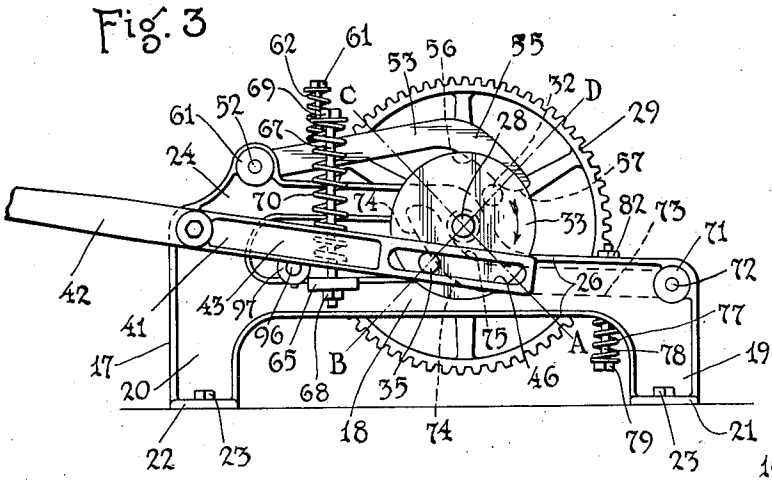
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Fig. 3



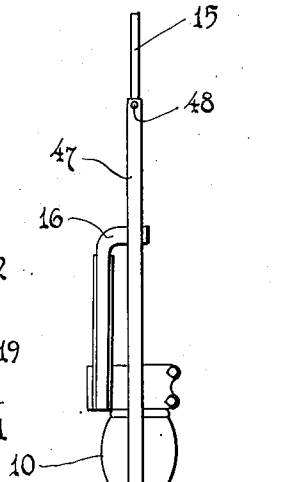
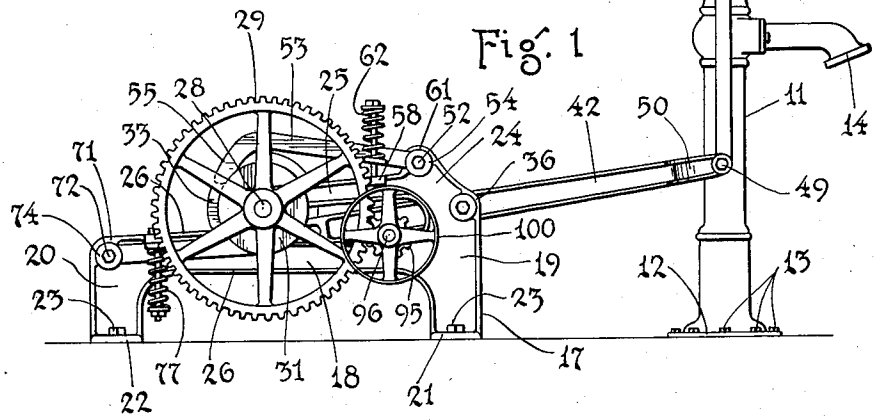


