



HOW/WHY HIGH-PRESSURE GAS LIFT (“SINGLE POINT GAS LIFT”) ADOPTION/USES CONTINUE TO GROW

Presenter: Larry Harms

Southwestern Petroleum Short Course

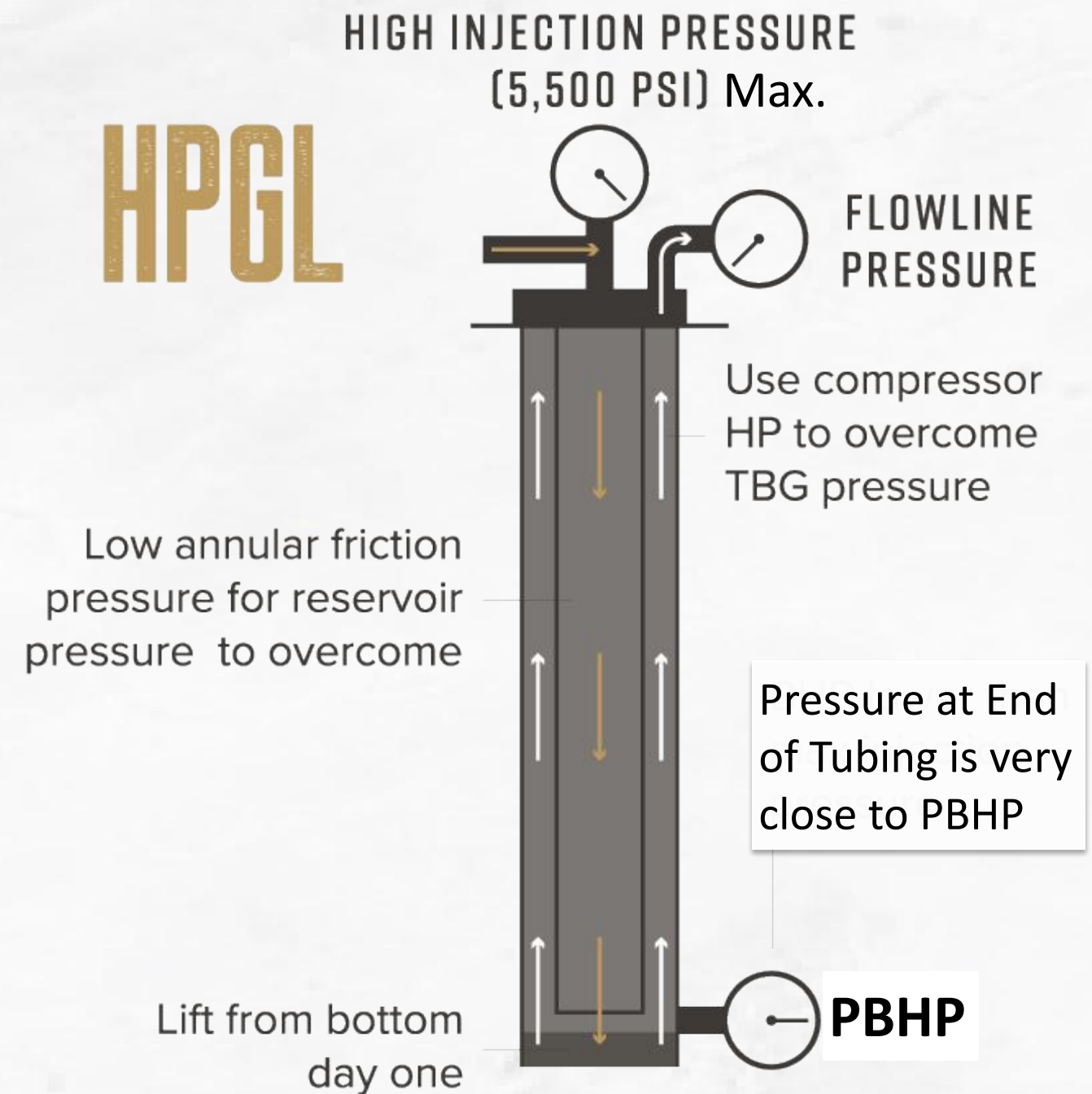
April 17-18, 2024

SWPSHORTCOURSE.ORG



WHAT'S IN A NAME?

