May 14, 1940. F. H. ECKERT 2,200,790

PUMP JACK

Filed June 16, 1938 2 Sheets-Sheet 1

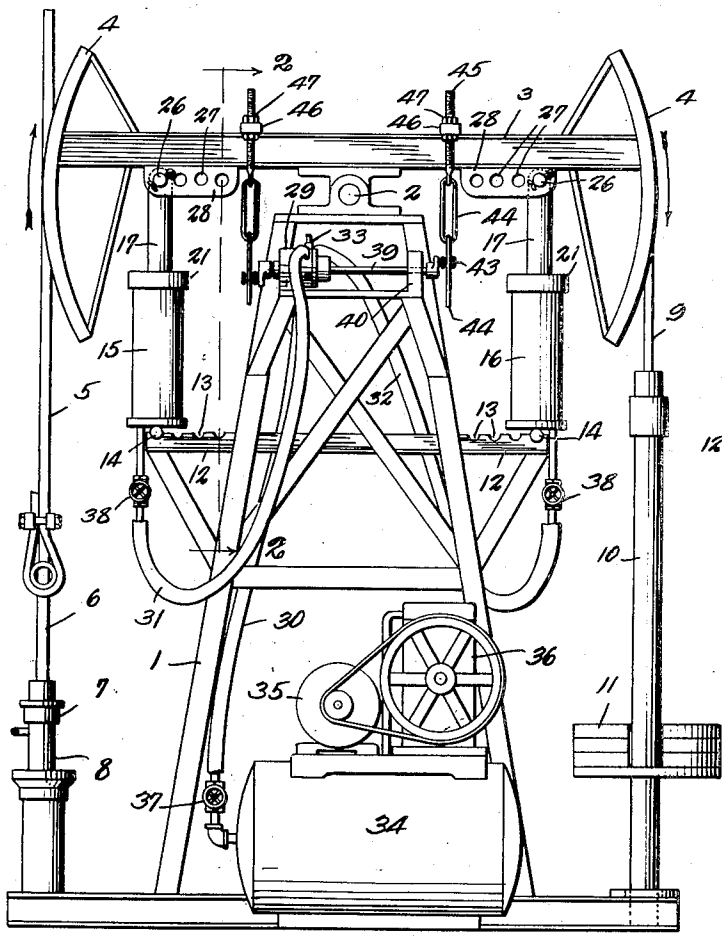


Fig. 1.

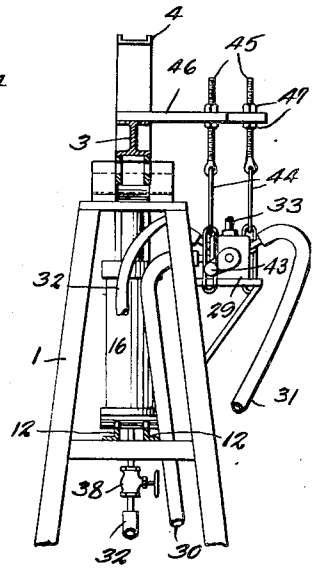


Fig. 2.

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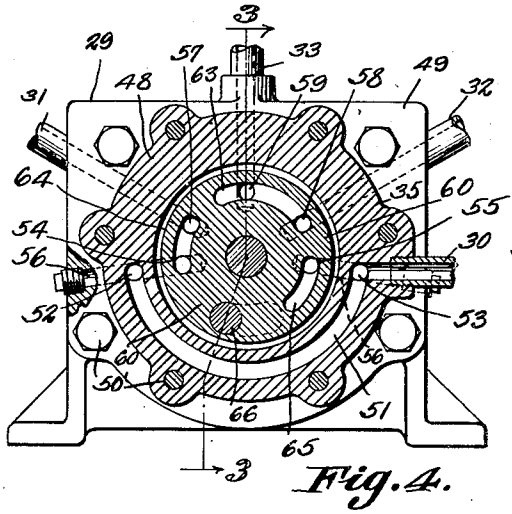


Fig. 4.

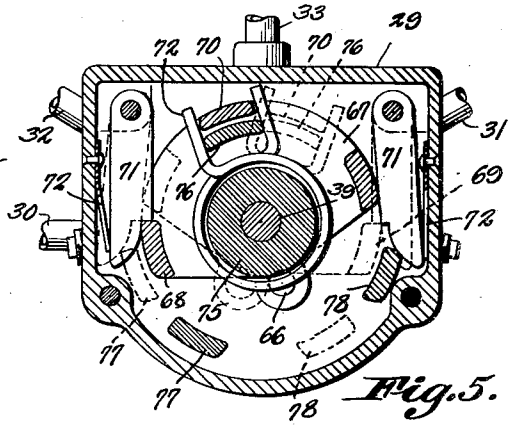


Fig. 5.

