Sept. 16, 1930. J. T. PHIPPS 1,775,733

PNEUMATIC COUNTERBALANCE FOR WALKING BEAMS

Filed Nov. 4, 1926

Fig. 1.

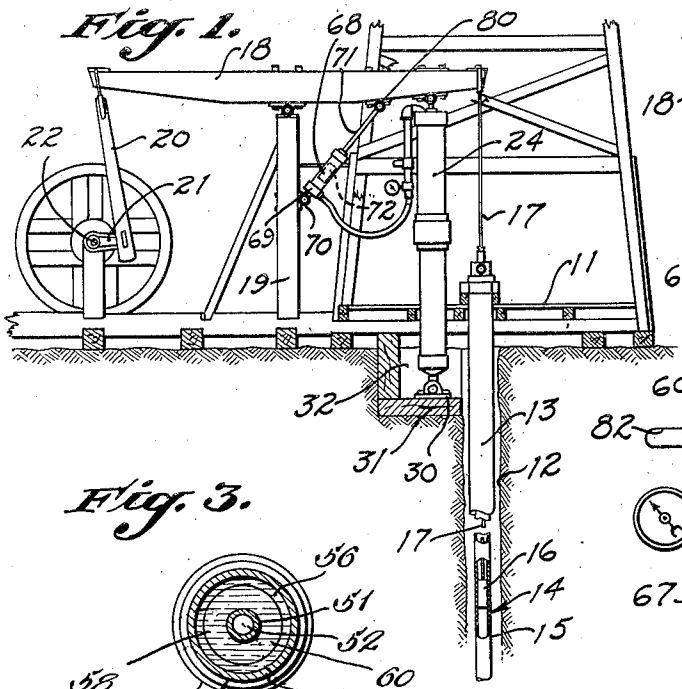


Fig. 3.

Fig. 4.

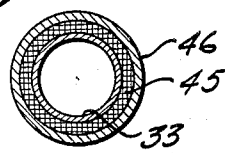


Fig. 5.

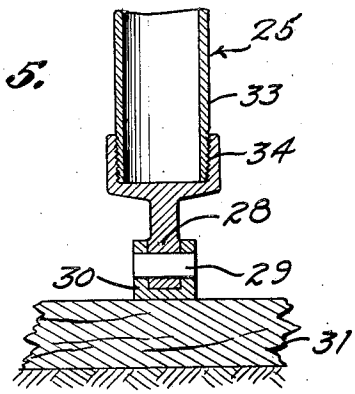
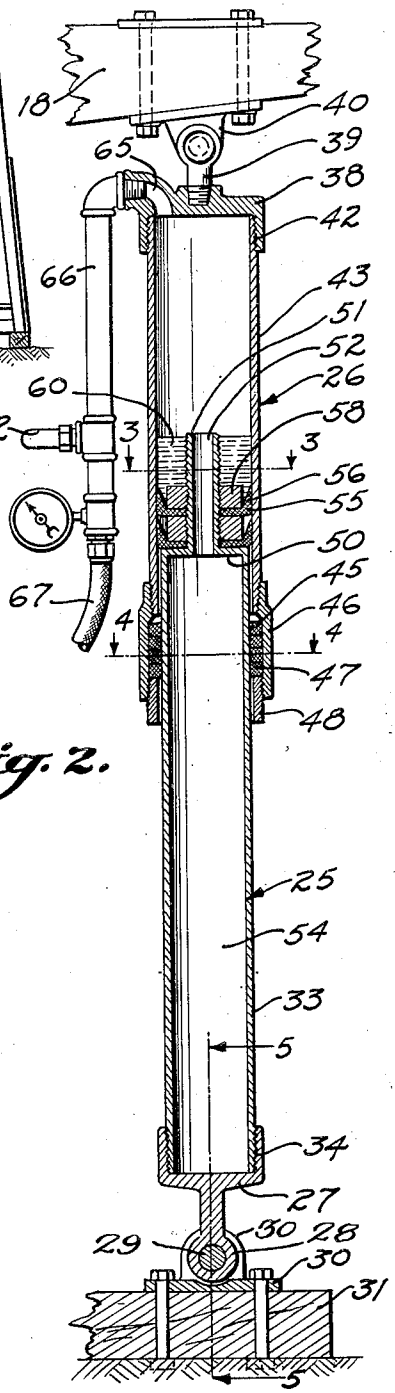


Fig. 2.



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UNITED STATES PATENT OFFICE

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PNEUMATIC COUNTERBALANCE FOR WALKING BEAMS

Application filed November 4, 1926. Serial No. 146,094.

