No. 753,319. PATENTED MAR. 1, 1904.

D. W. SAUNDERS.

WELL DRILLING MACHINE.

APPLICATION FILED SEPT. 26, 1903.

NO MODEL. 6 SHEETS—SHEET 1.

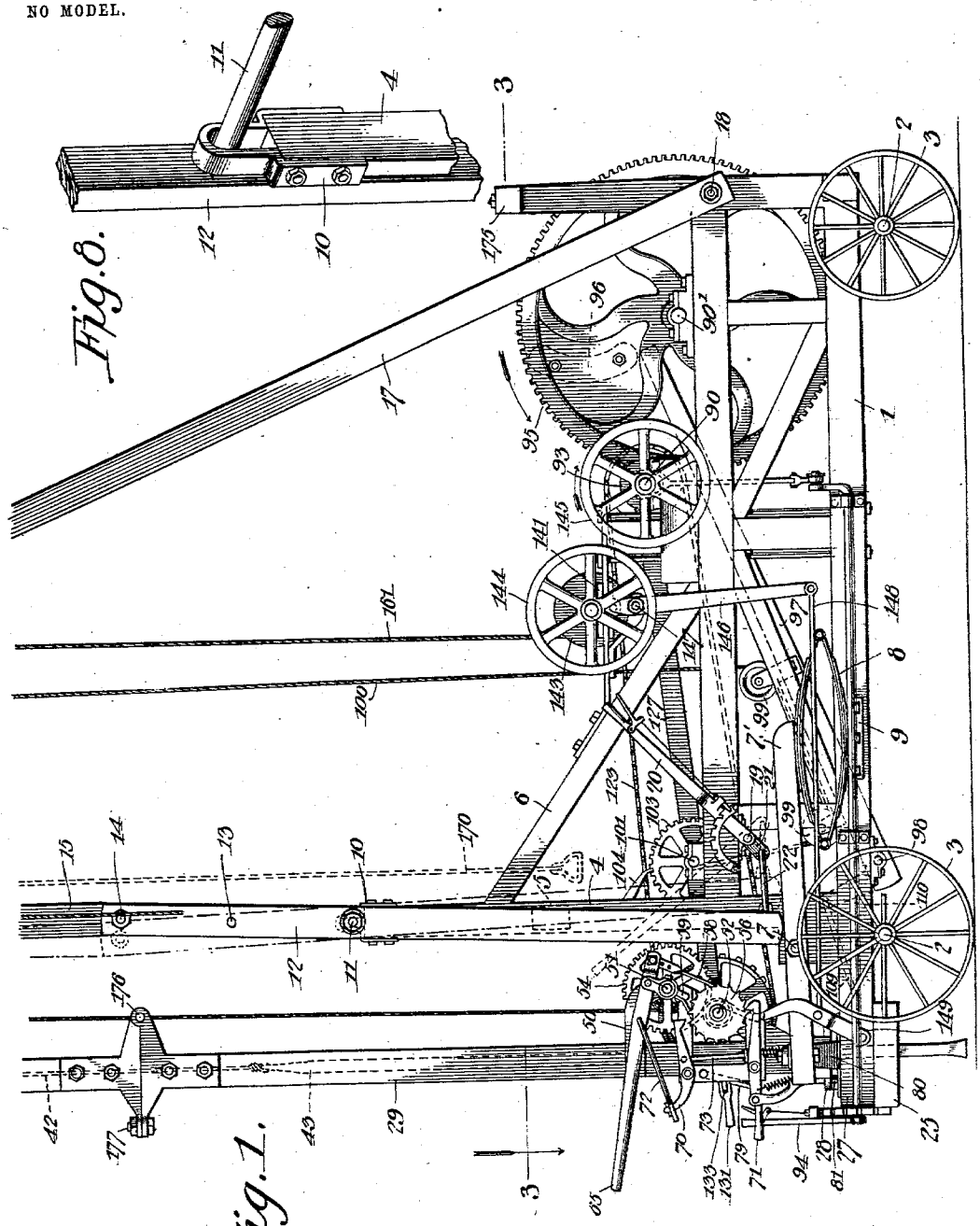

Fig. 8.

Fig. 1.

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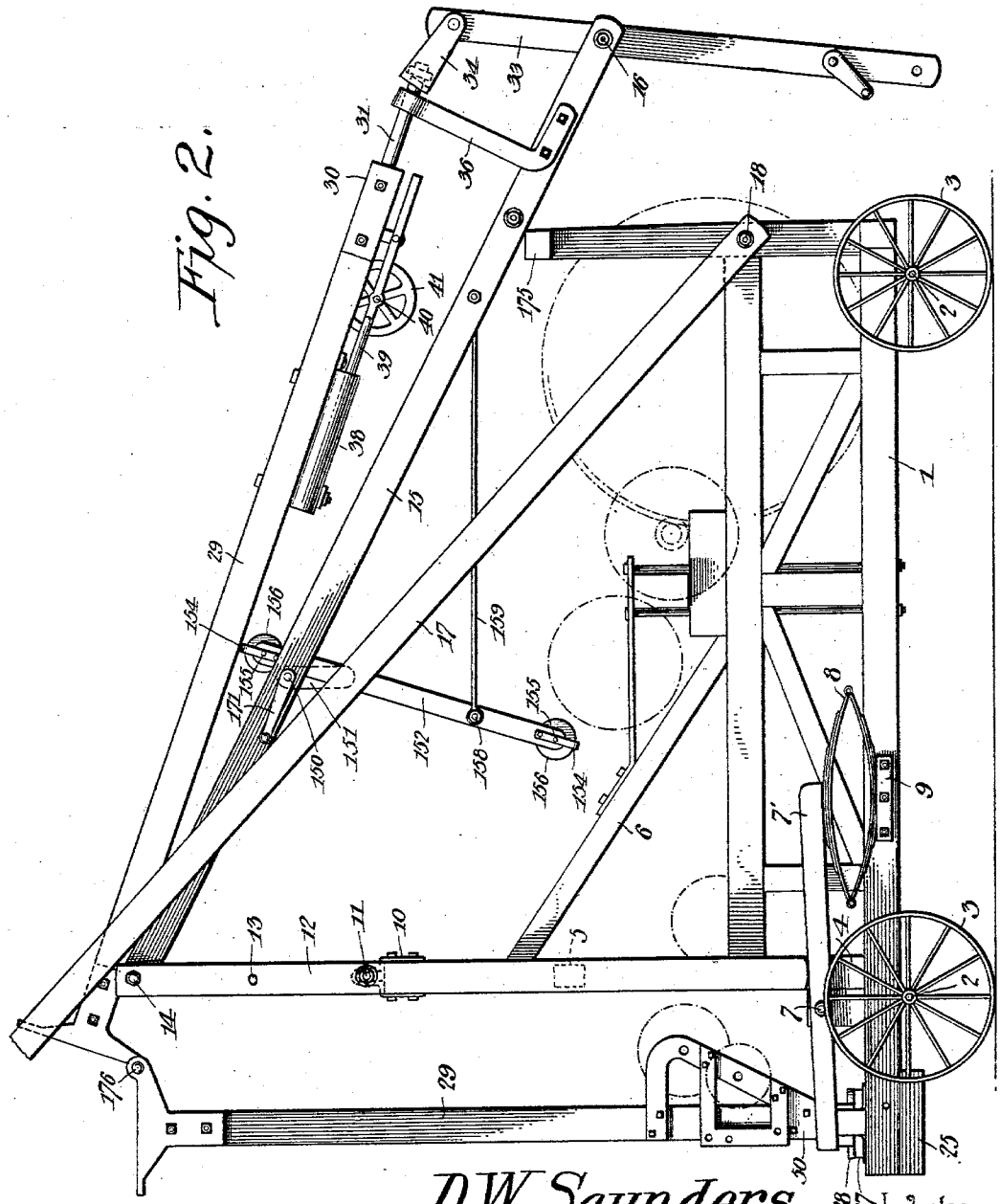
NO MODEL. 6 SHEETS—SHEET 2.

