April 4, 1939. W. M. MANSFIELD 2,152,702

PIVOTED COUNTERBALANCE FOR OIL PUMPING APPARATUS

Filed Aug. 9, 1938 2 Sheets-Sheet 1

Fig. 1

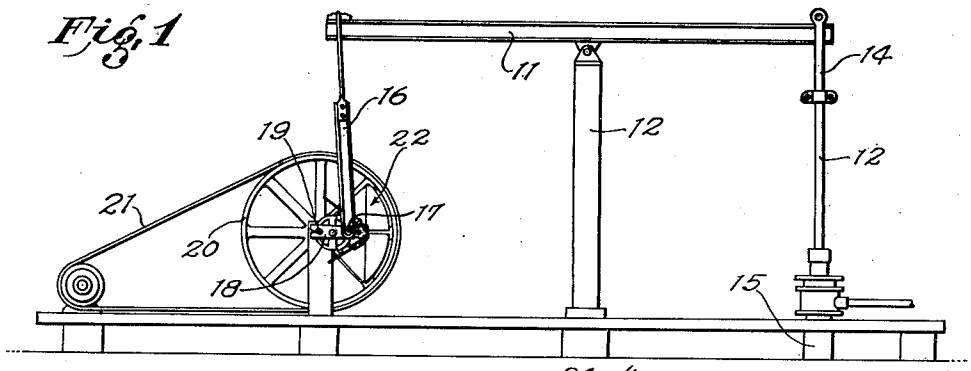


Fig. 2

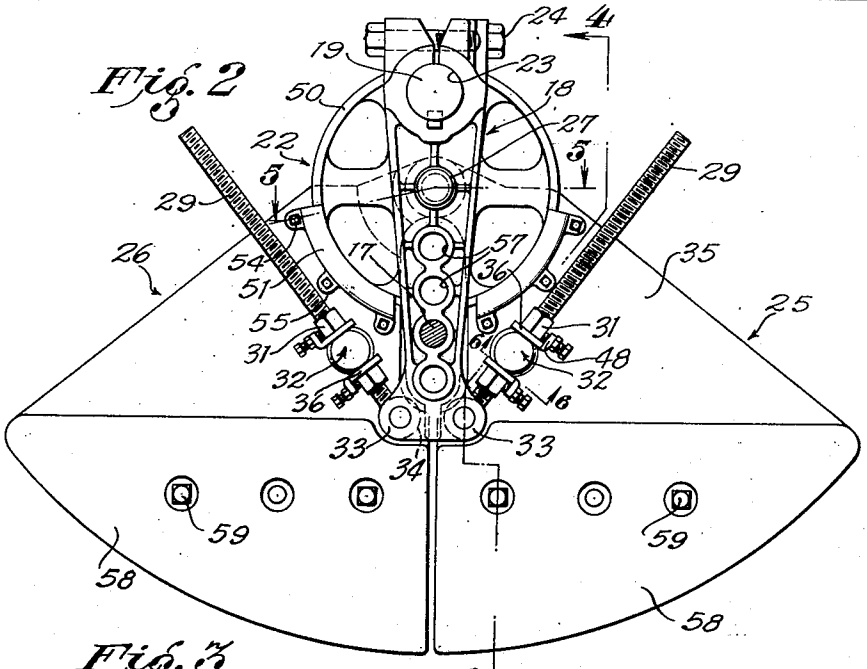
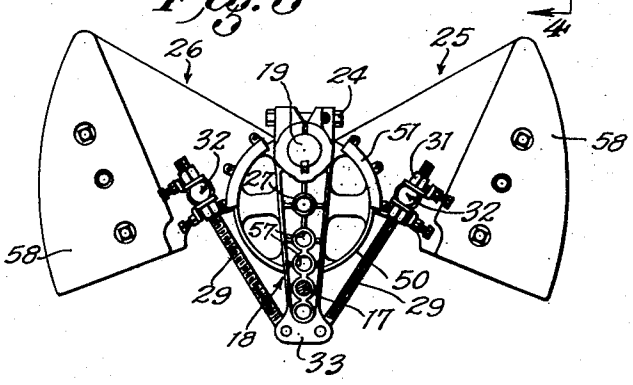


Fig. 3



WARREN M. MANSFIELD,
INVENTOR.

