S. LIPPERT.

POWER TRANSMISSION DEVICE.

APPLICATION FILED APR. 8, 1907.

955,816.

Patented Apr. 19, 1910.

2 SHEETS—SHEET 1.

Fig. 1

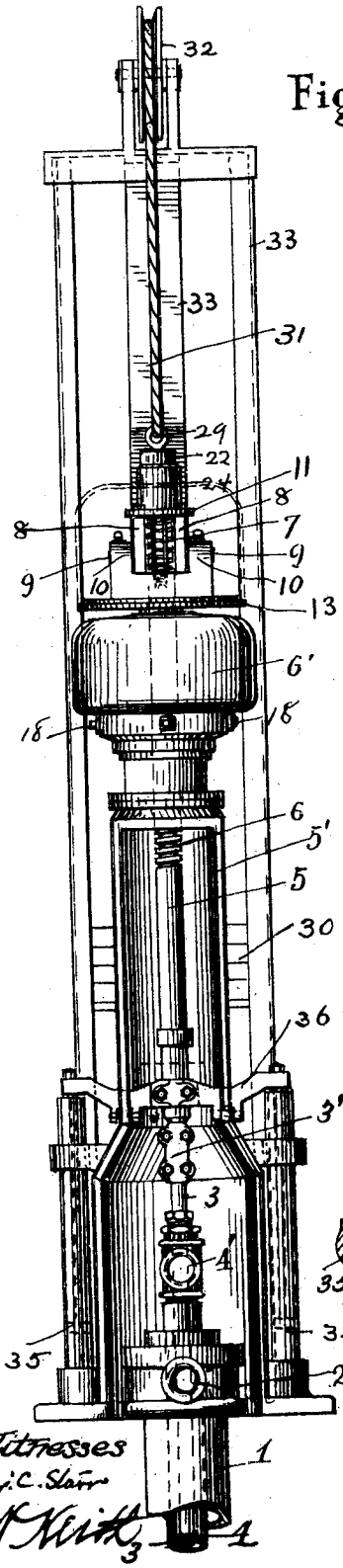


Fig. 2.

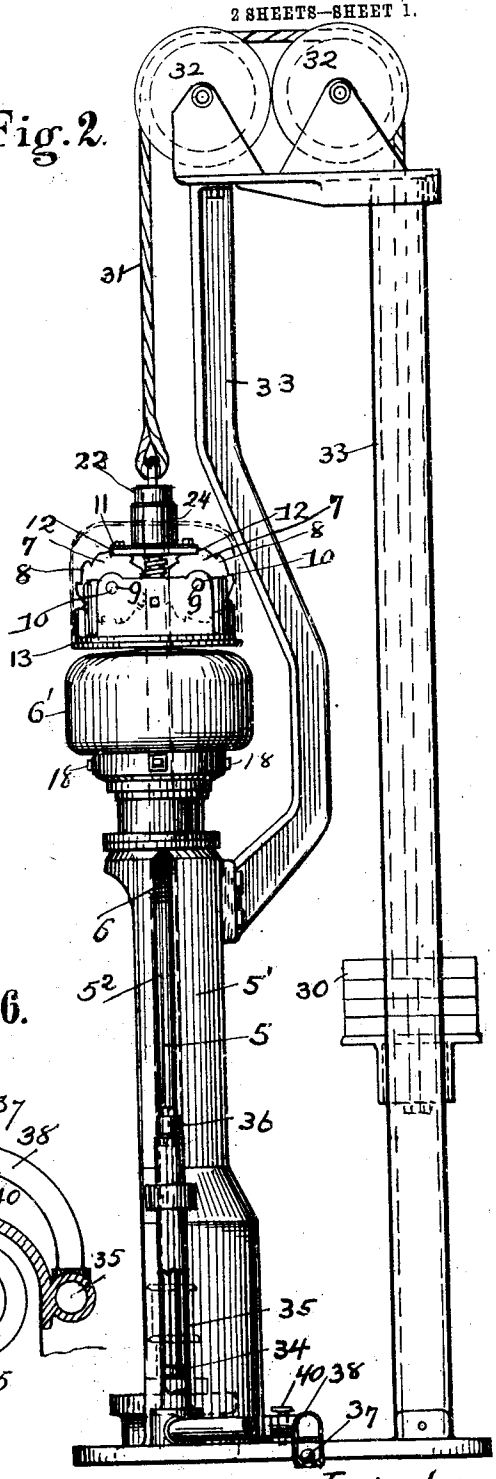
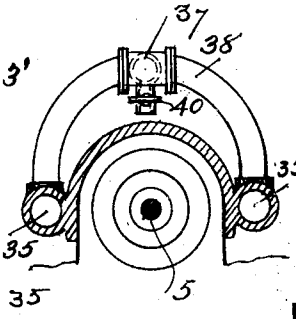