Fig. 2.



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NO MODEL. 6 SHEETS—SHEET 3.

Fig. 3.

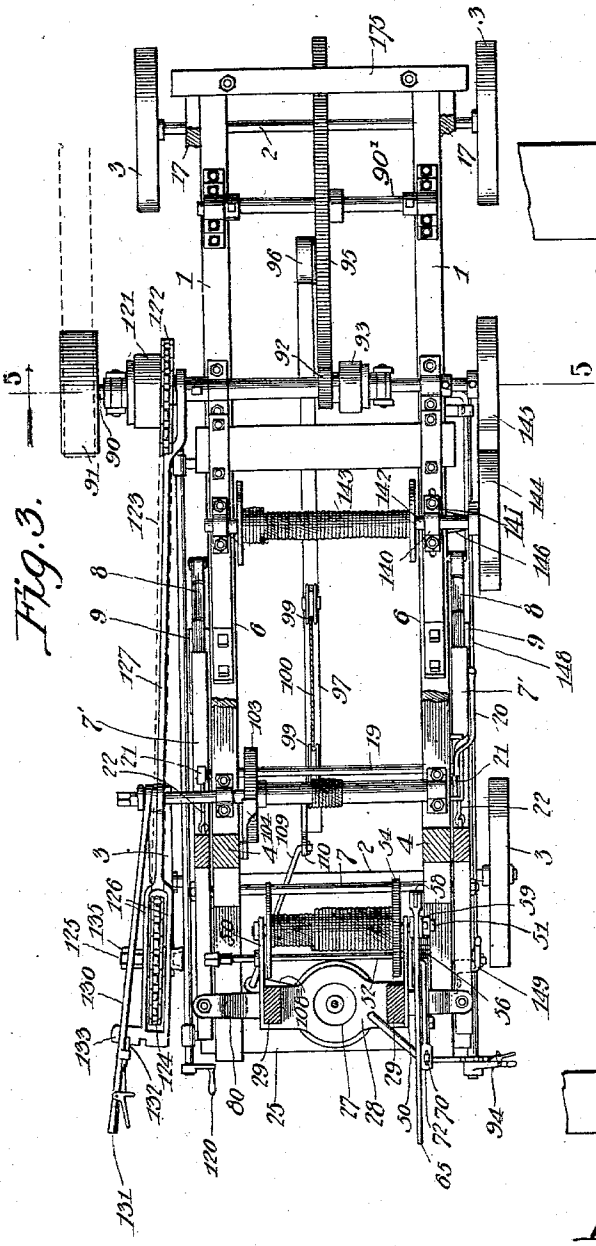


Fig. 10.

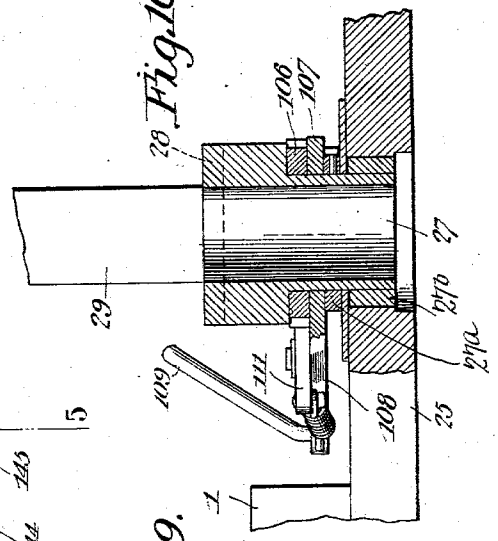
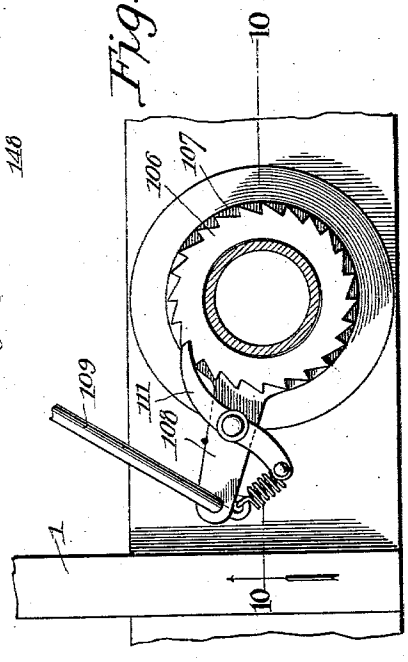


Fig. 9.



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NO MODEL. 6 SHEETS—SHEET 4.