BY

ATTORNEY

April 4, 1939. W. M. MANSFIELD 2,152,702

PIVOTED COUNTERBALANCE FOR OIL PUMPING APPARATUS

Filed Aug. 9, 1938 2 Sheets-Sheet 2

Fig. 4

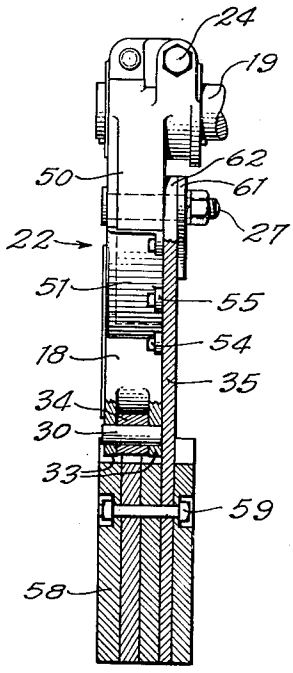


Fig. 6

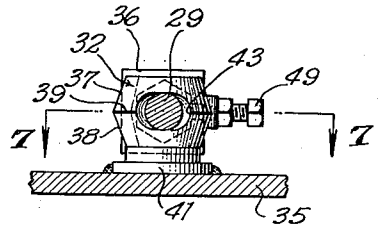


Fig. 7

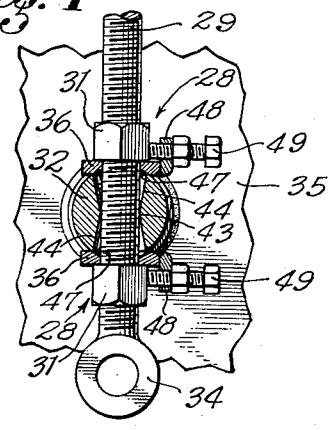
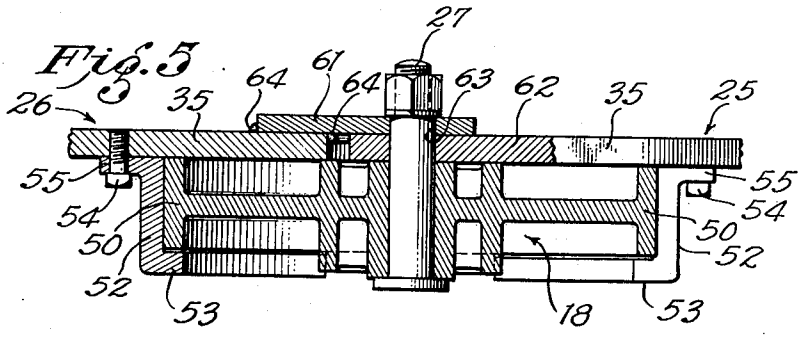


Fig. 5



WARREN M. MANSFIELD,
INVENTOR.

BY

ATTORNEY

Patented Apr. 4, 1939 2,152,702

UNITED STATES PATENT OFFICE

2,152,702

PIVOTED COUNTERBALANCE FOR OIL PUMPING APPARATUS

Warren M. Mansfield, Glendale, Calif., assignor to Emsco Derrick & Equipment Company, Los Angeles, Calif., a corporation of California

Application August 9, 1938, Serial No. 223,825

8 Claims. (Cl. 74—591)

My invention relates in general to apparatus for pumping oil from wells, and relates in particular to a counterbalance of utility in oil well pumping apparatus.

In oil pumping apparatus the pump proper, having a plunger or piston, is placed in the well and a string of sucker rods is extended to a reciprocating means at the surface of the ground. This reciprocating means ordinarily receives its power from a rotating crank driven by an engine or motor. Ordinarily a walking beam is placed in such position that its front end may be connected to the upper end of the string of sucker rods and its rear end may be connected to a pitman with the crank. To obtain optimum operating conditions in the use of pumping equipment of this character counterbalances are employed to counterbalance the weight of the string of sucker rods and the pump plunger, and approximately one-half the weight of the column of oil supported by the pump plunger.

It is an object of my invention to provide a counterbalance which may be adjusted from zero to maximum counterbalancing effect without the necessity of lifting and placing or removing weights from the counterweight structure, thereby making it possible to select for a particular well a counterbalance of approximately the desired mass and to thereafter adjust the counterbalance to a condition wherein best operation of the pumping apparatus is attained.