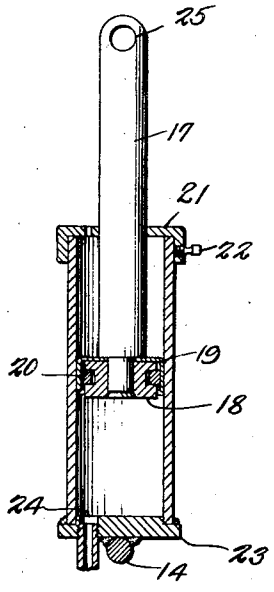


Fig. 6.

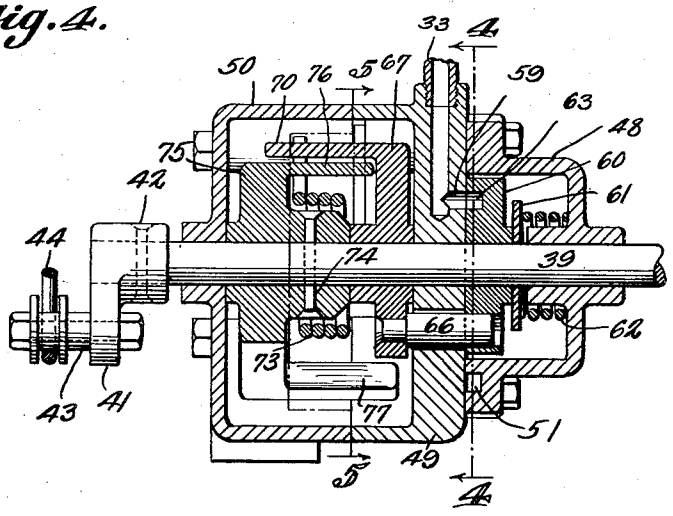


Fig. 3.

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UNITED STATES PATENT OFFICE

2,200,790

PUMP JACK

Felix H. Eckert, San Antonio, Tex.

Application June 16, 1938, Serial No. 214,108

5 Claims. (Cl. 121—160)

This invention relates to improvements in jacks for pumping wells and applies particularly to pump jacks for use in pumping oil wells.

An object of the invention is to provide a jack that will require equal power for its operation at all points during the up and down strokes.

Another object of the invention is to provide a jack which may be operated either from compressed air or from natural gas which is available in some locations.

A further object of the invention is to provide a jack in which the length of the stroke may be varied at will without the necessity of stopping the jack, or the removal of any parts of the jack.

With the foregoing and other objects in view which will appear as the description proceeds, the invention consists of certain novel details of construction and combinations of parts hereinafter more fully described and pointed out in the claims, it being understood that changes may be made in the construction and arrangement of parts without departing from the spirit of the invention as claimed.

In the accompanying drawings the preferred form of the invention has been shown.

In said drawings

Figure 1 is a side elevation of the jack in operating position.

Figure 2 is a fragmentary view, partly in section, taken on the line 2—2, Figure 1.

Figure 3 is a sectional view of the control and reversing valve taken on the line 3—3, Figure 4.

Figure 4 is a sectional view of the valve taken on the line 4—4, Figure 3.

Figure 5 is a sectional view of the valve taken on the line 5—5, Figure 3.

Figure 6 is an enlarged vertical section through one of the power cylinders.

Referring to the figures by characters of reference 1 designates a supporting frame the upper end of which is engaged by a pivot pin or bolt 2 which serves to connect the central portion of a walking beam 3 to the frame. Arcuate heads 4 are carried by the ends of the walking beam and one of these heads is connected by a line 5 to a sucker rod 6 mounted for reciprocation within the stuffing box 7 at the upper end of the tubing 8. Another line 9 is secured to the other head 4 and extends along a guide column 10 to a counterweight 11 which is slidable on the column so as thus to be held against swinging. The weight of the counter-balance can be varied by adding to or removing portions thereof so as to be equal to the weight of the rods in the well plus one-half the weight of the fluid being lifted.

Brackets or supporting members 12 are fixedly secured to the frame 1 and are formed in their top edges with notches or depressions 13 providing seats for pins 14. These pins are connected to the lower ends of cylinders 15 and 16 respectively in each of which is mounted the rod 17 of a piston 18 which, as shown particularly in Figure 6, is provided with a hydraulic cup 19 surrounding the piston and an expander ring 20. The upper end of each cylinder is closed by a cap 21 adapted to be secured in place by a set screw 22 or the like. Thus foreign matter can be excluded from the upper end of the cylinder. As shown particularly in Figure 6 each pin is preferably joined to the lower end of its cylinder by welding and the lower end plate or head of the cylinder, indicated at 23 is provided with an inlet port 24.

