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LUBRICATION OF AIR COUNTERBALANCE CYLINDERS

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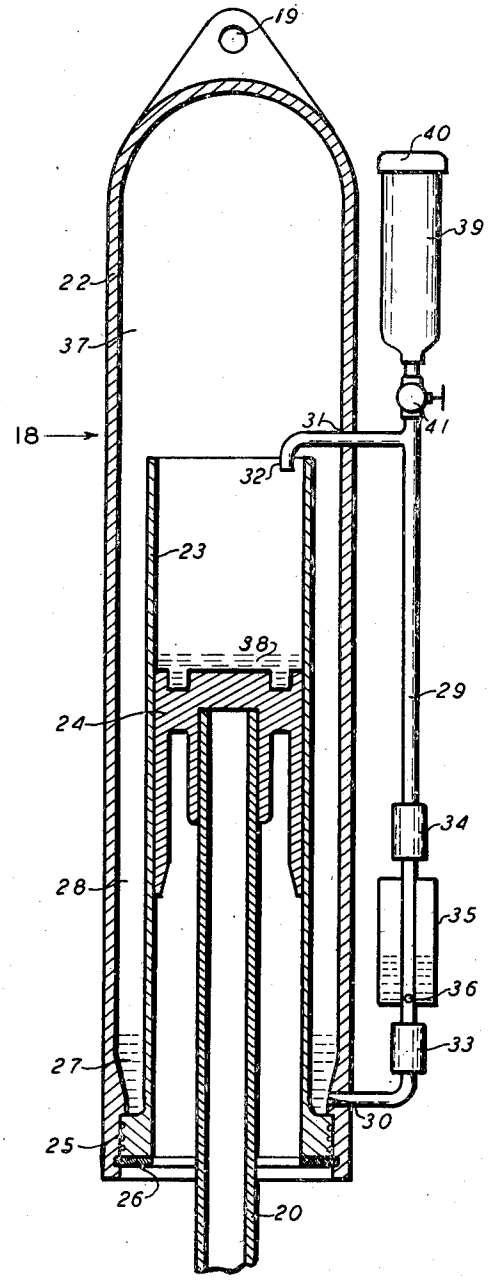


FIG. 2

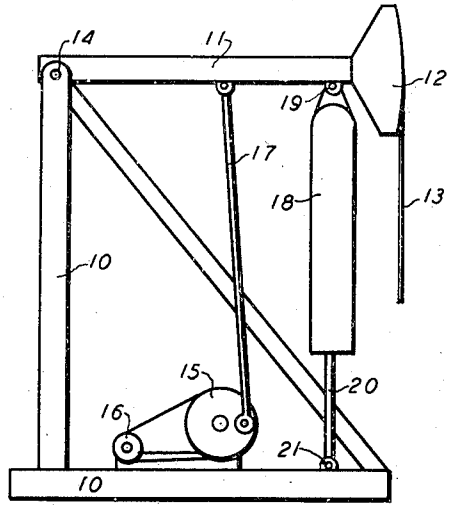


FIG. 1

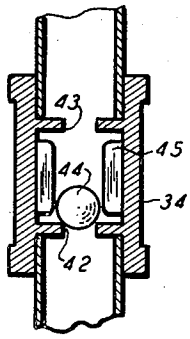


FIG. 3

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LUBRICATION OF AIR COUNTERBALANCE CYLINDERS

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3 Claims. (Cl. 267—1)

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A purpose of the invention is to provide means for effectively lubricating the working cylinders of the air counterbalances used in pumping deep wells such as oil wells.

A further purpose of the invention is to maintain the upper end of the counterbalance piston flooded with oil and thereby to prevent air leakage past the piston during shut-down periods.

The invention is explained with reference to the attached drawings, in which

Fig. 1 is a diagram of the type of counterbalanced pumping assembly to which the invention is particularly applicable;

Fig. 2 is a longitudinal section through the air reservoir 18 of Fig. 1, showing the working cylinder and the means for lubricating it, and

Fig. 3 is a sectional diagram of a type of check valve useful in connection with the apparatus of Fig. 2.

Referring first to Fig. 1, a frame 10 supports one end of a walking beam 11 provided with a horsehead 12 which carries the sucker rod line 13. The walking beam is reciprocated around the pivot point 14 by a crank 15 rotated by any prime mover 16, the crank and beam being coupled by a connecting rod or rods 17. The counterbalancing reservoir and cylinder unit 18 is swingingly attached to the walking beam as at 19 and the piston rod 20 is similarly attached to the base of the frame as at 21.

Referring now to Fig. 2, the counterbalancing unit 18 consists of an outer shell 22 providing a reservoir for air under pressure, a working cylinder 23, a piston 24 reciprocating in the cylinder, and the piston rod 20 of which only a fragment is shown in this figure. The barrel is tightly sealed into the reservoir shell at its lower end 25 and is retained in position by a split ring 26.

The reservoir is kept filled with air under pressure by a make-up compressor not shown, the pressure maintained being such as to counterbalance the weight of the pumping rod string plus one-half the weight of the column of oil in the tubing, thus equalizing the power required for producing the upstroke and downstroke of the rods.

The lubrication of the piston in the working barrel or cylinder of such counterbalances has been attended with some difficulty. Up to the present time it has been considered the best practice to provide an annular oil reservoir in the lower end of the cylinder, the skirt of the piston dipping into the oil in this cylinder at the end of each downstroke of the beam.

