April 1, 1969 A. A. PARISH 3,435,689

PUMP SUCKER ROD COUNTERBALANCE

Filed May 2, 1967 Sheet 1 of 2

Fig. 1

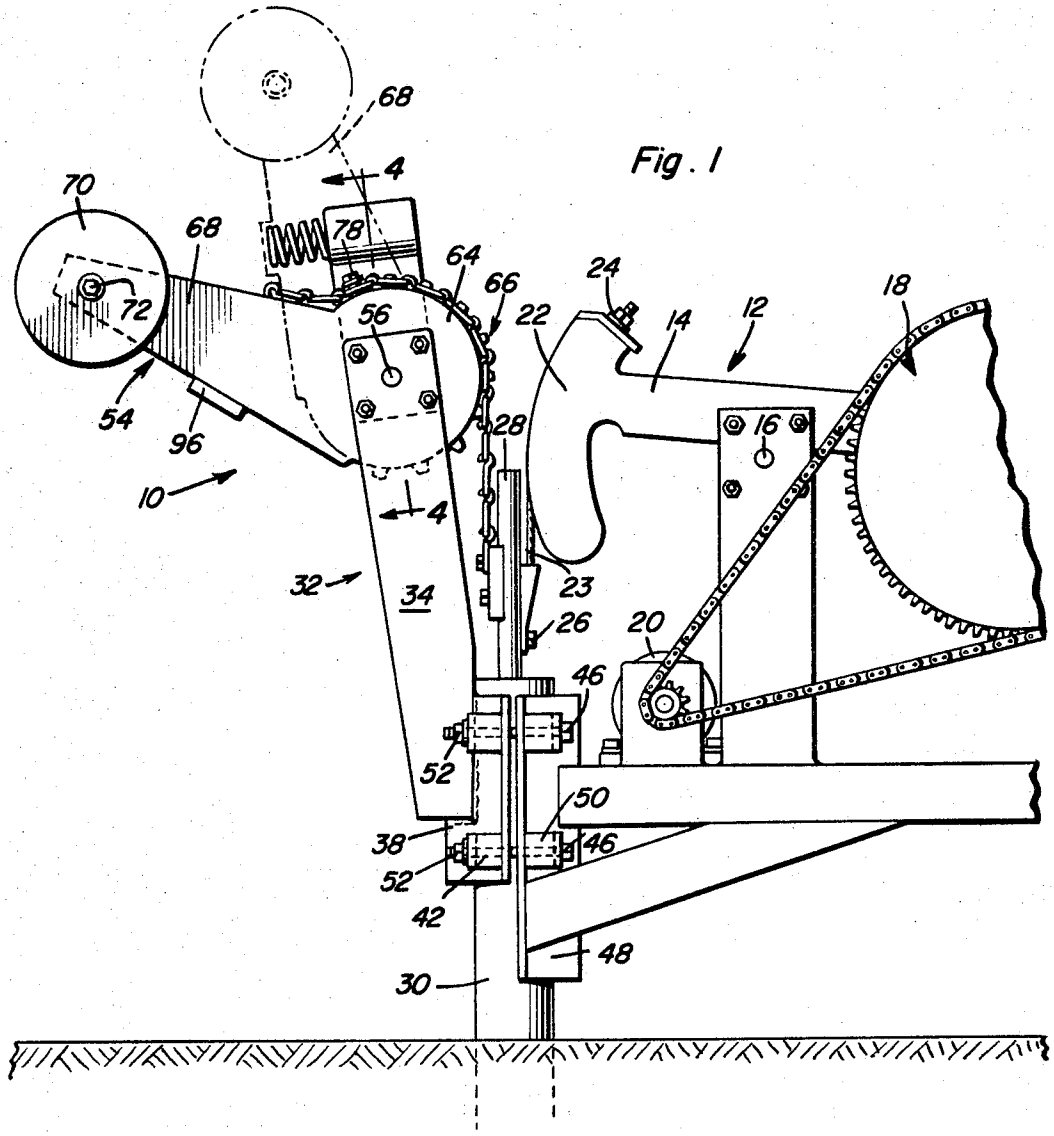
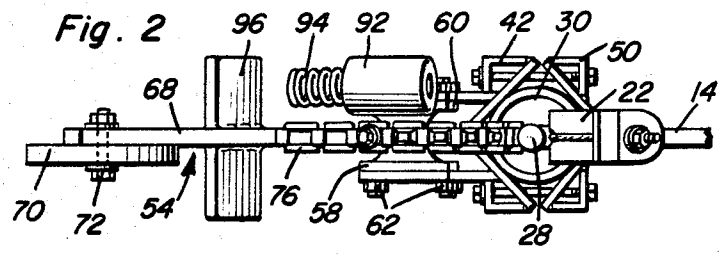