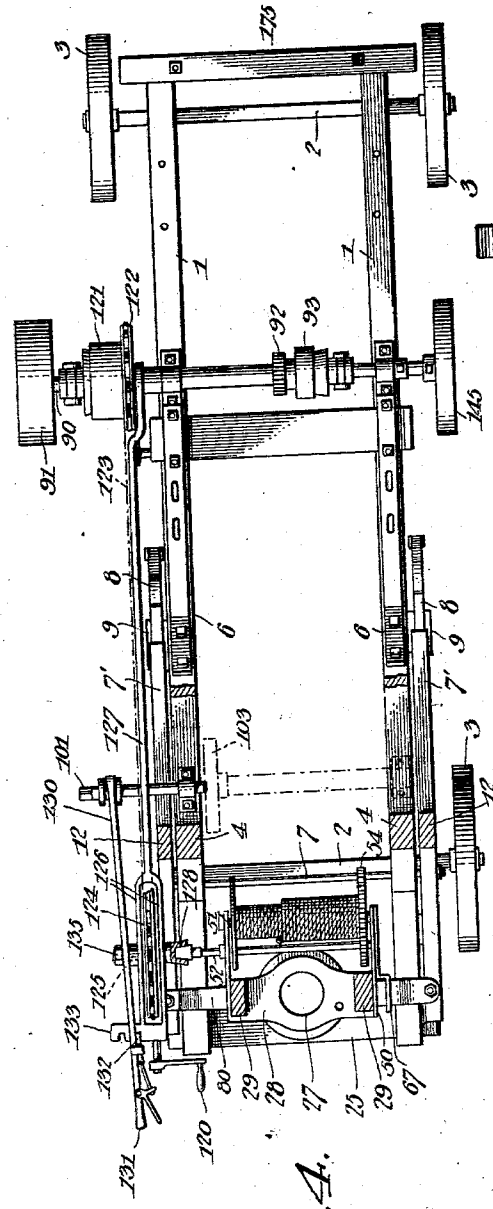

Fig. 4.

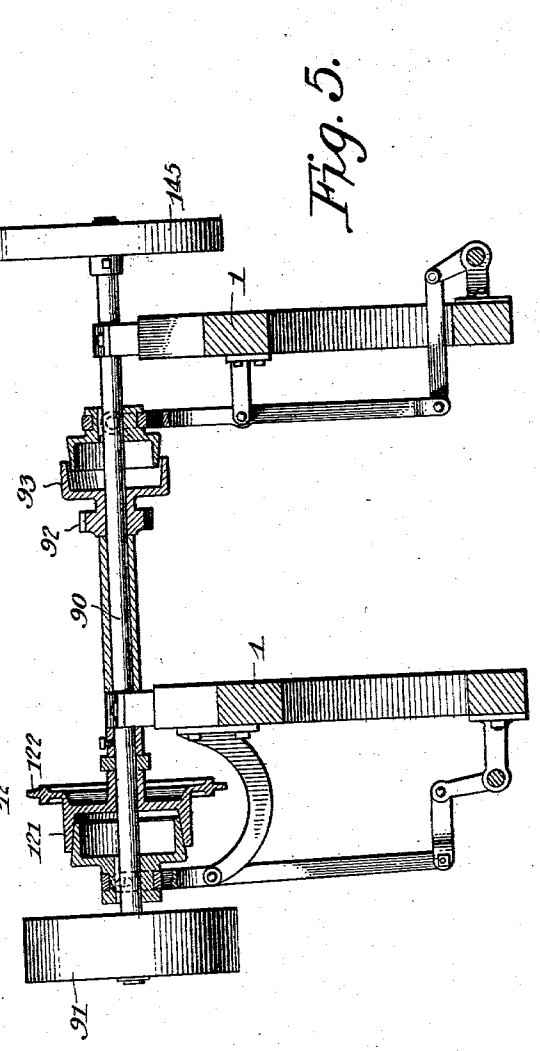

Fig. 5.

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NO MODEL. 6 SHEETS—SHEET 5.

