Sept. 26, 1950 C. F. MOSELEY 2,523,444

PUMPING UNIT

Filed April 14, 1947 2 Sheets-Sheet 1

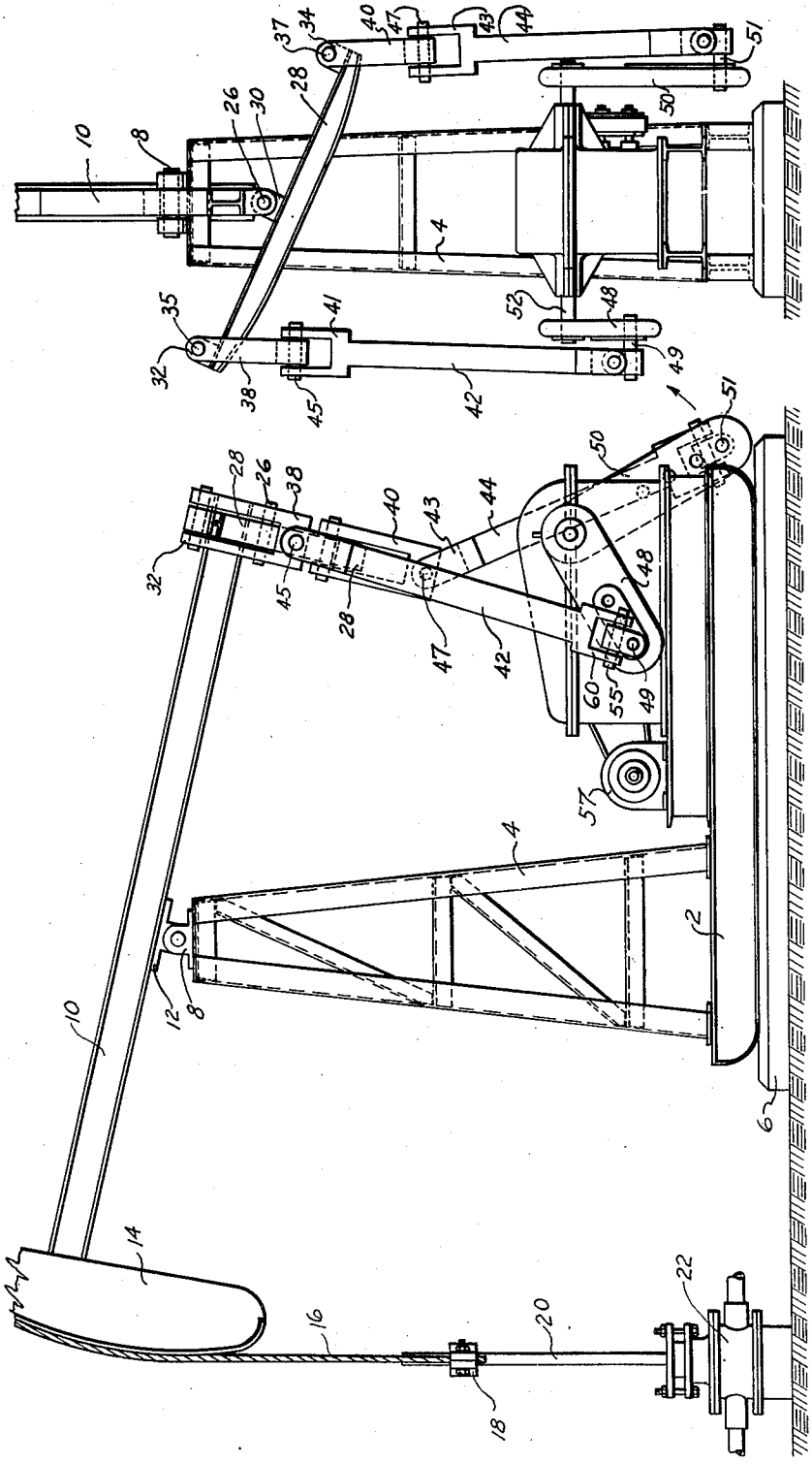


Fig. 2

Fig. 1

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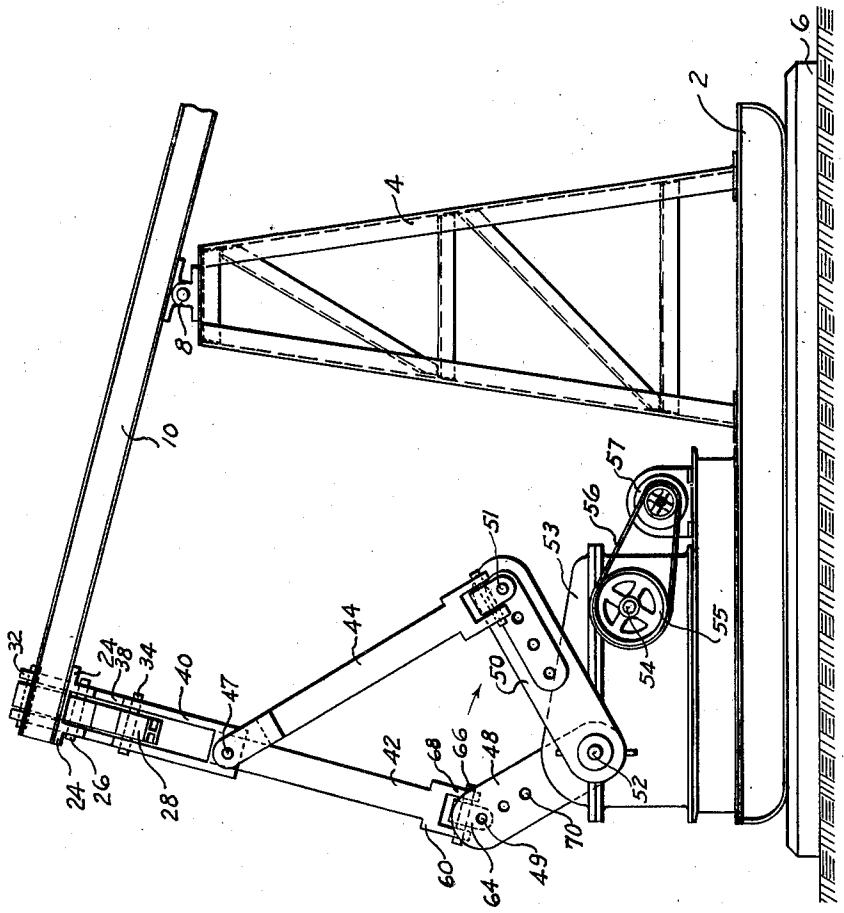


Fig. 3

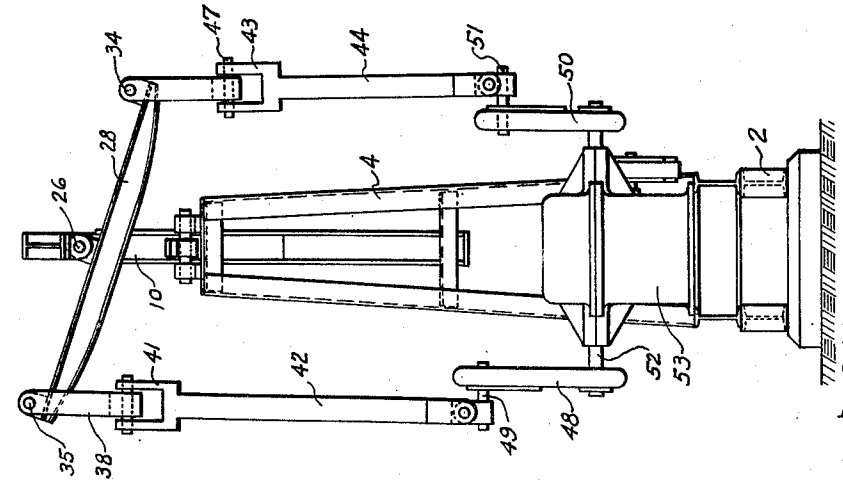


Fig. 4

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UNITED STATES PATENT OFFICE

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PUMPING UNIT

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10 Claims. (Cl. 74—41)

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This invention relates to pumping units for oil or water wells.

