June 4, 1940. H. A. HOLZER 2,203,148

PUMPING UNIT

Filed June 11, 1937 3 Sheets-Sheet 1

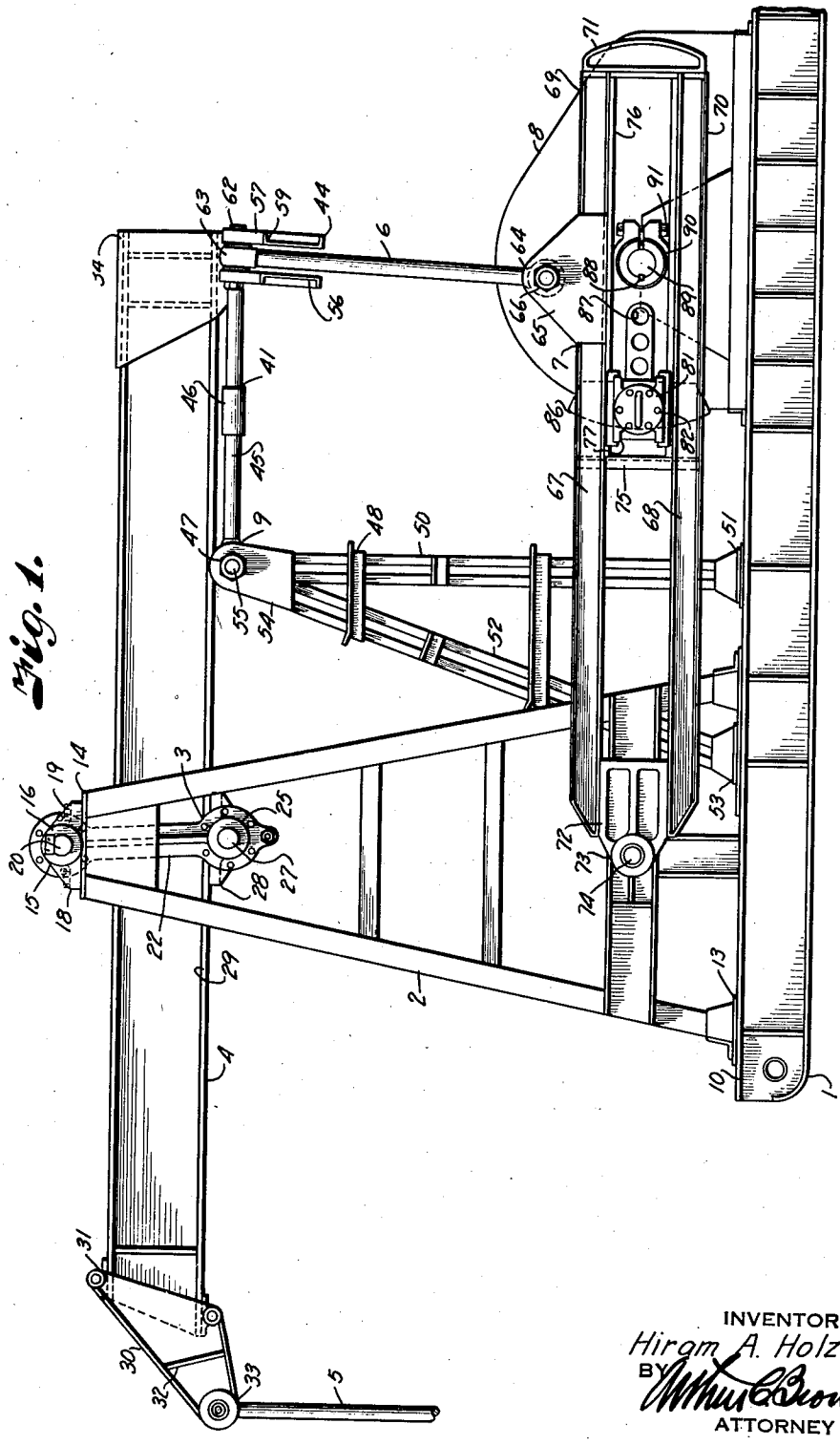


Fig. 1.