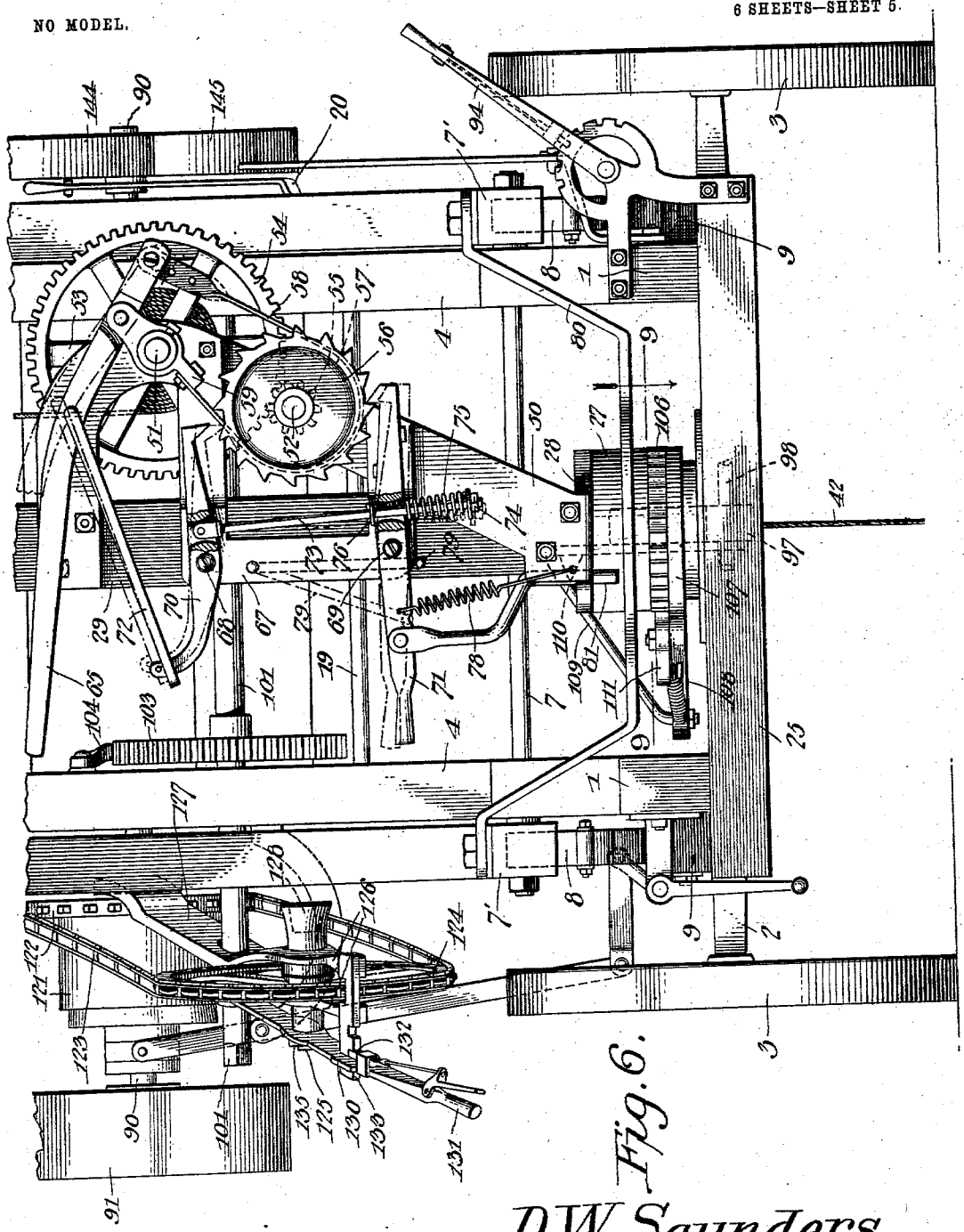

Fig. 6.

Witnesses
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NO MODEL. 6 SHEETS—SHEET 6.

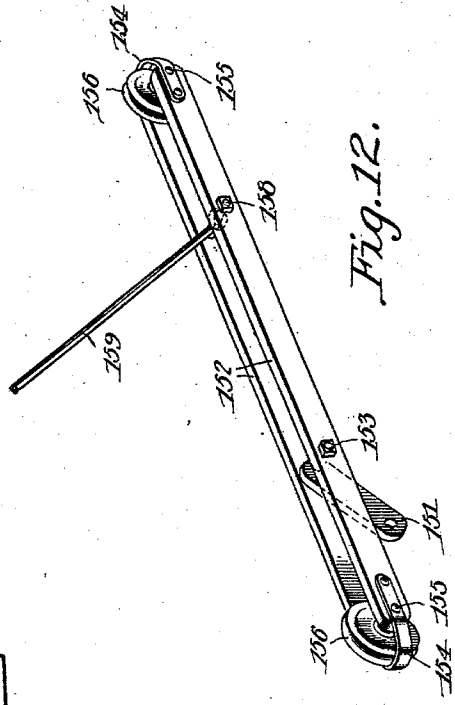

Fig. 12.

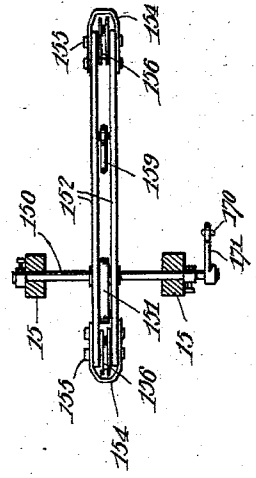

Fig. 11.

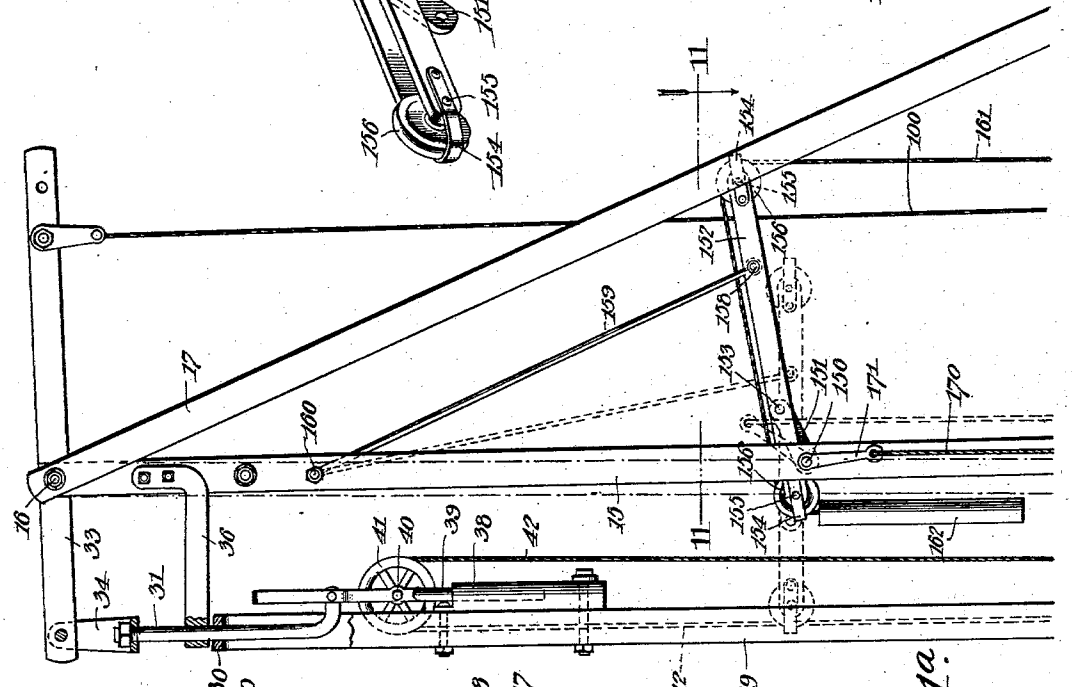

Fig. 1a.

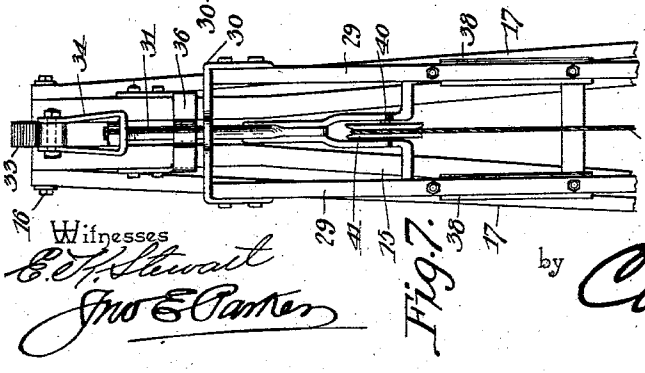

Fig. 7.

