Selection and Installation of Subsurface Pumps for Pumping Gaseous Wells

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INTRODUCTION

The oil industry is faced with a problem of lifting more oil and reducing lifting costs, and this problem has no doubt been a deciding factor favoring multiple completions. It is now common practice to drill a common hole and cement several strings of tubing to be used as casing, which lowers the cost of the initial program.

While the wells flowed and produced the allowable, the operators were not faced with some of the problems that they now have confronting them. Pumping wells from under a packer or from a situation from which it is impossible to vent the gas has always been a problem until the gas chaser type pumps were designed and placed in service. By using the gas chaser type pump operators are now able, with more efficiency, to pump more gassy wells than ever before; but even this fine type of pump must be given very careful setting and spacing to assure the best results.

To have the best compression ratio, the conventional insert type pump or tubing type pump requires that it be spaced as close to bottom as possible (Fig. 3).

The gas chaser type pump must be spaced as close to the top of the upstroke as possible if the best compression ratio is to be achieved. This pump is designed to compress on the top of the upstroke (Fig. 1).

Essential in this gas chaser type pump is a minimum of unswept area so the pump will, on the bottom of the downstroke, have less chamber area for the gas to occupy at the bottom of the primary plunger. The operator is advised never to use a longer primary barrel tube than is necessary to take care of over-travel and to get the pump spaced properly at the beginning of the installation. It is wrong to assume that a longer primary barrel tube will trap more fluid and that the pump will produce more fluid. Experience has proven that the shorter the lower or primary barrel tube the better the pump will perform.

Wells that have casing perforations below the seating nipple nearly always have a tendency to be gassy and troublesome to pump if much gas is present. Wells that are completed in open hole and have to be pumped far up the hole above the pay zone are also hard to pump. The gas in the above type completions almost always tries to escape out through the tubing or the casing. If it goes out through the tubing the pump is not going to operate very efficiently because of valve interference. If it goes out through the casing in large volume it will fill the ordinary pump with gas or foam, and a gas lock will result.

GAS LOCK

A gas lock occurs when the pressure in the tubing above the pump is greater than the pressure inside the pump barrel tube below the plunger. This gas lock condition cannot be overcome until the pressure inside the barrel tube and below the plunger is increased sufficiently to the point at which it can be compressed and the pressure differential inside the barrel tube below

GAS CHASER ROD PUMP

FIG. 1

the plunger is decreased so the standing valve can be opened and the pumping cycle again resumed.

Conventional pumps gas lock because of the fluid in the tubing exerting a pressure on the balls and seats in the plunger of stationary barrel type pump (Fig. 3). This hydrostatic head of fluid exerts on the valves a pressure that must be overcome by compression in the barrel tube below the plunger and against the standing valve in the pump. The pressure buildup on the down or compression stroke of a conventional pump must be greater than the pressure above the plunger before it can move out into the tubing above the plunger. But foamy, gassy oil cannot be compressed and when it expands and contracts with each stroke of the pump a gas lock condition exists.

Some of the causes of gas lock can often be contributed to the operator using a gas anchor that has a smaller diameter than has his pump bore. Or the operator may be using a gas anchor that is too long and the gas breaks out of solution before it enters the pump. It is recommended that gas anchors be of a diameter as near as possible to the diameter of the plunger and that the length of the gas anchor be designed where the inlet will be from 5 to 10 ft below the mud anchor perforations.

It is best to have the mud anchor perforations below the casing perforations in the well, and if that placement is not possible, then the mud anchor perforations should be moved up the hole several feet above the casing perforations. The mud anchor perforations should never be opposite the casing perforations, for this placement creates the most turbulence. Further, the free gas will enter the pump, and most of the pump capacity will be spent in handling gas.

If possible, the gas should be vented from the casing; and if not possible, the next best thing to be done is to install a back pressure valve on the tubing and pump the well against sufficient back pressure to prevent it from flowing through the pump at pressure buildup intervals. This back pressure system increases very slightly the polish rod load and it is an aid to keep paraffin from forming in the tubing and on rods. However, if a maximum gassy condition exists and if none of the above recommended suggestions improve the production in the tank, then it is time to install a gas chaser type pump that has the ability to compress the gassy, foamy oil.

It should be remembered that, after installing a gas chaser type pump in a problem well, the pump is doing a job of compressing foam and gassy oil; and if the production is increased, then the gas volume is also increased, and both these products can be sold. The increase may not be what had been hoped for, but the pump is handling much gas not previously handled, and this gas occupies the same space that oil would occupy if it were in proper solution for the pump to handle.

In many well conditions in which large volumes of gas are to be handled it is wise to use a larger bore pump than one would normally use if he were lifting all fluid.

