THE HYDRAULIC BEAM GAS COMPRESSOR® A STANDALONE VERSION OF THE BEAM GAS COMPRESSOR®

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ABSTRACT

The benefits of the Beam Gas Compressor® on rod pumped have been modified as a standalone technology to facilitate a broader range of operations and objectives. Historically, the Beam Gas Compressor® has been installed on pumping units and utilizes the prime mover of the pumping unit to drive a piston inside a proprietary designed cylinder. This paper describes how this technology has been adapted to a standalone compressor installation, how the changes allow more versatile uses and how the technology compares with other types of compression.

HISTORICAL DEVELOPMENT

The Beam Gas Compressor®, BGC, uses a single cylinder to reduce the pressure in the annulus of the sucker rod pumped well and then discharges the gas back into the surface flowline or sales line. The resulting removal of the backpressure on the formation allows more gas to flow at a quicker rate, while also improving the efficiency of the down hole pump with greater fillage percentages. The pumping unit uses the torque creation of its prime mover at the middle of each stroke and the BGC takes advantage of this torque at the top and bottom of the stroke. It is at this point the torque is typically converted into heat as the pumping unit does not require it, the BGC converts this wasted heat to torque to compress the gas in the BGC. Compared with conventional reciprocating compressors, the beam gas compressor has a number of advantages. Perhaps the greatest advantage is the greater compression ratio that can be achieved than a comparable single stage reciprocating compressor. The BGC offers up to a 9 to 1 compression ration vs 3-4 to 1 for other reciprocating systems. The higher compression ratio is achieved by the way heat is dissipated when gas is compressed. The large cylinder and slow speed allow much more heat to be dissipated over every stroke. For typical rod pumped installations, this greater compression ratio allows the beam compressor to deliver gas into a wider range of pipeline pressures without having to have multiple stages.

While the beam gas compressor is very effective for a single well, the single greatest limitation is the run time being restricted to the run time of the pumping unit. To extend the applications of the high compression ratios of the Beam Gas Compressor®, a standalone version was developed that has its own prime move. This prime mover is a fluid drive system that is comprised by a hydraulic pump, a motor and a directional valve. As a standalone device, the Hydraulic Beam Gas Compressor® (HyBGC) can now accommodate a continuous run schedule that can accommodate multiple wells for well head compression and tank batteries for vapor recovery.

BASIC DESCRIPTION:

The HyBGC uses hydraulic technology that is proven over many decades in combination with Beam Gas Compressor® technology developed over 35 years ago to provide exceptional compression and durability.
The Beam Gas Compressor® has internal proprietary seals and packing that can be used without external lubrication and operated to temperatures exceeding 400 degree Fahrenheit. It also is resistant to hydrogen sulfide, carbon dioxide and now steam. The Fluid Drive System is simple to operate and can be controlled thru a patent pending algorithm controller that gives the well's the ability to produce at maximum efficiencies. Utilizing an optional swash plate style pump and proportional valve the system can vary its stroke per minute on a moment by moment basis.

The main adaptation to convert from a Beam Gas Compressor® to a HyBGC is the addition of they hydraulic cylinder and insertion of the middle head with a triple redundant seal. This seal is what keeps the hydraulic fluid in the top chamber and the gas in the bottom chamber. The pressure that is created in the hydraulic chamber expands the seals and prevents any leakage of gas back into the fluid.

Below are examples of how much gas can be moved by different sizes of HyBGC.
(The Hydraulic cylinder is a standard diameter size and stroke length is equal to the BGC. The BGC can change diameter size to match the demands of any location. Below are a few examples)

Table 1-provides a range of cylinder and volume rating based on strokes per minute and suction pressure, for these examples the discharge pressure can vary from 150 psi up to 500 psi while maintaining the 9 to 1 compression ratio.

ADVANTAGES OVER RECIPROCATING GAS COMPRESSORS

Every reciprocating gas compressor in the world must have a filtration system, scrubber tank and pump to remove fluid from the scrubber tank. This is because any fluid that enters the compression chamber will create severe fluid pound and damage or disable the compressor. With the HyBGC this is ***not necessary.*** The HyBGC is the only compressor system in the world able to move fluid, as well as, gas in every stroke. This is a revolutionary concept and allows for much more flexibility in installations of the HyBGC. Fluid pressure is fluid pressure regardless of it being in the top or bottom cylinder the control panel simply reacts to pressure and pushes the fluid down the flowline.