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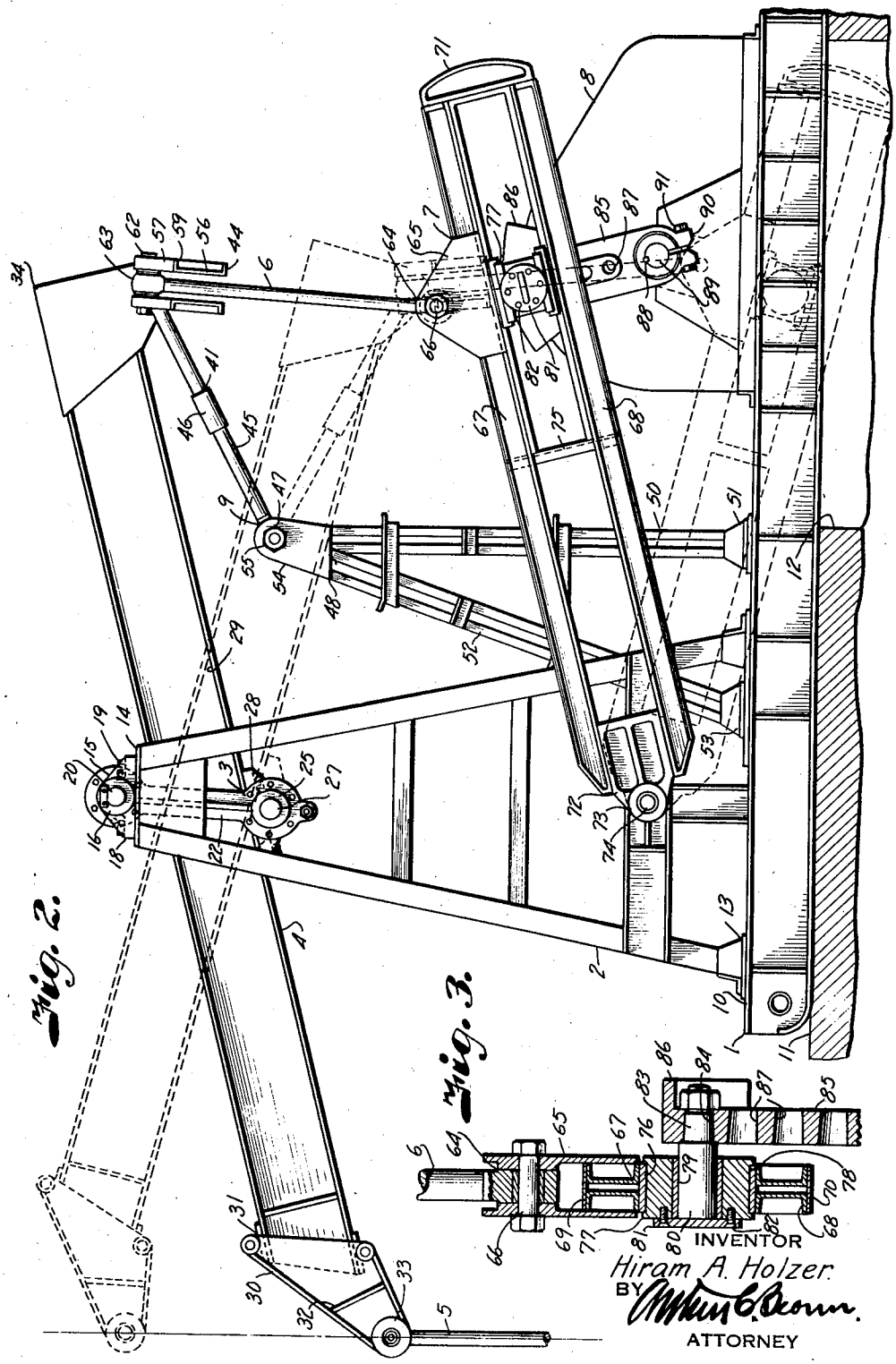


Fig. 2.

Fig. 3.