This invention has to do with oil pumping and drilling equipment. In the oil producing industry oil is pumped from a well by equipment which generally comprises a pump situated near the bottom of the well. The barrel of this pump is secured to the lower end of a pump tubing which extends upward through the well. The plunger of the pump is reciprocated by a string of sucker-rods which is connected to the plunger and is extended upward through the pump tubing. A polish-rod is inserted in and forms a part of the upper end of the string of sucker-rods and extends through a stuffing box in the top of the pump tubing. The polish-rod is attached to one end of a walking-beam which pivots on a Samson post. This walking-beam is oscillated by means of a crank, the crank being connected to the walking-beam by means of a pitman. When the crank is rotated an oscillating movement is given to the walking-beam by means of the pitman. This reciprocates the string of sucker rods and operates the pump plunger in the barrel. The operation of the pump plunger elevates oil through the pump tubing to the surface of the ground.

In drilling wells with "standard" tools a wire line is attached to the walking-beam and reciprocates the tools in the hole. My invention is also applicable to drilling wells.

In pumping equipment for deep wells the weight of the plunger and the oil on the walking-beam is very great and it is necessary to counterbalance this weight by use of a counterbalance which is usually attached to the walking-beam on the side of the pivot remote from the end to which the string of sucker-rods is connected. This counterbalancing of the walking-beam permits the pumping equipment to operate with a minimum strain and with a minimum consumption of power.

It is the broad object of this invention to provide a counterbalance for the purpose specified heretofore.

It is a further object of the invention to provide a pneumatic counterbalance.

During the first half of the up stroke of the plunger, the plunger accelerates; therefore, the rod placed on the walking-beam consists of static weight and the dynamic weight which results from the inertia. It is evident that at this time the force of the counterweight should be greatest.

It is accordingly one of the objects of this invention to provide a counterweight which will apply a great force to the walking-beam during the first half of the up stroke of the plunger.

Another object of the invention is to provide a pneumatic counterbalance in which the pneumatic pressure is maintained at a predetermined point.

A still further object of the invention is to provide a pneumatic counterbalance in which there will be a minimum leakage of compressed gas.

Other objects and advantages of the invention will be made evident hereinafter.

Referring to the drawing in which I illustrate my invention,

Fig. 1 is a diagrammatic view showing my invention utilized with a pump operating mechanism.

Fig. 2 is an enlarged vertical section through the counterbalance of the invention.

Fig. 3 is a section taken on the line 3—3 of Fig. 2.

Fig. 4 is a section taken on the line 4—4 of Fig. 2.

Fig. 5 is a section taken on the line 5—5 of Fig. 2.

Referring in detail to the drawing and particularly to Fig. 1, 11 represents a derrick which is situated over a well 12. Extended into the well 12 is a pump tubing 13 having a pump 14 attached at the lower end thereof. The pump 14 includes a pump barrel 15 and a pump plunger 16, the pump plunger 16 being attached to the lower end of a string of sucker-rods 17 which extends upward through the pump tubing to a point above the surface of the ground. The upper end of the string of sucker-rods 17 is attached to the working end of a walking-beam 18. The walking-beam 18 is pivoted on a Samson post 19. The driven end of the walking-beam 18 which is opposite to the working end is connected to a pitman 20,

which pitman 20 is connected to a walking-beam crank 21. The walking-beam crank 21 is attached to a band wheel shaft 22.

Connected to the walking-beam 18 is a counterbalance 24 embodying my invention. Referring particularly to Figs. 2 to 5 inclusive the counterbalance 24 has a standing member 25 and a traveling member 26. The standing member 25 has a lower casting 27 having a bearing 28. The bearing 28 surrounds a bearing pin 29 which is supported by a bracket 30. The bracket 30 as illustrated in Figs. 1, 2 and 5 is attached to a plank 31 placed in a pit 32 formed below the derrick 11 (Fig. 1). The upper part of the casting 27 provides a threaded cavity 34 into which the lower end of a shell 33 is screwed.

The traveling member 26 has an upper casting 38 to which a pivot member 39 is secured. The pivot member 39 is pivoted to a bracket 40, the bracket 40 being attached to the walking-beam 18. The upper casting 38 has a threaded cavity 42 into which the upper end of a tube 43 is secured. The tube 43 is of larger diameter than the shell 33 and the shell 33 is extended thereinto. When the walking-beam 18 is oscillated the traveling member 26 is moved up and down so that the tube reciprocates on the shell 33.

Attached to the lower end of the tube 43 and surrounding the upper end of the shell 33 is a packer 45. The packer 45 consists of a body 46 which is threadedly secured to the lower end of the tube 43, as shown, packing material 47 placed within the body 46 and a nut 48 secured to the body 46 for compressing the packing 47 into a fluid-tight relationship with the shell 33.