Lack of emissions. Reciprocal compressors by the nature of their design have “blow by”. This is where gas when it is under compression will blow by the piston and its seals out of the compression chamber and into the atmosphere. When you consider these systems often operate at 900-1500 cycles per minute and a small amount of gas is emitted on every stroke these amounts can be significant.
The HyBGC, on the other hand, has a high pressure hydraulic cylinder sitting on top of a low pressure gas compressor chamber. Gas is unable to escape the compressor cylinder because of the nature of our common seals between the two cylinders.

Hydrogen Sulfide is often very disastrous for reciprocating gas compressors, especially the ones used for vapor recovery. The HyBGC utilizes a chromed piston rod that is 2.5 inches in diameter and a nickeled piston nearly three inches thick with a corrosion resistant cylinder it is almost impervious to the caustic nature of H_2S.

They HyBGC can be utilized in a steam flood to allow a well to be operated as if it were vented. The proprietary nature of the seals and packing allow for the unit to operate to a temperature of over 400 degrees Fahrenheit. And as described above a scrubber system is not required to handle the condensation of the steam from any changes in pressure that occur as the gas goes thru the system.

ADVANTAGES OVER CONVENTIONAL BEAM GAS

With its own prime mover the Beam Gas Compressor® is no longer bound to the strokes per minute or runtime of the pumping unit. The HyBGC can be set to run at the speed necessary to move the volume of gas that is produced by the well or tank battery. With the addition of the “McCoy Algorithm” the optimum speed can be derived that will produce the most production.

The ability to move fluid is also an advantage over the Beam Gas Compressor®, as it can move condensate gas but not volumes of fluid like the HyBGC.

As a test vehicle prior to installing a standard Beam Gas Compressor®, a Hydraulic Beam Gas Compressor® can be utilized easily to test a formations responsiveness to a reduction in back pressure.

MAINTENANCE AND RUN TIME EXPERIENCE

Similarly to the Beam Gas Compressor® the HyBGC is very easy to maintain. With basic components of motor and pump they can easily be repaired by most roustabout crews. A serious problem would result in just the replacement with a similar pump and/ or motor.   Typically the Beam Gas Compressor® operates at rates in excessive of 99.4% of the year compared to reciprocating compressors of 94%. This difference in runtime can easily be translated into lost production on a yearly basis.

TYPICAL ECONOMICS

A Beam Gas Compressor® usually is priced about 1/3rd of reciprocal compressors as it has no fluid scrubber system or prime mover. A HyBGC is comparable in price to a reciprocal as we are single staged and require no fluid scrubber system.

REGULATORY COMPLIANCE IMPROVEMENTS

Quad OOOO has become relevant and the lack of emissions from the HyBGC offer a significant advantage in this area.

This legislation – 40 CFR 60 Subpart OOOO – is commonly referred to as “Quad O.” It states that as of April 12, 2013, all storage tanks must have a control device in place 60 days following startup or by April 2014, whichever is later. The EPA categorizes a “control device” as either an enclosed combustor or a vapor recovery device. 1

In addition the newly established standards will regulate volatile organic compound emissions from gas wells, centrifugal compressors, reciprocating compressors, pneumatic controllers and storage vessels. 2

So this will eliminate many types of compression unless they utilize an enclosed combustor or some other system to prevent emissions. All of which are not necessary for the HyBGC

IN CONCLUSION

They Hydraulic Beam Gas Compressor® is a significant step forward in wellhead compression and vapor recovery systems. Its capacity to handle virtually any gas stream in most any environment allows it to have tremendous flexibility.   This will offer the operator the ability to easily test his formations capacity to increase production when the back pressure is relieved.