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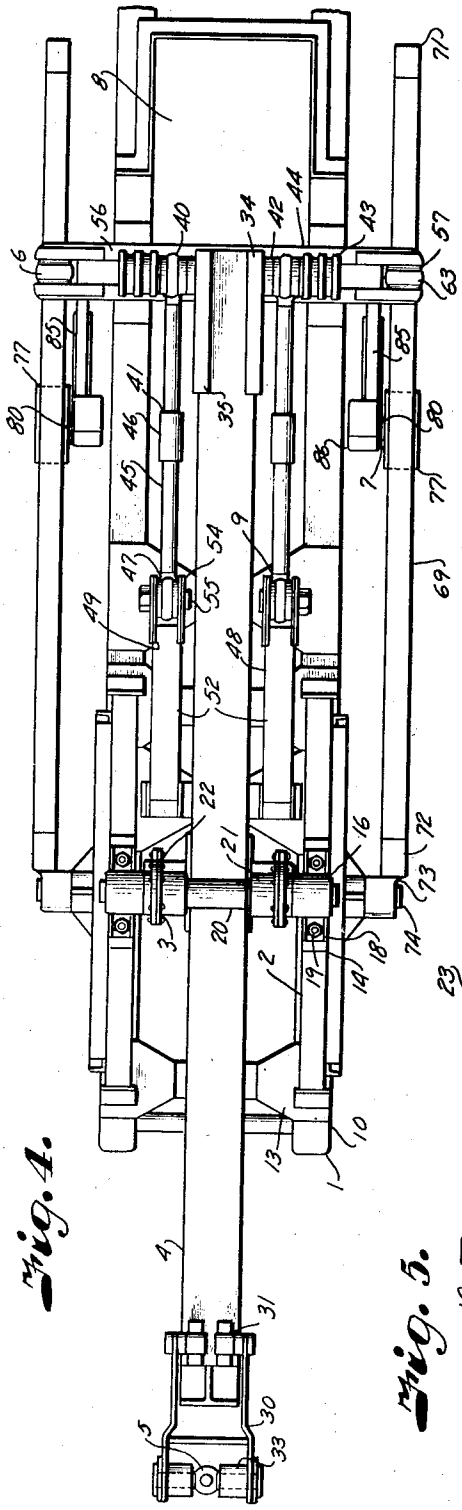


Fig. 4.

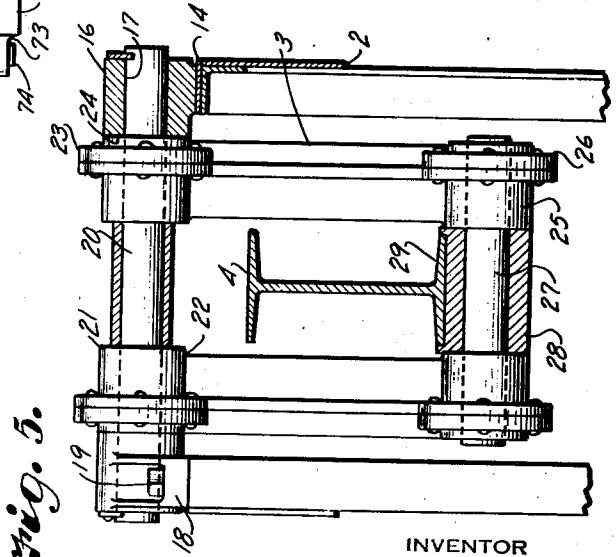


Fig. 5.

