Compressor-Gas Lift System for Individual Wells

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In the oil and gas industry small compressor gas lift systems are being utilized more extensively as an efficient and economic means of artificially lifting fluid from individual wells.

The success of the small compressor dewatering system for economically unloading gas wells has guided the gas lift industry into the development of a superior automatic pilot operated valve for downhole operation. The end product of this combination is a single well compressor-gas lift system which offers to the oil and gas operators a much lower initial cost than do other major types of artificial lift. Furthermore, maintenance cost is correspondingly low.

The Hugoton gas field in southwestern Kansas and the Texas and Oklahoma Panhandle was plagued with the problem of water encroachment which seriously decreased deliverability of gas wells. As long as the bottom hole pressure remained reasonably high, liquid could be blown to atmosphere periodically; the well would produce gas in commercial quantity until the encroaching liquid caused them be be logged up again (Fig. 1).

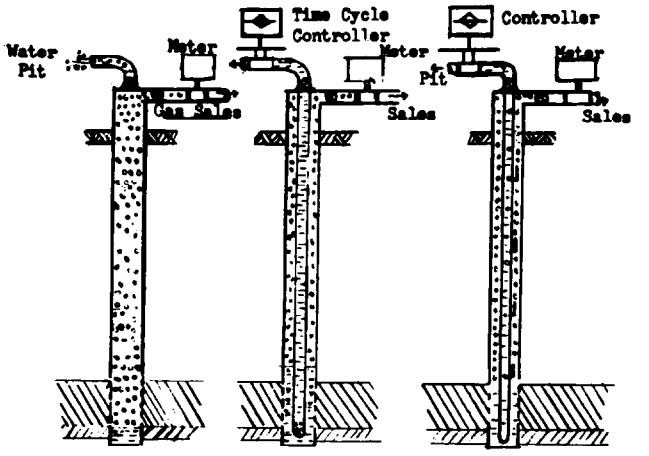

FIGURE 1

Decreasing pressures brought on many and various mechanical solutions. For example, small syphon tubing strings were installed; and when the wells were being blown dry they allowed more efficient flow of liquid with less gas waste. These were later augmented with surface intermitters or time operated stop cockers for slug flowing. As time went on, port collars were put into the tubing; then to save gas and increase efficiency, differential gas lift valves replaced the port collars. Many of these valves are still in operation. Various other methods such as plungers and foaming agents were employed; beam and hydraulically operated pumping units were installed; but gas locking, gas waste, pumping off, and other problems were prevalent.

In January, 1960, Colorado Oil & Gas installed the first Dewatermatic compressor system that provided a small closed rotative gas lift system which kept the well unloaded and eliminated any gas waste to atmosphere (Fig. 2). This unique arrangement effected a very short (2 1/2 months) payout and recouped back gas allowable of three-month duration.

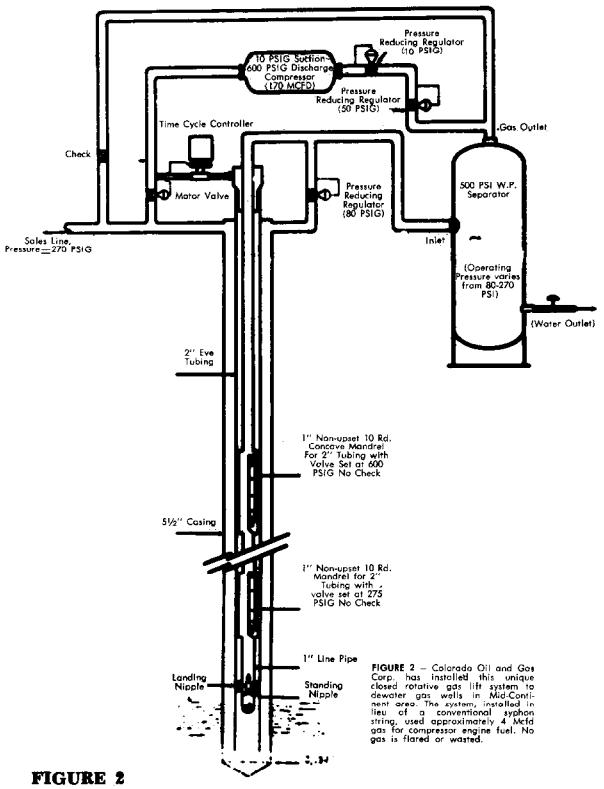

FIGURE 2 — Colorado Oil and Gas Corp. has installed this unique closed rotative gas lift system to dewater gas wells in Mid-Continent area. The system, installed in lieu of a conventional syphon string, used approximately 4 Mcfd gas for compressor engine fuel. No gas is flared or wasted.