Fig. 1



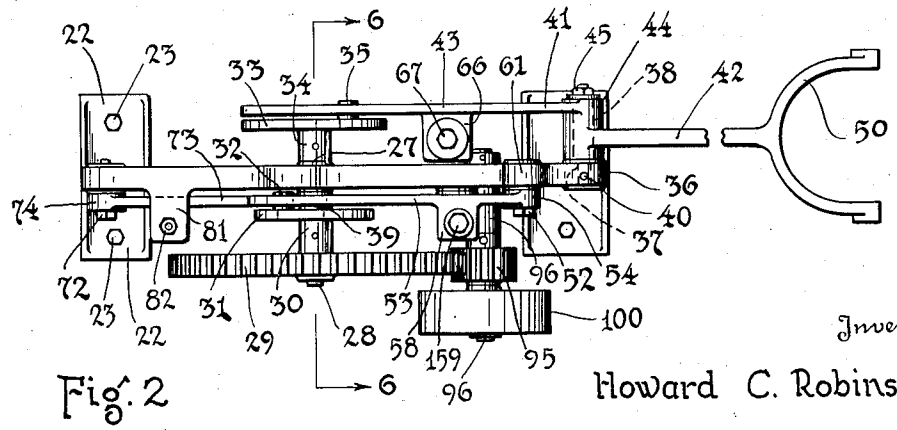


Fig. 2

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Fig. 4

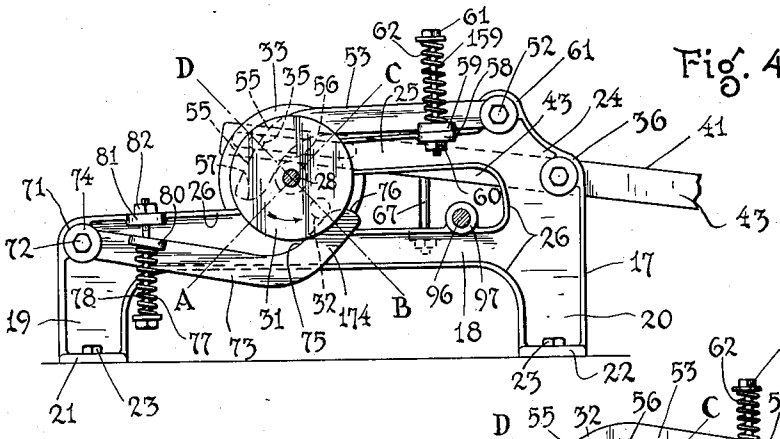


Fig. 5

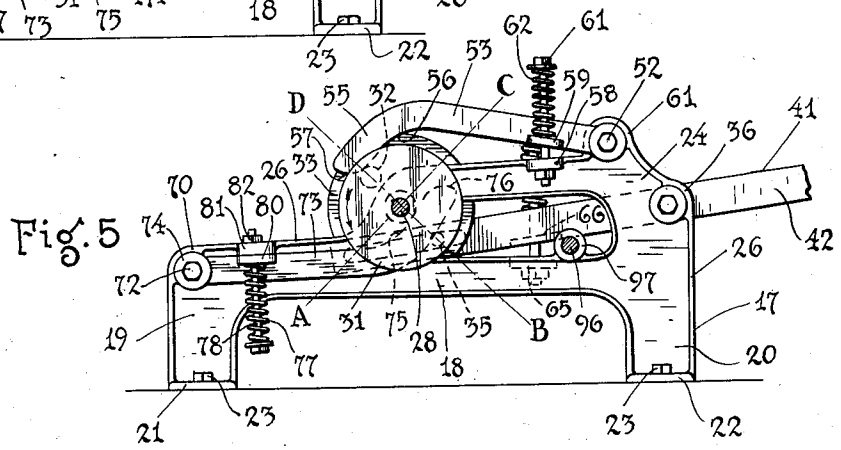


Fig. 6

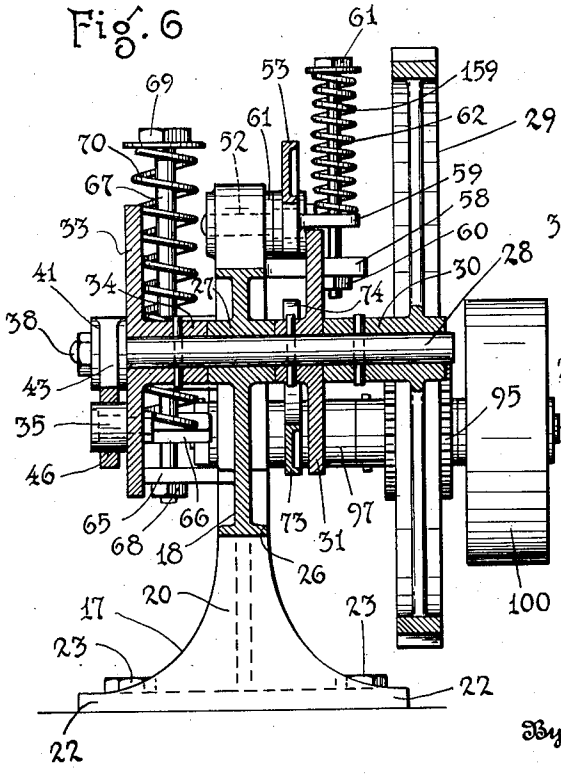
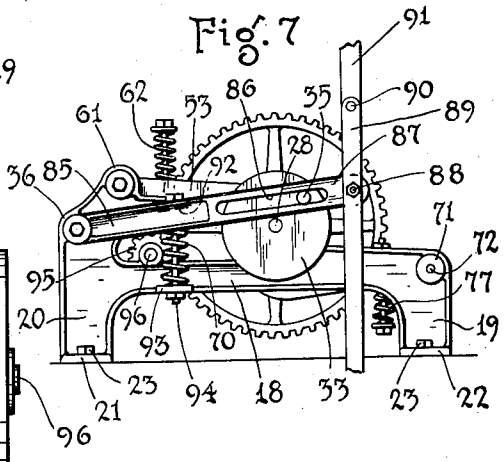