Fig. 6.



Witnesses
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2 SHEETS—SHEET 2.

Fig. 7.

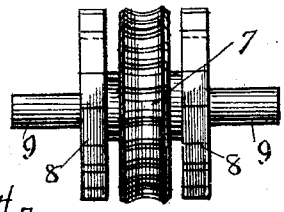

Fig. 3

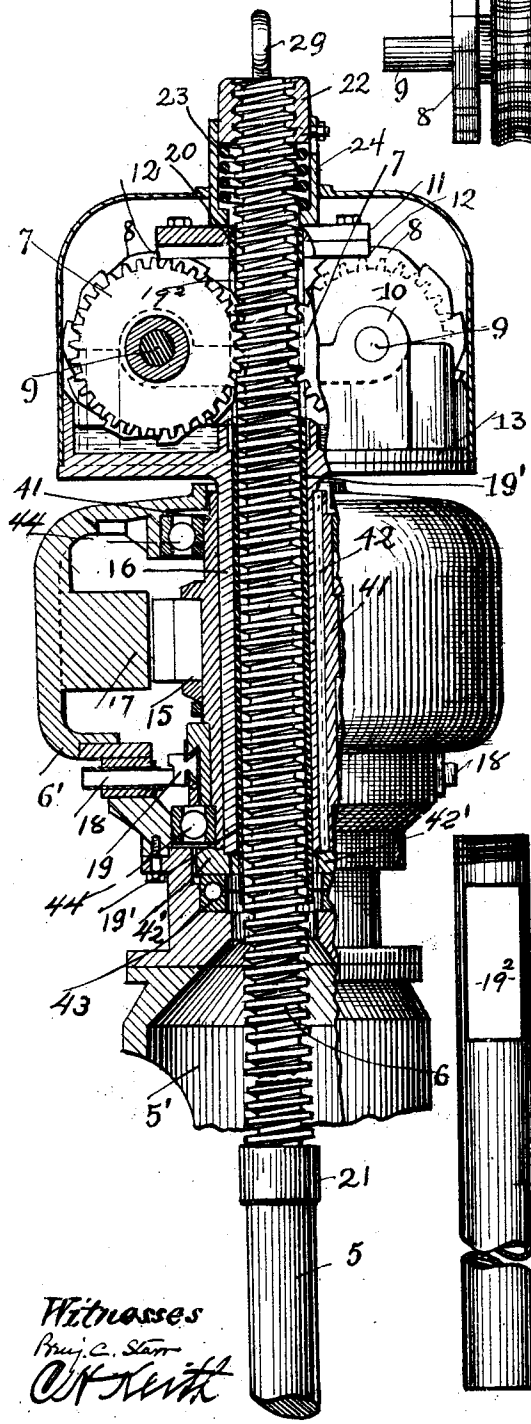

Fig. 4.