- High-Pressure Gas Lift (HPGL)
- Single Point Gas Lift (SPGL)
- Conventional Gas Lift (CGL)

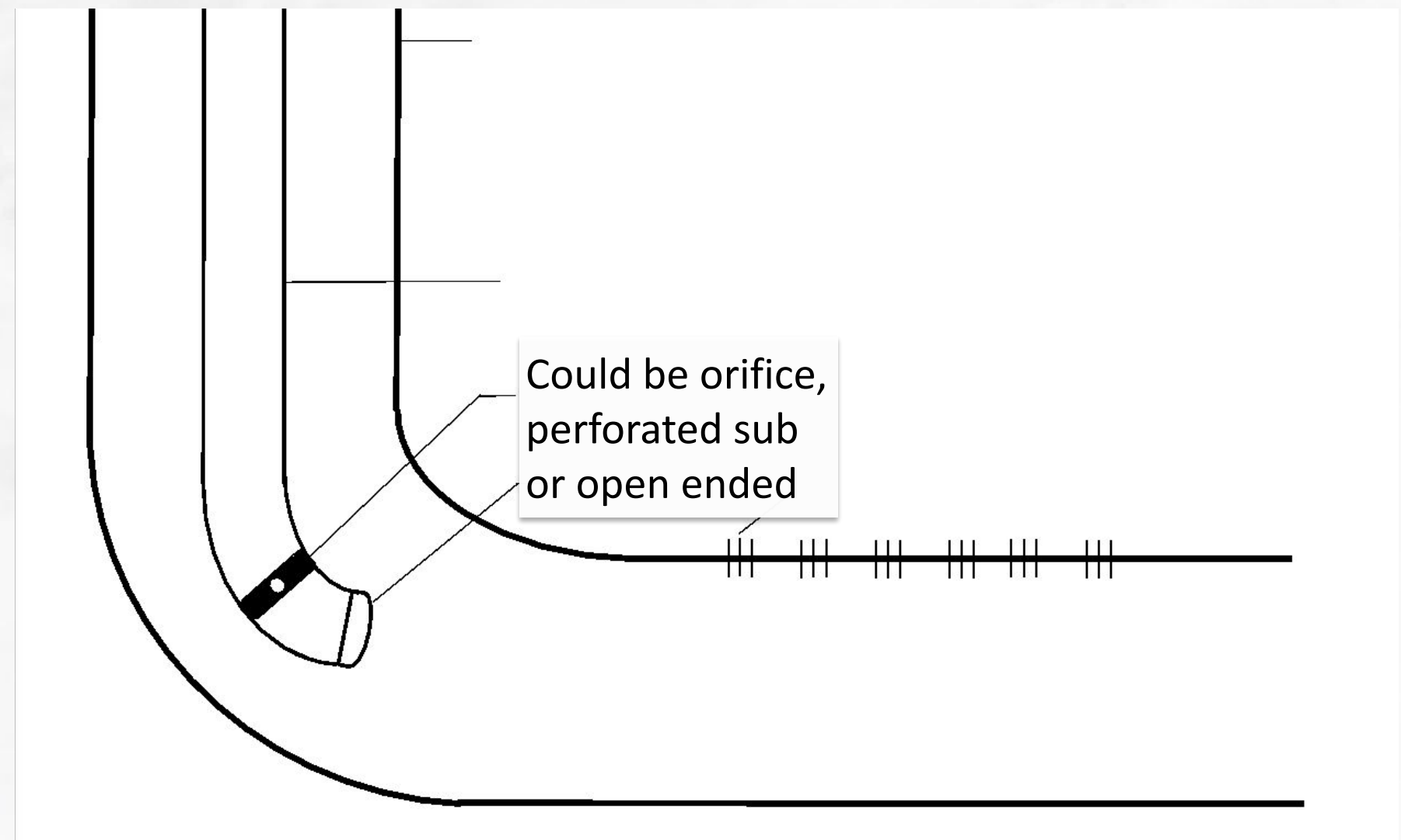




CAN HPGL REALLY BE THAT SIMPLE?