Fig. 2



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Fig. 3

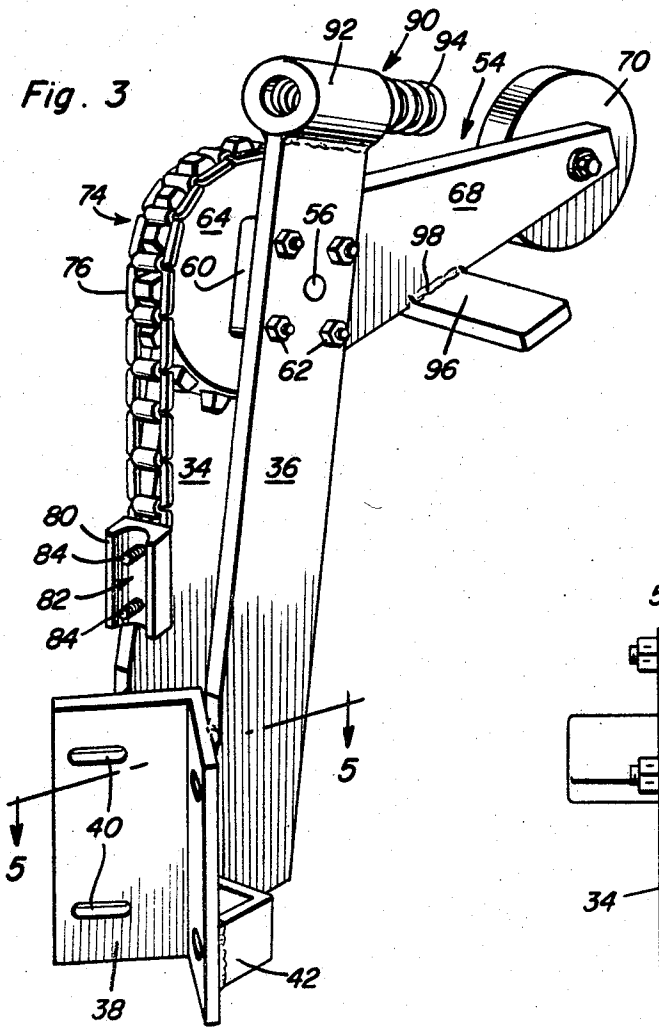


Fig. 4

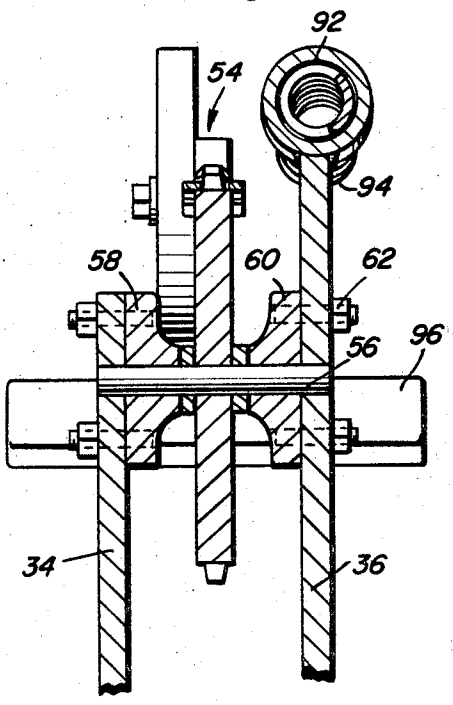


Fig. 5

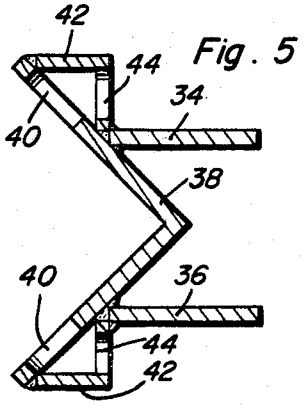
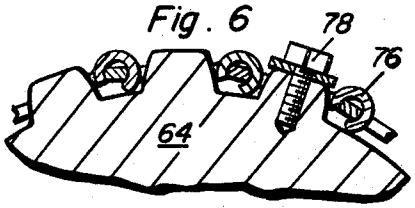


Fig. 6



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PUMP SUCKER ROD COUNTERBALANCE

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Int. Cl. F16h 21/10
U.S. Cl. 74—41 9 Claims

ABSTRACT OF THE DISCLOSURE

A counterbalance for a reciprocating pump sucker rod of a well pump to reduce the power necessary to lift the sucker rod, which counterbalance is pivotally mounted adjacent the sucker rod and rigidly yet resiliently connected thereto in such a manner so as to exert a lift upon the sucker rod during lifting of the rod by a primary power source.

The present invention relates to a pump sucker rod counterbalance adapted to be mounted adjacent a pump sucker rod to assist a primary source of operating power for the sucker rod in lifting the dead weight of the sucker rod and pump elements carried thereby. More particularly, the present invention contemplates the utilization of a pivotally mounted counterbalance arm having a toothed segment having one end of a rigid link flexible chain secured thereto whereby the other end of the rigid link flexible chain is secured to the sucker rod so as to cause oscillation of the counterbalance arm to assist in counterbalancing the weight of the sucker rod.

While counterbalances of the general utility disclosed herein have been proposed heretofore, most are not of a construction which can readily be adapted to existing pump apparatuses.

