March 3, 1942. H. H. RAULERSON 2,274,937

RESILIENT COUNTERBALANCING DEVICE

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FIG. 1

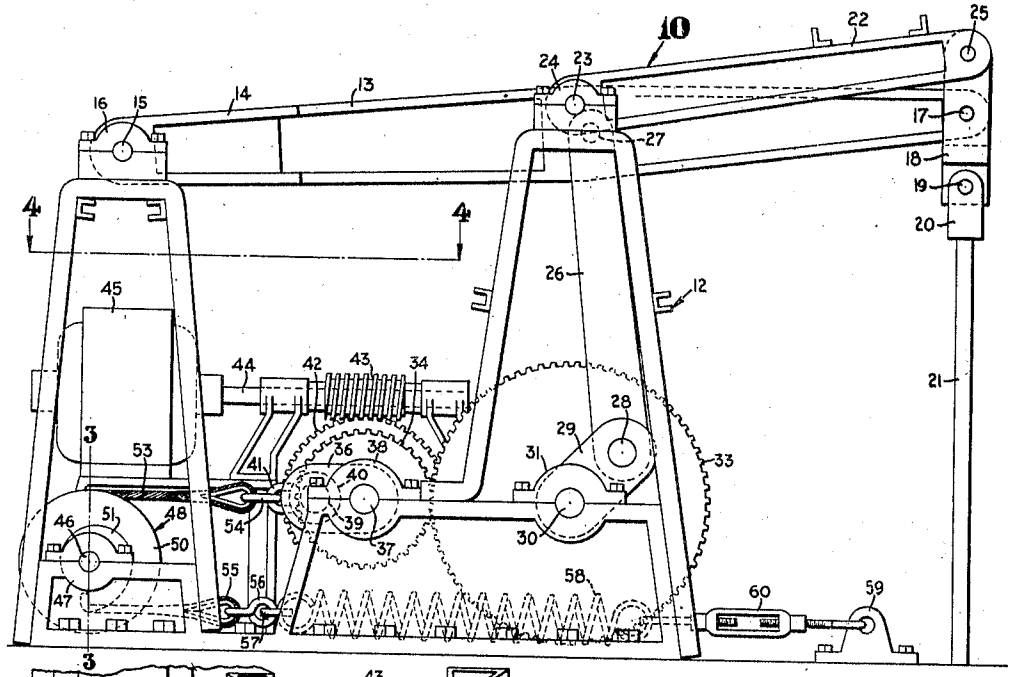


FIG. 2

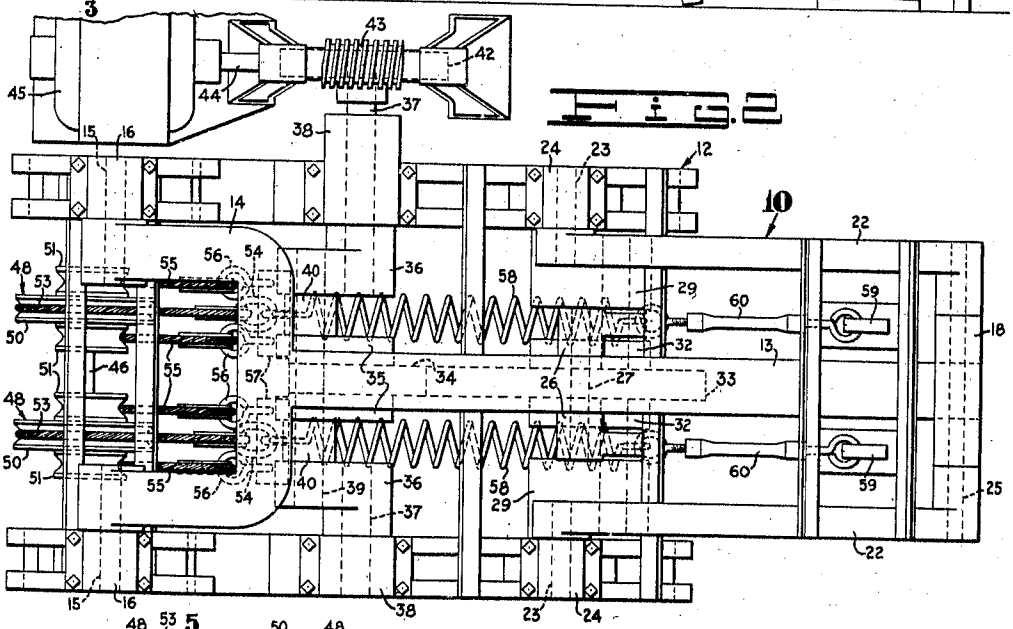
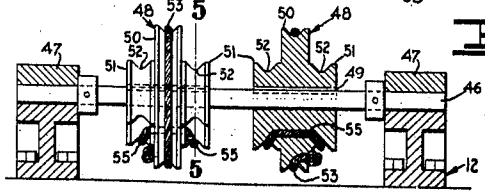