Witnesses
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No. 753,319. Patented March 1, 1904.

UNITED STATES PATENT OFFICE.

DELBERT W. SAUNDERS, OF MAQUOKETA, IOWA.

WELL-DRILLING MACHINE.

SPECIFICATION forming part of Letters Patent No. 753,319, dated March 1, 1904.

Application filed September 26, 1903. Serial No. 174,817. (No model.)

To all whom it may concern:

Be it known that I, DELBERT W. SAUNDERS, a citizen of the United States, residing at Maquoketa, in the county of Jackson and State of Iowa, have invented a new and useful Well-Drilling Machine, of which the following is a specification.

This invention relates to certain improvements in well-drilling machines.

One object of the invention is to construct a well-drilling machine in which provision is made for imparting a step-by-step rotative movement to the drill or bit without danger of twisting the rope or cable which serves to hoist the drill during the operation of the apparatus.

A further object of the invention is to provide a machine in which the drill, the main drill-rope, and the windlass are all carried by a frame having vertically-disposed pivots and revoluble as a whole in order to alter the angular position of the cutting edge of the drill after each stroke.

A still further object of the invention is to provide an improved means for imparting a step-by-step rotative movement to the drill by means of the mechanism employed for raising and dropping the drill, so that a positive feed in this direction will be insured after each stroke.

A further object of the invention is to provide an improved means for regulating the downward feed of the drill in accordance with the rapidity of the drilling operation and the character of the ground, the feed decreasing in speed as the degree of penetrability of the ground decreases, so that by avoiding a constant and uniform feed the drill-rope will not become slack.

A further object of the invention is to provide an improved means for controlling the extent of feed mechanically, as well as automatically, by adjusting the mechanism in accordance with the character of the soil, so that the weight of the falling drill during feeding movement may be exerted to more or less advantage.

A still further object of the invention is to provide mechanism in the nature of an adjustable escapement that will prevent any possibility of the occurrence of feeding movement to more than a predetermined extent at each operation and in which after each feeding movement the drill-rope will be positively locked from further movement until the completion of the next feeding stroke.

A still further object of the invention is to provide an improved drill-rope-controlling mechanism in which provision is made for adjusting or moving a portion of the mechanism to inoperative position and placing the remaining portion of the mechanism under the control of the operator, so that the drill may be allowed to descend into the well at any desired speed and to any desired distance, while remaining strictly under the control of the operator and avoiding all danger of accidental dropping, this being particularly valuable for the insertion of drills into the well after drilling has ceased for a time, as in the placing of a fresh section of well-tubing or in cleaning the well.

A still further object of the invention is to provide an improved mechanism for effecting rapid hoisting of the drill should it become necessary to remove the latter from the well and to provide means whereby the main driving-shaft of the apparatus may be quickly coupled to the drill-rope windlass and the hoisting of the drill accomplished with a minimum of delay and inconvenience.

A still further object of the invention is to provide an improved means for manipulating a drill whereby an effective stroke may be accomplished without regard to the depth of the well and, further, to so arrange this mechanism as to provide for the automatic downward feed of the drill-rope and drill should the drill fail to strike the bottom of the well with sufficient force.

A still further object of the invention is to provide means for adjustment of the drill-operating mechanism should it become necessary from slack in the connecting-rope, and in this connection a further object is to provide for the adjustment without stopping the operation of the apparatus or disconnecting any of the parts.

A still further object of the invention is to provide an improved mechanism for manipu-

lating the well-cleaning bucket to the end that this portion of the mechanism may be quickly and automatically adjusted to operative position without interference with any of the remaining parts of the apparatus.

A still further object of the invention is to provide an apparatus in which all of the several operative parts may be driven from a single shaft, the mechanism being so arranged that any one of the operative members may be readily connected to the shaft when necessary.

A still further object of the invention is to provide a well-drilling machine in which the derrick and the members to which it is immediately connected may be quickly lowered when it becomes necessary to transport the apparatus.

With these and other objects in view, as will hereinafter more fully appear, the invention consists in the novel construction and arrangement of parts hereinafter described, illustrated in the accompanying drawings, and particularly pointed out in the appended claims, it being understood that various changes in the form, proportions, size, and minor details of the structure may be made without departing from the spirit or sacrificing any of the advantages of the invention.

In the accompanying drawings, Figures 1 and 1ª illustrate in side elevation a well-drilling machine constructed in accordance with the invention. Fig. 2 is a view similar to Fig. 1, illustrating the position assumed by the derrick during transportation of the machine from place to place. Fig. 3 is a sectional plan view of the machine on the line 3 3 of Fig. 1. Fig. 4 is a similar view showing some of the parts in a slightly-different position. Fig. 5 is a transverse sectional elevation of the machine on the line 5 5 of Fig. 3. Fig. 6 is an elevation of the lower portion of the front end of the machine, the parts being drawn on a slightly-larger scale in order to more clearly illustrate the construction. Fig. 7 is a front elevation of the upper portion of the derrick. Fig. 8 is a detail perspective view of a portion of the derrick. Fig. 9 is a sectional plan view of a portion of the machine on the line 9 9 of Fig. 6. Fig. 10 is a transverse sectional elevation of the same on the line 10 10 of Fig. 9. Fig. 11 is a sectional plan view of a portion of the apparatus on the line 11 11 of Fig. 1ª. Fig. 12 is a detail perspective view of that portion of the mechanism illustrated in Fig. 11.

Similar numerals of reference are employed to indicate corresponding parts throughout the several figures of the drawings.

The well-drilling machine illustrated in the accompanying drawings is one of that general type in which the derrick is mounted on a wheeled supporting-frame in order that it may be readily moved from place to place.

The main frame of the machine comprises a pair of oppositely-disposed trusses 1, supported on traversely-disposed axles 2, having wheels 3 of any ordinary character. Near the upper end of the wheels, which are connected by suitable transverse supporting bars and rods, are arranged a pair of upright standards 4, constituting the lower portion of the derrick, and these standards are connected by a cross-brace 5 and are further braced by diagonal bars 6, leading downwardly and rearwardly to the upper sills of the trusswork.