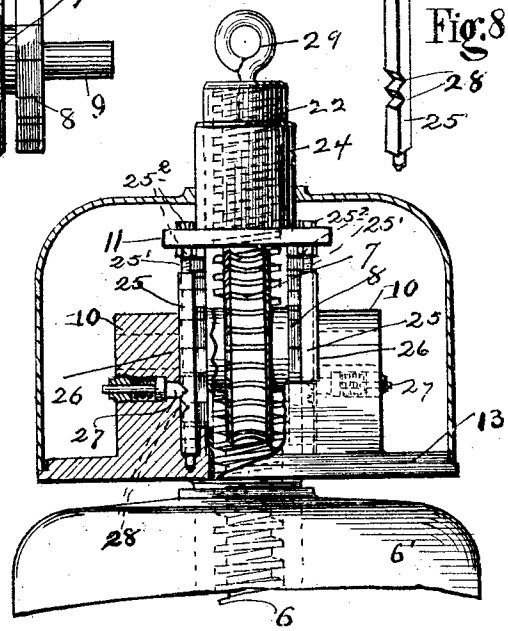

Fig. 8

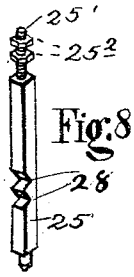

Fig. 5

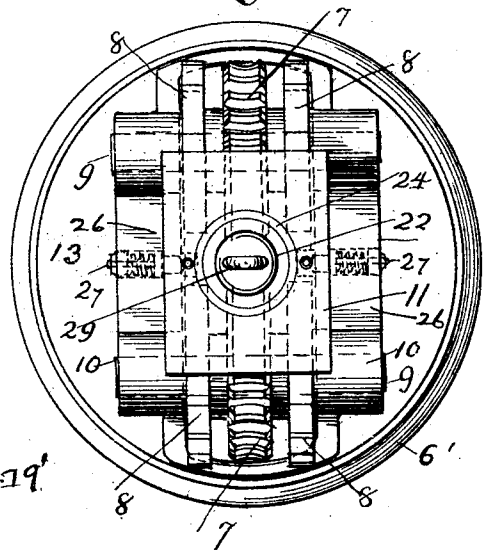

Fig. 9

Witnesses

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UNITED STATES PATENT OFFICE.

SAMUEL LIPPERT, OF EAST CLEVELAND, OHIO.

POWER-TRANSMISSION DEVICE.

955,816. Specification of Letters Patent. Patented Apr. 19, 1910.

Application filed April 8, 1907. Serial No. 366,913.

To all whom it may concern:

Be it known that I, SAMUEL LIPPERT, a citizen of the United States, and resident of East Cleveland, county of Cuyahoga, State of Ohio, have invented certain new and useful Improvements in Power-Transmission Devices, of which I hereby declare the following to be a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same.

The objects of this invention are primarily to provide instrumentalities for converting a rapid rotary movement into a relatively slow rectilinear one of great power, and thereby giving a movement to a reciprocating shaft in one direction, the return movement of which is accomplished automatically, and which is applicable to many important mechanical uses, which are too numerous to set forth herein. The application of these instrumentalities is exemplified in their use for operating the pumping rod of a deep well pump for oil fields, wherefore a definite structure designed for this use is clearly shown in the accompanying drawings and specifications. By using an electric motor for each well they can be pumped singly although far removed from the place where the current is produced.

The motor can be so connected that a group of wells can be started by throwing in a switch, or they can be arranged to run separately as the current is carried by wires on poles or in conduits and they will work equally well either in a mountainous or level country.

All the methods now in use are crude, expensive and far from satisfactory.

In rough or mountainous countries the derrick is used almost exclusively. This method is called "beam pumping," because the pumping rod is fastened to the walking beam. As the derrick is not really necessary after the well is drilled, and as it is expensive to maintain, it is moved from place to place in level territory to drill other wells with, but in rough and hilly countries it must be left to pump the wells since no other means can be used. It requires an engine at each well, and if the wells are isolated, one man can take care of only one well, or if the wells are close together one man can take care of no more than two or three wells. This method in level countries gives way to the "pumping power," which gives a horizontal stroke to shackle rods which are run to the well radially like a spider's web, and the horizontal movements of the rods are converted to a vertical stroke of the pump rod at the well, by means of a pumping jack. The shackle rods slide in grooves cut in the tops of short wooden posts set in the ground to carry them and reduce the friction. By this system the wells must balance the power; that is, if there are two wells on the north there must be two on the south side of the power, so that the down or gravity stroke returns the skackle rods for a new stroke and helps to lift the rods in the other well. The lost motion due to the sagging of the rods between the posts in a stretch of 3000 feet will reduce the stroke from 20 inches at the power to 6 inches at the well.

