Oct. 17, 1933. M. T. ARCHER 1,931,472

COUNTERWEIGHTED CRANK

Filed Nov. 26, 1928

Fig. 1

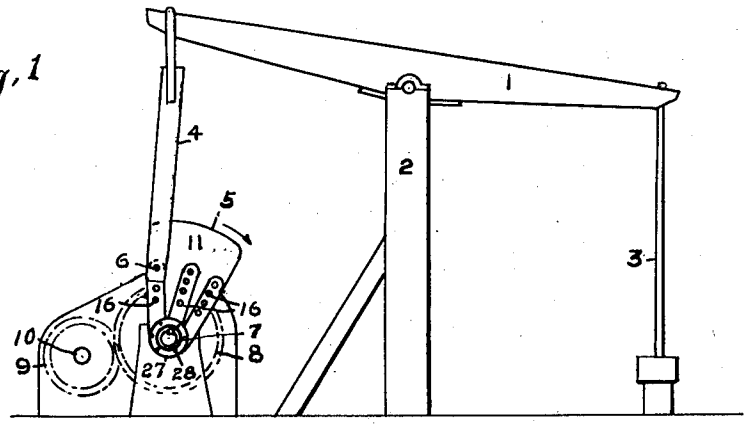


Fig. 2

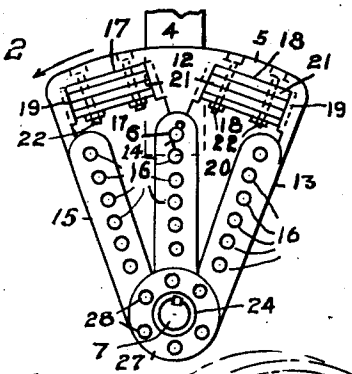


Fig. 3

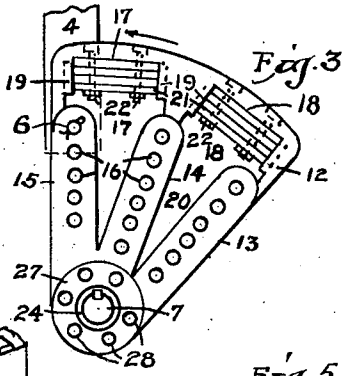


Fig. 4

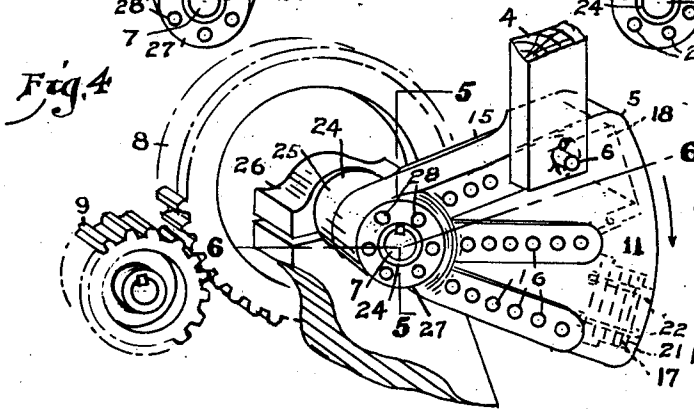


Fig. 5

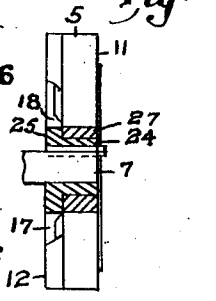
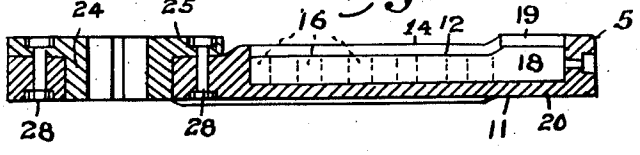


Fig. 6



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Patented Oct. 17, 1933 1,931,472

UNITED STATES PATENT OFFICE

1,931,472

COUNTERWEIGHTED CRANK

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Application November 26, 1928
Serial No. 321,816

4 Claims. (Cl. 74—71)

My invention relates to counterweighted cranks.