The upper end of the shell 33 is provided with a head 50 from which a central threaded tube 51 is extended. A passage 52 through the tube 51 connects the interior of the tube 43 with the interior of the shell 33 so as to form an air chamber 54. Placed on the threaded tube 51 is a pair of cup members 55, lips 56 of which are adapted to engage the inner face of the tube 43. The cups 55 are held in place by nuts 58 which are screwed onto the threaded tube 51. The cups 55, the nuts 58 and the tube 51 comprise a cup attachment of the invention. In the annular space surrounding the tube 51 is a body of sealed liquid 60 which is preferably oil. This sealing liquid assists the cup attachment and also the packer 45 in preventing a leakage of air or other gas from the air chamber 54.

The upper casting 38 of the traveling member 26 is provided with a port 65 to which a pipe 66 is connected. Attached to the outer end of the pipe 66 is a flexible hose 67 which is extended to an auxiliary pump 68. A body 69 of the auxiliary pump 68 is attached to the Samson post 19 by a suitable pivot bracket 70. A piston rod 71 which extends from a plunger 72 of the auxiliary pump is attached by a bracket 80 to the walking-beam 18. As the walking-beam oscillates, the auxiliary pump 68 is operated and forces air into the air chamber 54. The pipe 66 is provided with an adjustable relief valve 82 by means of which the pressure in the air chamber 54 may be relieved when it exceeds a predetermined pressure. The pressure in the chamber 54 may be ascertained from the gauge 83 attached to the pipe 66.

The operation of my invention is substantially as follows:

When the plunger 16 is at the upper end of its stroke, the pressure in the air chamber 54 is at a minimum, because the traveling and standing members 26 and 25 are in extended position. When the plunger 16 is at the lower end of its stroke, the pressure in the air chamber 54 is at its maximum because the traveling and standing members 26 and 25 are in contracted position. The reason for this will be readily understood from the fact that the volume of the air chamber 54 is decreased when the traveling member 26 is lowered. When the air pressure in the chamber 54 is at a maximum, a maximum force is exerted on the walking-beam 18.

During the up stroke of the plunger 16 the oil is raised. During the first half of the up stroke, the plunger and the oil must be accelerated and during the last half of the up stroke no appreciable acceleration takes place. During the first half of the up stroke the greatest load is placed on the pumping equipment and on the engine. In my invention the counterbalance is so designed that it will apply a maximum force on the walking-beam during the first half of the up stroke so as to compensate for the extra load which is imposed on the walking-beam at this time. As previously explained, the load is at a maximum at this time because of the inertia of the oil and rods which must be accelerated. The pressure in the chamber 54 and consequently the force applied by the invention to the walking-beam may be regulated by adjusting the relief valve 82. The relief valve 82 may be made to relieve the pressure at a predetermined amount. The cup attachment is an important part of the invention, since it effectively prevents a leakage of air from the air chamber 54. The lips 56 of the cups 55 fit closely against the inner face of the tube 43 and the body of the sealing liquid 60 cooperates therewith to provide a tight seal. The packer 45 is also of assistance in providing a seal and also in centralizing the shell 33 in the tube 43. The auxiliary pump 68 is an important part of the invention since it maintains the pressure in the air chamber 54 at a predetermined amount. In case of any leakage the auxiliary pump 68 immediately compensates for this leakage.

I claim as my invention:

1. In combination: a walking-beam; means

for pivotally supporting said walking beam; means for oscillating said walking-beam; a pump located in a well, said pump having a barrel and a plunger; a string of sucker-rods connected to said plunger and said walking-beam; a traveling member attached to said walking-beam; a standing member connected to a stationary thing, said members being telescopingly associated and providing an air chamber which changes in volume as said walking-beam oscillates, said air chamber at all times confining air under pressure; so that said confined gas will be compressed for the storage of energy during one stroke of said walking-beam and allowed to expand to impart said stored energy to the walking-beam during the succeeding stroke thereof, and means operated by said walking-beam for maintaining the air at not less than a predetermined pressure.

2. In combination: a walking-beam; means for pivotally supporting said walking-beam; means for oscillating said walking-beam; a pump located in a well, said pump having a barrel and a plunger; a string of sucker-rods connected to said plunger and said walking beam; a traveling member attached to said walking-beam; a standing member connected to a stationary thing, said members being telescopingly associated and providing an air chamber which changes in volume as said walking-beam oscillates, said air chamber being filled with air normally under pressure; and a pump operated by said walking-beam for maintaining the air at not less than a predetermined pressure.