Fig. 7



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UNITED STATES PATENT OFFICE

2,021,639

LOAD EQUALIZER

Howard C. Robinson, Pine City, Minn.

Application April 22, 1933, Serial No. 667,351

10 Claims. (Cl. 74—45)

My invention relates to load equalizers for reciprocating pumps and similar machinery and has for its object to provide a device by means of which equal loading of the motor, engine or other source of power may be procured.

Another object of the invention resides in providing a load equalizer by means of which the motor, engine or other source of power may travel at a substantially uniform rate of speed throughout the entire cycle of operation of the pump or other reciprocating member.

A still further object of the invention resides in providing a load equalizer for operation in conjunction with a swinging beam, a shaft and a crank pin driven by the shaft and operating to reciprocate said beam, said crank pin having four stages of movement for each rotation of said shaft during the first of which the pump is operated, during the second of which, movement of the crank pin occurs without appreciable movement of the swinging beam, during the third of which the pump is operated in its return movement and during the fourth of which the crank pin again moves without procuring appreciable movement of the swinging beam.

Another object of the invention resides in providing a load equalizer where energy is stored up during either or both of the second and fourth stages of movement of the crank pin and is imparted to the shaft during the succeeding stage.

A feature of the invention resides in providing a load equalizer in which energy is also stored up during the third stage and imparted to the shaft during the first stage.

An object of the invention resides in providing a cam mechanism for storing energy during one stage and imparting it to the shaft during the succeeding stage.

A feature of the invention resides in utilizing springs for the storage of energy and in employing a pivoted arm for flexing the spring to store energy therein.

Other objects of the invention reside in the novel combination and arrangement of parts and in the details of construction hereinafter illustrated and/or described.

In the drawings:

Fig. 1 is an elevational view of a pump illustrating an embodiment of my invention applied thereto and showing the pump rod at the end of its return stroke.

Fig. 2 is a plan view of the load equalizer detached from the pump.

Fig. 3 is an elevational view of the load equalizer shown in Fig. 1 and drawn to a larger scale.

Fig. 4 is an elevational view similar to Fig. 3, viewed from the opposite side of the load equalizer.

Fig. 5 is a view similar to Fig. 4 showing the parts in altered position.

Fig. 6 is an elevational sectional view taken on line 6—6 of Fig. 2 and drawn to a larger scale.

Fig. 7 is a view similar to Fig. 1 showing a modification of the invention.

In the operation of the reciprocating pumps such as are used for pumping water from wells, the customary practice has been to employ a pump jack to which the power is connected and by means of which rotating power is converted into reciprocating power for operating the pump. With such construction considerably more power is required during the suction stroke of the pump than during the return stroke thereof. This necessitates utilizing a much larger motor and entails considerable inefficiency, due to the fact that very little power is utilized during the return stroke of the pump and through such portions of the cycle of movement of the pump when the same reaches the ends of its stroke. In addition such systems cause an unnecessary strain upon the motor due to the fact that during the suction stroke of the pump the motor is running at a low rate of speed and during the return stroke of the pump, the motor is operating at a high rate of speed. The present invention provides a load equalizer by means of which energy may be stored during the portion of the cycle of movement of the pump when little power is being consumed, which stored energy is subsequently imparted to the pump during the suction stroke thereof when an appreciable amount of power is required.