All the wells must be pumped at the same time or the power will be out of balance. The light wells are soon exhausted and the oil remaining in the tube becomes roily and bad before the water is exhausted to get the oil, in the water producing oil wells, on the other side of the power. As these tubes hold from 5 to 7 barrels, it would often amount to the entire production of the well. The shackle rods run in all directions over the fertile land when this system is employed, cutting up the surface of the land into useless wedge shaped strips. The farmer in trying to utilize these strips drives over the rods and breaks them. The motion is necessarily slow, and the large wells are only partially pumped and not exhausted. The pump jack like the beam pulls the rods in the arc of a circle in going up and down, which wears an oblong hole in the stuffing box, and the leakage of oil from this source alone, if saved, would pay for this device. The plant is difficult to install and expensive to maintain, and is limited to pumping wells close to it. Many thousand small wells are located on the outer edge of the field that would not pay to pump with the beam, and since they are too far away to pump with the central power system, are abandoned annually and the money invested in them lost. These outlying and scattered wells are longer lived and are better producers than those located in the groups or center field and because of their isolated position may have a larger area to draw from.

There are two other systems which are rarely used, both because of the expense of installing and operating them.

This invention is designed to overcome all of these objectionable features, by using a horizontally rotating electric motor provided with a large central opening especially adapted to encircle a rotating and shaft operating device, a housing upon which it is mounted and vertical guides in the housing by means of which a screw threaded shaft is held from rotating on its axis, this shaft being engaged by screw threaded worms on each side and alternately locked and released by a ratchet device at the respective limits of its stroke. The rapid movement of the motor causes the shaft to travel up and down and to this shaft is connected the pump rod of an ordinary oil well. To further reduce the power required to operate the pump rod a counterbalance is provided, which is equal to the weight of the rod less the friction by about 100 pounds, so that in operating an oil well the motor will only have to lift the oil plus 100 pounds thereby decreasing the power required at each well.

The advantages may be enumerated as follows:

1st. The pumping of the well at any desired stroke and speed. By a straight stroke the stuffing box will stay packed and absolutely save the production now wasted because of worn stuffing boxes.

2nd. Should the well valves become worn and leaky or sanded the pumping head is so arranged that in a moment the rods can be lifted out of the well.

3rd. The shock of the falling stroke is minimized by means of pneumatic cushions so as to prevent jar and injury to the working parts.

4th. The land is unmolested for farming purposes. The wires carry the electric current to the well on long poles high enough to permit the free use of the ground underneath, and the device requires less surface space at the well.

5th. One man can operate as many wells as he can visit and can repair anything found wrong with any well, the device being especially arranged for quick repair and continuous working.

6th. This device can be used equally as well in rough and mountainous countries as on level surfaces and the wells can be widely separated or isolated and supplied by the same source of power.

7th. The motor is inclosed and impervious to weather, and therefore the insulation is unaffected by outdoor exposure.

In case of an oil well, an induction motor driven by an alternating current is advisable on account of the danger of igniting the escaping gas from sparks at the commutator. But ordinarily an inclosed well will be free from danger. I accomplish these results by means of a driving head which imparts longitudinal movement to the pumping rod in one direction, the return movement being obtained automatically as by gravity, and a motor preferably attached thereto, thus providing an exceedingly compact form of construction.

The invention consists further, in the peculiar mechanical movement for exerting longitudinal pressure upon the shaft in one direction, comprising a divisional and automatically released nut upon the screw threaded extremity of the shaft to which the sucker or pumping rod is secured, in mechanism for rotating the nut to raise the shaft, in mechanism for releasing the shaft to fall by gravity and in the various forms of construction, and combination and arrangement of parts, as hereafter described, shown in the accompanying drawings and specifically pointed out in the claims.