REFERENCES

1- http://abutec.com/quad-o-compliance/

2- http://en.wikipedia.org/wiki/Vapor_recovery

Table 1- shows different volume of gas capacity at different suction pressures and stroke length with varying diameters of gas

BGC Model					
6		Suction Pressure			
48	spm	0	10	20	50
	3	5.72	9.97	14.21	26.93
	4	7.63	13.29	18.94	35.90
	5	9.54	16.61	23.68	44.88
	6	11.45	19.93	28.41	53.85
	7	13.36	23.25	33.15	62.83
	8	15.27	26.57	37.88	71.81

BGC Model					
8		Suction Pressure			
48	spm	0	10	20	50
	3	10.18	17.72	25.26	47.88
	4	13.57	23.63	33.68	63.84
	5	16.97	29.53	42.10	79.80
	6	20.36	35.44	50.52	95.76
	7	23.75	41.35	58.94	111.73
	8	27.15	47.25	67.36	127.69

BGC Model					
10		Suction Pressure			
48	spm	0	10	20	50
	3	15.90	27.69	39.47	74.81
	4	21.21	36.91	52.62	99.75
	5	26.51	46.14	65.78	124.68
	6	31.81	55.37	78.93	149.62
	7	37.11	64.60	92.09	174.56
	8	42.41	73.83	105.24	199.49

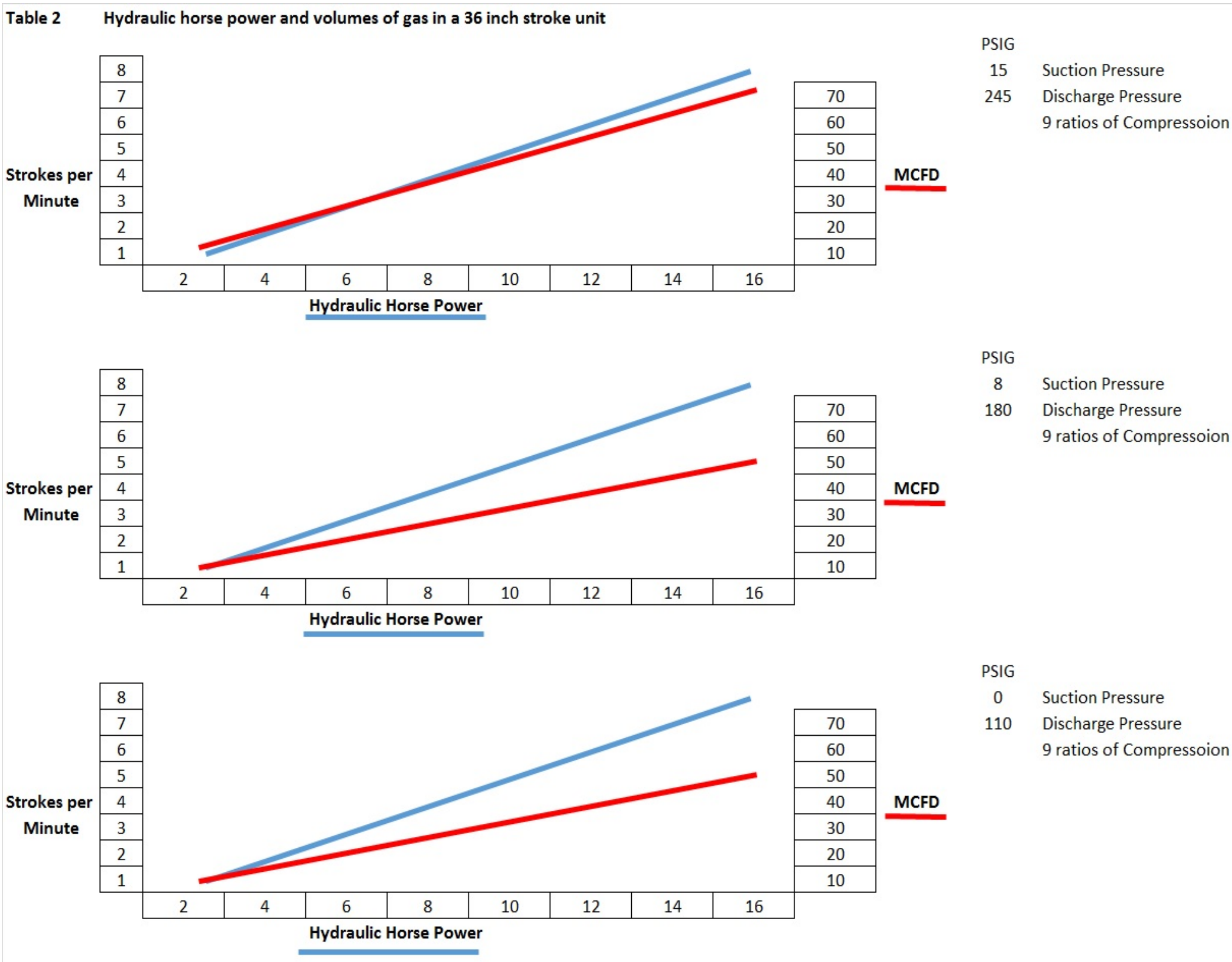
BGC Model					
6		Suction Pressure			
60	spm	0	10	20	50
	3	7.16	12.46	17.76	33.66
	4	9.54	16.61	23.68	44.88
	5	11.93	20.76	29.60	56.10
	6	14.31	24.91	35.51	67.32
	7	16.70	29.07	41.43	78.54
	8	19.08	33.22	47.35	89.76