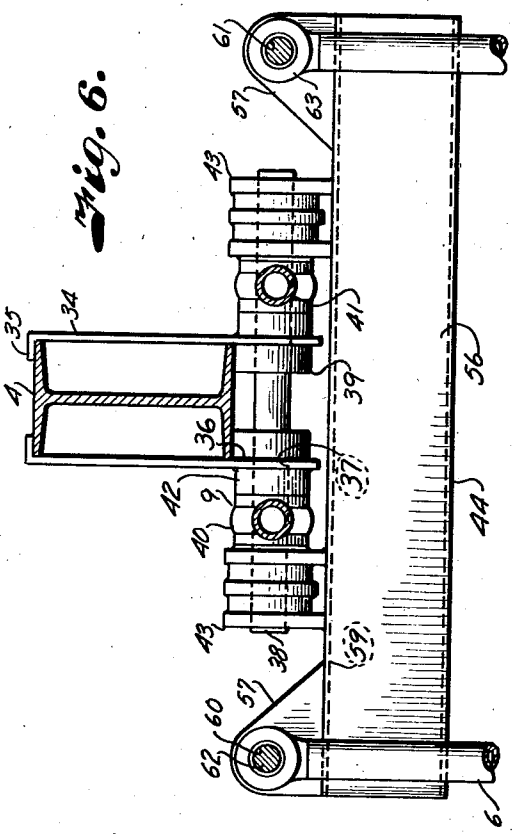


Fig. 6.

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UNITED STATES PATENT OFFICE

2,203,148

PUMPING UNIT

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7 Claims. (Cl. 74—103)

This invention relates to pumping units, and more particularly to those of a type adapted for pumping deep wells.

A particular problem to solve in pumping wells, and particularly deep oil wells, is the provision of sufficient power to raise the well fluids to the surface of the earth. When sucker rods are used for pumping the oil from the well, a stroke of sufficient length to adequately pump the oil causes a bend in the sucker rod line, as the sucker rods are reciprocated in the well by a walking-beam, for example, as is the usual practice, which results in wearing out the stuffing box and sucker rods, the resulting friction adding to the power required for reciprocating the rods in the well.

It is the principal object of the present invention to provide a straight lift pumping unit for the sucker rods, by which the sucker rods are raised coaxially relative to the central axis of the well, and wherein power is proportioned between the up and down strokes of the walking-beam in reciprocating the sucker rods in such a manner that the rods are picked up slowly and returned quickly, or vice versa under some conditions, but in any event with a gradual reversal in the direction of reciprocating motion of the rods.

Further objects of the present invention are to provide a swinging suspension for the walking-beam whereby longitudinal movement thereof is effected in addition to the usual rocking motion; to provide a mechanism for controlling the longitudinal swinging movement of the walking-beam for compensating and overcoming the customary arcuate motion of the polish rod, usually mounted on the top section of the rod line, as it is reciprocated in the well through its connection with the walking-beam and to provide a lever mechanism connected with the power for operating the walking-beam, whereby said slow pick-up and quick return, or vice versa, together with gradual reversal of direction of movement of the rods through the walking-beam is effected.

In accomplishing these and other objects of the present invention, I have provided improved details of structure, the preferred form of which is illustrated in the accompanying drawings, wherein:

Fig. 1 is a side elevational view of a pumping unit embodying the features of the present invention.

Fig. 2 is a similar view showing, in full lines, the relative positions of the parts of the unit when the rods are in lowered position; the relative positions of the parts of the unit, when the rods are in raised condition, being shown in dotted lines.

Fig. 3 is a detail vertical cross-section through portions of one of the pitmans, cranks, crossheads, and lever arms, illustrating the connections therebetween.

Fig. 4 is a plan view of the pumping unit.

Fig. 5 is a fragmentary detail vertical cross-section through the upper end of the Samson-post and walking-beam hanger.

Fig. 6 is a detail fragmentary vertical cross-section through the pitman end of the walking-beam and the motion control link mechanism.

Referring more in detail to the drawings:

The invention generally consists of a suitable support 1 on which is mounted a standard such as a Samson-post or the like 2 having a walking-beam hanger 3 mounted at its upper end which pivotally and swingingly carries or fulcrums the walking-beam 4, the walking-beam having a polish rod 5 or the like mounted at one end thereof, and pitman members 6 pivotally mounted at the other end thereof. Variable speed mechanisms 7 are provided between the pitman members and a power 8, and a walking-beam swinging motion control mechanism 9 is connected with the pitman end of the walking-beam for overcoming the usual arcuate movement of the sucker rods, as they are raised or lowered into a well, not shown.

The support 1 is of any suitable construction adequate for supporting a unit of this type and preferably consists of spaced parallel reinforced I-beams 10 resting on the ground or other solid support 11, pits or the like 12 being provided along the sides of and below the beams for receiving the ends of the variable speed mechanism levers 7 on their down stroke.