In the accompanying drawings, Figure 1 is a front elevation of the pumping device showing the casing head, the pumping head and frame therefor and pumping rod, an electric motor arranged for a direct current and suitable for inclosed wells, the counter weights and pneumatic cushion cylinders; Fig. 2 is a side elevation thereof; Fig. 3 is an enlarged face view of the pumping head, one side being in central vertical section, and showing the worm wheel nut engaging the screw threaded upper portion of the pumping shaft, and instrumentalities for retaining the worm wheels from rotation on their axes on the upward stroke, and for releasing them to rotate freely on their axes, so as to permit the pumping shaft to fall freely by gravity on the return stroke, and also a view partly in section of the motor; Fig. 4 is a similar edge view of the upper portion of the pumping head; Fig. 5 is a plan view of the pumping head with the dust cover removed; Fig. 6 is a plan view showing the casing head; and the housing in transverse section, and the arrangement of the air inlet tubes connecting the pnuematic cushion cylinders; Fig. 7 is a side elevation in detail of one set of worm gear and duplicate ratchet wheels which are attached together; Fig. 8 is a perspective view of one of the temporary retaining bars, which hold the ratchet retaining plate or detent alternately in its respective positions for engagement therewith and disengagement therefrom; Fig. 9 is a detail view of the tube which is employed to release the said ratchet retaining plate from engagement therewith at the upper limit of the stroke of the pumping rod.

In these views 1 is the well casing head having an outlet 2 for gas, 4 is the well tube having the oil outlet 4′, 5 is the operating shaft provided with the screw threaded portion 6, which is formed in as long a portion

of the rod as the extreme length of the greatest stroke may demand, 5′ is the frame or housing upon which the motor 6′ and pumping head are supported. This housing is provided with vertical slots or grooves 5^2 in its sides in which a yoke or cross-head 36 attached to the shaft 5 travels vertically and thus insures a rectilinear movement of the pumping shaft and a minimum of wear upon the stuffing boxes, 3 is the pump rod attached at 3′ to the shaft 5.

The instrumentalities for giving a longitudinal movement to the shaft 5 in one direction, provide in this pump for an upward vertical movement thereof and also provide for releasing the shaft at the upward limit of the stroke to fall by gravity, and exemplify the operation of the device for all uses to which it may be put and may be described as follows: 7, 7, are a pair of worm wheels which with duplicate pairs of ratchet wheels 8, 8, are mounted upon each side of the screw threaded portion 6 of the shaft 5 and are fixed upon axial shafts 9, 9. These worm wheels are in constant engagement with the screw 6.

The worm wheels are prevented from turning upon their bearings 10, 10 at the time of raising the shaft by means of the horizontal locking plate or detent 11, which engages at its edges at 12 with both pairs of ratchet wheels 8, 8, and securely locks them from turning.

The worm wheel bearings 10, 10 are mounted upon a rotatable head of plate 13, which encircles the pumping shaft, so as to bring the worm wheels into close engagement with the screw, and the head is rotatably supported upon the well frame or housing 5′ and may be rotated in any suitable manner, but the rotating means is here shown to consist of the electric motor 6′, the armature 15 of which encircles and is operatively connected with the depending sleeve 16 attached to or integral with the rotating head 13. In this motor, 17 is the stationary pole or casing, 18 the brushes, and 19 the commutator. The wiring being immaterial to this invention is not shown.

The worm wheels when held from rotation on their axes form a divided nut clasping the screw on two sides and when made to revolve about the screw as the head rotates will act as a nut to raise the pumping shaft so long as the worm wheels are secured by the ratchets and retaining plate from revolving on their axes.

In order to permit the pumping shaft and rod to fall by gravity when the upward limit of the stroke has been reached, the locking or detent plate 11 is automatically lifted out of engagement with the ratchet wheels, so that the worm wheels can rotate freely on their axes and thus present no resistance whatever to the fall of the screw. This action is accomplished by means of a longitudinal downwardly projecting member 19′ passing through the head and its depending sleeve and is shown as a sleeve or tube 19′ secured to the retaining plate 11, at 20, and has free vertical movement upon the screw threaded portion of the pumping shaft. A shoulder 21 upon the pumping shaft will strike the lower edge of this downwardly projecting member 19′ and raise the ratchet retaining plate until it is out of engagement with the teeth of the ratchets. Then the worm wheels being released will be permitted to revolve easily on their axes and allow the screw and pumping shaft to reverse its movement automatically. An opening 19^2 in this tube permits the worm wheels 7 to engage the screw. As soon as the reverse limit of stroke is reached a shoulder or head 22 upon the upper extremity of the screw will strike the retaining plate and force it into engagement with the ratchets again, and the worm wheels will again become stationary on their axes and the raising movement will commence again. A spring cushion obtained by means of the spring 23 and sleeve 24 reduces the shock of the fall and prevents it from breaking the locking plate.