It is the usual practice to place the counterbalance so that its center of mass is on a radial plane defined by the crank shaft and the operating crank. It is found, however, that if the center of mass of the counterbalance is moved forward or rearward with respect to the radial plane of the crank, that operating conditions may be sometimes improved. It is one of the objects of my invention to provide a counterbalance in which the center of mass thereof may be disposed on the radial plane defined by the crank or may be moved forwardly or rearwardly of this plane by a simple adjustment of counterweights attained without adding or removing weights of the counterbalance device.

The rig of a well is often used for operations other than pumping, and when so used, a counterbalance is an interference to the operation of the rotating part and must, therefore, be eliminated either by detaching it from the apparatus or moving it into a neutral position.

It is an object of my invention to provide a counterbalance which may be readily adjusted from a condition wherein counterbalance effect is produced to a position where the counterweights of the counterbalance are diametrally disposed so as to have flywheel effect instead of counterbalance effect.

A further object of my invention is to provide a counterbalance which includes two swingable counterweights positioned on opposite sides of an operating crank, and pivotally connected thereto, and in which the counterweights are independently adjustable by simple means into any position between retracted or neutral and extended position.

It is a further object of my invention to provide a counterbalance of the character pointed out in the preceding paragraph, which includes separate adjusting means for each of the counterweights in the form of rods or struts, one end of each being pivoted to one of the counterweights and the other end of each being pivoted to the operating crank, there being adjustment means associated with these rods for producing the desired adjusting movement of the counterweights.

For the purpose of teaching those skilled in the art how my invention may be practiced, I have selected for illustration a preferred form. It should be understood however that I do not wish to be limited in the practice of the invention to the precise details disclosed herein.

Further objects and advantages will be brought out in the following part of the specification.

Referring to the drawings which are for illustrative purposes only:

Fig. 1 is a diagrammatic view showing the utility of my invention.

Fig. 2 is an enlarged elevational view of the counterbalance in depending position and with the weights thereof disposed to give maximum counterbalance effect.

Fig. 3 is a face view of the counterbalance, showing the weights adjusted to another position.

Fig. 4 is an enlarged section taken as indicated by the line 4—4 of Fig. 2.

Fig. 5 is an enlarged fragmentary section taken as indicated by the line 5—5 of Fig. 2.

Fig. 6 is an enlarged fragmentary section taken substantially as indicated by the line 6—6 of Fig. 2.

Fig. 7 is a fragmentary plan view of a swivel connected, partly sectioned on the plane represented by the line 7—7 of Fig. 6.

Fig. 1 shows a well pumping apparatus wherein a walking beam 11 is pivotally supported in the customary manner on the upper end of a

Samson post 12. One end of the walking beam 11 is connected to the upper end of a string of sucker rods 14 which extends down through tubing 15 to a reciprocating pump, not shown. Rocking of the walking beam 11 so as to produce the desired pumping action is accomplished by connection thereof through a pitman 16 with a crank pin 17 carried by a crank 18 secured on a shaft 19 which is driven through use of a wheel 20 adapted to be rotated in a suitable manner such as by use of a belt 21. The rotary movement of the crank pin 17 is, through the pitman 16, transformed to a reciprocating motion of the walking beam 11.

The crank 18 preferably forms a part of my improved counterbalance 22, and such crank has an opening 23 to receive the shaft 19 on which the crank may be clamped by clamping bolts 24 placed at the upper end of the crank 18 so as to constrict the wall of the opening 23 into tight engagement with the crank shaft 19. The counterbalance 22 includes a pair of segmental counterweights 25 and 26, swingable on a pivot 27, carried by the arm 18 at a point near the opening 23 or at least in a position intermediate to the ends of the arm 18. The counterweights 25 and 26 are swingable from extended position as shown in Fig. 2 wherein such counterweights are capable of exerting their maximum counterbalance, to a laterally extended position wherein the counterweights lie close to a diametral plane extended through the axis of rotation of the counterweight device, defined by the opening 23 or the shaft 19 on which the counterweight device is secured.