For the purpose of illustrating my invention, I have shown an ordinary pump 10 which comprises a standard 11 having a flanged base 12 bolted to the floor on which the pump rests through bolts 13. Standard 11 is provided with the usual cylinder, not shown, which delivers water to a spout 14 connected to said standard. A pump rod 15 is connected to the piston operating in the cylinder, which pump rod is guided in a guide 16 secured to the upper portion of the pump proper. Inasmuch as my invention may be applied to any type of pump, the pump shown has not been illustrated in detail, though it can readily be comprehended that the invention may be applied to any construction, such as is now in common use.

My invention proper comprises a frame 17 which consists of a longitudinal frame member

18 having two legs 19 and 20 arranged at the ends thereof. The legs 19 and 20 have feet 21 and 22 issuing outwardly from the lower portions thereof which feet are adapted to rest upon the floor upon which the pump is installed and which may be secured thereto through bolts or lag screws 23. Frame 17 is constructed at the end thereof adjacent leg 19 with an upright portion 24 which is formed with a longitudinal frame member 25 extending in the same direction as the frame member 18 and meeting said frame member near the center thereof. The various frame members are preferably constructed with ribs 26 to stiffen and reinforce the same and to permit of constructing the frame at an economical cost.

Near the center of the frame member 18 is formed a bearing 27 which has journaled in it a shaft 28 disposed transversely of the frame proper. This shaft has secured to it at one end a gear 29 which is formed with a hub 30 extending toward the bearing 27. Gear 29 meshes with a pinion 95 secured to a shaft 96. Shaft 96 is journaled in a boss 97 formed on the longitudinally extending frame member 18. This shaft may receive a pulley or other driving means, not shown, whereby power may be applied to the shaft 28 and the same driven in the customary manner. Upon the shaft 28 and adjacent the hub 30 is provided a disk 31 which is constructed with a hub 39 disposed between the hub 30 and bearing 27. Disk 31 has secured to it a pin 32 projecting inwardly and toward the frame proper. The disk 31 is spaced from the frame members 25 and 28 for a purpose to be presently described in detail.

On the end of shaft 28 is another disk 33 which is provided with a hub 34 secured to said shaft. The hubs 30 and 34 abut against the bearing 27 and restrain the shaft 28 from longitudinal movement along said bearing. The disk 33 has secured to it a crank pin 35 which is used to impart reciprocating movement to the pump rod 15.

In the upright portion 24 of frame 17 is formed a boss 36 which is threaded to receive the end 37 of a stud shaft 38. The stud shaft 38 is rigidly held in the boss 36, through a pin 40 which passes through said boss and the end 37 of said stud. Upon the stud 38 is mounted for oscillation a beam 41 which consists of two arms 42 and 43. These arms are attached to a sleeve 44 which is bored to receive the shaft 38 and which is mounted for oscillation thereon. A head 45 formed on the end of the stud 38 holds the beam 41 in place upon said stud. The arm 43 of beam 41 is constructed at its outer end with a slot 46 which receives the pin 35 on disk 33. As the shaft 28 rotates, pin 35 moves along the slot 46 and causes the beam 41 to oscillate, the arm 42 moving in an up and down direction throughout the movement of said shaft.

For coupling the beam 41 to the pump rod 15, a pair of links 47 are employed which are pivoted to the pump rod 15 at a locality above the guide 16 through the agency of a bolt 48 which extends jointly through said pump rod and links. The lower ends of the said links are pivoted by means of bolts 49 to a yoke 50 formed on the end of the arm 42 of beam 41, which yoke straddles the standard 11 of the pump and permits the links 47 to travel in a substantially vertical direction thereby preventing binding of the pump rod 15 in the guide 16.