To prevent the locking plate from falling down upon the ratchets as the pump shaft falls, and to prevent it from being accidentally dislodged when in engagement therewith, a temporarily detaining device is employed, secured by spring pressure, but susceptible of being released by force, such as the blow from one of the shoulders upon the pump shaft. I exemplify this device in the vertically adjustable bars 25 attached to the locking plate 11 and moving parallel to the walls 26 of the rotating head. Screw extremities 25′ and clamping nuts 25^2 serve to secure these rods at the proper height in the plate 11. In these walls 26 are placed the spring actuated pins or detents 27 which are adapted to engage in turn the notches 28 in these vertical bars. The upper notch receives the detent when the retaining plate is down and the lower notch is used when the retaining plate is up. An eye 29 is set into the extremity of the screw threaded pumping shaft by means of which the shaft can be drawn out of the well.

To offset the extreme weight of the pumping rod as before stated, and the weight of the burden of oil carried thereby, and to lessen the friction and consequent wear upon the screw and worm wheels, adjustable counter weights 30 are suspended from the rope 31 which passes over pulleys 32 upon an adjacent frame 33, and is attached to the eye 29 on the shaft 5. These weights are adjusted to nearly balance the weight of the pumping rod, but still permit the fall of the rod by gravity in the well.

Any shock upon the working parts resulting from this fall is absorbed by means of pistons 34 operating in vertical pneumatic cylinders 35, and connected with the pumping rod by means of the yoke 36. A valve 37 is arranged in the connecting pipe 38 for these cylinders, which admits air but prevents its discharge, so that the cushioned effect of compressed air is obtained in the cylinders. A second valve 40 releases the air when desired, or adjusts the escape to obtain any desired degree of resistance.

It will be observed that by manipulating the valve 40 to regulate the escape of the compressed air when the pistons 34 fall with the pump rod, the resistance can be accurately adjusted to the weight of the rod and its load and this adjustment with a careful adjustment of the nuts 25^2 upon the detaining bars 25 of the locking plate 11 are the only adjustments required in the use of the pump.

The motor shown in the drawings is for a "direct current" and is adaptable to use in deep water wells or wherever no inflammable gases are likely to arise. A non-sparking induction motor would be preferable in oil pumping on account of the escaping gas and the danger of explosion. However, the working parts and the well are usually so inclosed that there will be very little danger of gas igniting from sparks.

A novel feature illustrated in the figures particularly in Fig. 3 is the large central sleeve 41 in the rotating part 15 of the motor, which is provided with the spline 42 upon which slides the sleeve 16 of the rotatable part of the driving head. This sliding connection of the driving head with the motor permits of free longitudinal movement of the head without affecting the motor in any way, and the head and pumping rod or shaft can readily be withdrawn and replaced through the center of the motor, to attach a new section to the shaft, or to repair any break. An annular ring 42′ supports the sleeve and rotating portion of the motor and a ball bearing 43 prevents friction caused by the excessive weight of the pumping shaft and its load. The rotating portion of the motor also runs upon centering ball bearings 44 to avoid friction and to make the parts run smoothly, also the vertical walls of the head above inclose oil in which the worm wheels constantly run to lessen the wear upon them and upon the screw.

It will be observed that the stationary motor casing completely incloses the pole pieces and armature and the field and armature winding, and together with the overhanging head above effectually prevent the entrance of moisture, so that the insulation is unaffected thereby, and the device can be exposed to the weather without danger of injury thereto and of short circuiting the current.