No Downhole Equipment

One Tubing String for Life





TELLING THE HPGL STORY FROM THREE PERSPECTIVES

- A testimony to the practical brilliance, dedication, and perseverance of an individual
- A glowing example of moving effective innovative practices along quickly.
- A “cautionary tale”





Things Start with **BILL ELMER**



- Smart
- Principled
- Practical
- Driven
- Focused
- Mentor
- Innovative

In a meeting with EOG Engineers on December 2, 2015...



From Bill's Original HPGL Presentation

High Pressure Gas lift

- Apparently has been used offshore with large tubing diameters
 - Conventional flow direction used due to safety valves, etc.
- Why is it applicable now?
 - Like the submersible pump using external energy to offset friction, the gas can be injected at high rates down the restrictive tubing.
 - Frictional losses are born by the compressor, and formation does not see them

Figure 3 - Slide from Bill Elmer December 2, 2015, presentation

Why?

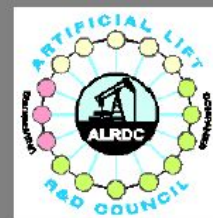


QUICK ADOPTION OF INNOVATIVE PRACTICES

- EOG immediately started looking for candidates
- No HPGL Compressors were available
- Dennis Estis decided to take a risk
- Will Nelle / Estis Compression **designed & built the unit**



QUICK ADOPTION OF INNOVATIVE PRACTICES?



39th Gas-Lift Workshop
Houston, Texas, USA
May 16 – 20, 2016

High Pressure Gas-Lift: Is Industry Missing a Potentially Huge Application to Horizontal Oil Wells?

- **Bill Elmer, P.E.**
- **Encline Artificial Lift Technologies LLC**





ENLISTING HELP - "THE THREE AMIGOS"

Jim Hacksma

Bill Elmer

Larry Harms



GET THE HPGL WORD OUT!

- SPE-187443- High-Pressure Gas-Lift: Is Industry Missing a Potentially Huge Application to Horizontal Wells?, Oct. 2017
- Many presentations at ALRDC, SPE and PBALF, etc.
- But we need “real” data from “real” wells

Table 1. Gas-lift Valves Required with Different Gas Supply Pressures

Gas Lift Supply Pressure, psig	Gas Lift Valves Required
1000	10
1200	6
1500	4
1700	3
2200	2
3700	Only Orifice



FINALLY, SOMEONE WILL LET US PUBLISH...

- SPE 195780 - Brandon Pronk (SM Energy), Bill Elmer, Larry Harms, Will Nelle, Jim Hacksma, "Single Point High-Pressure Gas Lift Replaces ESP in Permian Basin Pilot Test.", April 2019