The upper end of each piston rod 17 has an opening 25 for the reception of a pin 26 and each pin is adapted to be placed in any one of a series of apertures 27 formed in plates 28 secured to the bottom of the walking beam 3 at points equidistant from the pivots thereof. These openings 27 correspond, in their positions, to the depressions or notches 13 in the brackets 12 thereunder so that it is thus possible to bodily shift the cylinders along the brackets to position their pins 14 in any of the depressions and to correspondingly change the positions of the pins 26. By providing this adjustment for the cylinders, they can be placed in their outermost positions when the apparatus is working under a heavy load and low air pressure whereas, when working under light loads and high air pressure, the cylinders can be moved inwardly toward each other, thereby decreasing the stroke of the piston and reducing air consumption.

A reverse valve has been indicated generally at 29 and extending from this valve are air lines 30, 31 and 32. An exhaust line 33 is also extended from the valve.

In the structure illustrated a tank 34 is provided for holding compressed air used in operating the jack although it is to be understood that the jack can be operated from natural gas as hereinafter explained. This tank 34 can support a motor 35 for driving a compressor 36 also mounted on the tank. Air compressed in the tank by compressor 36 is adapted to flow into the line 30, there being a valve 37 for controlling the flow of air from the tank to the line.

Line 31 leads to the inlet 24 of cylinder 15 while line 32 leads to the corresponding inlet of cylinder 16. Both of these lines have valves 38 for the purpose of controlling the flow of air through the lines.

A shaft 39 is journalled in bearings 40 carried by frame 1 and this shaft also extends through and is journalled within valve 29. Oppositely extending crank arms 41 are secured to the respective ends of shaft 39 by means of pins 42 or the like and each of these crank arms has a wrist pin 43 loosely engaging in the lower link of a chain 44. Each chain is connected to the walking beam 3 by means of a screw threaded adjusting rod 45, these rods being extended through arms 46 to which they are held by nuts 47.

As the cranks 41 are extended in opposite directions, the main connections between them and the walking beam will cause a partial rotation of the valve parts on shaft 39 during the oscillation of the walking beam.

The construction of the valve mechanism has been clearly illustrated in Figures 3, 4 and 5. It will be noted that the body of the valve 29 is composed of three separate parts, 48, 49 and 50, these parts being secured together by means of suitable bolts, or screws 50'. The high pressure line 30 is led into the part 48 and communicates with the passage 51 leading to the ports 52 and 53 which are connected to the ports 54 and 55, located in the part 49, by means of the drilled passages 56, these passages being plugged at their outer ends to prevent escape of air. The part 49 is also provided with the ports 57 and 58 communicating with the lines 31 and 32 respectively, and the port 59 communicating with the exhaust line 33. All of these ports and passages are formed in the parts 48 and 49 and are stationary at all times.

Located inside the part 48 and rotatably mounted on the shaft 39, is a disc valve 60, held in position against the face of the member 49 by the washer 61 and the spring 62 and provided with ports 63, 64 and 65. This valve is also provided with the hole 55 to receive the actuating pin 66.

The valve actuating mechanism, with the exception of the pin 66, is located inside the part 50 of the valve housing. In describing the action of the reversing mechanism the relative positions of the various parts are shown in Fig. 5 by the full lines before reverse occurs and by the dotted lines after reverse is completed. A member 67 carrying stop fingers 68 and 69, a coupling finger 70 and the pin 66 is rotatably mounted on the shaft 39. The fingers 68 and 69 are engageable with latches 71 which are held in contact with the fingers by the springs 72. The finger 70 is positioned between the ends of a coil spring 73. Rigidly mounted on the shaft 39 and secured in position by pin 74, is a member 75 provided with a coupling finger 76 and two release fingers 77 and 78.

As shown in Fig. 4, the arrows indicate the passage of air through the valve, air from the high pressure line 30 entering the passage 51 and passing through the port 52 into the passage 56 and thence consecutively through the ports 54, 64 and 57 into the line 31 which leads to the cylinder 15. It will be noticed that there is no flow of air through the ports 55 or 65 when the valve is in this position, since the port 55 is the only opening leading into 65. The flow of air above described furnishes the power necessary to move the piston in the cylinder 15 during the up-stroke of the jack. Simultaneous with the admission of air to the cylinder 15, the air in the cylinder 16 must be discharged through the line 37, and into the exhaust line 33. It is shown that in this valve position, communication between the ports 58 and 59 of the lines 33 and 34 respectively is accomplished by the port 63 in the valve 60. Thus, the air in cylinder 16 is free to exhaust while the power is being applied to cylinder 15.