Pumping units of the type disclosed and commonly known as walking beam or pump jack units are used extensively for the pumping of oil for both shallow and deep wells. Considerable difficulty has been experienced in this type of unit, particularly in sucker rod breakage and well tubing wear, mainly due to the quick whipping action created by the walking beam actuating the conventional working barrel or pump disposed at the bottom of the well bore through the medium of the sucker rods. It is well known in pumping units of this type that the traveling valve of the bottom hole working barrel is closed on the upstroke of the sucker rods thereby placing substantially all the fluid weight in the tubing string on the rods to cause a tensioning or stretching thereof. Furthermore on the downstroke of the rods and pump plunger, the standing valve of the working barrel is closed whereby the fluid weight is transposed to the tubing string to cause a tensioning or stretching of the tubing in the well. This alternate disposition of the fluid or oil weight on the rods and tubing causes alternate stretching and shrinking thereof. Consequently this transition from a maximum stress to a minimum stress creates a whipping or rapid gyratory movement of the walking beam and actuating cranks therefor. This rapid whipping action especially on the downstroke of the rods will not provide sufficient time for the rods to compress from their previously elongated or stretched condition so that they may approach their maximum distance before another upstroke begins, thereby starting the rods upward in a stretched condition. Furthermore the rapid whipping action on the downstroke will not provide sufficient time for the tubing to stretch in its proper relationship to the rods before another upstroke begins. This has the effect of creating a constant reciprocation between the rods and tubing which is commonly termed in the oil industry as "breathing." This breathing or reciprocating effects a shortening of the pumping stroke to preclude maximum recovery of the oil or fluid from the well.

The present invention is particularly concerned with a power apparatus for actuating the walking beam in its pivotable or oscillatory movement in such a manner to provide a smooth and uniform stroke from the walking beam to sucker rods normally reciprocating in the well bore. Particularly the invention provides an apparatus which will cushion the movement of the actuating crank and its co-operating members in order to smooth out

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the rotation thereof and over-come the rapid whipping action thereby providing sufficient time for the rods to compress or retract from a previously stretched condition and simultaneously providing time for the steel tubing to stretch to a position for a sufficient pumping relationship with the rods in order to compensate for the breathing or reciprocation therebetween and obtain the full stroke of the pumping apparatus.

It is an important object of this invention to provide a surface pumping unit which has a uniform and smooth reciprocation in its relationship with its auxiliary pumping equipment utilized in an oil well.

A further object of this invention is to provide a pumping unit utilizing dual crank members for actuating the walking beam in such a manner that one of the crank members neutralizes the action of the other crank member to prevent any distortion in the reciprocation of the rods.

And still another object of this invention is to provide a twin crank actuation for a walking beam wherein one crank member of shorter length is angularly disposed relative the actuating crank member in order to cushion or slow down the movement of the actuating crank member when approaching the end of its stroke, thereby preventing a whipping movement of the actuating crank and the walking beam when moved past the center of gravity.

And still another object of this invention is to provide a dampening action to the actuating crank member of a walking beam pump unit in order to dampen the movement of the walking beam as it approaches the end of its stroke, thereby providing sufficient time to compensate for alternate tensioning and compression of the sucker rods and tubing in the well to provide a more efficient pumping stroke.

And still another object of this invention is to design a pumping unit of the walking beam type which will provide a more effective application of power in the translation of the rotary motion to reciprocatory motion in order to increase the overall efficiency of the unit by diminishing the work load on the surface equipment and thereby reduce operating expenses.

And still another object of this invention is to design a pumping unit of the walking beam type that will preclude any rapid gyratory movement of the actuating crank for the beam in order to provide a slow pickup of the fluid weight of the tubing by the sucker rods, and a slow release from the rods to the tubing thereby preventing considerable rod breakage and tubing wear.

Other objects and advantages of the invention

will be evident from the following detailed description, read in conjunction with the accompanying drawings, which illustrate my invention.

In the drawings,

Figure 1 is a side elevational view from one side of the apparatus and showing one position of operation.

Figure 2 is a front elevation of Figure 1.

Figure 3 is a view similar to Figure 1 taken from the opposite side of the apparatus and showing another position of operation.

Figure 4 is a front elevation of Figure 3.