**Growth Accelerated
Early 2016 – Zero
April 2024 – 3,000+**

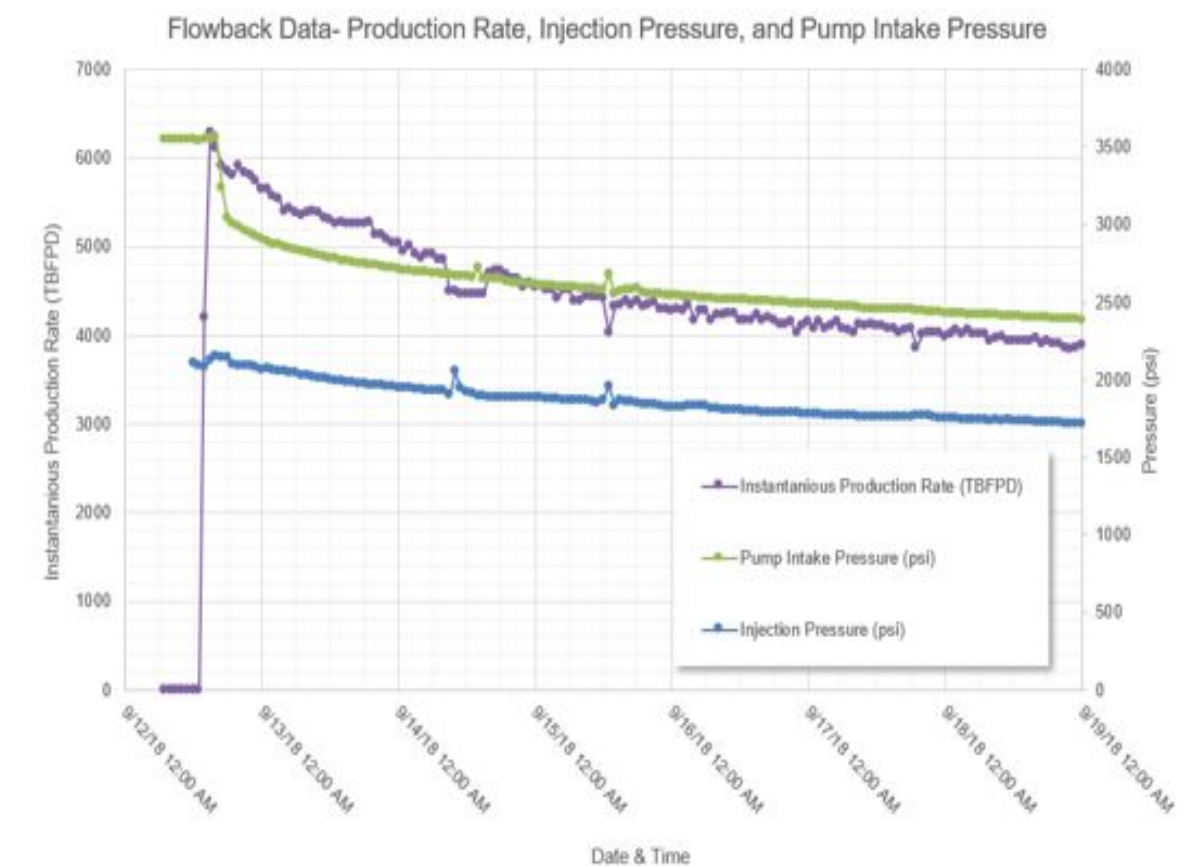


Figure 5 – Flowback Data



WHY DID IT GROW?

- Rates competitive with ESP's at lower costs
- Gas lift is well suited to unconventional
- Simple
- Reliable
- Flexible
- Promoted and word of mouth