In analyzing the movement of the crank pin 35 it will be found that the said pin has four distinct stages of movement for each revolution of shaft 28, the movement of the pin occurring successively between the positions of said pin designated at A, B, C and D in Fig. 3. The shaft 28 travels in a clockwise direction as indicated by the arrow in Fig. 3. When the crank pin 35 is moving from position B, being the position illustrated in full lines in Fig. 3 to the position C, beam 41 is being oscillated and the pump rod 15 lowered. During such movement, a very small amount of power is required. When the pin 35 moves from position C to position D, beam 41 and pump rod 15 remain substantially motionless. When pin 35 moves from position D to position A, the pump rod 15 is being raised and the piston of the pump is moved through its suction stroke, causing the raising of the water from the well. During such movement of the shaft 28, power is being consumed for the purpose of pumping. When pin 35 travels from position A to position B, the beam 41 and pump rod 15 again substantially remain motionless. It will thus be seen that the pin 35 travels through four stages in which the beam 41 is either stationary or moving in one direction or the other. The present invention provides means whereby energy may be stored while the crank pin is traveling in the two stages in which no movement of the beam occurs and also during the stage in which the pump rod is traveling in its return stroke. This is accomplished as follows:

As previously stated, power is delivered from the shaft 28 to operate beam 41 and to lift water when the pin 35 travels from its position D to its position A. When the pin 35 travels from position B to position C, the pump is operating on its return stroke. During such movement of the pump, very little power is required and the surplus energy available through the motor is stored up. For this purpose the longitudinal frame member 18 of frame 17 is provided with a lug 63 which extends outwardly therefrom on the forward side of said frame member. A lug 66 on the arm 43 of beam 41 overlies the lug 65. A bolt 67 passes jointly through the two lugs 65 and 66 and is threaded at its free end to receive a nut 68 which engages the underside of the lug 65. Upon the shank of the bolt 67 and between head 69 thereof and the lug 66, is provided a compression coil spring 70 which serves to urge the arm 43 downwardly and to raise the pump rod. When the pin 35 travels from position B to position C, spring 70 is compressed and energy is stored therein. When the pin 35 subsequently travels from position D to position A, the energy stored in spring 70 is imparted to the beam 41 which assists in operating the pump throughout the suction stroke thereof.

On the upright portion 24 of frame 17 is formed a boss 61. This boss is threaded to receive a bolt 52 which serves as a stud shaft for pivotally supporting an arm 53 for oscillation with respect to the shaft 28. The arm 53 is constructed with a head 54 at one end through which the bolt 52 passes and which serves as a bearing for said arm. The other end of the arm is constructed with a finger 55 extending downwardly therefrom and formed with a cam surface 56 along the inside of the same adapted to be engaged by the pin 32. At the extreme end of the finger 55 is formed another cam surface 57 which is adapted to further engage the pin 32. The pin 32 engages cam surface 56 while the said pin is traveling from the position C to position D and en-

gages the cam surface 57 while the said pin is traveling from position D to position A. Issuing outwardly from the longitudinal frame member 25 on the rear side thereof is a lug 58. A similar lug 59 is formed on the arm 53 which latter lug is disposed immediately above the lug 54. A bolt 159 passes through the two lugs 55 and 58 and is threaded at its free end to receive a nut 60 which engages the under surface of lug 58. On the shank of the bolt 159 and between the head 61 thereof and lug 55 is disposed a compression coil spring 62 which is adapted to urge the arm 53 in a downward direction. When the pin 32 travels from position C to position D the same rides along cam surface 56. This cam surface is so constructed that the arm 53 is positively forced outwardly and away from the axis of the shaft 28. During such movement of the arm 53 spring 62 is compressed and energy is stored therein. As the pin 32 moves from position D to position A, the pin 35 is traveling from position B to position C which has the effect of swinging the arm 43 of beam 41 upwardly and compressing spring 70. Spring 62 hence assists in compressing spring 70 while the cam surface 57 rides upon the pin 32.