The mechanism of the divided nut specified herein whereby a swift rotary movement is converted to a slow rectilinear one, and the rectilinear movement is imparted to a shaft in one direction, the return movement to be accomplished automatically as by gravity, is applicable to so many uses that they need not be enumerated herein, and is exemplified in the action of the pump described.

The invention therefore is not limited in scope to any particular use, but may be employed wherever a continuous movement of the shaft in one direction and automatic return movement are desired.

It is not essential that the driving agency should be electric or applied exactly as shown, since any rotatable device driven in any desired manner and bearing the worm rollers can be employed to operate a shaft in an analogous manner.

Furthermore in a modified use of this instrumentality for obtaining powerful pressure, it is obvious that the reversal of the movements of the parts will obtain the same result. For instance the shaft may be rotated and the nut composed of individual worm rollers may be placed upon a support which moves longitudinally to the shaft, the release freeing the shaft from the nut in the same manner as before described.

I claim—

1. In a device for obtaining movement of a shaft in one direction, the movement in the other direction being an automatic one, a screw threaded shaft, a divided nut thereon comprising, a rotatable member sleeved over the shaft, a pair of worm wheels pivotally mounted thereon, one on each side of the said screw thread and engaging therewith, axial shafts for said worm wheels, ratchet wheels secured to said axial shafts, a releasably locking and retaining plate adapted to engage all said ratchet wheels, a striking member passing through said rotatable member, a device on the shaft adapted to engage said striking member and release the ratchets at the extreme end of the stroke of said shaft, a corresponding device upon said shaft adapted to return the locking plate into engagement with the ratchet wheels at the other end of the stroke, a cushioning spring in said corresponding device, bars having notches therein depending from said locking plate, transversely placed spring detents in said rotating member adapted to engage said notches alternately and temporarily secure the said plate from movement and a rotating means for said rotatable member, substantially as described.

2. In a device for the purpose set forth, in combination, a frame, a reciprocating shaft having a screw threaded upper extremity, a

rotatable member upon said frame encircling said screw threaded portion of the shaft, a motor casing fixed upon said frame, a rotatable part of said motor within said motor casing secured to said rotatable member, a divisional nut mounted upon said rotatable member comprising worm gears pivotally mounted thereon, for free movement on their axes, and rotatable with said rotatable member, and forming a nut therewith engaging said screw threaded portion of the shaft, means for locking said worm wheels to raise said shaft when rotated, and releasing and relocking means therefor operated by said shaft, at the limits of its stroke, said shaft adapted to automatically fall when said worm wheels are released, substantially as described.

3. In a device for the purpose described, a longitudinally movable shaft, automatically operated in one direction and having a screw threaded portion, a nut thereon comprising a rotatable member, sleeved thereover, worm gears and shafts therefor, bearings in said rotatable member for said shafts, said worm gears being in constant engagement with said screw ratchet wheels on said worm wheel shafts, a plate adapted to engage and lock said ratchet wheels, a tube encircling said shaft and secured to said plate, a shoulder on said shaft adapted to engage said tube and release said plate at the limit of feed of the said nut, to permit of the automatic return movement of the shaft, and a bar on said plate and spring actuated detent in said rotatable member, substantially as and for the purpose described.

4. In a device for the purpose described, the combination with a frame, of a reciprocating shaft or rod, having a screw threaded portion, a divisional nut thereon rotatably mounted on said frame, comprising rotatable worm wheels thereon engaging the shaft, means for locking said worm wheels and for releasing the same at the respective longitudinal movements of the shaft, means for rotating said rotatable nut, a counterweight for said shaft, a crosshead upon said shaft, pistons connected with the ends of said crosshead, and compressed air cylinders, for said pistons, substantially as described.

5. In combination with a reciprocating rod, a screw threaded shaft secured to the reciprocating rod, a housing, said housing having vertical guides therein, a cross-head secured to said shaft adapted to reciprocate in said guides, a motor rotatably mounted upon said housing, a rotating member secured thereto, a device in said member provided with teeth engaging said screw threaded shaft and arranged to raise said shaft through a predetermined stroke and thereupon to permit it to fall by gravity, a counter weight for said shaft and rod, and pneumatic cylinders and pistons therefor, said pistons connecting with said cross-head, and controlling valves for said cylinders, substantially as described.