FIGURE 2

The past year has witnessed the small compressor's entry into the oil field, for an improved down hole automatic pilot controlled valve (Fig. 3) has eliminated the surface controller or timer and thus allowed the use of the entire casing annulus as a volume chamber. The continuous operation of the compressor is compatible with the operation of the pilot controlled valve, and acceleration or deceleration of compressor speed will dictate the frequency of opening the down hole valve (Fig. 4). The pilot valve spread (opening and closing pressures) is predetermined when the well information -- which includes casing and tubing size, depth, gas gravity, temperature, etc. -- is available. The majority of wells having these installations are fairly deep with low bottom hole pressure, and production is less than one hundred BPD on calendar day basis. The pilot valve is generally wire line retrievable and uses an accumulation chamber which insures even greater efficiency (Fig. 5). The volume of gas that is used each day is easily computed by chart calculation.

PRINCIPLE OF OPERATION

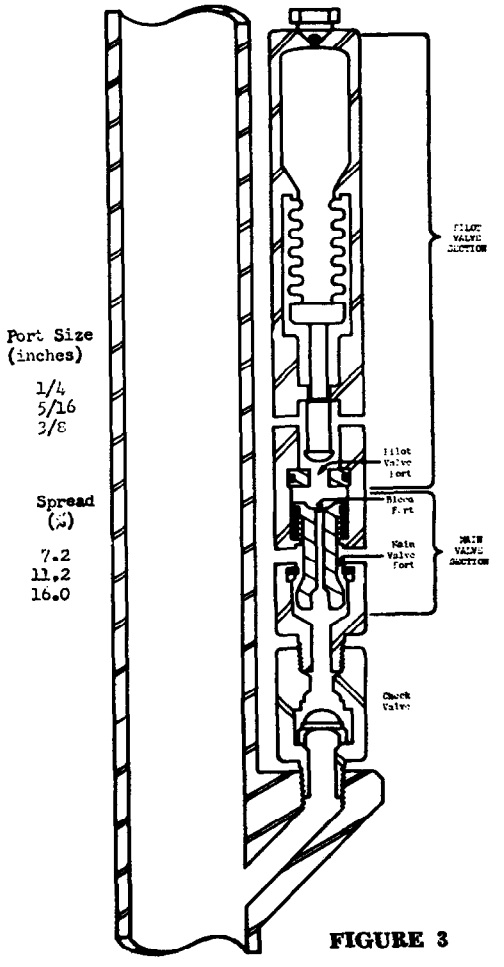

FIGURE 3

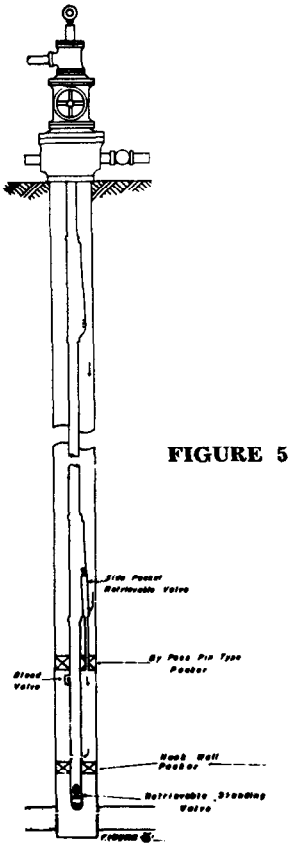

FIGURE 5

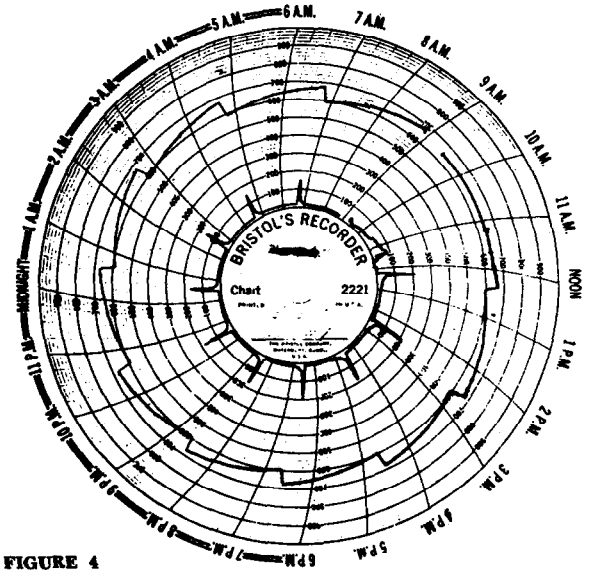

FIGURE 4

CALCULATIONS

Known:

Gas Gravity : .85
BHT at 6850' : 122 F
Valve Depth : 6850'
Pvo at surface : 670 psig
Pvc at surface : 590 psig
Pvo at 6850' : 855 psig
Pvc at 6850' : 750 psig
Production : 36 BPD of fluid
11 cycles/day
Tubing : 2"
CSG : 5 1/2" - 17#