FIG. 3



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FIG. 6

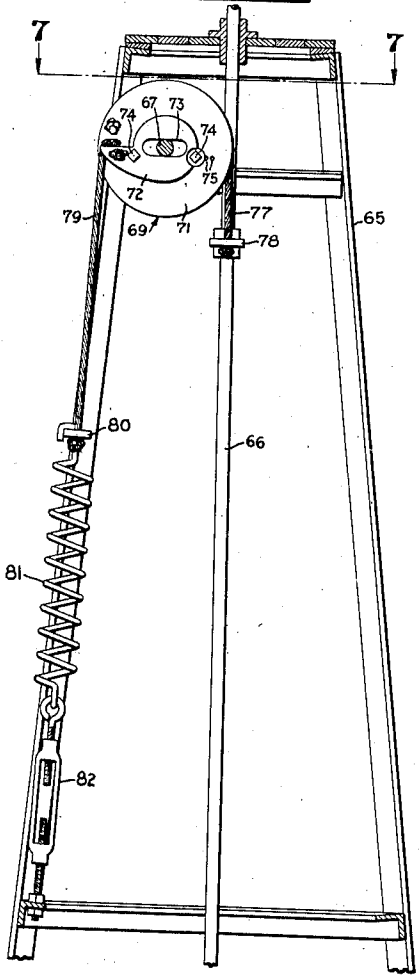


FIG. 4

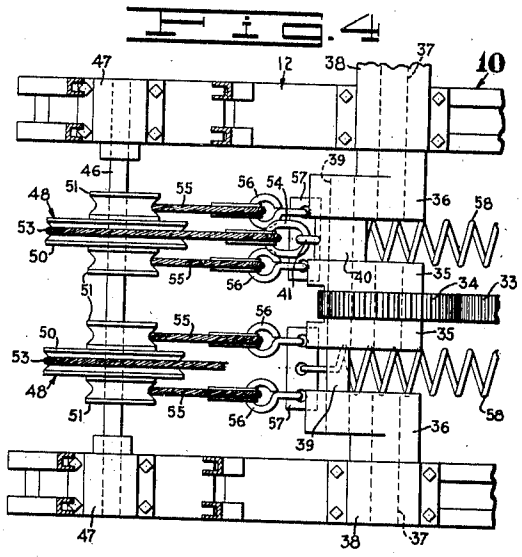


FIG. 8

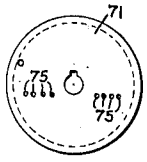


FIG. 5

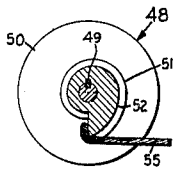


FIG. 9

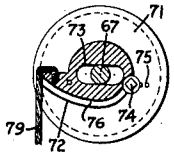


FIG. 10

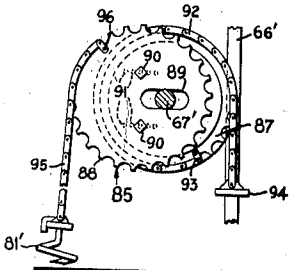


FIG. 7

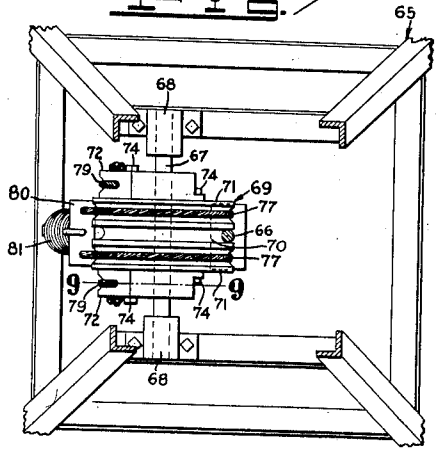
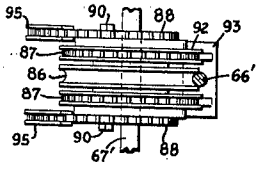


FIG. 11



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UNITED STATES PATENT OFFICE

2,274,937

RESILIENT COUNTERBALANCING DEVICE

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Application December 19, 1939, Serial No. 309,981

7 Claims. (Cl. 74—592)

This invention relates to improvements in spring counterbalance devices.

The general object of the invention is to provide for counterbalancing the weight of a pump sucker rod.

A more specific object of the invention is to provide an improved spring operated counterbalancing means for use with pump jacks of various kinds.

A further object of the invention is to provide a spring counterbalancing device including means whereby the force exerted by a coiled spring normally partly expanded remains the same during a predetermined expansion and contraction from the normal position.

Other objects and the advantages of this invention will be apparent from the following description taken in connection with the accompanying drawings, wherein:

Fig. 1 is a side elevation of a pump jack embodying the features of my invention;

Fig. 2 is a top plan view of the pump jack shown in Fig. 1;

Fig. 3 is a section taken on line 3—3, Fig. 1;

Fig. 4 is a fragmentary section taken on line 4—4, Fig. 1;

Fig. 5 is a section taken on line 5—5, Fig. 3;

Fig. 6 is a fragmentary vertical section through a water well pump tower with my invention operatively mounted thereon to work in conjunction with the pump rod;

Fig. 7 is a section taken on line 7—7, Fig. 6;