GAS CHASER TYPE PUMP

The gas chaser type pump is a dual plunger pump that might be compared to a two stage air compressor that has a large primary piston and a smaller secondary or compression piston. The gas chaser pump is designed to give the maximum in compression ratio which is achieved by installing a secondary stage plunger and seal. In effect, this secondary stage plunger carries the ever present fluid load in tubing above the pump and allows the primary or large lower plunger to operate a better suction to obtain a maximum entry of gas, or fluid and gas mixed, into the primary chamber. From the primary chamber the gas or mixture of fluid and gas goes into the secondary chamber where it is compressed on the upstroke; and when sufficient pressure is built up inside the long secondary plunger and overcomes the hydrostatic head on top of the plunger it is moved out into the tubing. This action clears the primary barrel tube of fluid or gas or foam, and differential pressure is now lower in this primary tube: the gas or fluid can enter from well bore at the beginning of the up stroke.

The gas chaser type pump is made by installing the secondary stage plunger and seal in the top of a con-

SPRING LOADED
METAL PLUNGER
ROD PUMP

FIG. 2

ventional stationary barrel rod pump. This assembly consists of a packing box that is connected to the barrel tube of the lower or primary pump. The upper plunger is of a smaller diameter than is that of the lower plunger, and they are connected by two adapters. The top of the secondary plunger has a connection to adapt the cage holding the ball and seat, and the cage can be open for sucker rod or closed for hollow tubing.

The purposes of the secondary plunger are to furnish seal against which the primary plunger can compress and to support the fluid load in the tubing. The capacity of the pump is figured by using the diameter of the lower or primary plunger. In the event that a traveling standing valve is desired, the balls and seats are removed from the hold down.

To figure the capicity of the gas chaser type pump with a traveling standing valve it is necessary to substract the area of the secondary plunger from the area of the primary plunger, and the result is the effective diameter that one has with a standing valve removed from gas chaser type pump.

EXAMPLE: 2 in. x 1-1/2 in. x 1-1/16 in. x 15 ft x 18 ft Gas Chaser Type Travelling Standing Valve

	Area in Sq in.
Diameter of primary plunger - 1-1/2 in.	1.767 in.
Diameter of secondary plunger - 1-1/16 in.	.887 in.
Diameter of effective plunger is approximately - 1-1/16 in.	.880 in.

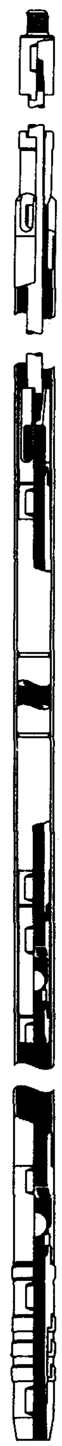
Gas chaser type pumps with traveling standing valves are often used when hollow rods are being utilized and where ever the capacity is large enough to produce the desired amount of fluid. When using hollow rods some operators experience some difficulty with gassy wells and they perforate their tubing above the seating nipples to allow the gas to vent out on the outside of the hollow rods. Some operators also experience difficulty in getting the hollow rods to drop free; then it is necessary to go to this traveling standing valve system.

It is well to remember that oversized seating cups must be used when the pump is used with hollow rods and when fluid cannot be maintained above the pump in the tubing. The fluid in the tubing usually has sufficient hydrostatic head to keep a pump seated; but, when the tubing is perforated above the seating nipple or perforated holddowns are used, the hydrostatic head of fluid must be replaced by a dual seating device or oversized cups on the holddown of the pump.

Sufficient upper seal on the secondary plunger is required if one is to get the maximum compression from his gas chaser type pump. Experience has proven that this upper seal must be maintained to prevent any fluid previously pumped through the pump system from slipping down into the secondary compression chamber. When slippage from the upper seal occurs it can be seen that fluid is merely circulating around the secondary plunger and this circulation renders useless the compression chamber in secondary stage; for it cannot help to create a lower differential pressure in the primary barrel tube. When this action takes place one has, in effect, a stationary barrel type pump system operating without the advantage of compression.

RECOMMENDED SEAL:

Depth of Well	Feet of Seal Recommended
1500 ft	1 ft
1600 ft to 3200 ft	2 ft
3300 ft to 7600 ft	3 ft
8000 ft to 9500 ft	4 ft
10,000 ft to 12,000 ft	5 ft



METAL PLUNGER ROD PUMP

FIG. 3

On this upper or secondary plunger hard surfaced material should be used to reduce the coefficient of friction in the packing box assembly and to allow the primary or lower plunger to drop freely. Many materials are available to make this upper plunger hard and long wearing; and one cannot emphasize enough the importance of having this plunger made of proper material for the well condition. Sand and well trash will wear soft plungers, and slippage will result very soon after it is installed, and one will not get the desired results from his gas chaser type pump.

Corrosion is another enemy of pumps and even though one uses an excellent inhibitor it does not protect the outside of the pump. One must buy materials to resist corrosion in the pump and also be sure to get sufficient top seal to do the job right. Then the operator will see an increase in production and a reduction in well pulling and servicing because of pump troubles.

Gas chaser type pumps are available for use in slim hole tubing as well as 2 in. and 2-1/2 in. and 3 in. tubing. They are available in top hold down and bottom hold down types, and they can be made of corrosion resistant materials to take care of mild or severe corrosion. They also can be made to pump sand and one has a large selection of balls and seals from which to choose. Gas chaser type pumps can be set as casing pumps on anchors in all sizes of API tubing and are made for long stroke hydraulic units.