Referring to the drawings in detail, reference character 2 designates a portable skid upon which is mounted a standard or Samson post 4. The skid is disposed on the floor 6 of the derrick (not shown). The Samson post 4 extends vertically upward and is provided at its top with a bearing member 8 having a walking beam 10 fulcrumed thereto by the bracket 12. It will be apparent that the bearing 8 will permit pivotable movement of the walking beam 10 in the usual manner. One end of the beam 10 is provided with a projecting hanger 14 commonly called a "mule-head." A cable or like connecting member 16 is secured to the front of the hanger 14 and extends into connection with a polish rod hanger 18, which in turn is connected with the polish rod 20 extending through a tubing hanger and stuffing box 22 into the well bore (not shown). It will be apparent that the polish rod 20 connects with sucker rods disposed in the well bore for actuating a bottom hole pump disposed therein in the usual manner, all of which is a conventional arrangement and not shown. The end of the walking beam 10 opposite the "mule-head" 14 is provided with a pair of spaced brackets 24 for journaling a shaft 26. A cross member or double tree 28 is provided at an intermediate point of its body with a bracket 30 adapted to be journaled on the shaft 26 to loosely secure the double tree 28 to the shaft and provide a freely pivotable movement thereabout, for a purpose as will be hereinafter explained. At each end of the double tree is provided upstanding brackets 32 and 34 respectively having similar shafts 35 and 37. An arm or link 38 is provided with a bifurcated end having apertures loosely receiving the shaft 35 in order to secure the link thereto. A similar arm 40 is loosely secured to the shaft 37 at the opposite end of member 28. The links 38 and 40 are in turn connected with the bifurcated ends 41 and 43 of lower pitmans 42 and 44 respectively, through the connecting shafts or pins 45 and 47. The pitman 42 extends downwardly from the arm 38 into connection with a short crank member 48 through a suitable pin 49. Similarly the pitman 44 is connected with a crank 50 of a length greater than that of crank 48, and through a suitable pin 51. The cranks are rigidly mounted at the opposite ends of a driven shaft 52 disposed in the housing 53. A main drive shaft 54 is also disposed in the housing 53 and connects through a pulley 55 and belt 56 with a prime mover 57 causing rotation of the main drive shaft 54. The main shaft 54 drives the shaft 52 through speed reduction gearing (not shown) enclosed in casing 53. The prime mover 57, casing 53 are all disposed on the skid 2 adjacent the Samson post 4 as clearly shown in Figures 1 and 3.

As will be noted in Figures 1 and 3, the lower end of each of the pitmans 42 and 44 is provided with a bifurcated end or bracket 60 and 62 respectively for receiving the connecting crank pins. The connection of the crank with each of the pitmans is identical, so only one will be explained. A bearing 64 is loosely journaled on the shaft 66 supported by the legs 68 of the forked member 60. The crank pin 49 is loosely journaled in bearing 64 for connecting the pitman 42 with the crank 48. It will be apparent that the pitman 44 is similarly connected through its pin 51 with the crank arm 50. Each of the crank arms 48 and 50 are secured to the ends of the driven shaft 52 by any suitable means (not shown) in order that the cranks 48 and 50 will rotate simultaneous with rotation of the shaft 52.

The crank arms, as is clearly shown in Figure 3, are disposed on the shaft 52 in such a manner to be substantially perpendicular to each other, or 90 degrees apart. The crank arm 48 is of a lesser length than the crank arm 50. Each of the crank arms are provided with a plurality of apertures 70 permitting adjustment of the crank pins 49 and 51 in order to vary the throw thereof. It will be apparent that the 90 degree angle between the crank arms 48 and 50 may be varied and that the disposition of the crank arms, as shown, does not in any manner limit the invention herein. Furthermore, the exact length of the arms 48 and 50 relative to each other is not considered a limitation on the invention. The angular distance between the crank arms as well as the variance in length may always be worked out for a particular pumping situation and the best mechanical advantage.

As clearly shown in Figures 2 and 4, it will be apparent that the cross member or double tree 28 is provided with a pivotable or oscillatory movement relative to the beam 10 due to the fulcrumed connection with the shaft 26. Furthermore, the bifurcated connections of the links and pitmans with the double tree and crank members provide a substantially universal movement relative to the various co-operating members.

Rotation of the crank shaft 52 in the usual manner by power from the prime member 57 will cause simultaneous rotation of the fixed crank members 48 and 50. As shown in Figures 1 and 3 the crank member 50 is greater in length and is the actuating crank member for the walking beam 10 through the pitman 44, link 40 and cross member 28 in order to translate the rotary motion of the crank into an oscillatory motion for the beam which in turn transmits the oscillatory motion to the polish rods 20 and the sucker rods (not shown). The crank member 48 is of a shorter length than the crank member 50 and is similarly connected through pitman 42 and link 38 with member 28 for translating rotary motion to reciprocatory motion. However the decreased length as well as the angular disposition of the crank 48 during the rotation of the crank shaft 52 and the cranks 48 and 50 will act as a brake or dampening means for the actuating crank 50 in the following manner. As the crank 50 approaches the end of its stroke either upwardly or downwardly, it would have a tendency to speed up and create a whipping rotary action for the reasons hereinbefore referred to and particularly after the rapid transition of the oil weight in the tubing string. Immediately upon passing the center of gravity at either zero or 180 degrees of its revolving path, the crank 50 is prevented from going into a rapid gyratory movement by the braking of the crank 48, because the crank 48 lagging behind the crank 50 has not passed the center of gravity at zero or 180 degrees, and as such will prevent any possibility of the whipping movement by the crank 50.