The Samson-post 2 preferably consists of a pair of spaced A-frames having suitable mounting 13 on the beams 10 of the support 1 and suitable capping members 14 at their upper ends. Walking-beam hanger castings 15, which are particularly shown in Fig. 5, and which consist of cylindrical body portions 16 having aligned bearing members 17, and laterally extending wing supports 18, are mounted in aligned and spaced relation at the upper ends of the A-frames on the capping members 14 by suitable fastening devices 19. A hanger pivot pin 20 is mounted in the bearings 17 and in the bearings 21 which are formed as a part of the link members 22, the bearings 21 having bearing caps 23 on the outer faces thereof adapted for bearing

engagement with inner faces 24 of the bearing members 17, both of which have central bores by which they are adapted to mount the pin 20 for carrying the links 22 between the A-frames. The lower ends of the links are provided with similar bearings 25 and bearing caps 26 having aligned central bores for mounting the pivot pin 27, on which is sleeved a walking-beam supporting sleeve 28 for mounting the bottom flanges 29 of the preferably I-shaped walking-beam 4.

Mounted on one end of the walking-beam 4 is the member 30 which is suitably secured, as at 31, to the end of the walking-beam and which is provided with converging sides 32 terminating in a pivot member 33 to which a string of sucker rods or the like is pivotally connected, by means of the polish rod 5 in the usual manner.

The opposite end of the walking-beam is provided with cap members 34 which consist of vertical plates having flanges 35 fixed to the top flanges of the walking-beam, the plates 34 extending below the bottom flanges of the walking-beam to provide bearing members 36 having suitable bores 37 for receiving the pivot pin 38, which extends therethrough and through the inside walking-beam flange hubs 39. Suitably bored heads 40 of a pair of walking-beam motion control links 41 are mounted on the pin 38 and are suitably spaced from the plates 34, as shown at 42. Also mounted on the pin 38 are spaced pairs of bored lugs 43 extending upwardly from an equalizer 44, later more fully described.

The walking-beam control links 41 preferably consist of tubular members formed in sections 45, as shown for example in Fig. 2, which are adjustably connected by turn-buckles 46, the sections 45 of the links being pivotally mounted on the upper end of the link support 9, as shown at 47. The link support 9 consists of a pair of spaced standards 48 and 49 having vertical legs 50 suitably mounted on the support 1, as at 51, and diagonally extending legs 52 mounted on the support 1, as shown at 53. The upper end of each of the standards is provided with spaced bearing plates 54 having aligned bores for receiving the pivot pins 55 which complete the pivotal mounting of the links between the support 9 and the pitman end of the walking-beam.

The links 41 are adjusted to a length, the chordal depths of the arcs of rotational movement at the outer or walking-beam ends of which are equal to the chordal depth of rotational movement at the polish rod end of the walking-beam, the result of which is that the walking-beam will be moved to the right in Fig. 2 on each of its up and down strokes, a distance equal to its chordal depth of rotational movement in such a manner that the polish rod is raised and lowered in a straight line.

The equalizer 44 consists of a pair of spaced cross-plates 56 which are preferably of channel shape having spaced pairs of bored lugs 57 mounted on the opposite ends of the upper flanges 59 of the channels. The ears are bored, as at 60 and 61, for receiving pivot pins 62, on which the ends 63 of the pitmans 6 are pivotally mounted, as particularly shown in Fig. 6. The pitmans 6 extend downwardly for pivotal connection, as at 64, with pairs of spaced plates 65 fixed to the lever arms 7, the plates being provided with bores for receiving the pivot pins 66 which extend through the lower ends of the pitmans for pivotally connecting the lower ends of the pitmans to the lever arms.