Fig. 8 is a side view of one of the pulleys of the device in Fig. 7 with the cam member removed;

Fig. 9 is a section taken on line 9—9, Fig. 7;

Fig. 10 is a side elevation of a modified form of my invention; and

Fig. 11 is a top plan view of the device shown in Fig. 10.

Referring to the drawings by reference characters I have shown my invention embodied in a pump jack which is indicated generally at 10.

My invention is applicable to various types of pump jacks. The pump jack shown includes a frame indicated generally at 12 which adjacent the upper end supports a walking beam 13. One end of the beam 13 includes a spoke portion 14 each side of which includes a trunnion 15 mounted in a bearing 16 on the frame. The opposite end of the beam 13 is pivotally connected as at 17 to a cross head 18 which includes a pivot 19 pivotally supporting a fitting 20 which supports a sucker rod 21.

On each side of the beam 13 I provide a guide arm 22 which includes a trunnion 23 supported in a bearing 24 on the frame 12. The opposite end of each of the guide arms 22 is pivotally connected as at 25 to the cross head 18.

The beam 13 is adapted to be actuated by a pair of link members 26 positioned one on each side of the beam and pivotally connected thereto adjacent their upper ends as at 27. Adjacent their lower ends the links 26 are each pivotally connected by a pin 28 to one end of a crank arm 29. Each crank arm adjacent the other end includes a trunnion 30 positioned in bearings 31 on the frame 12.

The pins 28 extend inward and are each mounted in an arm member 32 mounted on a gear 33. The gear 33 meshes with a reduced gear 34 which has arm members 35 mounted thereon. Spaced from the arms 35 the device includes crank arms 36 which include trunnion portions 37 mounted in bearings 38 on the frame 12. Adjacent their outer ends each crank arm 36 is connected to the adjacent arm member 35 by a pin 39. Mounted on each of the pins 39 I provide a sleeve 40 which includes a projecting eye member 41.