Expect hyperbolic growth in the future



**WAIT A MINUTE,
ARE YOU SURE
HPGL IS
NEW/INNOVATIVE
TECHNOLOGY?**

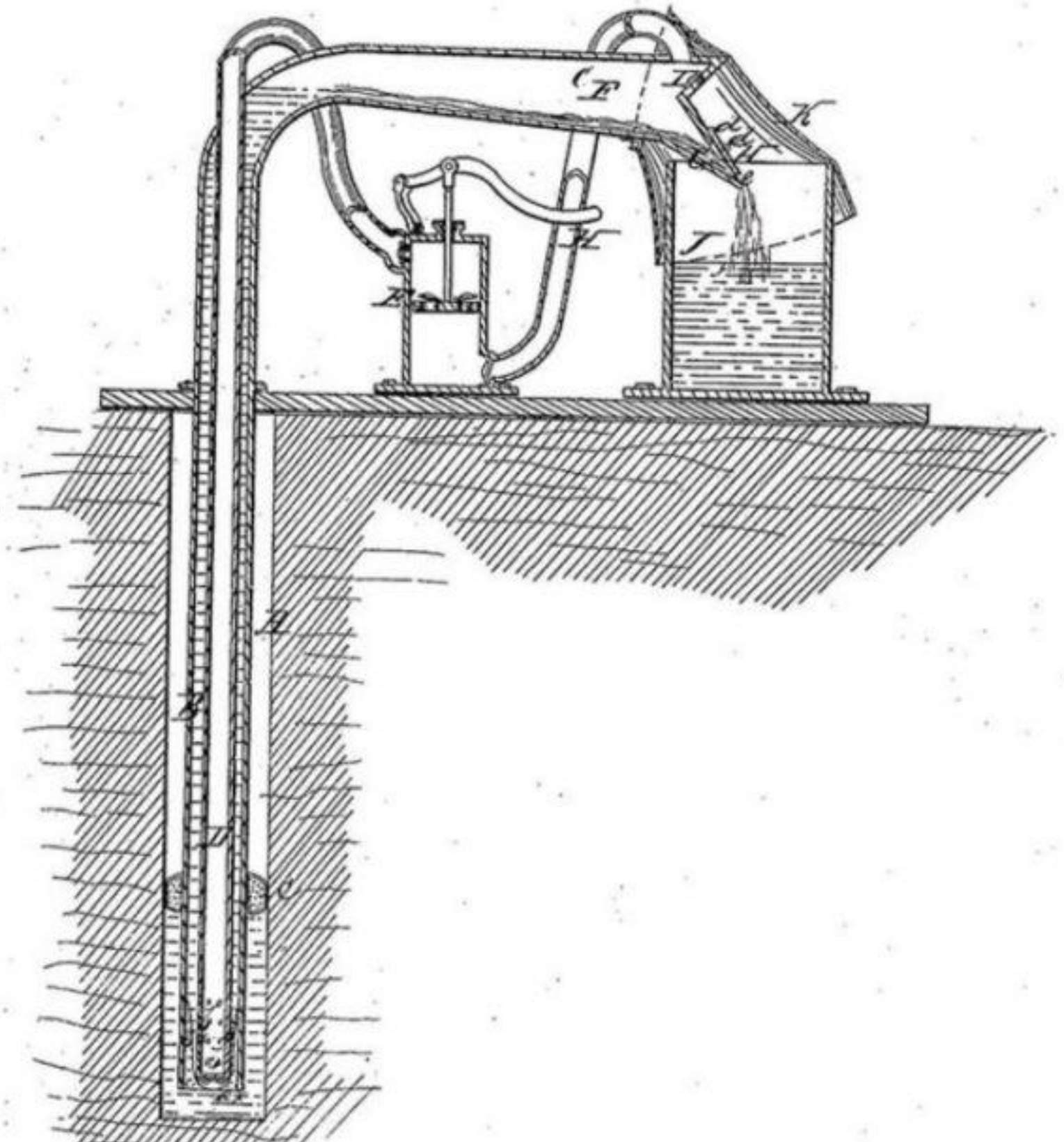


Figure 1 - Thomas B. Gunning under patent no. 45,153 issued in November 1864.

*Witnesses,
Henry Morris
Thos. Trench.*

*Inventor,
Thos B Gunning*

Source: US Patent and Trademark Office.



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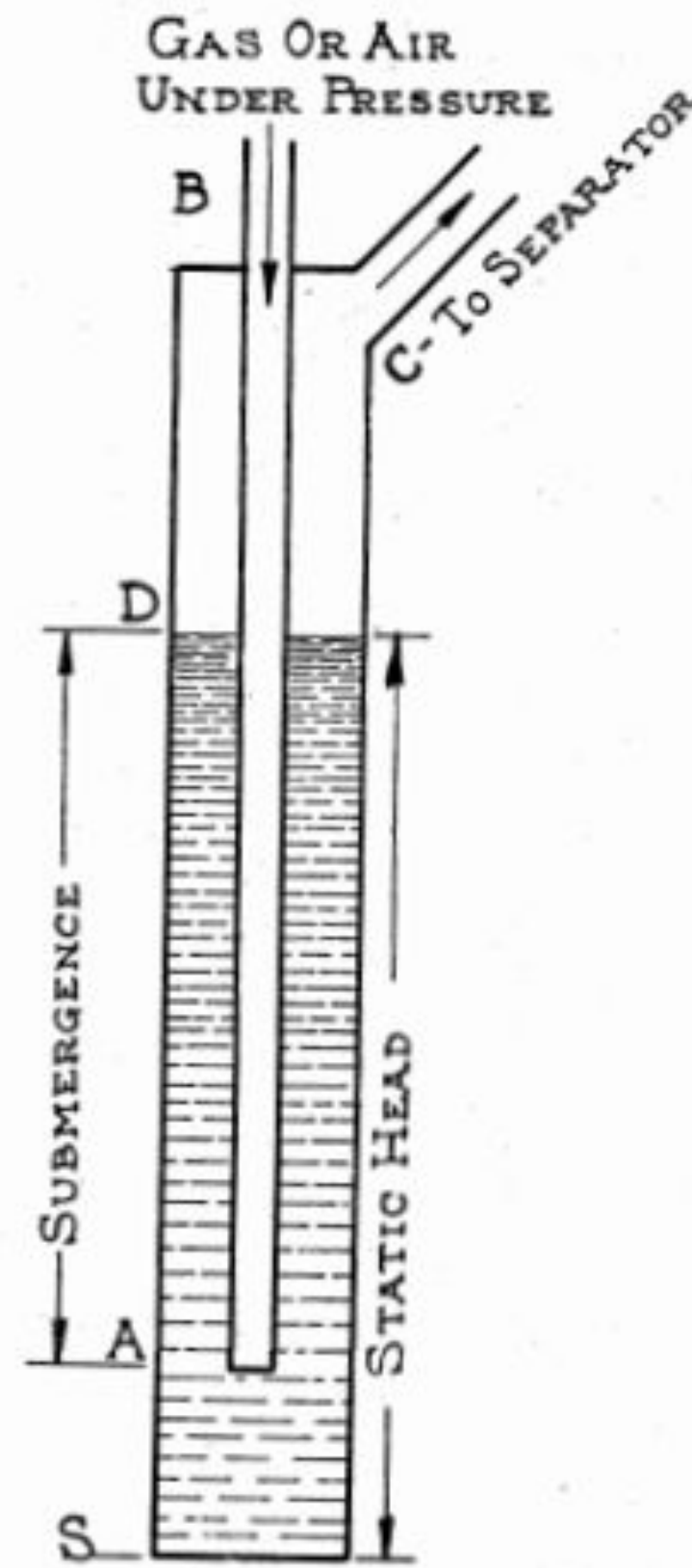