Adjustment of the counterweights 25 and 26 through the various positions thereof is accomplished by adjusting means 28, each of which includes a screw 29, a pivot 30, for one end of the screw 29, adjusting nuts 31, and a head 32 through which the screw 29 extends. The lower end of the crank arm 18 has a pair of spaced plates 33 disposed in spaced planes which are perpendicular to the axis of the shaft 19. Each screw 29 has an eye 34 adapted to extend into the space between the plates 33 so as to swing on the pivot 30 comprising a pin which is extended from one to the other of the plates 33. The head 32 is mounted on the web 35 of a counterweight 25 or 26. As shown in Fig. 2 the nuts 31 are spaced on opposite sides of the head 32 and are separated therefrom by shoes or washers 36. Adjustment of the nuts 31 along the screw 29 may be employed to force the head 32 along the screw 29, thereby causing the counterweight associated with the head 32 to swing on the pivot 27, since the mounting of the screw 29 on a pivot 30 which is stationary relative to the crank arm 18 prefers axial movement of the screw 29 relative to the crank arm 17.

Each head 32 is shown as having a pair of conoidal faces 37 and 38 converging respectively upwardly and downwardly from a medial line or ridge 39 and on an axis transverse to the axis of the screw 29 which passes therethrough. As best shown in Fig. 6. A shank or post 40 extends down from the head 32 to a base 41 of plate form. This base 41 is shown of polygonal form and the same is secured to the web 35 of a counterweight 25 or 26 by a weld 42. For passage of a screw 29 the head has an opening 43, the axis of which preferably lies in the plane defined by the ridge 39. This opening 43 is laterally enlarged at its ends, as shown at 44 so that there may be a relative lateral swinging of the screw 29 as the head 32 is adjusted from a position such as that which is shown in Fig. 2 toward its position in Fig. 3.

In the inner faces of the washers 36, grooves or channels 47 are milled to fit portions of the conoidal faces 37 and 38 of the head 32, and these washers slide on the head as the screw 29 swings in the opening 43. Since the surface-portions of the head 32 engaged by the walls of the grooves 37 are non-spherical, the washers 36 will not rotate on the axis defined by the screw 29. I employ this characteristic of the washers in the provision of locking means for the nuts 31, by providing a means of engagement between the non-rotatable washers and the nuts, so that the nuts will be thereby held from rotation. This nut locking means consists in a member 48 projecting from an edge of a washer 36 in parallel relation to the axis of the screw 29, and a locking screw 49 threaded through the projection 48 in such position that it may be caused to bear against a face of a nut 31, thereby preventing rotation of the nut on the screw 29.

The counterweight device has guide means cooperating with the crank arm 18 and the counterweights 25 and 26 to guide the same in their swinging movement around the pivot pin 27 from one position of adjustment to another. This guide means includes arcuate walls 50 formed on the crank arm 18 and channel means 51 carried by the webs 35 of the counterweights 25 and 26. The arcuate walls 50 are generated around the axis of the pivot pin 27, and the channel means 51, as best shown in Fig. 5, each have a cylindrical wall 52 adapted to be secured to a web 35 and segmental lip 53 thereon to extend over the edge of the wall 50 opposite to that edge thereof which lies adjacent to the web 35. This lip 53 does not make clamping engagement with the wall 50 but merely cooperates with the wall 52 and a portion of the web 35 in forming a channel which slides along a wall 50 when the counterweight is adjusted from one position to another. The channel forming members may be secured to the web 35 by bolts 54 which extend through lugs 55 formed along the inner edge of the wall 52.

The crank arm 18 has a plurality of crank pin openings 57 spaced along a radial line, to make possible variations in the throw of the crank, as may be required of the pumping device, by moving the crank pin 17 from one opening to another. The counterweights 25 and 26 each include a plurality of removable weight sections 58 which are secured to the outer portions of the web 35 by means of bolts 59. The web 35 of the counterweight 25 is flat from the lower to the upper end thereof and the upper portion of this web lies flat against the back of the crank 18 and the rear edge of the cooperating arcuate wall 50. The web 35 of the counterweight 26, as shown in Fig. 5, has a portion 60 which lies flat against the rear edge of an arcuate wall 50, and an offset portion 61 which lies over the upper end portion 62 of the web 35 of the counterweight 25 and has an opening 63 therein to receive the pivot pin 27. The offset portion 61 is comprised of a small properly formed plate connected by welds 64 to the back face of the plate portion 60.