Referring particularly to Figure 3 which discloses the crank 50 rotating in a clockwise direction as shown by the arrow, and having substantially completed the downstroke of the beam 10 and is starting the upstroke. The crank 50 is precluded from a fast gyratory movement at the start of the upstroke because the crank 48 has not moved past its center of gravity. Furthermore, upon the continued clockwise rotation of the crank 48, and with the crank 48 moving past the center of gravity, the rapid gyratory movement is prevented because by this time the actuating crank 50 through the sucker rods has picked up the load of the tubing string to place a maximum stress thereon. From the above it will be apparent that the present structure provides sufficient time for a transition of the oil weight, or an easy pick up and release of the oil weight. Similarly and referring to Figure 1 showing the rotation of the actuating crank 50 in a counter clockwise movement as shown by the arrow, and about to start the down stroke, it will be apparent that the crank is precluded from any rapid gyratory movement because of the lagging angular disposition of the dampening crank 48 which has not moved past the center of gravity. However, when the crank 48 moves past the center of gravity, the disposition of the crank 50 is such that it will have been moved to substantially complete the down stroke in a smooth and uniform movement to provide for the compression of the rods, and any increase in the rotary movement would be substantially inconsequential.

It will be apparent that the rotary motion of the crank members 48 and 50 will be translated through the pitmans 42 and 44 to the double tree 28 to provide an oscillatory or pivotable movement in its relationship with the beam 10, and simultaneous with an oscillatory or reciprocatory movement of the beam 10. It will thus be seen that the rotary motion is translated into a mechanical movement which combines simultaneous oscillatory movements to effect a smooth and uniform operation in a pumping apparatus of this type.

From Figures 2 and 4 it will be apparent that the oscillatory path of the cross beam 28 is in a direction substantially perpendicular to the longitudinal axis of the walking beam 10.

The rotary motion of the crank 50 is transmitted to its pitman which causes the oscillatory or pivotable movement of the double tree 28 which in turn causes the oscillatory or reciprocatory movement of the walking beam 10. Furthermore the universal connections between the pitmans and crank members as well as between the links and the double tree permit the combined and simultaneous oscillatory movement of the double tree and the walking beam.

It is well known that counter balancing is utilized in pumping units of this type in order to balance out the oil and rod weight in their relationship with the actuating crank, however it will be apparent that the present apparatus will eliminate the necessity of any substantial amount of counter balancing, although it may be utilized if desired.

From the foregoing it will be apparent that the present invention provides a walking beam type of pumping apparatus wherein the throw of the actuating apparatus is smoothed out in order to provide a uniform and smooth reciprocation of the sucker rods, and particularly a slowing down of the reciprocation to provide sufficient time to compensate for the alternate stretch of the rods and tubing which will allow for a slow pickup of the fluid weight by the sucker rods, at the start of the upstroke, and a slow release from the rods to the tubing at the start of the downstroke. This slow pickup and slow release as well as the smooth uniform reciprocation of the rods will prevent considerable rod breakage and snapping as well as tubing wear in the well bore, thus eliminating considerable shutdown time for repair. The pumping efficiency of the unit will be substantially increased in that substantially all the stroke of the working barrel in the bottom of the well bore will be utilized thereby assuring that the maximum recovery of oil will be made. This maximum recovery will be due from the elimination of the constant reciprocation between the tubing and the rods to provide the maximum pumping stroke. An increased efficiency can be maintained with considerably less power thereby reducing the operating expenses as well as wear and tear on the bearings and other moving parts of the unit and all pumping equipment.

Changes may be made in the specifications and drawings without departing from the spirit of the invention within the scope of the following claims, as set forth.

What I claim is:

1. In a walking beam pump unit for wells comprising a rotary crank shaft, a crank secured to the shaft, a pitman connected to the crank, a cross member connected to the beam, means permitting oscillatory movement of the cross member in a direction substantially perpendicular to the longitudinal axis of the beam, means connecting the pitman to one end of the cross member, and means connected between the crank shaft and the cross member to dampen the momentum of the crank in the actuation of the beam.