FIG. 1

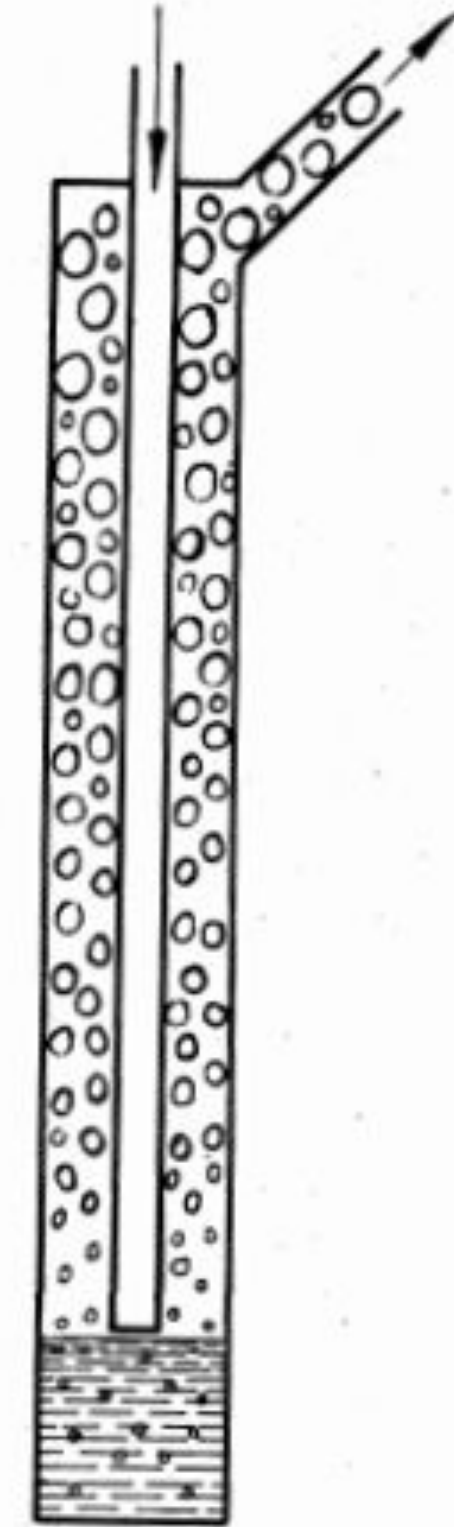


FIG. 2

Diagram showing approximate conditions
in a well before and after "kick-off."

[31]

Figure 2 – Diagram from "Actual Practice" Chapter of "Something about GAS LIFT
(1928)"



SO WHICH IS IT?

- A testimony to the practical brilliance, dedication, and perseverance of an individual.
- A glowing example of moving effective innovative practices along quickly.
- A “cautionary tale”





HPGL FLEXIBILITY ENABLES OTHER APPLICATIONS

- Unloading Frac Hits
- EOR
- Preventing Flaring
- Conventional/ “Problem” Wells



UNLOADING FRAC HITS - SWABBING

SWABBING ADVANTAGES

1. High success rate on packer wells.
2. No outside gas requirements.

SWABBING DISADVANTAGES

1. General risk from putting tools into the well.
2. Specific risk of getting stuck with solids.
3. Limited fluid removal rates
4. Generally, requires an extra tank and the flaring/venting of natural gas.