Determined:

(1) Injection gas per cycle
(2) Injection GLR

$$\text{Pvo (AVG)} = \frac{670 + 855}{2} = 762.5$$

$$\text{Pvc (AVG)} = \frac{590 + 750}{2} = 670$$

From Figure 6:
Qso = 4800
Qsc = 4250

Gso Qsc = 4800 4250 = cu ft/1000 cu ft/cycle

Injection gas/cycle = $\frac{550\ (6850)}{1000}$ = 3760 cu ft per cycle

B/cycle = $\frac{36}{11}$ = 3.27 Bbls per cycle

Injection GLR = $\frac{3760\ \text{cu ft per cycle}}{3.27\ \text{Bbls per cycle}}$ = 1150 cu ft Bbl

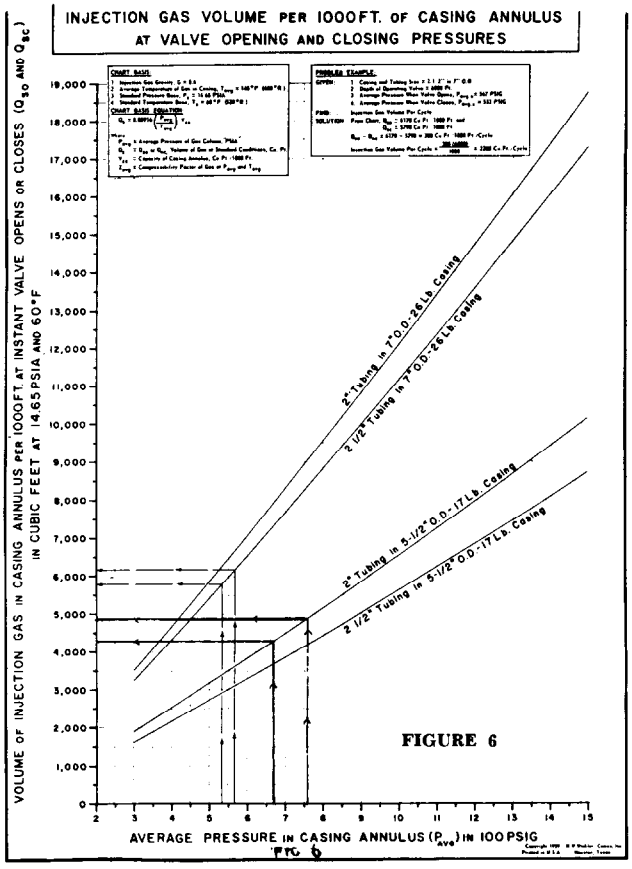

FIGURE 6

The small compressors are skid mounted and installed a short distance from the well that is being lifted, or equal distance from two or three wells, depending on spacing and arrangement. The close proximity assures entry of warm gas into the casing annulus. This heat is conducted into the tubing and is observed; as a result, paraffin formation is practically non-existent even in the surface flow lines in areas where paraffin plugging is normally a problem.

The complete compressor hook up can usually be made in one day's time, for the skid mounted compressor unit need not necessarily be tied down since it is primarily designed for balance. Further, the suction line is laid from the gas separator at the battery to the compressor location. Since only very low pressure is required for the suction, the operator may use thin wall pipe or old casing or tubing unfit for high pressure service. The low pressure gas goes through the second scrubber and separator phase which is contained in the skid mounted unit and which assures clean dry gas before compression.

The compressor unit is equipped with safety shut-down switches to insure shutdown in event of a mal-function.

Typical cost of installation for 7,000 ft well:
Production: 50 BOPD
Static bottom hole pressure: 600 psi
P. I.: 0.26
5 1/2 in. 17 lb casing; 2 3/8 in. tubing

1-Compressor Unit Skid Mounted
15 psig to 800 psig, volume 125 MCF per day at 3,000 ft elevation: $5,150.00

Downhole Gas Lift Equipment consisting of

1-Conventional pressure controlled valve	218.00
1-Wire Line Retrievable Pilot Operated Valve and Latch	335.00
1-Side Pocket Chamber Mandrel	350.00
1-Pin type By-pass Packer	450.00
1-Differential Valve (Chamber Vent)	90.00
1-Retrievable Standing Valve	75.00
1000 ft 1 1/4 C.W. Line Pipe at $35.00/hundred ft	350.00
1-Repair of existing Hookwall Packer (approximate)	50.00
1-Pull and run 7,000 ft Tubing	200.00
	$7,268.00

* Slides may be shown for related figures

Field gas lift compressor system in the Spraberry Field of West Texas.