2. In a walking beam pump unit for wells comprising a rotary crank shaft, a crank secured to the shaft, a pitman connected to the crank, a cross member connected to the beam, means permitting oscillatory movement of the cross member in a direction substantially perpendicular to the longitudinal axis of the beam, means connecting the pitman to one end of the cross member, and means provided on the crank shaft and connecting with the cross member to preclude any increase in the momentum of the walking beam reciprocation due to a transition of the fluid weight in the well.

3. In a walking beam pump unit for wells comprising a rotary crank shaft, a crank secured to the shaft, a pitman connected to the crank, a cross member connected to the beam, means permitting oscillatory movement of the cross member in a direction substantially perpendicular to the longitudinal axis of the beam, means connecting the pitman to one end of the cross member, a second crank secured on the shaft and connected to the cross member, said second crank arranged relative to the first mentioned crank to preclude any increase in the momentum of the first mentioned crank due to a transition of the fluid weight in the well.

4. In a pumping unit for an oil well or the like comprising a Samson post extending upwardly therefrom, a walking beam pivotably mounted for oscillatory movement thereon, a crank shaft, a pair of cranks secured to the crank shaft, a pitman secured to each of the cranks, a double tree pivotably connected to the beam,

means for connecting the double tree to each of the pitmans, one of said cranks arranged at an angle to the other of said cranks to provide a dampening effect in the rotary movement thereof.

5. In a pumping unit for an oil well or the like, comprising a Samson post extending upwardly therefrom, a walking beam mounted for an oscillatory movement thereon, a crank shaft, a pair of cranks secured in spaced relationship on the shaft, a pitman secured to each of the cranks, a double tree pivotably connected to the beam, and means for connecting the double tree to each of the pitmans to permit movement of the double tree in a direction perpendicular to the longitudinal axis of the beam, one of said cranks arranged at an angle to the other of said cranks to provide a dampening effect on the oscillatory movement of the beam.

6. In a pumping unit for an oil well or the like, comprising a Samson post extending upwardly therefrom, a walking beam mounted for an oscillatory movement thereon, a crank shaft, a pair of cranks secured in spaced relationship on the shaft, a pitman secured to each of the cranks, a double tree pivotably connected to the beam, and means for connecting the double tree to each of the pitmans to permit movement of the double tree in a direction perpendicular to the longitudinal axis of the beam, one of said cranks being of a length shorter than the other of said cranks and arranged on the shaft at an angle thereto to provide a dampening effect on the reciprocation of the beam as it approaches the end of a stroke.

7. In a pumping unit for an oil well or the like, comprising a Samson post extending upwardly therefrom, a walking beam mounted for an oscillatory movement thereon, a crank shaft, a pair of cranks secured in spaced relationship on the shaft, a pitman secured to each of the cranks, a double tree pivotably connected to the beam, and means for connecting the double tree to each of the pitmans to permit movement of the double tree in a direction perpendicular to the longitudinal axis of the beam, one of said cranks being of a length greater than the other of said cranks.

8. In a walking beam type pump unit for oil wells comprising a rotating crank shaft, an actuating crank secured to the shaft, a pitman connected to the crank, a cross member connected to the beam, means permitting oscillatory movement of the cross member in a path substantially perpendicular to the longitudinal axis of the beam, means connecting the pitman to one end of the cross member, a second crank secured on the shaft and connected by a pitman to the cross member, said second crank being of a length shorter than the first mentioned crank, and arranged at an angle thereto to preclude any increase in the momentum of the first mentioned crank due to a transition of the fluid weight in the well.

9. In a walking beam type pump unit for wells comprising a rotary crank shaft, a crank secured to the shaft, a pitman connected to the crank, a cross member connected to the beam, means permitting oscillatory movement of the cross member in a path substantially perpendicular to the longitudinal axis of the beam, means connecting the pitman to one end of the cross member, a second crank secured on the shaft, means connecting the second crank to the opposite end of the cross member, said second crank being secured on the shaft to provide a lagging angle with the first mentioned crank whereby the cranks provide a substantially smooth and uniform acceleration.

10. The combination of a twin crank pumping unit for oil wells or the like, comprising a Samson post extending upwardly therefrom, and a walking beam pivotably mounted for oscillatory motion on the post, a crank shaft, twin cranks secured to the shaft, a cross member pivotably connected to the beam, means permitting oscillatory movement of the cross member in a path substantially perpendicular to the longitudinal axis of the beam, pitmans connecting the cranks to opposite ends of the cross member, one of said cranks secured on the shaft and arranged at a lag angle relative to the other of said cranks to provide an even velocity for the cranks.

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REFERENCES CITED

The following references are of record in the file of this patent:

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Number	Name	Date
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