It is an object of the present invention to provide a novel construction for a pump sucker rod counterbalance that can be secured adjacent the sucker rod of a well pump to assist a primary source of power provided for the reciprocation of the sucker rod in effecting reciprocation of the sucker rod.

Another object of the present invention is to provide a novel construction for a pump sucker rod counterbalance which may be readily utilized with conventional walking beam well pumps and the like and operatively positioned relative thereto by securing the counterbalance device to the well pipe, pump stand, and the like.

Still another object of the present invention is to provide a novel construction for a pump sucker rod counterbalance including a laterally extending counterbalance arm mounted for oscillatory movement about a horizontal axis tangentially disposed relative to the longitudinal axis of a sucker rod and operatively connected thereto whereby as the sucker rod is moved downwardly a weight means associated with the counterbalance arm moves upwardly, but not over top dead center, whereby upon the upstroke of the sucker rod the weight means moves downwardly to effectively counterbalance the dead weight of the sucker rod thereby assisting the primary power source during the upstroke of the sucker rod.

A further object of the present invention is to provide a novel construction for a pump sucker rod counterbalance of the aforementioned type wherein the counterbalance arm means of the device includes a generally circular hub portion having a generally arcuate toothed segment on a peripheral edge thereof whereby a rigid link flexible chain having one end fastened to the toothed segment meshes therewith and has its other end secured to the sucker rod whereby oscillatory movement of the counterbalance arm assists in effecting lifting of the sucker rod.