When the walking beam reaches the upper limit of its stroke the direction of air flow in the lines 31 and 32 must be reversed in order that power may be applied to the proper cylinder to make the down stroke. This is accomplished by a partial rotation of the disc valve 60 (in a counter-clockwise direction as viewed in Fig. 4) so as to connect the lines 30 and 32 by means of the port 65, and, simultaneously establishing communication between the lines 31 and 33 through the port 63. Thus, a reversal of the air flow in the lines 31 and 32 is attained, thereby furnishing power for the down stroke of the walking beam.

As the jack nears the upper limit of its stroke the lowermost link of the chain 44 will engage the wrist pin 43 of the crank 41 which is connected to the shaft 39 by the pin 42 and further movement of the jack will cause the shaft 39 to be rotated in a clockwise direction as viewed in Fig. 5. As the member 75 rotates with the shaft 39, the fingers 76, 77 and 78 will rotate to the positions shown by dotted lines in Fig. 5 causing the right hand end of the spring 73 to move with the finger 76. The left hand end of the spring 73 is held in its original position by the finger 70 on the member 67 until near the last portion of the rotation. This is because the member 67 is not rigidly secured to the shaft 39 and is held against rotation by the latch 71 which engages the finger 68 until the finger 77 rotates far enough to disengage the latch 71 from the finger 68. When this occurs, the left hand end of the spring 73 acting against the finger 70 will cause the member 67 to rotate in a clockwise direction to the position illustrated by the dotted lines, when the latch 71 will engage the finger 69 and hold it in this position. The rotary motion of the member 67 is transmitted through the pin 66 to the disc valve 60. In this manner a reversal of the air flow through the lines 31 and 32 is accomplished and the direction of the walking beam is reversed as before described.

The crank arm 41 limiting the down stroke is placed on the opposite side of the shaft 39 so that when the walking beam reaches the limit of its down stroke, the shaft 39 is caused to rotate in a counter-clockwise direction as viewed in Fig. 5 and the reverse of the above described actions takes place, returning the disc valve 60 to its original position, as shown in Fig. 4.

It will be noticed that the arc formed by the head 4 has a radius equal to the distance from the head to the center of the pivot pin 2. This construction imparts a straight line motion to the rod 6 and eliminates strain and wear between the rod and the stuffing box 7. The heads 4 are of course rigidly attached to the beam 3.

As the rods 17 are connected to the beam 3 by means of the pins 26, provision is thus made for the slight difference in angularity between the working parts of the jack during various positions of the walking beam.

During operation of the jack the load on the well end of the walking beam varies during the up and the down strokes as follows: During the up-stroke the load is equal to the weight of the string of sucker rods (which varies, of course with the depth of the well) plus the weight of the fluid being lifted by the pump. During the down stroke, no fluid is being lifted and, consequently,

the load on the well end of the walking beam is equal to the weight of the rods only.

Adjustment of the stroke length is accomplished by means of the adjusting rods **45** and the nuts **47**, two independent adjusting rods being employed, the one on the well end governing the upper stroke limit and the one on the rear end governing the lower stroke limit. It is clear that shortening the length of the adjusting member on the well end of the jack will result in decreasing the upper stroke limit, while shortening the rear adjustment will decrease the down stroke limit. Conversely, lengthening the adjustment on either end will result in an increased stroke limit for the corresponding stroke.

In using natural gas for power purposes, the mechanical operation of the jack is the same as above described except that the gas is piped to the reverse valve instead of using the compressed air. If necessary, a conventional pressure regulating valve may be incorporated in the gas line between the reverse valve and the source of supply. The exhaust line **33**, for purposes of conservation, is led into a reservoir or flow line, the difference between the pressures on either side of the reverse valve being the net operating pressure.

The use of natural gas for power, in locations where it is available, greatly reduces the cost of pumping the well, both in the original cost of the equipment and in maintenance.

The invention as above described comprises a simple, practical and economical means of producing oil from wells and while the preferred embodiment of the invention is here described it is to be understood that such changes as may be required to suit individual conditions may be made so long as these changes do not depart from the spirit of the invention.