One of the trunnions 37 extends outward beyond the frame 12 and has a worm gear 42 thereon which meshes with a worm pinion 43 on the armature shaft 44 of an electric motor 45. From the foregoing it will be apparent that when the motor 45 is operating the worm pinion 43 will rotate the shaft 37 on which it is mounted which in turn will rotate the gear 34 to thus rotate the gear 33. As the gear 33 rotates the arm members 29 and 32 move with it and swing the pins 28 about the axis of the trunnions 30 thus vertically reciprocating the link members 26.

As the link members are thus moved they move the beam 13 up and down about the axis of the trunnion 15 thus vertically reciprocating the cross head 18 and the sucker rod 21.

Spaced from the gear 34 opposite the gear 33 I provide a transverse shaft 46 which is mounted in bearings 47 on the frame 12. Mounted on the shaft 46 I provide two sets of pulley units 48 each of which is secured to the shaft by a key 49. Each of the units 48 includes a central grooved pulley 50 with a grooved cam member 51 on each side. The working surface or bottom 52 of the groove of each cam member is shaped to include a portion spaced a predetermined distance from the center and then following a helical path approaching the axis of the shaft 46. (See Fig. 5.)

Each of the pulleys 50 has one end of a cable 53 secured thereto whence the cable extends over the pulley and is connected by a link 54 to the eye 41 of one of the sleeves 40.

Each of the pulleys 50 have a cable 55 extending through a suitable aperture therein as shown in Fig. 3 and the two lengths of the cables 55 extend over the outer ends of the cam members 51 and extend towards the gear 34 where the ends of both cables are connected by links 56 to plates 57.

Each of the plates 57 has one end of a coiled spring 58 connected thereto while the opposite end of each of the springs is anchored to a lug member 59 through the medium of a turnbuckle 60.

The cam members 51 are arranged so that the extremities thereof are below the axis of the shaft 46 when the crank arms 35 and 36 extend horizontally towards the shaft 46 as shown in Figs. 1 and 2. In this position of the cam members the springs are under a predetermined amount of tension which is sufficient to balance the weight of the sucker rod 21.

Thus when the motor 45 operates to reciprocate the sucker rod as previously described and the crank arms 35 and 36 swing away from the shaft 46, the cables 53 move with them and rotate the pulleys 50 and cam members 51 in a clockwise direction approximately one quarter revolution. As the cam members thus move the cables 55 wind against the working surface 52 and extend the springs 58. Due to the shape of the working surfaces 52 of the cams as the cables wind thereon they move towards the axis of the shaft and thereby the leverage arm is decreased. Thus substantially the same resistance is exerted against the cables 53 at all times to counterbalance the weight of the sucker rod 21.

The weight of the fluid pumped may be counter-balanced in any of the usual manners such as by properly positioning a weighted (not shown) on the shaft 30.

In Figs. 6 and 7 I have shown my invention applied to a windmill type of water pumping device which includes a tower frame 65 and a vertically reciprocating sucker rod 66 which may be operated by the conventional windmill.

At one side of the sucker rod 66 I provide a horizontal shaft 67 which is journaled in bearings 68 on the frame 65. Mounted on the shaft 67 I provide a pulley assembly indicated at 69 which includes a grooved center portion 70 to receive the sucker rod 66 and grooved pulley portions 71 on each side thereof.

Mounted on the outer faces of each of the pulley portions 71 I provide a grooved cam member 72 each of which has elongated aperture 73 therein in which the shaft 67 is positioned. Each of the cams 72 is secured to its respective pulley by a pair of bolts 74 which are positioned in one of a set of threaded apertures 75 in the pulley.

Each of the cams 72 includes a working surface 76 which is defined by the bottom of the groove therein, (see Fig. 9). The working surfaces of the cams each includes an end portion positioned a predetermined distance from the axis of the cam which is connected to a portion which extends inwardly in a curve which approaches the axis of the cam. By providing a plurality of the threaded apertures 75 in the pulleys the cams may be adjusted to move the extremities thereof towards or from the axis of the shaft 67.