In pumping operations pump rods suspended from walking beams are subjected to varying stresses. Up-strokes set up much greater stresses in the pump rods than down-strokes, due largely to the fact that on up-strokes liquid as well as the pump rods and plungers must be moved in opposition to the force of gravity, while on down-strokes the descending parts are relieved of stresses due to the weight of fluid and are moved in the direction in which gravity acts on them. The energy required during the starting and acceleration of up-strokes of pump rods is considerably greater than that required after the moving parts have accelerated to normal pumping speed. Variations in the depth of wells and the quantity of fluid pumped and the speed of pumping cause great variations in the pumping load and affect considerably the angular position of the crank at the time when peak loads occur. Due to the elasticity of pump rods, walking beams operating pumping rods travel a short distance before the shocks or impacts of the loads to be lifted are fully transmitted to the walking beams. These shocks or impacts are carried from the rods through the walking beams to the pitmen, gears and prime movers and increase with the depths of the wells and speed of pumping.

It is usually desirable that the energy stored up in a moving counterweight for a well-pumping apparatus be transmitted to a pump rod in a gradually increasing intensity in order that it may counteract as much as possible the impact loads on the pump rod at the beginning of its up-strokes, during which great loads must be started from rest and accelerated against gravity. It is one object of this invention to meet the conditions just described by providing a counterweight whose center of mass may be adjusted or is arranged so that, when peak loads occur on the pump rods, the influence of the said stored-up energy may be greatest at the point desired.

Another object is to increase the mass and adjust the center of mass of counterweights by means of weights applied preferably to a plurality of pockets in the counterweights.

Another object is to provide adjustments of the counterweight angularly on its shaft in order to shift the wear on the teeth of the gear wheels which drive the pump, and to facilitate the installation and renewal of the crank.

Referring to the accompanying drawing, Fig. 1 is a side elevation of a well-pumping apparatus of the walking-beam type, showing the pitman connected to the left-hand part of the front face of the counterweight. Fig. 2 is a rear view of the counterweight with the pitman broken off and connected to the central portion of the counterweight. Fig. 3 is a rear view like Fig. 2, but showing the pitman connected to the left-hand part of the front face of the counterweight. Fig. 4 is a perspective view showing the counterweight, the pitman broken off and connected to the same, the driving shaft and a pair of gears for driving the shaft, and a portion of one bearing for the shaft. Fig. 5 is a section on the line 5—5 on Fig. 4, the section being confined to the counterweight and the shaft being in elevation and broken off. Fig. 6 is a section on the line 6—6 on Fig. 4.

On the drawing 1 designates a walking-beam pivoted between its ends on the post 2 and having pivotally suspended thereon at one end the pump rod 3 and at the other end the pitman 4 which has its lower end pivotally connected to the crank 5 by the wrist-pin 6. The crank 5 is preferably indirectly keyed to the driven shaft 7 which carries the gear wheel 8 meshing with the driving pinion 9 on the shaft 10 actuated by any suitable prime mover.

The inner vertical face 12 of the counterweight, that is, the face opposite the outer face 11, has a number of radial ribs 13, 14 and 15 which are provided with rows of holes 16 extending entirely through the counterweight, the wrist-pin 6 being located in the lower end of the pitman 4 and any selected one of the holes 16.

The face 12 of the counterweight has a number of pockets. In the present instance only two pockets 17 and 18 are provided, symmetrically disposed at the outer end of the counterweight and at opposite sides of the central radial line of holes 16 through the rib 14. The pockets have their outer ends closed by the outer wall of the counterweight. Their sides next to the wheel 8 are open except that their lateral edges have the flanges 19 projected toward each other and spaced from the outer or bottom wall 20 of the pockets. Weights 21 may be inserted into the pockets near the outer ends of the ribs and then pushed outwardly with their ends between the flanges 19 and the wall 20. Bolts 22 are passed through the outer walls of the pockets and through the weights, nuts being applied to the bolts and turned up tightly against the faces of the innermost weights to hold the weights securely in the pockets.