Still a further object of the present invention is to provide a resilient stop means on a pump sucker rod counterbalance of the aforementioned construction whereby the counterbalance arm will be precluded from traveling over top dead center.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIGURE 1 is a side elevational view of an exemplary embodiment of a pump sucker rod counterbalance constructed in accordance with the principles of the present invention and shown operatively positioned relative to a pump sucker rod of a walking beam pump, further showing the pump sucker rod counterbalance clampingly mounted to the well pipe;

FIGURE 2 is a top elevational plan view of the embodiment of the device of FIGURE 1;

FIGURE 3 is an enlarged perspective view of the device of FIGURE 1, shown detached from the pumping means, and further as seen from the side opposite that shown in FIGURE 1;

FIGURE 4 is an enlarged generally vertical transverse cross-sectional view of the device of FIGURE 1 taken substantially along the plane of the line 4—4 of FIGURE 1;

FIGURE 5 is a horizontal cross-sectional view of a portion of the pump sucker rod counterbalance mounting means taken substantially along the plane of the line 5—5 of FIGURE 3; and

FIGURE 6 is an enlarged fragmentary vertical cross-sectional view of a toothed portion of a counterbalance arm means of the present invention.

Referring now to the drawings and to FIGURE 1 in particular it will be seen that the exemplary embodiment indicated at **10** comprising the pump sucker rod counterbalance of the present invention is shown, for purposes of illustration only, operatively associated with a walking beam actuated well pump indicated generally at **12**. It will be appreciated of course that the pump sucker rod counterbalance **10** of the present invention may be operatively associated with pumping devices of other configurations, such as a windmill pump for example, wherein a reciprocating sucker rod of either a solid or hollow configuration is connected to a downhole pump.

The walking beam pump **12** illustrated includes a walking beam **14** pivoted as at **16** and oscillated by an eccentric drive means **18** including an electrical motor **20** adapted to affect reciprocation of a horsehead **22** having a flexible wire cable **23** secured as at **24** to the horsehead **22** and as at **26** to a pump sucker rod **28** which is reciprocated within a well tubing **30** all of which, it will be appreciated, is conventional.

The pump sucker rod counterbalance **10** includes a support bracket means indicated generally at **32** and comprising steel plates **34** and **36** fixed, such as by welding for example, to an angle iron mounting plate **38** having a plurality of elongated mounting holes **40** therein and **44** generally complementary to the apertures **40** in the angle iron mounting plate **38**. It will thus be seen that provided with a corresponding number of fastener positioning lugs **42** provided for a purpose which will become clear hereinafter. The lugs **42** are prvided with apertures the support bracket means **32** may be removably or otherwise secured to the well pipe **30** by means of fasteners such as bolts **46** which pass through the lugs **50**, mounting angle iron **48**, lugs **50**, mounting plate **38**, and lugs **42**, secured by threadably received nuts **52**. As in-

dicated heretofore the illustrated manner in which the support bracket means **32** is secured relative to the sucker rod **28** is merely exemplary and in addition to being mounted on the well pipe **30** the support bracket means, or the equivalent thereof, could be mounted on a floor stand either comprising a portion of the walking beam pump means **12** or supported directly on the ground adjacent the well pipe **30**.

A counterbalance arm means indicated generally at **54** is journaled to the support bracket means **32** for oscillatory movement about a shaft **56** rotatably journaled to the plates **34** and **36** by means of antifriction bearing blocks **58** and **60** secured adjacent the upper ends of the plates **34** and **36** by suitable fasteners **62**. It will thus be seen that the journal blocks **58** and **60** provide a horizontal axis for oscillation of the arm means **54** which is tangential to the longitudinal axis of the sucker rod **28** for oscillatory movement of the counterbalance arm means **54** generally between the full and phantom line positions as seen in FIGURE 1.

The counterbalance arm means includes a generally circular disk portion **64** having a toothed segment indicated generally at **66**, of a gear-like configuration, extending about a portion of the peripheral edge of the disk **64**, and a laterally projecting arm portion **68** to which is removably secured a counterweight **70** by means of a suitable through blt **72**. Although not shown, it will nevertheless be understood that the size and weight of the counterweight **70** may be selectively altered and additional apertures other than that receiving the through bolt **72** may be provided in the arm **68** to permit changing the effective weight of the counterweight **70** by moving it in or out along the arm **68**.