The lever arms 7 each preferably consist of spaced pairs of channel members 67 and 68 having the webs thereof adjacent each other, and having plates 69 and 70 fixed to the top and bottom flanges thereof respectively for securing the channels together, a casting 71 being provided at the outer ends of the arms for maintaining that end of the arms in spaced parallel relation. A casting 72 is also suitably fixed to the inner ends of the arms for spacing and maintaining the arms in parallel relation, the casting 72 being provided with a pivotal connection 73 having a bore mounted on a pin 74 suitably fixed to the A-frames in spaced relation to the main supporting beams. A cross-piece 75 is also provided on each of the lever arms 7 substantially intermediate the length thereof for dividing the arms 7 into sections. Plates 76, which connect the paired channels 67 and 68, form a track for receiving cross-heads 77 therebetween, the cross-heads being provided with grooves 78 at opposite ends thereof of substantially the same width as the plates 76, which adapts the cross-heads for sliding reciprocatory movement between the end castings 71 and the cross-pieces 75 in each of the lever arms 7. Each of the cross-heads 75 is provided with a bore 79 for receiving one end of the crank pins 80 and each cross-head has a cap 81 for closing the outer ends of the bored cross-heads, the caps being secured thereto by the fastening devices 82.

Each of the crank pins 80 is provided with a reduced tapered inner end 83, seating in a similarly tapered socket 84 in the free end of crank arms 85. Each of the crank arms 85 is provided with the usual counter-balance 86 and pin socket 87 for adjusting the crank arms for length of stroke in operating the lever arms, the crank arms also being provided at their opposite ends with keyed connections 88, Fig. 1, with the ends of a drive shaft 89 which is driven by the power 8, the cranks preferably having operating ends 90 provided with fastening devices 91 for clamping the crank arms to the drive shaft of the power.

The operation of a pumping unit constructed as described is as follows:

Assuming the unit to be at rest in the position shown in Fig. 1, the power 8 is energized for operating the crank shaft. The crank is then turned by the shaft in a clockwise direction, which raises the levers 7 through their sliding engagement with the cross-heads for raising the pitman end of the walking-beam through its pivotal connection therewith to a height limited to a tangential line extending from the lever pivot point 73 to the periphery of a circle bounded by the arcuate path of movement of the crank. During the upward movement of the pitman end of the walking-beam, the links 41 are also pivoted upwardly and follow an arc, the radius of which is the length of the links, which results in forcing the walking-beam longitudinally to the right, as shown in Fig. 2, through its pivotal connection on the links 22 supported by the Samson-post. The length of the links is predetermined in such a manner that the walking-beam is moved longitudinally a distance equal to the chordal depth of an arc ordinarily bounded by the pivoted polish rod end of a fixed walking-beam. The sucker rods connected with the polish rod are, therefore, lowered in a straight line.

As the cross-heads pass the tangential point of the planes through the center line of the lever arms 7 in their raised position in continued clockwise rotation, they travel to the right on

their tracks between the channels of the lever arms and force the levers downwardly, as shown in dotted lines in Fig. 2, for raising the polish rod end of the walking-beam through its pitman connection therewith. The lowering of the pitman end of the walking-beam will continue until the cross-heads reach a point in tangential relation to the juncture of the periphery of their arcuate movement and the center line of the levers in down position, whereupon, upon continued rotation, they raise the levers to continue the reciprocating operation of the walking-beam. It is apparent that the distances between the tangential points on opposite sides thereof are of different lengths, and that the longer length is on the down stroke of the levers, which results in slowing upward travel of the sucker rods in such a manner that less power is required for actuating the crank. It is, further, apparent that the short distance of travel of the cross-heads on the up-stroke of the levers causes quick return of the sucker rods to down position in the well, thereby utilizing the time ordinarily required for the return of the rods where the arcs are of equal length, the reversal of direction of movement of the rods, however, being gradual for reducing the shock and strain on the rods and power. Under some conditions, it is desirable to provide a quick lift and slow drop of the rods in the well as, for example, when compensating for momentum of the rods at the time of change of direction of movement thereof in order to provide a slow settling of the rods in the well. This is accomplished by merely reversing the gear box ordinarily connected with the power and, with the pitman and beam connections remaining the same, such variances in speed of lift and drop of the rods are adequately effected.