UNLOADING FRAC HITS - NITROGEN

NITROGEN ADVANTAGES

1. Does not require entry into the well.
2. Provides the lifting gas required, no outside gas requirements.
3. Liquid nitrogen can provide high rates, although these are not normally needed.
4. Can be used to displace fluids from the well via bullheading.

NITROGEN DISADVANTAGES

1. Requires venting of nitrogen and then some natural gas until the produced gas meets pipeline requirements.
2. Liquid nitrogen is expensive, especially if long term unloading is required.
3. Nitrogen generation has relatively low-rate capability and the potential for introducing undesirable impurities such as oxygen into the well.



UNLOADING FRAC HITS - CNG

CNG ADVANTAGES

1. Does not require well entry.
2. No additional outside gas requirement.
3. No venting or flaring should be needed.
4. Can be used to displace fluids from the well via bullheading.

CNG DISADVANTAGES

1. Cost of trucking and gas
2. Limited amount of gas in tank
3. Pressure drops as the tank is emptied meaning much of the gas that is in the tank may not be able to be used to lift the well.



UNLOADING FRAC HITS – TRAILER MOUNTED HPGL (TM HPGL)

TM HPGL ADVANTAGES

1. Does not require well entry.
2. No venting/flaring should be required.
3. Ability to lift the well for as long a period as needed with reasonable costs.
4. Minimal personnel attendance required (with proper instrumentation/automation)

TM HPGL DISADVANTAGES

1. An outside gas source is required from a buyback meter or CNG until the well produces enough gas to fuel the unit.

Case Histories on Unloading Frac Hits with HPGL from Operator in the Northeast



UNLOADING FRAC HITS WITH TM HPGL – CASE 1

Gas Lift Well, MD= 7550', TVD = 7200'

(All wells have 5.5", 23#/ft casing, 2 7/8" tubing set near Max TVD)

- Kickoff - 2315 psig
- TM HPGL Time on well - 9 days

Case 1 GL Well	MCFD	BOPD	BWPD	MCFD Inj.	Tub., psig	Cas., psig
Pre Frac Hit Avg.	1607	321	65	207	356	654
Post Frac Hit Avg.	1325	558	366	0	677	1604



UNLOADING FRAC HITS WITH TM HPGL – CASE 2

Gas Well, MD= 9370', TVD = 8980'

- Kickoff - 2924 psig
- TM HPGL Time on well - 34 days

Case 2 Gas Well	MCFD	BOPD	BWPD	Tub., psig	Cas., psig
Pre Frac Hit Avg.	6393	0	0	888	1303
Post Frac Hit Avg.	5397	0	0	1356	1783



UNLOADING FRAC HITS WITH TM HPGL – CASE 3

Packer Well, MD= 8660', TVD = 8440'

- Kickoff – NA (Pushed Fluid into well)
- TM HPGL Time on well - 2.5 days

Case 3 Packer Well	MCFD	BOPD	BWPD	Tub., psig	Cas., psig
Pre Frac Hit Avg.	953	0	17	435	0
Post Frac Hit Avg.	1288	0	19	407	0



LEARNINGS FROM OPERATOR UNLOADING ALL FRAC HITS TM HPGL

- Train Personnel on specifics – Compressor and Moving
- Instrument TM HPGL Skid/facilities for Unattended/Remote Operations
- Set up compressor for max. flexibility
 - Suction and Discharge Control Valves
- Consider HP Hoses



FLEXIBILITY ENABLES OTHER USES

- EOR
- Preventing Flaring
- Conventional/ “Problem” Wells



CONCLUSIONS

- Bill Elmer started the modern era of HPGL in Dec. 2015
- Dennis Estis' willingness to package Will Nelle's HPGL unit design was key
- Industry Forums like SWPSC, PBALF, SPE and ALRDC were important for industry acceptance of HPGL
- Branden Pronk/SM Energy willingness to publish high rate results greatly accelerated HPGL
- Use of HPGL in unloading fracs, EOR, preventing flaring, conventional/problem wells and other areas will continue to expand
- The best of HPGL is yet to come!



THANK YOU

Questions?