A WAY TO ELIMINATE FLUID AND GAS POUND WITH THE NEW TWO-STAGE CHARGER VALVE

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Lack of submergence and gas interference are the principal causes of poor pump efficiency; both create fluid pound. Fluid pound contributes greatly to rod parts, bearing and gear failure in pumping units, V-belt failure and prime mover damage. The greatest loss is in production when gas interference is present.

Subsurface gas separators of many designs are being used; these separators are essential. The more gas that is separated from the oil and permitted to escape up the casing before it can reach the pump intake, the better. Some of the gas that remains in solution until it reaches the pump intake will break out of solution as it passes through the dip tube and standing valve.

Intermittent pumping will greatly reduce equipment damage where fluid pounds are created by lack of submergence. One can intermittently pump a well with gas interference and reduce damage to equipment, but often at a sacrifice in production.

Much of the gas breaks out in the formation and enters the casing through the perforations as free gas. Free gas escapes up the casing at about six inches per second in oil, and this gas should not present a pumping problem unless the well is overpumped or excessive back pressure is held on the casing. Some gas remains in solution until it enters the pump. *Some* gas remains in solution even through the pump. This gas breaks out when it reaches its bubble point and quite often flows off. This is called "heading up".

Gas-locking occurs when the traveling valve remains closed throughout the stroke.

The "Charger" valve supports the fluid load above the traveling valve until near the bottom of the downstroke, then charges the upper chamber with fluid. A fluid pound cannot exist unless the fluid load is supported by the traveling valve on the downstroke. A fluid pound on the upstroke cannot exist if the traveling valve supports the entire fluid load. With a "Charger" valve, the seal opens at the beginning of the upstroke because the pump is filled with liquid.

The seal closes and supports the fluid load at the beginning of the downstroke. The upper chamber approaches zero psi quickly after the plunger starts its downward movement. The fluid and gases in the lower chamber simply pass through the traveling valve as it moves down. The fluid load is supported by the seal and the buoyant effect is eliminated permitting the rods to fall more freely, thus increasing the weight of the rods on the downstroke. In every test we have to date, the range of load in rods has been reduced because of this increased weight on the downstroke. The peak polished rod loads have remained about the same or have been reduced, except in one test where there was an increase, which will be discussed later.

WHAT WILL A "CHARGER" VALVE DO?

A "Charger" valve will:

1. Eliminate the adverse effects caused by fluid pound and gas pound in both the upstroke and downstroke
2. Eliminate gas-lock without sacrificing pump displacement
3. Usually reduce the range of load on the rods where fluid or gas pound would exist
4. Usually increase production where gas interference exists
5. Act as a sand check valve.

WHERE SHOULD A "CHARGER" VALVE BE APPLIED?

A "Charger" valve should be applied on:

1. *Every* installation that is pumping from under a packer
2. *Every* installation where a "gas pound" occurs due to gas breaking out of the oil during pump filling
3. *Every* installation where a gas separator does not work effectively
4. *Every* installation where "gas locking" occurs
5. *Every* installation where "tapping bottom" is necessary to keep it pumping
6. *Every* installation where the customer must "pound fluid" to get all the fluid.

THE TYPES OF API PUMPS ON WHICH A "CHARGER" VALVE CAN BE INSTALLED

A "Charger" valve can be installed on all tubing pumps, all top holddown pumps, and all bottom holddown pumps.

On the upstroke, an API pump fills with oil and gas. The standing valve is open. At the beginning of the downstroke the standing valve closes. When the traveling valve strikes the fluid in the pump with the tubing load supported by it, a pound occurs. (Figure 1A)

A pump having a conventional two-stage valve attached will pound on the upstroke. If this pound occurs just at the peak torque moment, one can imagine the added torque that must be transmitted to the gear box. This pump and the API pump can and do become gas-locked. Two-stage pumps cannot pound on the downstroke because the tubing load is supported by the two-stage valve. (Figure 1B)

Pumps with charger valves cannot pound on either upstroke or downstroke. On the upstroke, the lower chamber fills with oil and gas. On the downstroke, the tubing load is supported by the charger valve. The traveling valve opens quickly. This permits the oil and gas in the lower chamber to pass through the traveling valve. Near the bottom of the downstroke, some of the fluid supported by the charger valve is dumped, filling the upper chamber. The traveling valve, once again, is supporting the tubing load. As it starts up, the charger opens, preventing a pound. This pump cannot gas-lock. (Figure 1C)

Figure 2A is a dynamometer card taken from a major oil producer's well, south of Big Spring, Texas. The well had been pumping continuously for many years producing 148 BFPD from under a packer. Figure 2B is the same well after being shut-in

BOTH OF THESE PUMPS CAN AND DO BECOME GAS-LOCKED. BOTH POUND FLUID.