What is claimed is:

1. In a pump jack, a walking beam, a valve housing, means for directing fluid under pressure to said housing, separate means operated by fluid under pressure for oscillating the walking beam, said means being connected to the beam at opposite sides of its fulcrum, a rock shaft extending into the housing, means actuated by the walking beam for imparting a back and forth rotation to said shaft, and a valve on the shaft and in the housing for directing the fluid under pressure successively to the respective fluid-operating means and for exhausting fluid from each of said means while pressure is being supplied to the other one of said means, said valve comprising cooperating fixed and rotatable members, opposed latches, opposed stop fingers rotatable with the movable valve member and into engagement with the respective latches for holding the valve member against rotation in either direction respectively, a coupling finger movable with said stop fingers, release fingers rotatable with the shaft against the respective latches to disengage them from the engaged stop fingers, a coupling finger movable with the release fingers, and resilient means for transmitting thrust from one coupling finger to the other during their relative rotation.

2. In a pump jack, a walking beam, a valve housing, means for directing fluid under pressure to said housing, separate means operated by fluid under pressure for oscillating the walking beam, said means being connected to the beam at opposite sides of its fulcrum, a rock shaft extending into the housing, means actuated by the walking beam for imparting a back and forth rotation to said shaft, and a valve on the shaft and in the housing for directing the fluid under pressure successively to the respective fluid-operating means and for exhausting fluid from each of said means while pressure is being supplied to the other one of said means, said valve comprising cooperating fixed and rotatable members, opposed latches, opposed stop fingers rotatable with the movable valve member and into engagement with the respective latches for holding the valve member against rotation in either direction respectively, a coupling finger movable with said stop fingers, release fingers rotatable with the shaft against the respective latches to disengage them from the engaged stop fingers, a coupling finger movable with the release fingers, and resilient means for transmitting thrust from one coupling finger to the other during their relative rotation, said resilient means including a spring loosely coiled about the axis of rotation of the shaft and within the area defined by the paths of movements of the fingers, the terminals of the spring being spaced apart to straddle and yieldingly grip the coupling fingers.

3. The combination with a walking beam, a valve casing, a shaft in the casing, a fixed valve member, a movable valve member cooperating therewith and means actuated by the walking beam for imparting a back and front rotation to the shaft, of means controlled by the shaft for imparting a delayed movement to the movable valve member during the completion of each movement of the shaft, said means including opposed latches, opposed stop fingers movable successively into engagement with the respective latches during the completion of each movement of the shaft in one direction thereby to delay actuation of the fingers by the shaft when moved in the opposite direction, a coupling finger movable with and interposed between said stop fingers, a connection between the said stop fingers and the movable valve member, spaced release fingers movable with the shaft and positioned to engage and shift the respective latches during the completion of each movement of the shaft thereby to release the retained stop finger, a coupling finger movable with the release fingers and extended along but separate from the other coupling finger, and yielding means engaging the coupling fingers for transmitting thrust from one of said fingers to the other.

4. In a pump jack, a walking beam, a valve, means for directing fluid under pressure to said valve, separate means operated by fluid under pressure for oscillating the walking beam, said means being connected to the beam at opposite sides of its fulcrum, means actuated by the walking beam for imparting a back and forth rotation to said valve for directing the field under pressure successively to the respective fluid-operating means and for exhausing fluid from each of each means while pressure is being supplied to the other one of said means, said valve comprising cooperating fixed and rotatable members, opposed latches, opposed stop fingers rotatable with the movable valve member and into engagement with the respective latches for holding the valve member against rotation in either direction respectively, a coupling finger movable with said stop fingers, release fingers rotatable with the shaft against the respective latches to disengage them from the engaged stop fingers, a coupling finger movable with the release fingers, and resilient means for transmitting thrust

from one coupling finger to the other during their relative rotation.

5. In a pump jack, a walking beam, a valve, means for directing fluid under pressure to said valve, separate means operated by fluid under pressure for oscillating the walking beam, said means being connected to the beam at opposite sides of its fulcrum, means actuated by the walking beam for imparting a back and forth rotation to said valve for directing the fluid under pressure successively to the respective fluid-operating means and for exhausting fluid from each of said means while pressure is being supplied to the other one of said means, said valve comprising cooperating fixed and rotatable members, opposed latches, opposed stop fingers rotatable with the movable valve member and into engagement with the respective latches for holding the valve member against rotation in either direction respectively, a coupling finger movable with said stop fingers, release fingers rotatable with the shaft against the respective latches to disengage them from the engaged stop fingers, a coupling finger movable with the release fingers, and resilient means for transmitting thrust from one coupling finger to the other during their relative rotation, said resilient means including a spring loosely coiled about the axis of rotation of the shaft and within the area defined by the paths of movements of the fingers, the terminals of the spring being spaced apart to straddle and yieldingly grip the coupling fingers.

FELIX H. ECKERT.