Mexico.

Currently in the Four Corners Area there are 176+ clutches installed dating back to the first installation in August of ’99. These wells range from a depth of 2700’ to 7500’,and are oil and gas producing zones. With installations for 11 different companies and different methods of operations, the clutches have complied with all safety and company policies. Failure rate from the inception of the clutch is only 8%, and the last ***6*** month trend has been only a 5% failure rate. Production numbers are available upon request, but are inline with automation results on electric driven pumping units.

LINER LOADING

There is a condition found in the Four Corners Area that has been detected and labeled as liner loading. Many wells completed in 7” casing may also have 5.5” casing a third of the way up the hole. With a high volume of gas traveling up the casing, it also tries to carry with it the fluid from the producing zone. Once the fluid reaches the top of the liner, it loses velocity and restricts the gas flow from underneath the liner. With the fluid carried away from the pump the pump acts like it is “pumped off’. Using the ACT 1 clutch along with the Lufkin Automation MPC pump off controller, we are able to put the compressor onsite in re-circulation and close the casing valve. Once the casing valve is shut the casing pressure begins to increase, thus reducing the velocity of the gas, and causing the fluid to fall back down to the pump. Engaging the pumping unit with the ACT 1 Clutch, the pumping unit pumped until the pumpoff Controller registered the well as pumped off. The unit was disengaged, the casing valve opened, and the compressor put back into service. Results have been remarkable, in some cases increasing gas production 500-800 MCF/D.

ENERGY SUPPLIES

Wellhead Gus currently no clutches are certified for H2s. Recommended operating pressure for the ACT1 Clutch is 100#. Should the well not be able to accommodate that pressure there are other solutions. If the gas is very wet, there should be sufficient moisture removal to prevent fluid from entering the clutch.

Compressors on site may be a good source of pressure, and adequate removal of on site liquids is a must. Wet gas on location is a problem but through drip pots and filters the operators can keep the fluid out of the bladder.

Nitrogen Bottles are used in the Four Corners, because of its dry nature, inert properties, and low cost. Nitrogen also is a constant pressure and does not fluctuate as the casing pressure does due to line pressure and other factors.

Booster, which is in research and development, would allow the operator to take casing pressure as low as 25#, and “boost” it to the recommended 100#.

Air Compressor is available and is charged by an alternator, which is run off of the radiator fan belt. This alternator charges a battery, which in turn feeds the air compressor and keeps the necessary pressure supplied to the clutch