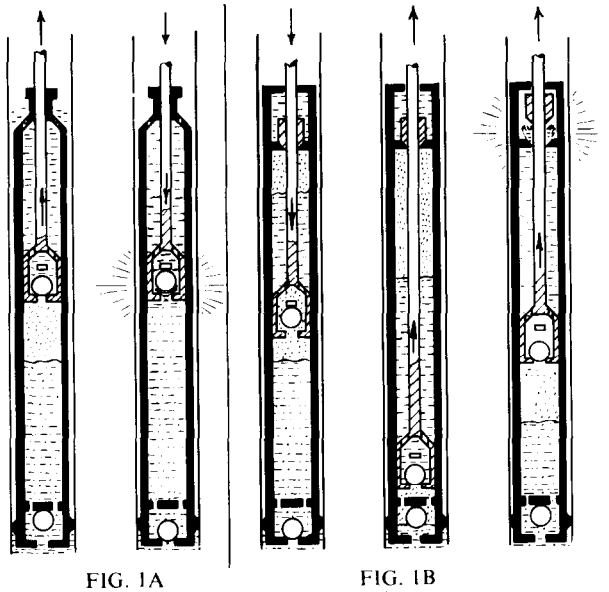


FIG. 1A FIG. 1B

FIG. 1A API ROD PUMP-POUND ON THE DOWNSTROKE.
FIG. 1B CONVENTIONAL TWO STAGE PUMP POUNDS FLUID ON THE UPSTROKE.

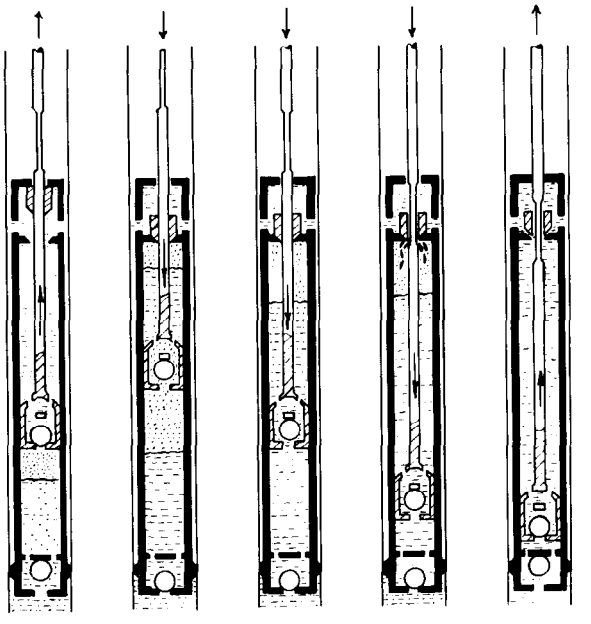


FIG. 1C CHARGER VALVES ELIMINATE GAS LOCK AND PREVENT FLUID POUND ON THE UP OR DOWN STROKE.

for three hours. Figure 2C is the same well with a charger valve. The valve was installed on October 26, 1975. The well produced 505 BFPD until the valve was removed to be installed in a better well. The minimum load has been increased; this is the only well tested that had a significant increase in peak polished rod load.

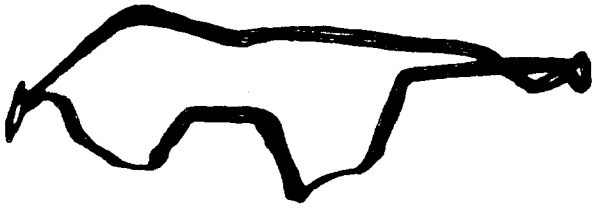


FIG. 2A—API TUBING PUMP, 148 BFPD.

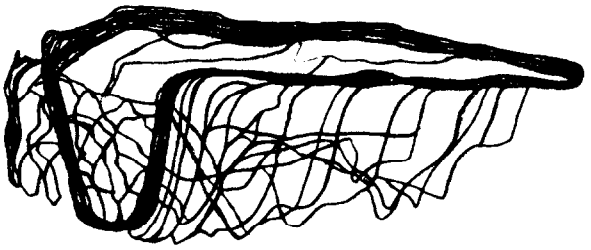
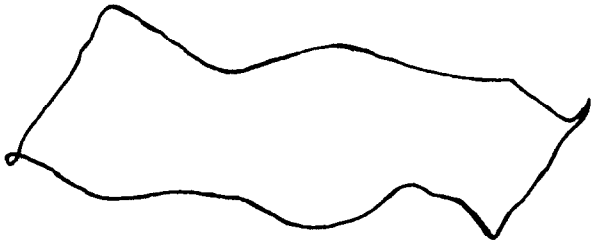


FIG. 2B API TUBING PUMP, SHUTIN 3 HR.