3. In combination: a walking beam; means for pivotally supporting said walking-beam; means for oscillating said walking-beam; a pump located in a well, said pump having a barrel and a plunger; a string of sucker-rods connected to said plunger and said walking-beam; a traveling member attached to said walking-beam; a standing member connected to a stationary thing, said standing member being telescoped into said traveling member, said members providing an air chamber which changes in volume as said walking-beam oscillates, said air chamber confining air under pressure; so that said confined gas will be compressed for the storage of energy during one stroke of said walking-beam and allowed to expand to impart said stored energy to the walking-beam during the succeeding stroke thereof, a cup attachment secured to said standing member for forming a seal between said traveling member and said standing member; and means for maintaining a body of sealing liquid around said cup attachment.

4. In combination: a walking-beam; means for pivotally supporting said walking-beam; means for oscillating said walking-beam; a pump located in a well, said pump having a barrel and a plunger; a string of sucker-rods connected to said plunger and said walking-beam; a traveling member attached to said walking-beam; a standing member connected to a stationary thing, said standing member being telescoped into said traveling member, said members providing an air chamber which changes in volume as said walking-beam oscillates, said air chamber being filled with air under pressure; a cup attachment secured to said standing member for forming a seal between said traveling member and said standing member; means for maintaining a body of sealing liquid around said cup attachment; and means for maintaining the air at not less than a predetermined pressure.

5. In combination: a walking-beam; means for pivotally supporting said walking-beam; means for oscillating said walking-beam; a pump located in a well, said pump having a barrel and a plunger; a string of sucker-rods connected to said plunger and said walking-beam; a traveling member attached to said walking-beam; a standing member connected to a stationary thing, said standing member being telescoped into said traveling member, said members providing an air chamber which changes in volume as said walking-beam oscillates, said air chamber being filled with air under pressure; a cup attachment secured to said standing member for forming a seal between said traveling member and said standing member; means for maintaining a body of sealing liquid around said cup attachment; and means operated by said walking-beam for maintaining the air at not less than a predetermined pressure.

6. In combination: a walking-beam; means for pivotally supporting said walking-beam; means for oscillating said walking-beam; a pump located in a well, said pump having a barrel and a plunger; a string of sucker-rods connected to said plunger and said walking-beam; a traveling member attached to said walking-beam; a standing member connected to a stationary thing, said standing member being telescoped into said traveling member, said members providing an air chamber which changes in volume as said walking-beam oscillates, said air chamber being filled with air under pressure; a cup attachment secured to said standing member for forming a seal between said traveling member and said standing member; means for maintaining a body of sealing liquid around said cup attachment; and a pump operated by said walking-beam for maintaining the air at not less than a predetermined pressure.

7. In combination: a walking-beam; means for pivotally supporting said walking-beam; means for oscillating said walking-beam; a pump located in a well, said pump having a barrel and a plunger; a string of sucker-rods connected to said plunger and said walking-beam; a traveling member attached to said walking-beam; a standing member connected to a stationary thing, said standing member

being telescoped into said traveling member, said members providing an air chamber which changes in volume as said walking-beam oscillates, said air chamber confining air under pressure; so that said confined gas will be compressed for the storage of energy during one stroke of said walking-beam and allowed to expand to impart said stored energy to the walking-beam during the succeeding stroke thereof; a cup attachment secured to said standing member for forming a seal between said traveling member and said standing member; means for maintaining a body of sealing liquid around said cup attachment; and a packer carried by said traveling member and surrounding said standing member.

8. In a well drilling and pumping mechanism, the combination of: a pivoted walking-beam; means for supporting said walking-beam; means for driving said walking-beam; walls forming a gas chamber; a member adapted to cooperate with said walls to confine a gas in said chamber and movable in such a manner as to increase and diminish the volume of said chamber; means for exhausting gas from said chamber when compressed above a predetermined maximum pressure; means for supplying compressed gas to replace said exhausted gas; and means for attaching said member to said walking-beam so that it is movable therewith and whereby said confined gas is compressed for the storage of energy during one stroke of said walking-beam and is allowed to expand to impart said stored energy to said walking-beam during the succeeding stroke thereof.

9. In a well drilling and pumping mechanism, the combination of: a pivoted walking-beam; means for supporting said walking beam; means for driving said walking-beam; a primary member containing a gas chamber; a secondary member sliding in gas-tight relationship on said primary member in such a manner as to increase or diminish the volume of said gas chamber; means for exhausting gas from said chamber when compressed above a predetermined maximum pressure; means for supplying compressed gas to replace said exhausted gas; means for attaching one of said members to a stationary support; and means for attaching the other of said members to said walking-beam, whereby said confined gas is compressed for the storage of energy during one stroke of said walking-beam and is allowed to expand to impart said stored energy to said walking-beam during the succeeding stroke thereof.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 30th day of October, 1926.

JOHN T. PHIPPS.