6. In a device for the purposes set forth, the combination, with a reciprocating rod, of a housing therefor, a screw threaded shaft at the upper end of said reciprocating rod, an electric motor rotatably mounted upon said housing, a rotatable member encircling said shaft, and vertically movable in said electric motor, a device on said rotatable member arranged to convert the rapid rotation of said motor into a rectilinear movement of said screw threaded shaft in one direction, and to permit the shaft to fall automatically in the other direction, a counter weight for said reciprocating rod and shaft, and pneumatic mechanism for lessening the concussion of the shaft and rod in falling, substantially as described.

7. In a device for the purpose set forth, the combination, with a reciprocating rod, and reciprocating shaft secured thereto, of a housing inclosing the same, an electric motor rotatably mounted on the housing and provided with a central opening through which said reciprocating shaft passes, a cross-head on said reciprocating rod, guides in the housing for said cross-head, a rotatable member operatively connected with said motor, and provided with a depending sleeve passing through the central opening in said motor, an armature for said motor having a central sleeve, a spline connecting operatively said armature and depending sleeve of said rotatable member, a device mounted upon said rotating member adapted to raise said screw threaded shaft and to permit the same to fall by gravity, a releasing and engaging device for said screw raising device, controlled by the movements of said shaft, a pneumatic cushioning device for said reciprocating rod, and shaft, controlling outlet and inlet valves therefor and a counter weight for said shaft and rod, substantially as described.

8. In a rotating driving head, the combination with a screw threaded shaft, of a motor having a horizontally rotating part, and provided with a central opening through which said shaft projects, a horizontally rotating member provided with a depending sleeve encircling said shaft, a spline connecting said sleeve and said rotating part of said motor, vertically rotatable worm wheels on said horizontally rotating part, adapted to jointly raise said shaft, ratchet wheels therefor, a locking device adapted to engage the ratchets of both wheels simultaneously, means controlled by said shaft whereby said locking device is alternately released and brought into engagement with said ratchets at opposite limits of the stroke of said shaft, and a spring buffer at the upper extremity of the shaft for the protection of said lock-

ing device, when said shaft falls, substantially as described.

9. In a rotating head adapted to give a longitudinal rectilinear movement to a screw threaded shaft, the combination with said shaft, of an electric motor having a horizontally rotatable part, a housing upon which said motor rotates, the said rotatable part of said motor having a central opening, a rotatable member mounted upon said motor, a depending sleeve therefor encircling said shaft, and passing through said opening in said rotatable part of said motor, a spline connecting said sleeve and rotatable part of said motor, permitting vertical movement of said rotating member, worm wheels having horizontal axes and mounted on said rotatable member and engaging opposite sides of said shaft, ratchet wheels on the axis of said worm wheels, a locking device for said ratchet wheels, a shoulder on said shaft at each limit of its stroke, a spring buffer on the upper shoulder adapted to strike the locking device when the shaft falls, a depending tube about said shaft, secured to said locking device and passing through said rotating member and its sleeve, and adapted to engage the lower shoulder on said shaft when said shaft rises, the said tube having openings through which said worm wheels pass, and means for temporarily holding said locking device in and out of engagement with said ratchet wheels, substantially as described.

10. In a device arranged to give a rectilinear movement to a screw threaded shaft, the combination with said shaft, of a stationary frame, an electric motor casing secured thereto and provided with stationary pole pieces, and brushes, a rotatable armature within said casing, said armature provided with an axial opening, a rotatable member mounted upon said armature and provided with a depending sleeve secured for longitudinal movement within the opening in said armature, and a device upon said rotatable member engaging said shaft, and adapted to give a rectilinear movement thereto in one direction, the said motor casing inclosing said poles and armature and provided with a central opening through which said depending sleeve passes and the said rotating member extending over said opening, substantially as described.

In testimony whereof I hereunto set my hand this 6th day of April 1907.

SAMUEL LIPPERT.

In presence of—
WM. M. MONROE,
H. C. BOYD.