Extending transversely across the frame is a pivot-bar 7, the opposite ends of which project slightly beyond the sides of the frame and form supports for derrick carrying-levers 7′, the rear ends of which rest on springs 8, that are arranged at the sides of the frame and are supported on laterally-extended blocks or shoulders 9, carried by the main sills. The pivot-bar extends through openings formed in the levers 7′ at a point intermediate of the length of the latter, and the forward ends of said levers are connected to suitable mechanism for controlling the downward feed of the drill in the manner more fully described hereinafter.

The upper ends of the bars 4 are provided with metallic straps 10, that are bent to form vertical elongated eyes at a point above the tops of the bars. These eyes receive a transversely-disposed bolt 11, the opposite ends of which are secured to a pair of vertically-disposed bars 12, and the lower ends of said bars 12 rest upon and are supported by the levers 7′, the weight being received at a point between the pivot-bars and the springs. The two bars 12 are further connected by a transverse tie-bar 13 and at their upper ends carry a transverse pivot-bar 14, which also extends through an **A**-frame 15, that forms the upper portion of the derrick. The two side members of the **A**-frame are slightly spaced at the top and form supports for a transversely-disposed bolt 16, which also extends through openings formed in the upper ends of a pair of bracing-bars 17, extending downwardly and rearwardly to the main frame of the machine and connected thereto by suitable bolts, as indicated at 18. The connections of the several parts are such that the main or upright portions of the derrick-frame are in a measurable degree loose and free to move in a substantially vertical line, and their lower ends, resting upon the spring-supported levers 7′, serve at times to effect downward movement of the rear ends of said levers against the action of the springs, and thus effect operative movement of the feeding mechanism, to which the forward ends of said levers are connected.

The truss-frames are provided with suitable bearings for the reception of a transversely-disposed rock-shaft 19, having at one end an adjusting-lever 20, and at each end of the rock-shaft are rocker-arms 21, connected by links 22 to the lower ends of the bars 12, in order to

adjust the position of the latter with respect to the fulcrum of the supporting-levers 7'.

The lower sills of the truss-frames are extended forward for some little distance and are connected by a transversely-disposed bar 25, having a central opening for the passage of the drill and drill-rope and also forming the center of rotative movement of the drill-supporting frame, the drill-rope windlass, and its associated mechanism. Through this opening extends a sleeve 27, (see Figs. 9 and 10,) provided, preferably, with upper and lower collars or rings 27^a 27^b in order to prevent vertical play of the sleeve, and at the upper end of said sleeve is a transverse bar 28, on which rest the lower ends of a pair of vertically-disposed and parallel bars 29, forming the main portion of the drill-supporting frame. These bars, which are formed in jointed sections in the manner hereinafter described, are extended up to a point near the top of the derrick and are connected together by a strap 30, having a central opening for the passage of a vertically-diposed bar 31, which is arranged in vertical alinement with the lower opening in the cross-bar 25, and these two form vertical pivots for the rotative movement of the drill-carrying frame.

On the transverse pivot-bolt extending across the top of the **A**-frame is mounted a lever 33, having at its front end a depending yoke 34, provided with a central opening for the passage of the bar or rod 31, and said bar or rod is provided with a fixed collar in order to prevent its downward movement independent of the yoke. The bar or rod 31 is further guided and supported by a bracket 36, the rear ends of which are securely connected to the upper portion of the **A**-frame, and the arrangement is such that while the derrick-frame may receive free rotative movement, with the rod 31 as a center, the latter may receive vertical reciprocating movement in hoisting and dropping of the drill.

To one edge of each of the bars 29 is secured a tubular guide 38, and into these guides extend the opposite parallel arms of a guiding-yoke 39, connected at its upper end to the rod 31 and provided with a transversely-disposed pin 40, on which is mounted a grooved roller 41 for the support of the drill-rope 42. One end of the drill-rope is connected to the drill or bit 43, which may be of any ordinary construction, while the opposite end extends down through the lower portion of the drill-frame and is connected to a windlass, and the windlass is under the control of the derrick-supporting levers 7' and arranged in such manner that as the drilling progresses the windlass will be allowed to turn and gradually lower the drill. In connection with this portion of the mechanism it is to be observed that the lever 33 at the top of the derrick-frame has its inner end connected to suitable mechanism for the purpose of first lowering the rear end and raising the forward end of the lever to elevate the drill, after which the actuating mechanism is disconnected to allow the drill to fall by gravity, and during the raising of the drill its weight will of course be for the most part supported by the main frame of the derrick, and this in turn will be supported by the levers 7' and the springs interposed between said levers and the fixed frame.

The transversely-disposed bar 28, arranged at the lower portion of the vertical bars 29, is preferably formed integral with a windlass-supporting frame 50, comprising a pair of arms or standards supported one by each of the bars 29. The frames 50 are provided with suitable bearings for the reception of a pair of transversely-disposed shafts 51 and 52, of which the shaft 51 forms the support for the winding-drum 53 of the windlass. To the shaft or drum is secured a gear 54, that intermeshes with a pinion 55, secured to the lower shaft 52, and on this lower shaft, at a point outside the frame, is an escapement-wheel 56, with which engages a pair of escapement anchors or pawls in such manner as to permit a step-by-step rotative movement of the windlass.

The escapement-wheel 56 has its teeth spaced for a much greater distance than is usual in ratchet-wheels or escapement-wheels of similar character, the pitch of the teeth being about equal to twice the width of the root of each tooth, so that between adjacent teeth there is formed a space about equal the width of a tooth. The escapement-wheel is also provided with a flange or drum 57, with which engages a band-brake 58, having one of its ends secured to the lower arm of a lever 59, fulcrumed loosely on the end of the shaft 51. The opposite end of the lever 59 is bifurcated to form a pair of pivot-ears for the reception of a lever 65, the inner end of which is connected to the band-brake, and said band-brake is provided with a plurality of openings for the passage of the connecting-bolt, so that the parts may be adjusted to compensate for wear of the friction-drum. To one of the bars or frames 50 is secured a plate 67, having a pair of pivot-studs 68 and 69, carrying, respectively, escapement anchors or pawls 70 and 71, adapted for engagement with the teeth of the escapement-wheel 56. The upper pawl 70 is connected by a link 72 to the controlling-lever 65 to permit its manipulation by hand. To the upper pawl is pivotally connected a bar 73, the lower end of which extends through a guiding-opening in the pawl 71 and is provided with a threaded lower end for the reception of a nut 74. Between the upper face of the nut and the lower edge of the pawl is a coiled compression-spring 75, the stress of which may be adjusted when necessary by the nut 74. The bar 73 carries a pin or lug 76, bearing against the upper surface of the pawl 71, and the relation of the parts is such that

under normal conditions the manipulation of the lever 65 will effect the movement of the pawls alternately into and out of engagement with the teeth of the wheel 56, and the latter will be permitted to rotate under the weight of the drill and accomplish the desired downward feed of the latter. It is to be noted that the arrangement of the pawls and teeth is such that before one pawl moves out of engagement with the tooth with which it is interlocked the second pawl will be moved to position to engage another tooth, so that it will be absolutely impossible for the drill to descend rapidly or to be released from the control of the operator.