Cables 77 extend over the pulleys 71 with each cable having one end anchored to its associated pulley and the opposite end connected to a cross head 78 on the sucker rod 66.

Each of the cams 72 has one end of a cable 79 anchored thereto. Each cable extends over the extremities of the working surface 76. The opposite ends of the cables 79 are connected to a bar 80 to which one end of a coiled spring 81 is connected. The opposite end of the coiled spring 81 is anchored to a portion of the frame 65 through the medium of a turnbuckle 82.

The cams 72 are arranged so that when the sucker rod 66 is at the limit of its upward movement the extremities of the working surfaces are farthest from the sucker rod. When the cams are in this, the initial position the spring 81 is under a predetermined amount of tension. As the sucker rod moves downward the cables 77 rotate the pulleys 71 in a clockwise direction which in turn rotate the cams. As the cams 72 are thus rotated the cables 79 wind upon the working surfaces 76 thereof against the action of the spring 81 and extend the spring. Due to the shape of the working surfaces 76 of the cams as the cables wind thereon they move towards the axis of the shaft 67 and thereby the active leverage is decreased. Thus the substantially same resistance is exerted against the cables 77 at all times.

In Figs. 10 and 11 I have indicated a device generally at 85 which may be used in place of the device 69. As shown the device 85 includes a central grooves wheel 86 which receives the sucker rod 66'. At each side of the wheel 86 I mount a sprocket 87.

On the outer face of each sprocket 87 I provide a sprocket 88 the axis of which is positioned eccentric to the axis of the adjacent sprocket 87. The sprockets 88 each has an elongated aperture 89 therein in which the shaft 67' is positioned. The sprockets 88 are each secured to the sprockets 87 by a pair of bolts 90 each of which is positioned in one of a plurality of threaded apertures 91 in the sprockets. By providing a plurality of the apertures 91 the sprockets 88 may be positioned closer or farther from the axis of the sprockets 87.

The sprockets 87 each has one end of a sprocket chain 92 anchored thereto as at 93 and which extends over the sprocket and has the opposite end connected to a cross head 94 on the sucker rod 66'.

Each of the sprockets 88 has one end of a sprocket chain 95 anchored thereto as at 96 and which extends downward and is connected to the spring 81'. In operation the sprockets 88 act in the same manner as the cam members 72.

From the foregoing description it will be apparent that I have provided a novel spring counterbalancing device which is simple in construction and highly efficient in use.

I claim:

1. In a counter-balance for an oscillating beam, a base, a shaft on said base, means operated by the shaft for oscillating said beam, a crank arm on said shaft, a second shaft mounted on said base and spaced from said first shaft, a pulley member on said second shaft, said pulley including a flexible member engaging portion, a flexible member having one end anchored to said pulley and passing thereover and having the opposite end connected to said crank arm, a resilient member on said base, a second flexible member having one end connected to said resilient member, a second flexible member engaging portion rotatable with said pulley, means to secure the other end of said second flexible member to said second engaging portion, one of said engaging portions including a spiral cam surface, the relation of said cam surface and said crank arm being such that when the crank arm is

nearest the second shaft the portion of the cam surface most remote from the cam axis is operatively engaged by its flexible member.

2. A pump jack including a pivoted walking beam having means thereon to engage a sucker rod, a shaft, means driven by said shaft for oscillating said beam, a crank arm on said shaft, a second shaft spaced from said first shaft, a cam member on said second shaft, said cam member including a cam portion having a spiral working surface diminishing towards its axis, a flexible member anchored to said cam member and engaging the working surface of said cam, a resilient member having one end connected to said flexible member and having the other end anchored, said cam member having a pulley groove therein, a second flexible member disposed in said pulley groove and having one end connected to the cam member and the other end connected to said crank arm, the relation of said cam working surface and said crank arm being such that when the crank arm is nearest the second shaft the second flexible member operatively engages the portion of the cam most remote from its axis and approaches its axis as the crank member recedes from the second shaft.