BGC Model					
8		Suction Pressure			
60	spm	0	10	20	50
	3	12.72	22.15	31.58	59.85
	4	16.97	29.53	42.10	79.80
	5	21.21	36.92	52.63	99.75
	6	25.45	44.30	63.15	119.71
	7	29.69	51.68	73.68	139.66
	8	33.93	59.07	84.20	159.61

BGC Model					
10		Suction Pressure			
60	spm	0	10	20	50
	3	19.88	34.61	49.33	93.51
	4	26.51	46.14	65.78	124.68
	5	33.13	57.68	82.22	155.85
	6	39.76	69.21	98.67	187.02
	7	46.39	80.75	115.11	218.19
	8	53.01	92.28	131.55	249.36

CYLINDERS.

Table 2- Illustrates the relationship between hydraulic horse power need to compress volumes of gas into different flowline pressures



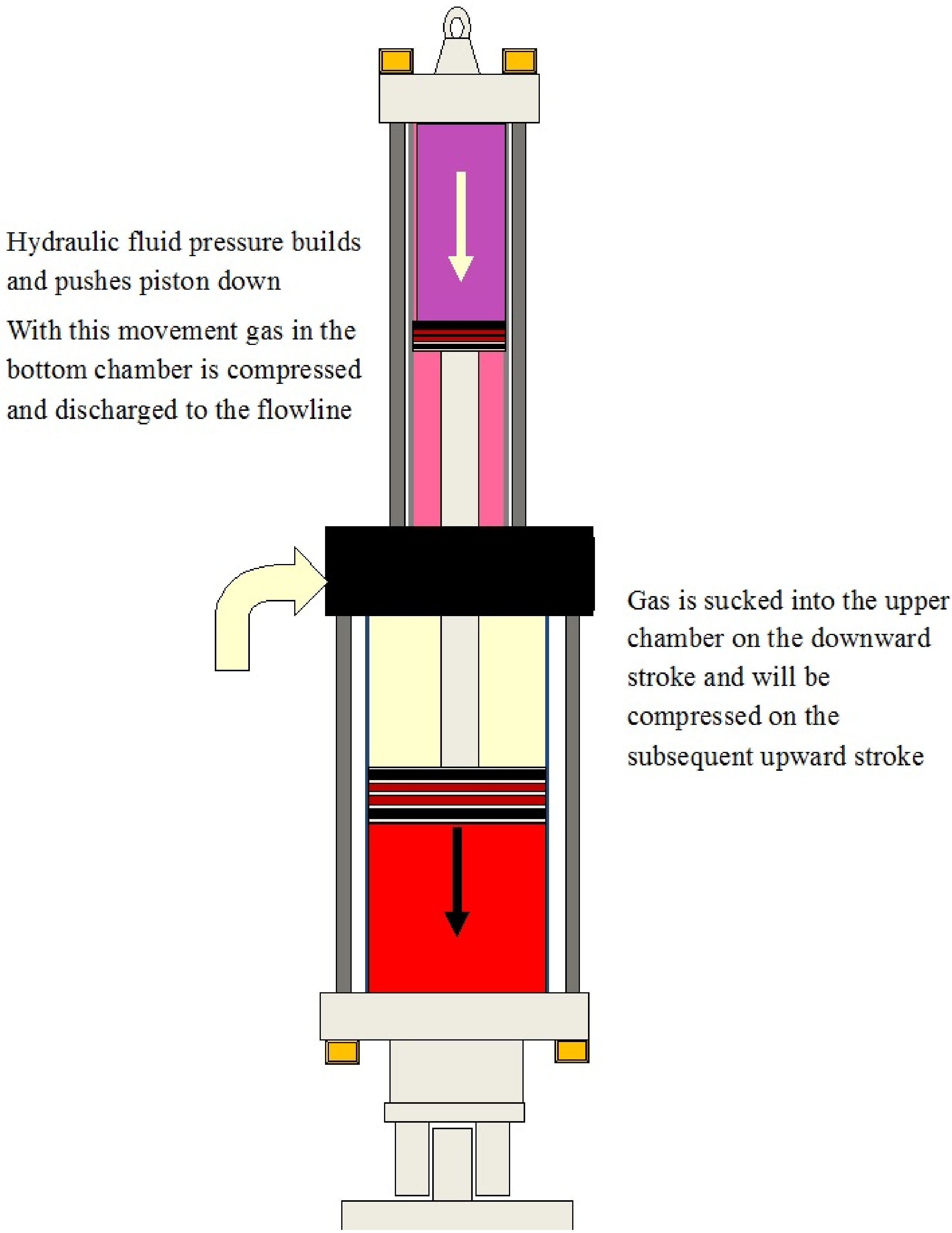
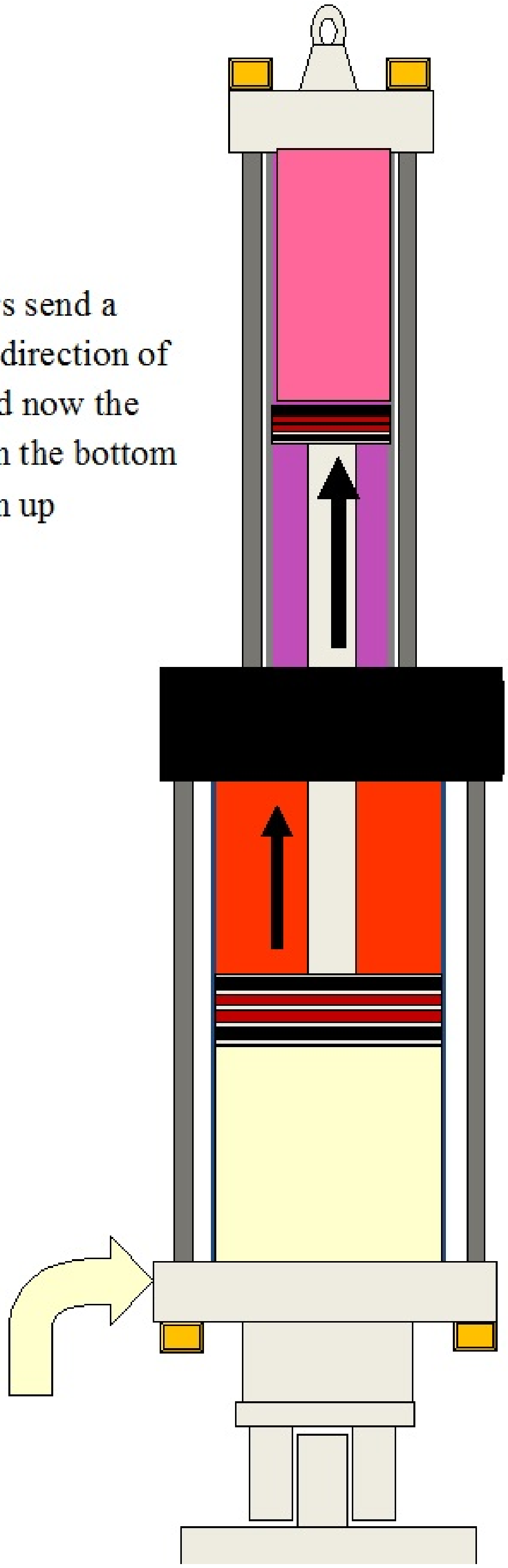
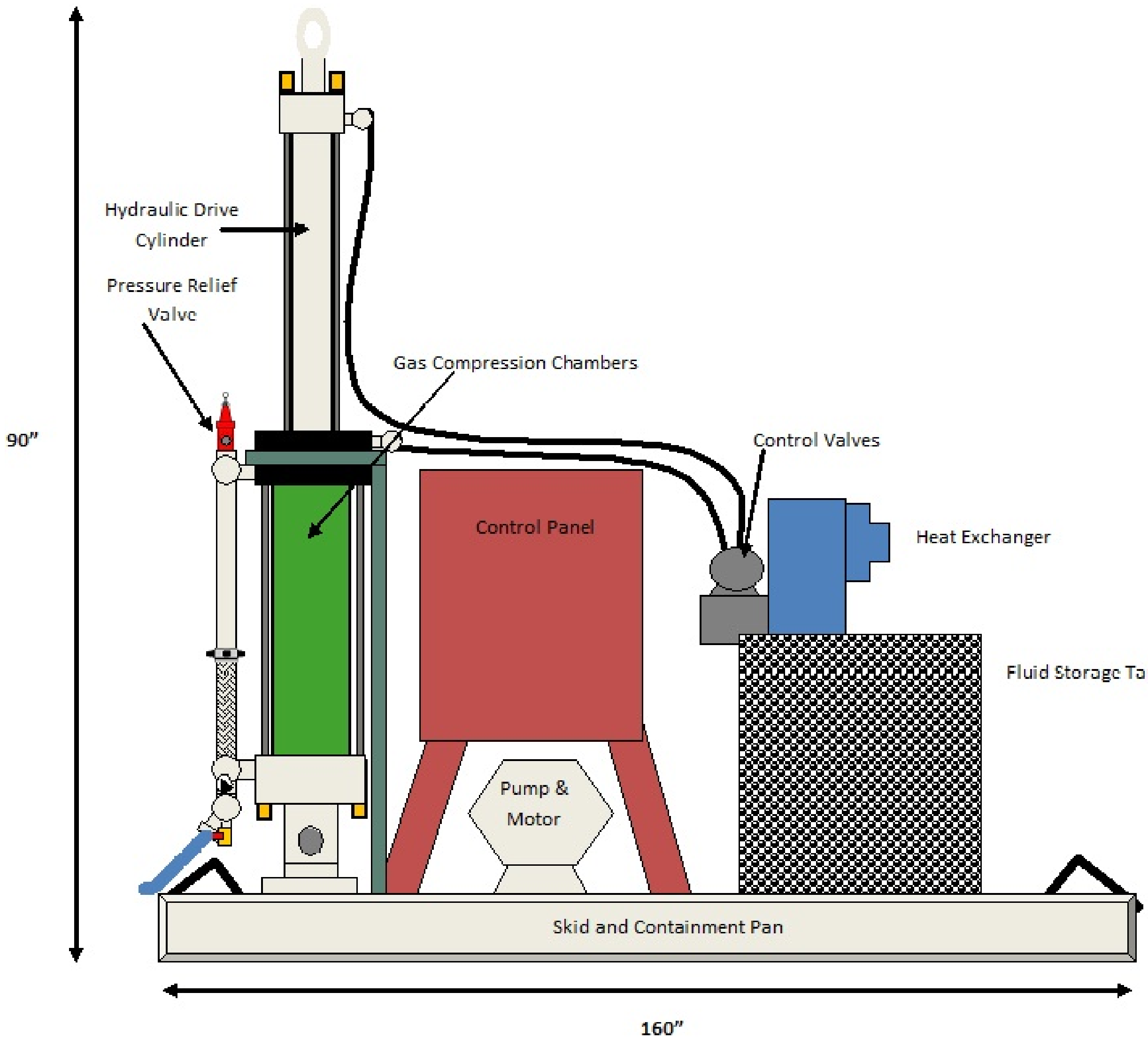


Figure 1- Movement of Gas and fluid thru the HyBGC

Proximity sensors send a signal to change direction of the fluid flow and now the pressure builds in the bottom forcing the piston up



Gas is sucked into the lower chamber on the upward stroke and will be compressed on the subsequent downward stroke



Typical Layout of a HyBGC

HyBGC on location as a wellhead compressor

As a Vapor Recovery Unit