As seen best in FIGURE 3 a rigid link flexible connector means indicated generally at **74** such as comprising a stamped-link chain **76** has one end secured to the toothed segment **66** of the disk **64** such as by a bolt and washer assembly **78** threadably received in a threaded bore within the disk **64**. The opposite end of the chain **76** is provided with a sucker rod connector block means **80** having a concavity, as indicated at **82**, generally complementary to the outer diameter of the sucker rod **28**, and secured thereto by a plurality of bolts **84** at least one of which pass through the end of the chain **66** and may, although not shown herein, also be a portion of the assembly securing the cable **23** to the sucker rod **28**.

The pump sucker rod counterbalance **10** further includes a counterbalance arm stop means indicated generally at **90** which includes a tubular member **92**, such as secured to the top end portion of the support plate **36**, within which is removably secured a helical spring **94**, such as of the type, for example, utilized in an automotive suspension assembly. The stop means **90** further includes a bumper plate **96** secured such as by welding at **98** to the counterbalance arm **68** so as to coact with the helical spring **94** to resiliently arrest the travel of the counterbalance arm means **54** as it moves between the full and phantom line psitions shown in FIGURE 1 in a manner to be described hereinafter during discussion of the operation of the counterbalance device.

In operation, actuation of the electric motor **20** effects rotation of the drive means **18** rocking the walking beam **14** about the axis provided by the shaft **16** so as to reciprocate the horsehead **22** and impart a reciprocatory movement to the sucker rod **28** through the connecting cable **23**. In doing so, and more particularly during the downward stroke of the horsehead **22**, when the sucker rod **28** is substantially falling of its own weight, the counterbalance arm means **54** moves in a clockwise direction, as seen in FIGURE **1**, from the full line to the phantom line position by virtue of the chain **76** connecting the sucker rod **28** with the toothed segment **66** of the disk **64**. The segment **66**, length of the chain **76**, and diameter of the disk **64** are predetermined so as to ensure that the arm **68** of the counterbalance arm means **54** does not pass over top dead center of the axis provided by the shaft **56**. It will be readily apparent that this is done so as to ensure that upon the upstroke of the horsehead **22**, the counterbalance arm **68**, under the influence of the counterweight **70**, will assist the horsehead **22** to lift the sucker rod **28** thus completing one pumping cycle. In order to ensure that the arm **68** does not pass over top dead center the bumper **96** is so positioned relative to the spring **94** to ensure that it contacts the spring **94** before the arm **68** reaches top dead center. It will also be understood that the spring **94** does not compress sufficiently to permit the arm **68** to pass over top dead center while simultaneously resiliently arresting travel of the arm **68**. Of course, it will be appreciated that the travel of the arm **68**, when translated to a reciprocatory motion of the lower portion of the chain **76**, should correspond to the distance the sucker rod **28** reciprocates.

From the foregoing, it will be readily apparent that the pump sucker rod counterbalance **10** of the present invention provides a simple inexpensive means of substantially reducing the horsepower required for the primary power operator of the pump means **12**, thereby effecting substantial economies of installation, operation and maintenance of the pump means **12**.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. In combination with a reciprocating pump sucker rod, and the like, provided with a primary source of reciprocatory operating power, a pump sucker rod counterbalance which comprises, a bracket means rigidly mounted adjacent the sucker rod to the counterbalanced, journal means carried by said bracket means for journaling a counterbalance arm means for oscillatory movement about a horizontal axis generally tangentially disposed relative to the longitudinal axis of the sucker rod, said counterbalance arm means including a first generally circular hub portion and a second laterally projecting arm portion, said first portion including a toothed segment, a fastener means secured to said first portion at one end of said segment, a rigid link flexible connector means fastened in meshing engagement with said toothed segment and having one end secured by said fastener means, the other end of said rigid link flexible connector means being secured to the sucker rod whereby reciprocation of the sucker rod by the primary source is assisted by said counterbalance arm, and said bracket means and said counterbalance arm means being provided with resilient stop means for arresting travel of said counterbalance arm means before it passes over top dead center relative to said journal means carried by said bracket means.