This pump is the most versatile pump that one can run in a deep well and be assured of getting the maximum in pumping efficiency.

SPRING LOADED PUMP

The spring loaded pump is another of the gas moving type pumps that is available to pump foamy, gassy, troublesome wells (Fig. 2).

The spring loaded pump was designed for use in wells in which it has been necessary to let the pump bump bottom to either dislodge trash from under the valves or to equalize the pressure inside the barrel tube with the pressure in the well bore. When the pressure is equalized the gas lock is eliminated.

Conventional pumps are not designed to bump bottom very long without something in the pump or the rod string parting or breaking.

On the other hand the spring loaded pump is designed to allow the upper plunger to strike against the lower plunger; therefore, the unswept area between the standing and traveling valves has been eliminated. This elimination can be accomplished without damage to the pump or rod string or to the pumping unit.

This pump was first designed for use on central powers that carry relatively short polish rod strokes, during which temperature differences cause stroke variations and the pump cannot be set for close valve spacing. The first pumps were made of eight cup plungers, but experience has proven that metal plungers or flexite ring plungers applicable to individual well conditions can be used with the same excellent results in deep wells.

<u>OPERATION:</u> On down stroke, the pump is set so the spring loaded plunger is partially depressed against the spring cushion on each stroke. (Maximum travel of spring is 12 in.). This engagement permits extra close valve spacing and serves to insure that the pump chamber is completely cleared of gassy fluid on each upstroke. On upstroke, the tubing pressure load holds the spring loaded plunger down.

This pump can be spaced to allow the two cages that contain balls and seats to strike against each other, if necessary, to jar out any trash that otherwise would be difficult to jar out in conventional pumps. The shock to the rods and the pumping unit is minimized by the hydraulic effect of the fluid column above the top pump plunger.

This spring loaded assembly can easily be installed on any existing subsurface pump.

By installing the proper adapter to connect the pump to the tubing or hollow rods, this pump can be used with hollow rods; and the pump also offers all of the advantages of a conventional traveling barrel rod pump with the added feature of being able to break gas locks.

SUMMARY

It will pay the reader to remember that, when installing this assembly, he should always remove the standing valves and install them on top of the lower plunger. If double valves are favored they should be installed both on the top of the bottom plunger and on the bottom of the top plunger. A ball and seat should never be placed in the top of the pump, for this placement will defeat the principle of the operation. An adapter is standard equipment that will not permit the use of a ball and seat; but an existing open cage with a seat only can be used if one desires to reduce costs. The seat only serves to permit a tight fit with shoulder to the bushing on top of extension nipple. Hard balls and seats and stellite lined cages are recommended in all pumps handling large volumes of gas, for the valve system is the heart of any pump and must be dependable if one is to keep down lifting costs.

CASE HISTORY ON WELLS

<u>WELL NO. A:</u> Dual completion - Under Packer
Perforated 5250-5300 ft.
12 - 54 in. SPM.
GOR - 705 to 1
Pump set at 5175 ft
PRODUCTION: 8 bbl of oil
<u>2</u> bbl of water
Total 10 BPD
PUMP: Gas Chaser Type -
1-1/2 in. x 1-1/4 in. x 3/4 in. x 16 ft x 19 ft
Unable to produce this well before installing Gas Chaser Type Pump.

<u>WELL NO. B:</u> Triple Completion - Under Packer -
Open Hole 10,609 ft.
8 - 120 in. SPM
G. O. R. - 1,107 to 1
Pump set at 7,700 ft
PRODUCTION: 30 bbl of oil
<u>194</u> bbl of water
Total 224 bbl of fluid
PUMP: Gas Chaser Type -
2-1/2 in. x 1-1/4 in. x 1 in. x 22 ft x 28 ft
Gas Chaser Type Pump was part of original equipment.
No other types were used before present pump was installed.

WELL NO. C: Dual Completion - 2 strings Cemented in - Perforated 3300 ft.
16 - 54 in. SPM
G. O. R. - 925 to 1
Pump set at 2847 ft
PRODUCTION: 24 bbl of oil
76 bbl of water
Total 100 bbl
PUMP: 2 in. x 1-1/4 in. x 12 ft x 15 ft Gas Chaser Type Adapted for 2-1/2 in. tubing.
Before installing Gas Chaser Type Pump, well made from 0 to 50 bbl total fluid each 24 hrs. Four different pumps were installed in this well before the Gas Chaser Type was placed in service;

WELL NO. D: Single completion - Several Zones - Open Hole Completion 7560 ft
10 - 84 in. SPM
G. O. R. - 1254 to 1
Pump set at 7133 ft
PRODUCTION: 89 bbl of oil
1 bbl of water
Total 90 bbl of fluid
PUMP: 2 in. x 1-1/2 in. x 1-1/16 in. x 18 ft x 21 ft Gas Chaser Type.
This well made from 15 to 54 bbl each 24 hr before Gas Chaser Type was installed.