The principal advantages in an apparatus or unit of this character are that a straight lift for the polish rod is effected through the link connection of the walking-beam with the Samson-post, and its linked connection with the lever arms, as controlled by the motion control links and, further, since the travel is greater on the up stroke of the walking-beam, less power is required than would ordinarily be needed, and a faster return of the rods is effected which results in a substantial saving of time in operating a well.

What I claim and desire to secure by Letters Patent is:

1. A pumping unit of the character described including a standard, a link having one end pivotally mounted on the standard, a beam fulcrumed on the other end of the link, the opposite ends of said beam being adapted for engagement with a load and an actuating mechanism respectively, a second standard, and a second link pivotally mounted on the second standard, the second link being pivotally connected with the end of the beam to be actuated and adapted to move the beam longitudinally in response to actuation of the beam.

2. A pumping unit of the character described including a standard, a link having one end pivotally mounted on the standard, a beam fulcrumed on the other end of the link, the opposite ends of said beam being adapted for engagement with a load and an actuating mechanism respectively, a second standard, a second link pivotally mounted on the second standard, the second link being pivotally connected with the end of the beam to be actuated and adapted to move the beam longitudinally in response to actuation of the beam, and means interconnecting the beam and second link adapted to equalize stresses applied thereto.

3. A pumping unit of the character described including a standard, a link having one end pivotally mounted on the standard, a beam fulcrumed on the other end of the link, one end of the beam being adapted to support a load, a pitman pivotally connected with the other end of the beam, a lever pivotally mounted on the standard and pivotally engaged with the pitman, a crank slidably connected with the lever for actuating the beam at different speeds in opposite directions, a second standard, and a second link pivotally mounted on the second standard, the link being pivotally connected with the end of the beam to be actuated and adapted to move the beam longitudinally in response to actuation of the beam.

4. A pumping unit of the character described including a standard, a link having one end pivotally mounted on the standard, a beam fulcrumed on the other end of the link, one end of the beam being adapted to support a load, a pitman pivotally connected with the other end of the beam, a lever pivotally mounted on the standard and pivotally engaged with the pitman, a crank slidably connected with the lever for actuating the beam at different speeds in opposite directions, a second standard, a second link pivotally mounted on the second standard, the link being pivotally connected with the end of the beam to be actuated and adapted to move the beam longitudinally in response to actuation of the beam, and means interconnecting the beam, pitman and second link adapted to equalize stresses applied thereto.

5. A pumping unit of the character described including a Samson-post, a walking beam pivotally and swingingly mounted on the Samson-post having one end thereof adapted for pivotal connection with rods of a well, a pitman pivotally mounted on the opposite end of the walking beam, a crank, means for actuating the crank, variable speed means including a lever pivotally mounted on the Samson-post and pitman respectively having a track, a cross-head pivotally mounted on the crank having sliding engagement in said track for actuating said lever to reciprocate the walking beam and raise and lower the rods in the well at different speeds in opposite directions, a support other than said Samson-post, and a link pivotally mounted on said support and walking beam respectively for swinging the walking beam in response to reciprocation thereof.

6. A pumping unit of the character described including a Samson-post, a walking beam pivotally and swingingly mounted on the Samson-post having one end thereof adapted for pivotal connection with rods of a well, a pitman pivotally mounted on the opposite end of the walking beam, a crank, means for actuating the crank, variable speed means including a lever pivotally mounted on the Samson-post and pitman respectively having a track, a cross-head pivotally mounted on the crank having sliding engagement in said track for actuating said lever to reciprocate the walking beam and raise and lower the rods in the well at different speeds in opposite directions, a support other than said Samson-post, a link pivotally mounted on said support and walking beam respectively for swinging the walking beam in response to reciproca-

tion thereof, and an equalizer interconnecting said pitman, link and walking beam for equalizing stresses applied thereto.

7. A pumping unit of the character described including a standard, a beam, means fulcruming the beam on the standard, one end of the beam being adapted to support a load, an equalizer engaged with the other end of the beam, pitmans pivotally connected with the opposite ends of the equalizer, levers pivotally mounted on the standard and pivotally engaged with the pitmans, and a crank spaced from the standard and arranged substantially below the pitman end of the beam, said crank being slidably connected with the levers for actuating the beam at different speeds in opposite directions.

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