Preferably, the counterweight, instead of being directly keyed to the shaft 7, is bolted to the stepped sleeve or bushing 24 which is keyed directly to the shaft 7. The bushing has the flange 25 between the shaft bearing 26 and the hub 27 of the counterweight, bolts 28 extending through the flange and the hub to secure the same together. The bolts are evenly spaced so that the counterweight may be adjusted to any number of angular positions about the shaft corresponding to the number of bolts employed. I have shown six bolts 28. Accordingly, the counterweight can be secured to the shaft 7 at any one of six angular positions about the shaft.

The crank 5 is supposed to be moving in the direction indicated by the arrows in Figs. 1 to 4. In Fig. 1 the crank is ready to initiate an up-stroke of the pump rod 3. Here substantially the entire mass of the counterweight has passed the dead center of the wrist pin 6 and will apply practically all the stored-up energy therein to the wrist pin at the beginning of the stroke. As the crank moves, the counterweight moves downwardly faster and faster until the pin 6 reaches the horizon of the shaft 7 when its rate of speed decreases during the next 90°. During the time the pump rod is lengthening or stretching before the entire load is picked up, the effect of the counterweight is increasing and will supply a considerable force for starting the pump rod upwardly when the shock or impact load is fully and suddenly received by the pump rod.

In Fig. 2 the center of mass of the counterweight lies in the dead-center line of the pin 6. Accordingly, the up-stroke will not be so greatly assisted at its start as it would be with the pitman connected as in Fig. 1. However, as the rising parts of the counterweight pass their highest points, they add their stored up energy to that of the other parts which have antecedently been going downwardly, so that there is a growing force applied to the up-pull on the pump rod at the time the shock or impact load is fully and suddenly applied. It may be, however, that the shock may come before all of the counterweight has started downwardly, in which case the shock would be somewhat lessened.

In Fig. 3, the pitman is attached to a hole in the rib 15. The wrist pin 6 is at dead-center and the parts of the counterweight are lagging behind, so that the shock on the pump rod will be largely if not entirely taken up before the counterweight adds any appreciable up-force on the pump-rod. It will materially aid in the acceleration of the parts and will lessen the shock or impact on the pump rod as the column of fluid is set in motion upwardly.

The addition of weights in the pockets 17 and 18 increases the effectiveness of the counterweight and permits regulation of the stored energy to secure the best power consumption for the various loads carried by the pump rods. Weights may be equally distributed in the pockets or weights may be put into only one pocket as desired.

By my counterweight, the mass of the counterweight may be increased or decreased as desired to accommodate the varying pumping loads due to varying depths of wells and the varying weights of fluid pumped per stroke. Also the position of the center of mass of the counterweight may be varied to compensate most effectively for the lag of the inertia peak load due to variations in pumping speeds and varying depths of wells. My counterweight secures economical power consumption and reduces the impact and shock stresses on the pumping equipment.

I claim—

1. A counterweight carried by a rotatable shaft and carrying a wrist pin and a pitman connected to the wrist pin, the counterweight having pockets in which separate weights may be enclosed to position the center of mass of the counterweight ahead of a line through the centers of the pitman and the shaft or behind the same or coincidental with the same.

2. A shaft, a counterweight thereon having a plurality of outwardly diverging lines of holes at the same side of the shaft, a pitman, and a wrist pin insertible through the pitman and into any selected hole, the counterweight having pockets arranged in angular relation with each other about the shaft and adapted to enclose removable weights for positioning at will the center of mass of the counterweight circumferentially ahead of a line connecting the centers of the shaft and the wrist pin or behind the same or coincident therewith.

3. A shaft, a counterweight rotatable thereby, a wrist-pin carried by the counterweight, a pitman connected to the wrist-pin, the counterweight having pockets arranged at different circumferential positions about the shaft, and weights enclosed in one or more of the pockets to circumferentially shift the center of the combined mass of the counterweight and the weights selectively ahead of a line connecting the centers of the shaft and the wrist-pin or behind the same or coincident with the same.

4. A shaft, a counterweight rotatable thereby having circumferentially-arranged holes in which a wrist-pin may be selectively inserted, the counterweight having a circumferential wall at its outer end, and weights positioned between the said wall and a portion of the counterweight nearer the axis of rotation of the counterweight and supported by the wall and distributed circumferentially to selectively position the center of the combined mass of the counterweight and the weights ahead of a line connecting the centers of the shaft and the wrist-pin or behind the same or coincident therewith.

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