2. The combination of claim **1** wherein said bracket means includes a pair of generally vertically disposed parallel support plates and said generally circular hub portion of said counterbalance arm means is provided with a shaft journaled within said journal means carried by said bracket means.

3. The combination of claim **2** wherein said toothed segment on said generally circular hub portion is concentric to the axis of rotation of said circular hub portion.

4. The combination of claim **3** wherein the periphery of said generally circular hub portion is disposed in generally vertical alignment with the reciprocating pump sucker rod.

5. The combination of claim **1** wherein said laterally projecting arm portion is provided with a weighting means intermediate said generally circular hub portion thereof and its end.

6. The combination of claim 5 wherein said weighting means includes an adjustably and removably secured counterbalance weight.

7. In combination with a reciprocating pump sucker rod, and the like provided with a primary source of reciprocatory operating power, a pump sucker rod counterbalance which comprises, a bracket means rigidly mounted adjacent the sucker rod to be counterbalanced, journal means carried by said bracket means for journaling a counterbalance arm means for oscillatory movement about a horizontal axis generally tangentially disposed relative to the longitudinal axis of the sucker rod, said counterbalance arm means including a first generally circular hub portion and a second laterally projecting arm portion, said first portion including a toothed segment, a fastener means secured to said first portion at one end of said segment, a chain fastened in meshing engagement with said toothed segment and having one end secured by said fastener means, the other end of said chain being secured to the sucker rod whereby reciprocation of the sucker rod by the primary power source is assisted by said counterbalance arm, said bracket means including a pair of generally vertically disposed parallel support plates, said generally circular hub portion of said counterbalance arm means is provided with a shaft journaled within said journal means carried by said bracket means, and said bracket means and said laterally projecting arm portion being provided with resilient stop means adapted to resiliently arrest travel of said laterally projecting arm portion before it passes over top dead center relative to said journal means carried by said bracket means.

8. A pump sucker rod counterbalance adapted to be utilized to reduce the power necessary to lift a sucker rod being acted upon by a primary source of lifting power which counterbalance comprises, a bracket means rigidly mounted adjacent the sucker rod to be counterbalanced, journal means carried by said bracket means for journaling a counterbalance arm means for oscillatory movement about a horizontal axis generally tangentially disposed relative to the longitudinal axis of the sucker rod, said counterbalance arm means including a first generally circular hub portion and a second laterally projecting arm portion, said first portion including a toothed segment, a fastener means secured to said first portion at one end of said segment, a chain fastened in meshing engagement with said toothed segment and having one end secured by said fastener means, the other end of said chain being secured

to the sucker rod whereby reciprocation of the sucker rod by the primary power source is assisted by said counterbalance arm, said bracket means including a pair of generally vertically disposed parallel support plates and said generally circular hub portion of said counterbalance arm means is provided with a shaft journaled within said journal means carried by said bracket means, and said bracket means and said laterally projecting arm portion being provided with resilient stop means adapted to resiliently arrest travel of said laterally projecting arm portion before it passes over top dead center relative to said journal means carried by said bracket means.

9. In combination with a reciprocating pump sucker rod, and the like, provided with a primary source of reciprocatory operating power, a pump sucker rod counterbalance which comprises, a bracket means rigidly mounted adjacent the sucker rod to be counterbalanced, journal means carried by said bracket means for journaling a counterbalance arm means for oscillatory movement about a horizontal axis generally tangentially disposed relative to the longitudinal axis of the sucker rod, said counterbalance arm means including a first generally circular hub portion and a second laterally projecting arm portion, said first portion including a segment, means fastening one end of a flexible connector means to said segment, the other end of said flexible connector means being secured to the sucker rod whereby reciprocation of the sucker rod by the primary power source is assisted by said counterbalance arm and means carried by said counterbalance arm and said bracket means for arresting travel of said counterbalance arm before it passes over top dead center relative to said journal means carried by said bracket means.

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U.S. Cl. X.R.

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