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This practice has not proven altogether satisfactory. First, when the apparatus is shut down for any reason, the film of oil between the piston and the cylinder oil is soon displaced and, no matter how carefully the piston rings may be fitted, air leakage will occur and may be rather rapid. This is highly undesirable as the pumping up of pressure once lost is a tedious and expensive operation.

Second, and contrary to all reasonable expectation, the oil wiped onto the wall of the cylinder tends to move upwardly past the piston, is finely atomized in the space above it and is thus carried over into the reservoir, accumulating as a pool 27 in the lower end of the annular space 23 between the cylinder and the reservoir wall. This occurrence necessitates rather frequent interruption of pumping to drain the pool and return the oil to the annular reservoir and, if this attention is not given promptly, the cylinder may run dry and be damaged.

I have improved over this prior art method by providing for a supply of oil to the top of the piston together with means for returning to this position any oil carried out of the cylinder and accumulated in the lower end of the reservoir.

The oil return means consists broadly in a pump taking suction on oil pool 27 and discharging into the upper end of the cylinder. This pump may be mechanically actuated if desired but I prefer the type of pump illustrated in Fig. 2 by reason of its low cost and extreme simplicity.

In the form shown, the oil return pump comprises a pipe or tubing conduit 29 communicating at its lower end with oil pool 27, as indicated at 30. The upper end of the conduit is sealed in the wall of the reservoir as at 31 and passes over the upper end of the cylinder as at 32.

A check valve 33, opening to permit upward flow, is placed at or close to the lower end of this conduit and a second check valve 34 is interposed in the conduit at a somewhat higher level. A small air chamber is also connected with the conduit at some point between the check valves, preferably close to the lower one. This may be branched from the conduit 29 or it may conveniently be formed as indicated at 35, by surrounding the conduit with a closed-end cylinder and providing a communicating orifice near the lower end, as at 36.

As the reservoir, attached to the walking beam, moves downwardly to perform the return stroke of the rods, the volume of space 37 within the reservoir is decreased by the relative upward movement of the piston. Thus the pressure in

the entire system is increased, and as fluid cannot pass downwardly through the upper check valve, a small quantity of oil is displaced from the pool through the lower check valve, compressing the air in chamber **35**.

As the beam produces the upstroke of the rods, the piston is retracted, the pressure in the system diminishes, and the expansion of the air in chamber **35** moves the displaced oil past the upper check valve, through which it cannot return.

In this manner, by displacing from the pool a small amount of oil with each stroke of the beam, the return of the lubricant to the top of the piston is produced solely by fluctuations in reservoir pressure and without any mechanical actuation. The returned oil forms a pool **38** on top of the piston, effectively sealing it against air leakage during shut-down periods and providing highly effective lubrication for the wall of the cylinder.

Make-up oil may be introduced into the reservoir in any desired manner, but a convenient arrangement is that illustrated in Fig. 2. An oil reservoir **39** having an air-tight removable cap (or a valve with wide opening) **40** is connected with conduit **29** through a manual valve **41**. With this valve closed and the cap removed, the reservoir is filled with oil, and on replacing the cap and opening the valve the oil in the oil reservoir will be pumped into the system during the first few ensuing strokes of the walking beam.

Under some circumstances the reciprocation of the piston is used to charge the reservoir with air. During this operation the pressure in the system fluctuates violently with each stroke. In order to prevent conduit **29** from bypassing the cylinder during this pumping-up operation it is desirable to form upper check valve **34** as a two-way check, as illustrated in Fig. 3. This fitting has two seats **42** and **43** facing toward each other and a ball **44** retained by guides **45**. The ball lies on the lower seat so long as pressure is exerted downwardly and lifts from its seat to permit oil to pass at normal velocity. In the event of a sudden surge of upward pressure the ball is lifted into engagement with the upper seat, preventing further flow.

I claim as my invention:

1. In an air counterbalance comprising an air reservoir, a working barrel concentrically arranged within said reservoir and communicating therewith at the upper end of said barrel, a seal between the lower end of said working barrel and the wall of said reservoir, and a piston relatively reciprocating in said working barrel; a conduit affording communication between the lower portion of the space between said working barrel and the wall of said reservoir and the space within said working barrel above said piston; a pair of upwardly opening check valves interposed in said conduit, one of said valves being adjacent the lower end of said conduit and the other at a higher level, and an air chamber communicating with said conduit at a point located between said check valves.

2. In an air counterbalance comprising an air reservoir, a working barrel concentrically arranged within said reservoir and communicating therewith at the upper end of said barrel, a seal between the lower end of said working barrel and the wall of said reservoir, and a piston relatively reciprocating in said working barrel; a conduit affording communication between the lower portion of the space between said working barrel and the wall of said reservoir and the space within said working barrel above said piston; a pair of upwardly opening check valves interposed in said conduit, one of said valves being adjacent the lower end of said conduit and having an upwardly facing seat normally closed by a ball and a downwardly facing seat normally spaced from said ball, the other of said check valves being at a higher level, and an air chamber communicating with said conduit at a point located between said check valves.

3. In an air counterbalance comprising an air reservoir, a working barrel concentrically arranged within said reservoir and communicating therewith at the upper end of said barrel, a seal between the lower end of said working barrel and the wall of said reservoir, and a piston relatively reciprocating in said working barrel; a conduit affording communication between the lower portion of the space between said working barrel and the wall of said reservoir and the space within said working barrel above said piston, and a pair of upwardly opening check valves interposed in said conduit, one of said valves being adjacent the lower end of said conduit and the other at a higher level.

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