3. A pump jack including a pivoted walking beam having means thereon to engage a sucker rod, a shaft, means driven by said shaft for oscillating said beam, a crank arm on said shaft, a second shaft spaced from said first shaft, a pulley member on said second shaft, a flexible member having one end anchored to said pulley and passing thereover and having the opposite end connected to said crank arm, a cam member, means to adjustably secure the cam member on said pulley, said cam member having a spiral working surface, a second flexible member anchored to said pulley and engaging the working surface of said cam, and a resilient member connected at one end to said second flexible member and having the other end anchored.

4. A pump jack including a pivoted walking beam having means thereon to engage a sucker rod, a shaft, means driven by said shaft for oscillating said beam, a crank arm on said shaft, a sleeve member rotatably mounted on said crank arm, a second shaft spaced from said first shaft, a pulley member on said second shaft, a flexible member having one end anchored to said pulley and passing thereover and having the opposite end connected to said sleeve member, said pulley including a cam portion having a spiral working surface, a second flexible member anchored to said pulley and engaging the working surface of said cam, a resilient member connected at one end to said second flexible member and having the other end anchored, the relation of said cam and said crank arm being such that when the crank arm is nearest the second shaft the second flexible member operatively engages the portion of the cam most remote from its axis and approaches its axis as the crank member recedes from the second shaft.

5. A pump jack including a base, a walking beam pivotally mounted on said base, a shaft on said base, means operated by the shaft for oscillating said beam, a crank arm on said shaft, a sleeve member rotatably mounted on said crank arm, a shaft mounted on said base and spaced from said first shaft, a pulley member on said second shaft, said pulley including a cam portion on each side thereof, a flexible member having one end anchored to said pulley and passing thereover and having the opposite end connected to said sleeve member, said cam portions each including a spiral working surface, a pair of flexible members each having one end anchored at one end to one of said cam portions, a resilient member, means connecting the other end of said pair of members to said resilient member, means to anchor the other end of said resilient member, the relation of said cam portions and said crank arm being such that when the crank arm is nearest the second shaft the pair of flexible members operatively engage the portion of the cam portions most remote from the cam axis and approaches its axis as the crank member recedes from the second shaft.

6. A pump jack including a base, a walking beam pivotally mounted on said base, a pair of shafts rotatable on said base, means operated by one shaft to drive the other shaft, means operated by the other shaft to oscillate the beam, a pair of crank arms on said one shaft, a third shaft spaced from said pair of shafts, a pair of pulley members mounted on said third shaft, each of said pulleys including a cam member on each side thereof, flexible members each having one end anchored to one of said pulleys and passing thereover and having the other end connected to one of said crank arms, said cam members each including a spiral working surface, a plurality of pairs of flexible members each associated with one cam, each of said pairs of flexible members being anchored at one end to its cams, a pair of resilient members on said base and means connecting each pair of flexible members to the resilient members.

7. A pump jack including a base, a walking beam pivotally mounted on said base, a pair of shafts rotatable on said base, means operated by one shaft to drive the other shaft, means operated by the other shaft to oscillate the beam, a pair of crank arms on said one shaft, a sleeve member rotatably mounted on each of said crank arms, a third shaft spaced from said pair of shafts, a pair of pulley members mounted on said third shaft, each of said pulleys including a cam on each side thereof, flexible members each having one end anchored to one of said pulleys and passing thereover and having the other end connected to one of said sleeve members, said cams each including a spiral working surface, a plurality of pairs of flexible members each associated with one cam, each of said pairs of flexible members being anchored at one end to its cam, a pair of resilient members, means connecting each pair of flexible members to one end of one resilient member, means to anchor the other opposite ends of said resilient members, the relation of said cams and said crank arms being such that when the crank arms are nearest the third shaft the pairs of flexible members operatively engage the portion of the cams most remote from the cam axis.

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