The outer or tail end of the lower pawl 71 is engaged by one end of a tension-spring 78, the opposite end of which is secured to the fixed frame and serves to force the toothed end of the pawl into engagement with the escapement-wheel. The plate 67 carries a catch in the form of a pivoted bar 79, which may be hooked under the outer end of the lower pawl 71 and maintain the pawl out of engagement with the escapement-wheel when necessary, and this is at times found desirable when the drill is to be lowered to working position after its removal from the well for the purpose of adding a new section of pipe or for the insertion of the cleaning-bucket. When this is done, the escapement-wheel remains under the control of the operating-lever 65, the pawl 70, and the band-brake, and the parts are so related and proportioned that by proper manipulation of the operating-lever the upper pawl may be held out of engagement with the ratchet-teeth, while the band-brake alone controls the unwinding movement of the windlass and the lowering of the drill, and at any time the parts may be locked by lowering the pawl 70 into engagement with the teeth. Under normal conditions, however, the catch 79 is inactive, and both pawls remain in operative positions.

Extending across the frame and connected at its opposite ends to the derrick-carrying levers 7′ is a bar 80, having an enlarged central portion provided with an opening for the passage of the sleeve 27, and this enlarged central portion forms, in effect, an annular band or ring which at all times is in position to engage the lower end of a bar 81, provided vertically in an opening formed in the bar 28 and connected at its upper end to the lower locking-pawl 71, so that upward movement of the bar will cause the ring to come into engagement with the bar 81 and will move the lower pawl out of engagement with the ratchet-teeth and through the connecting-bar 72 move the upper pawl 70 into position to be engaged by another tooth on the wheel.

In the operation of the mechanism as thus far described the drill is raised by pulling upward on the yoke 39 and raising the guiding wheel or sheave 41. This raises the drill the required distance, and at the completion of the movement the rope is allowed to descend by gravity and the drill drops against the bottom of the well in the usual process of drilling. Should the drill fail to come into contact with the bottom of the well with sufficient force to exercise any cutting effect, it will throw the jar or strain of the falling drill on the drill-rope 42, and this movement will be transmitted through the guiding roller or sheave 41 and yoke to the lever 33 and through said lever and the pivot-bolt to the main frame of the derrick. As the derrick rests on the levers 7′ the rear ends of said levers will be forced downward against the action of the springs by this sudden shock, and the stirrup 80 will be raised into engagement with the bar 81 and cause the pawl 71 to release a tooth of the escapement-wheel, thus paying out a portion of the drill-rope on the winding-drum and allowing the drill to descend a short distance. When the drill strikes against any hard resisting substance, there will be no strain on the rope and no feeding movement will occur, so that under all circumstances the extent of feed will be proportioned to the speed of the cutting operation and there can never be any accumulation of slack drill-rope in the well.

Should it be desired to increase the rapidity of cutting action or to otherwise alter the feed in accordance with the character of the ground, the operating-lever 20 and the connecting-links 22 may be operated to shift the point of contact between the derrick and the levers 7′, so that it will require a greater or less jar to operate the feeding mechanism, and this adjustment may be altered to accommodate drills of different weight as well as to suit varying depths of wells, it being sometimes necessary to adjust gradually while cutting at great depths where the weight of the drill-rope in the well adds materially to the effective downward strain on the derrick. The main frame of the machine is provided with suitable bearings for the reception of a pair of parallel transversely-disposed shafts 90 and 91, of which the shaft 90 forms the main driving-shaft of the machine and is provided with a belt-wheel 91, connected to any suitable source of power. On the shaft 90 is loosely mounted a pinion 92, carrying one member 93 of a friction-clutch, the opposite member of the clutch being connected by a series of intervening links and rods to an operating-lever 94, arranged adjacent to the front end of the machine and provided with the usual locking bolt and notched segment for convenience in locking the clutch in or out of operative position. The pinion 92 intermeshes with a gear-wheel 95, secured to a suitable transverse shaft 90′, and on said gear-wheel is a cam 96, adapted to engage the rear end of a lever 97, that extends forwardly between the framework and is fulcrumed on a transversely-disposed bar

98, carried by the frame. The lever 97 carries a pair of sheaves or blocks 99, forming guides for an operating-rope 100, the upper end of which is connected to the lever 33 at the top of the derrick. The opposite end of the operating-rope is secured to a winding shaft or drum 101, extending transversely of the frame of the machine and adapted to suitable bearings thereon. The winding-shaft extends for some distance outward beyond one side of the frame and is provided with a non-circular end for the reception of a suitable crank or other device by means of which the shaft may be wound to take up any slack in the operating-rope, and the shaft is provided with a ratchet-wheel 103, that is engaged by a locking-pawl 104, pivoted to the main frame and serving to hold the operating-rope taut.

The collar 27 receives a pair of rings 106 and 107, of which the lower is provided with a radially-extending arm 108, that is connected by a link 109 to an arm 110, carried by the lever 97. The second and upper ring 106 is provided with a toothed periphery and is engaged by a pawl 111, pivoted to the arm 108, the parts being so arranged that at each downward movement at the rear end of the lever under the influence of the cam 96 movement will be transmitted to the arm 108 and pawl 111, and thus rotate the toothed annulus 106 to the extent of a single tooth. The annulus 106 may be formed integral or may be secured to the collar 27, if desired, and effect certain positive rotative movement of the collar, the arms 29, the windlass, and all of the members associated therewith; but in order to prevent any danger of breakage it is preferred to mount the annulus 106 loosely on the collar and to depend on the friction resulting from the weight of the windlass and the arms 29, as well as the added weight of the rope and drill, to connect the parts in such manner as to insure rotative movement, while permitting yielding should any of the parts be locked temporarily in position.