During the pumping operation the counterweights are supported in counterbalancing position, that is to say in or near the position in which they are shown in Fig. 2. When the counterweights 25 and 26 are in the positions in which they are shown in Fig. 2 the counterbalancing effect thereof will be centralized with respect to

a plane defined by the shaft 19 and the crank pin 17. The counterweight effect may be offset from this plane by swinging one of the counterweights into a different angular position relative to the plane than the position occupied by the other of the counterweights. If less counterbalancing effect is desired, both of the weights may be swung simultaneously upward from the position thereof in Fig. 2 toward the position thereof in Fig. 3. When the counterweights 25 and 26 are brought into the diametrally opposed positions in which they are shown in Fig. 3, their counterbalancing effect will be substantially neutral and therefore when the rig is to be employed for purposes other than pumping and the pitman 23 is disconnected from the crank 21, it will not be necessary to remove the counterweight, but the same may be readily adjusted to neutral position wherein flywheel effect is obtained. From the foregoing it will be foreseen that my present invention provides the simple, easily adjusted means whereby maximum to minimum counterbalancing effect may be obtained, whereby the effective center of mass of the counterbalance means may be shifted from one side to the other of the crank arm, and wherein flywheel effect neutral counterbalancing or flywheel effect may be obtained without the necessity of disassembling all or part of the counterweight device.

I claim as my invention:

1. In a counterbalance device of the character described, the combination of: a crank arm adapted for use with a rotatable member; a pair of counterweights; a pivot pin passing through the central radial plane of said crank arm intermediate the ends thereof and supporting said counterweights one on each side of said arm so as to swing into different counterbalancing positions relative to said arm; and means for effecting independent adjusting movement of said counterweights about said pivot pin and for holding said counterweights during and after adjustment, said adjusting means comprising a rod for each counterweight, two pivotal connections for each of said rods, one of said connections attaching said rod to the free end portion of said crank arm and the other of said connections attaching said rod to its associated counterweight at a point radially spaced from said pivot pin, said last named connection including means to cause its pivotal axis to be actuated along said rod whereby to swing said counterweight on said pivot pin.

2. In a counterbalance device of the character described, the combination of: a crank arm adapted for use with a rotatable member; a pair of counterweights; a pivot pin passing through the central radial plane of said crank arm intermediate the ends thereof and supporting said counterweights one on each side of said arm so as to swing into different counterbalancing positions relative to said arm; and means for effecting independent adjusting movement of said counterweights about said pivot pin and for holding said counterweights during and after adjustment, said adjusting means comprising a threaded rod for each counterweight, two pivotal connections for each of said rods, one of said connections attaching said rod to the free end portion of said crank arm and the other of said connections attaching said rod to its associated counterweight at a point radially spaced from said pivot pin, said last named connection comprising a head connected to said last named counterweight, there being a diametral opening through said head through which said rod passes and nuts threaded on said rod on opposite sides of said head, the adjustment of which nuts will cause said head to move along said rod and swing said counterweight on said pivot means.

3. In a counterbalance device of the character described, the combination of: a crank arm adapted for use with a rotatable member; a pair of counterweights; pivot means carried by said crank arm intermediate the ends thereof and supporting said counterweights one on each side of said arm so as to swing into different counterbalancing positions relative to said arm; and means for effecting independent adjusting movement of said counterweights about said pivot means and for holding said counterweights during and after adjustment, said adjusting means comprising a threaded rod for each counterweight, two pivotal connections for each of said rods, one of said connections attaching said rod to said crank arm and the other of said connections attaching said rod to its associated counterweight at a point radially spaced from said pivot means, said last named connection comprising a head connected to said last named counterweight and having a peripheral ridge, there being a diametral opening through said head through which said rod passes, plates on said rod having grooves to fit said ridge of said head and nuts threaded on said rod in positions to bear against said plates, the adjustment of which nuts will cause said head to move along said rod and swing said counterweight on said pivot means.