At the upper end of the leg 20 is provided a boss 71 which is threaded to receive a bolt 72 which is similar to the bolt 52, constituting a stub shaft. Another arm 73 similar to the arm 53 being arranged in inverted relation with respect thereto, is constructed with a head 74 bored to receive the shank of the bolt 72 and to form a bearing for journalling the arm 73 for oscillatory movement with respect to the frame 17. The arm 73 is constructed with a finger 74 extending outwardly therefrom in a manner similar to the finger 55, which finger is provided with two cam surfaces 75 and 76 corresponding with the cam surfaces 56 and 57. These cam surfaces are adapted to be engaged by the pin 32 and the arm 73 is adapted to be oscillated thereby. Acting between the arm 73 and the frame 17 is a compression coil spring 77. This spring is mounted on the shank 78 of a bolt 79. Bolt 79 extends through two lugs 80 and 81, the lug 81 issuing outwardly from the arm 73 and the lug 81 issuing outwardly from the longitudinal frame member 18 in proximity to the leg 20. The bolt 79 is threaded at its free end to receive a nut 82 which engages the upper surface of the lug 81. Spring 77 is seated between the head 84 of bolt 79 and the under surface of lug 80. When the pin 32 travels from position A to position B, lever 73 is swung downwardly in a manner to compress the spring 77 and to store energy therein. When the pin 32 travels from position B to position C, the cam 76 on lever 73 engages said pin and imparts the energy stored in spring 77 to the shaft 28. During such movement of the shaft the pin 35 is traveling from position D to position A. While so traveling, pump rod 15 is traveling upwardly and the piston of the pump is operating through the suction stroke thereof. During such movement of the pump rod, spring 77 is delivering its energy to shaft 28 and assisting in the operation of the pump.

The operation of my invention is as follows: Assuming the crank pin 35 to be at position A and the pin 32 to be at position C. Movement of the shaft 28 in the direction of the arrow would cause the crank pin 35 to move from position A to position B. During such movement the said pin moves along slot 46 without causing appreciable movement of the beam 41. At the same time pin 32 moves from position C to position D. During such movement the said pin engages the cam surface 56 of arm 53 and swings said arm outwardly compressing spring 62 and storing energy therein. As the pin 32 moves from position D to position A, the cam surface 57 acting upon pin 32, imparts the energy stored in spring 62 to shaft 28. During such movement, crank pin 35 is traveling from position B to position C. Although the crank pin is doing no appreciable work in moving the pump, yet the same is compressing spring 70. During this phase of the cycle, pin 32 assists in the compressing of spring 70 and transfers the energy previously stored in spring 32 to spring 70 which may be subsequently utilized as will be presently described. Further movement of the shaft 28 in the direction of the arrow would bring pin 32 from position A to position B. This pin would during such movement engage the cam surface 75 and swing the arm 73 outwardly compressing spring 77. Crank pin 35 during such movement, would pass from position C to position D. During this phase of the cycle, the crank pin 35 would be traveling substantially along the slot 46 and no appreciable movement would be imparted to the beam 41 and pump rod 15. All of the energy available in the motor would hence be stored in the spring 77. When pin 32 travels from position B to position C, the cam surface 76 engages pin 32 and urges rotation of the shaft 28 in the direction of the arrow. During this phase of the cycle of movement of the parts, the beam 41 is traveling in a manner to raise the pump rod 15 and to cause the same to lift the water. Power is now being utilized to perform this work which is assisted by the action of the finger 74 of lever 73 which, through the cam 76, forces the pin 32 in a manner to cause rotation of said shaft and to assist in the operation of the pump. During this same phase of the cycle of movement of crank pin 35, which is traveling from position D to position A, spring 70 is giving the energy stored therein to the beam 41 also assisting in raising the pump rod and elevating the water. In this manner all of the energy stored in the various springs is finally delivered to the pump rod during the suction stroke thereon when water is being elevated. With the particular arrangement of parts, the load upon the motor is hence more uniformly distributed and uniform action procured.