FIT. 2C SAME API TUBING PUMP AS IN FIGS. 2A AND 2B WITH CHARGER VALVE. 505 BFPD.

The charger valve was pulled and installed in another well. The card (Fig. 3) indicates a severe pound on the upstroke. This is typical of the conventional two-stage valve. It is also to be expected if a charger valve is not spaced properly.

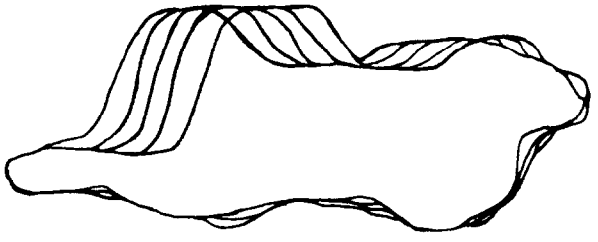


FIG. 3 SAME API TUBING PUMP AS IN FIGS. 2A, 2B AND 2C WITH CHARGER VALVE - POOR SPACING

FIG. 4A API INSERT PUMP, 205 BFPD.

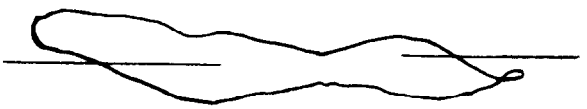


FIG. 4B—SAME API INSERT PUMP (FIG. 4A) WITH CHARGER VALVE, 226 BFPD

A pump having a charger-type valve must be spaced with the traveling valve as close to the standing valve as possible. The grooves in the valve rod must extend through the sealing element.

The well in Fig. 4A was producing 205 BFPD. The card indicates a delayed pound that is harmonically in sequence with the peak load.

The same well four days later was producing 226 BFPD with a "Charger" valve. Fluid pound was eliminated, and high peaks and valleys were smoothed out, Fig. 4B.

A major company in the Denver City area had the condition shown in Fig. 5A in one of their San Andres wells. The well was producing 409 BFPD. The well had a fluid level 3540 ft down and the card indicates a severe fluid pound. With a "Charger" valve the well is producing 440 BFPD. Working

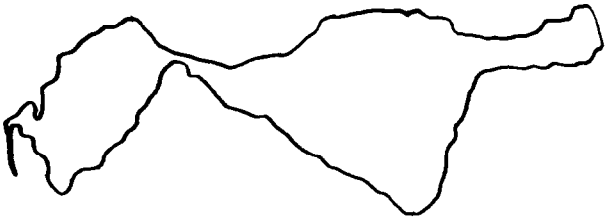


FIG. 5A—API INSERT PUMP, 409 BFPD, FLUID LEVEL 3540 FT DOWN.

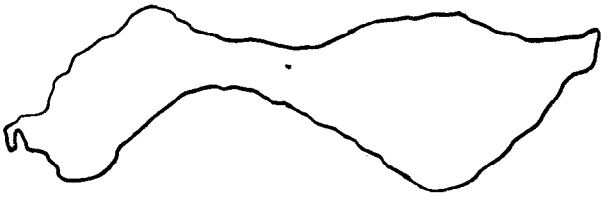


FIG. 5B SAME API INSERT PUMP (FIG. 5A) WITH CHARGER VALVE, 440 BFPD, FLUID LEVEL 5100 FT DOWN

FIG. 6A -API INSERT PUMP, 32 BFPD AND 1 MCF GAS, FLUID LEVEL 548 FT DOWN.

FIG. 6B—SAME API INSERT PUMP (FIG. 6A) WITH CHARGER VALVE, 87 BFPD AND 1.47 MCF GAS, FLUID LEVEL 2300 FT DOWN.

fluid level is 5100 ft down. Fluid pound is very slight, Fig. 5B.

A southern Oklahoma well was producing 32 BFPD with slightly over one million cubic feet of gas, Fig. 6A. The fluid level was 548 ft from the surface.

Three days after charger was installed, the well was producing 87 BFPD along with a 47% increase in gas, Fig. 6B. Fluid level is now 2300 ft from the surface. This well settled at 61 BFPD and slightly over 1.5 million cubic feet gas per day. The fluid level is 5000 ft down.

CONCLUSION

Fluid pound and gas-locking in all API pumps, except traveling tube type, can be eliminated with the installation of a "Charger" valve. Pump efficiency can be increased if gas interference is present. Longer rod life is to be expected if the range of load is reduced. Good gas separators are always an improvement.

It is hoped that a more profitable operation may be realized in extended equipment life through a better understanding of fluid pound and how to prevent it.