4. In a counterbalance device of the character described, the combination of: a crank arm adapted for use with a rotatable member; a pair of counterweights; pivot means carried by said crank arm intermediate the ends thereof and supporting said counterweights one on each side of said arm so as to swing into different counterbalancing positions relative to said arm; arcuate guide means disposed on the sides of said crank arm and having sliding engagement with intermediate portions of said counterweights so as to guide the same as they are swung from one position of adjustment to another; and means for effecting independent adjusting movement of said counterweights about said pivot means and for holding said counterweights during and after adjustment, said adjusting means comprising a rod for each counterweight, two pivotal connections for each of said rods, one of said connections attaching said rod to a counterweight at a point spaced radially from said pivot means, and the other of said connections attaching said rod to the end portion of said crank arm, one of said connections having means to move its pivotal axis along said rod and to thereby change the effective length of said rod so as to swing the counterweight associated therewith on said pivot means.

5. In a counterbalance device of the character described, the combination of: a crank arm adapted for use with a rotatable member; a pair of counterweights; a pivot pin passing through the central radial plane of said crank arm intermediate the ends thereof and supporting said counterweights one on each side of said arm so as to swing in the plane of rotation of said arm; arcuate guide means concentrically disposed relative to said pivot pin on the sides of said crank arm, channel forming means attached to the intermediate portions of said counterweights to slidably engage the said arcuate guide means so as to guide the counterweights as they are swung from one position of adjustment

to another; and means for effecting independent adjusting movement of said counterweights about said pivot pin and for holding said counterweights during and after adjustment, said adjusting means comprising a rod for each counterweight, two pivotal connections for each rod, one of said connections attaching said rod to a counterweight at a point spaced radially from said pivot pin, and the other of said connections attaching said rod to said crank arm, one of said connections having means to move its pivotal axis along said rod and to thereby change the effective length of said rod so as to swing the counterweight associated therewith on said pivot means.

6. In a counterbalance device of the character described, the combination of: a crank arm adapted for use with a rotatable member; a pair of counterweights; pivot means carried by said crank arm intermediate the ends thereof and supporting said counterweights one on each side of said arm so as to swing on the plane of rotation of said arm; arcuate guide means disposed on the sides of said crank arm and having sliding engagement with intermediate portions of said counterweights so as to guide the same as they are swung from one position of adjustment to another; and means for effecting independent adjusting movement of said counterweights about said pivot means and for holding said counterweights during and after adjustment, said adjusting means comprising a threaded rod for each counterweight, two pivotal connections for each of said rods, one of said connections attaching said rod to said crank arm and the other of said connections attaching said rod to its associated counterweight at a point radially spaced from said pivot means, said last named connection comprising a head connected to said last named counterweight and having a peripheral ridge, there being a diametral opening through said head through which said rod passes, plates on said rod having grooves to fit said ridge of said head and nuts threaded on said rod in positions to bear against said plates, the adjustment of which nuts will cause said head to move along said rod and swing said counterweight on said pivot means.

7. In a counterbalance device of the character described, the combination of: a one-piece crank arm and arcuate guide adapted for use with a rotatable member; a pair of counterweights; a pivot pin passing through the crank arm at the axis of said guide which is located intermediate the ends of said arm and supporting said counterweights one on each side of said arm for movement into different counterbalancing positions relative to said arm; means attached to each counterweight and cooperating with the latter to slidably engage said arcuate guide to restrain said counterweights against undesired movement in directions axially of their pivot pin during and after adjustment of said counterweights; and means operatively associated with the counterweights and the crank arm for effecting independent adjusting movement of said counterweights about said pivot pin and for holding said counterweights during and after adjustment; said adjusting means being arranged entirely radially outwardly of said arcuate guide and its cooperating means.

8. In a counterbalance device of the character described, the combination of: a one-piece crank arm and arcuate guide adapted for use with a rotatable member; a pair of counterweights; a pivot pin passing through the crank arm at the axis of said guide which is located intermediate the ends of said arm and supporting said counterweights one on each side of said arm for movement into different counterbalancing positions relative to said arm; means attached to each counterweight and cooperating with the latter to slidably engage said arcuate guide to restrain said counterweights against undesired movement in directions axially of their pivot pins during and after adjustment of said counterweights; and means operatively associated with the counterweights and the crank arm for effecting independent adjusting movement of said counterweights about said pivot pin and for holding said counterweights during and after adjustment; said adjusting means being arranged entirely radially outwardly of said arcuate guide and its cooperating means, and comprising a rod for each counterweight pivotally connected to the free end of said crank arm and pivotally and adjustably connected to its counterweight at a point located radially outwardly of the arcuate guide.

WARREN M. MANSFIELD.