In Fig. 1 my invention is illustrated as applied to a pump rod near the base of the pump. The invention can also be installed at the head of a windmill and similarly connected to the pump rod thereof. In Fig. 7 I have shown a device capable of being so installed. This device differs only from the device previously described in certain details and the same reference numerals have hence been used to refer to corresponding parts. In Fig. 7 a swinging arm 85 is substituted for the beam 41, which arm is pivoted on the stud shaft 38 and extends solely inwardly with respect to the frame 17. This arm is formed with a slot 86 in which the crank pin 35 is movable. The extreme end 87 of this arm has mounted in it a bolt 88 which is directly pivoted to a link 89. Link 89 in turn is pivoted through a bolt 90 to the pump rod 91. Spring 70 instead of being mounted as shown in Fig. 1, acts between a lug 92 formed on arm 85 and a lug 93 formed on the frame member 18 of frame 17. Spring 70 is a compression coil spring and acts in a manner to cause the movement of the arm 85 opposite to that of beam 41. The rod 94 passes through

the two lugs 92 and 93 and serves to hold the spring 90 properly seated against the two lugs 92 and 93. This rod may be permanently secured to one of said lugs and is mounted to pass freely through the other of said lugs. Due to the fact that the pump rod 91 is situated on the opposite side of the axis of oscillation of this arm, the action of the device shown in Fig. 7 and the operation of the same is identical with that previously described.

The advantages of my invention are manifest. By means of my improved power equalizer, the motor, engine or other source of power may run at a uniform rate of speed. At the same time the load on the source of power is substantially equal throughout the entire operation of the pump jack. With my invention smoother operation is procurable and less wear on the parts results. My invention may be installed at any locality with respect to the pump rod and may be utilized with any type or construction of pump. With my invention, the energy ordinarily wasted on the return stroke of the pump rod is utilized as well as the energy ordinarily wasted during movement of the crank pin when the pump rod is stationary. In this manner an extremely efficient device results.

Changes in the specific form of my invention, as herein disclosed, may be made within the scope of what is claimed without departing from the spirit of my invention.

Having described my invention, what I claim as new and desire to protect by Letters Patent is:

1. In combination with a pump having a reciprocating member, a power driven device for operating said member, said device including a swinging arm, a shaft, a crank operated by said shaft and engaging said arm for swinging the arm, said arm being connected to the reciprocating member of the pump, said crank being adapted to swing said arm throughout a stage of movement of said crank constituting a fraction of a half revolution to operate said pump and to swing said arm in reverse order through another stage constituting another fraction of a half revolution to return the reciprocating member of said pump, resilient means operated by said arm and adapted to store energy during the return movement of said arm and cam means operated by said shaft for further storage of energy during movement of said shaft during stages intermediate the first named stages.

2. In combination with a pump having a reciprocating member, a power driven device for operating said member, said device including a frame, a shaft journaled in said frame, a swinging beam mounted for oscillation in said frame, said beam being connected to the reciprocating member of the pump, a crank operated by said shaft for reciprocating said beam, an arm pivoted to said frame, a member movable with said shaft, means on said member and arm for causing the arm to swing in synchronism with the movement of said shaft, a spring operated by said arm adapted to store energy during movement of said shaft throughout a portion of a revolution, said spring being adapted to impart the energy back to said shaft during another portion of the revolution thereof, and a spring on said beam, said spring being adapted to receive energy from said crank throughout a portion of the revolution of said shaft other than that employed to impart energy to said first named spring, both of said springs operating to jointly impart energy to said shaft during the same portion of a revolution thereof.

3. A load equalizer for reciprocating pumps comprising a frame, a shaft journaled in said frame, a beam mounted for oscillation in said frame, a crank pin for reciprocating said beam, said crank pin having four successive stages of movement during each revolution of the shaft, said crank pin during its first stage operating said pump, during its second moving in a manner to maintain the beam substantially motionless, moving during its third stage to procure return operation of the pump, and moving during its fourth stage in a manner to cause the beam to remain substantially motionless, a spring carried by said frame, means operable from said shaft for flexing said spring to store energy therein, said means being operable during one of the stages of the cycle of movement other than the first stage, said means further serving to impart the stored energy to said shaft during the succeeding stage.

4. A load equalizer for reciprocating pumps comprising a frame, a shaft journaled in said frame, a beam mounted for oscillation in said frame, a crank pin for reciprocating said beam, said crank pin having four successive stages of movement during each revolution of the shaft, said crank pin during its first stage operating said pump, during its second moving in a manner to maintain the beam substantially motionless, moving during its third stage to procure return operation of the pump, and moving during its fourth stage in a manner to cause the beam to remain substantially motionless, an arm pivoted to said frame, a spring acting between said arm and frame and adapted to be flexed upon movement of said arm in one direction, means for moving said arm during one stage other than the first stage in a manner to store energy in said spring and operating in a reverse manner to cause the energy stored in said spring to be imparted to said shaft during the succeeding stage.

5. A load equalizer for reciprocating pumps comprising a frame, a shaft journaled in said frame, a beam mounted for oscillation in said frame, a crank pin for reciprocating said beam, said crank pin having four successive stages of movement during each revolution of the shaft, said crank pin during its first stage operating said pump, during its second moving in a manner to maintain the beam substantially motionless, moving during its third stage to procure return operation of the pump, and moving during its fourth stage in a manner to cause the beam to remain substantially motionless, an arm pivoted to said frame and a finger projecting therefrom and formed with two cam surfaces, a cam engaging member rotatable with said shaft and adapted during one of said second and fourth stages to act upon one of said cam surfaces and to procure flexing of said spring and the storing of energy therein, said cam engaging member during the succeeding stage of the cycle of movement of said shaft engaging said second cam surface and operating to impart energy from said spring to said shaft during such stage.

6. In combination with a pump having a reciprocating member, a power driven device for operating said member, said device including a swinging arm, a shaft, a crank operated by said shaft and engaging said arm for swinging the arm, said arm being connected to the reciprocating member of the pump, said crank being adapt-

ed to swing said arm throughout a stage of movement of said crank constituting a fraction of a half revolution to operate said pump and to swing said arm in reverse order through another stage constituting another fraction of a half revolution to return the reciprocating member of said pump, resilient means operated by said arm and adapted to store energy during the return movement of said arm, a cam member having a substantially radial cam surface and a spiraling cam surface, a complemental member adapted to engage said cam surfaces, a spring acting upon one of said members, means for driving the other of said members from said shaft, to procure engagement of the complemental member with one of said cam surfaces during movement of said shaft during stages intermediate the first named stages, said means storing up energy in said spring during engagement of said complemental member with one of said cam surfaces, said spring returning the energy to said shaft during the engagement of said complemental member with the other of said cam surfaces.

7. In a load equalizer for reciprocating pumps, a shaft, means actuated by said shaft for operating the pump, a cam member having a substantially radial cam surface and a spiraling cam surface, a complemental member adapted to engage said cam surfaces, a spring acting upon one of said members, means for driving the other of said members from said shaft, said means storing up energy in said spring during engagement of said complemental member with one of said cam surfaces, said spring returning the energy to said shaft, during the engagement of said complemental member with the other of said cam surfaces.

8. In a load equalizer for a reciprocating pump, a shaft, a reciprocating member operated by said shaft throughout a portion of a revolution thereof for operating said pump, two springs, both acting at the same time and during the portion of the revolution of the shaft during which the pump is operated to assist in operating the pump and means actuated by the shaft at different portions of the revolution of the shaft for separately storing energy in said springs.

9. In a load equalizer for a reciprocating pump, a shaft, a swinging arm operated by said shaft throughout a portion of the revolution thereof for operating said pump, a spring operating in conjunction with said arm to assist in swinging said arm in a manner to assist in operating the pump, a second swinging arm, a spring operating in conjunction with said second arm to further assist in operating the pump, and means for separately storing energy in said springs at different portions of a revolution of the shaft.

10. In a load equalizer for a reciprocating pump, a shaft, means actuated by said shaft for operating the pump, a cam member having a cam surface extending from its outer periphery inwardly toward the center of the cam and another cam surface extending in a reverse manner, one of said cam surfaces embracing a greater angle than the other cam surface, a complemental member adapted to engage said cam surfaces, a spring acting upon one of said members, means for driving the other of said members from the shaft, said means storing up energy in said spring during engagement of said complemental member with one of said cam surfaces, said spring returning the energy to said shaft during engagement of said complemental member with the other of said cam surfaces.

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