Feathered to the main driving-shaft 90 is one member of a friction-clutch, and this member is connected by suitable intervening mechanism to an operating-lever 120, arranged near the front end of the machine. The opposite clutch member 121 is loose on the shaft and carries a sprocket-wheel 122, that is connected by a link belt 123 to a sprocket-wheel 124, secured on a shaft 125. The shaft 125 is held in suitable bearings formed by the spaced arms 126 of a bar 127, that is loosely supported on one end of the shaft 90 and at an intermediate point on the shaft 101. The inner end of the shaft 125 is provided with a hub member having a non-circular socket 128 for the reception of the similarly-shaped end of the shaft 52, and when the bar 127 is moved in the direction of the shaft 52 and the latter is engaged in socket 128 the windlass may be turned by operating the lever 120 and connecting the clutch to the main driving-shaft.

To the end portion of the shaft 101 is fulcrumed one end of a lever 130, the opposite end of which terminates in an operating-handle 131 and is provided with a locking-bolt 132, adapted to engage notches in a segment 133, carried by the arms 126. The operating-lever 130 is provided with an opening for the reception of the shaft 125; but the connection is comparatively loose and the lever is held from disengagement by means of a suitable collar or nut 135. In operating this portion of the mechanism the clutch 93 is moved to disengaging position and the lever 130 is operated in such manner as to force the bar 127 in the direction of the shaft 52 until the non-circular end portion of the latter is engaged in the socket 128. When this is accomplished, the locking-bolt 132 is allowed to enter the innermost notch of the segment 133, and the parts are thus locked rigidly in position. When the lever 120 is manipulated, the sprocket-wheel 122 is clutched to the shaft 90 and the rotative movement of the latter is imparted through the link belt 123 and sprocket-wheel 124 to the shaft 125, and thence to the winding-drum, so that when necessary the drill may be hoisted to the top of the well when it is desired to insert a new section of pipe or tubing or when it becomes necessary to use the cleaning-bucket in the well.

The frame of the machine carries two bearings 140 and 141, of which the bearing 140 is adjustable in a direction longitudinal of the frame. These bearings carry a shaft 142, on which is mounted a bucket-hoisting drum 143, and the shaft is provided with a friction wheel or disk 144, that may be moved into or out of engagement with a friction-wheel 145, secured to the shaft 90. The lower portion of the bearing 141 is connected to one end of the lever 146, fulcrumed at an intermediate point on a stud 147, and the lower end of said lever is connected by a rod 148 to an operating-lever 149, arranged at the front of the machine and under the control of the operator, so that when necessary the shaft may be shifted to engage the two friction-wheels and operate the winding-drum before raising and lowering the cleaning-bucket. During manipulation of this portion of the mechanism the two clutches of the shaft 90 are disengaged and the remaining portion of the mechanism is inoperative. Extending transversely across the A-frame that forms the upper portion of the derrick is a bar 150, on which is fulcrumed the lower end of a link 151. The upper and rear end of the link extends between a pair of parallel bars 152 and is connected thereto by a pivot-bolt 153. The opposite ends of the pair of bars 152 are connected together by straps 154 and pins 155, the latter constituting the spindles for a pair of sheaves 156 and the straps forming guards for the bucket-

hoisting rope. The two bars are further connected together at a point near their rear ends by a pin or bolt 158, that is connected by a link 159 to a pin or bolt 160, extending across the upper portion of the derrick-frame.

The bucket-rope 161 has one end secured to the winding-drum 143 and after passing over the guiding-sheaves 156 is secured to the cleaning-bucket 162. Under normal conditions—that is to say, during the drilling operation—the bucket may be allowed to remain in the position shown in Fig. 1ª. When it is desired to adjust the bucket to operative position or into direct vertical alinement with the well, the friction-wheels are engaged and the drum 143 is turned until the bucket is pulled up tightly against the outer end of the bars 152 and the sheave carried thereby. On continuing the winding operation the pivot pin or bolt 158 will be found to form the fulcrum for the bars 152, and the rear end of the latter will be depressed while the forward end is raised and moved forward with the bolt or bar 150 of the center of movement, the link causing upward movement of the bars and the downward strain at the rear end of the bars causing forward movement thereof until the parts assume the position shown by dotted lines in Fig. 1, and the parts will remain in this position during the raising and lowering of the bucket during the cleaning operation.

When the bucket-supporting bars are to be again restored to inoperative position, a downward stress is exerted on a rope or rod 170, the upper end of which is connected to an arm or crank 171, secured to the projecting end of the rod 150, and inasmuch as the crank, the rod, and the arm 151 are all rigidly secured together the bars 152 may be readily forced back to the inoperative position. (Shown in full lines in Fig. 1ª.)

The apparatus as shown and described is constructed also with a view of facilitating its ready transportation from place to place, and during travel it is desirable that the derrick be lowered. For this purpose the angular brace-bars are detached from the top of the derrick and allowed to fall forward to assume the inclined position, (shown in Fig. 2,) while the **A**-frame forming the upper portion of the derrick turns on its pivot-bar until the head of the derrick rests on a transverse bar 175, arranged at the rear portion of the main frame of the apparatus. In order to permit this lowering of the derrick-frame, the bars 29 of the drill-support are made in section, being joined at a point adjacent to the pivot-point of the **A**-frame. The adjacent ends of the sections of bars 29 are extended laterally in both directions and are connected at one end of the extended portion by hinges or pivots 176, while the opposite ends are provided with suitable openings for the passage of bolts 177, by means of which the sections of the bars may be firmly locked in operative position. The extended pivotal connections between the sections of the drill-carrying frame are such as to permit the derrick and the upper portion of the frame to be folded or turned down simultaneously, and thus bring the weight of the upper portion of the structure nearer to the ground, so that the apparatus may be transported without danger of overturning.

Having thus described the invention, what is claimed is—

1. In a well-drilling machine, a vertically-pivoted frame revoluble in a horizontal plane, means for imparting a step-by-step rotative movement thereto, a winding-drum carried by the frame, a drill-rope connected to the winding-drum and having a guiding means supported by the frame, a drill supported by the drill-rope, and means operable by downward movement of the drill for permitting release of the winding-drum to feed said drill.

2. In a well-drilling machine, a frame revoluble in a horizontal plane, a winding-drum supported by the frame, a drill-rope, a vertically-guided sheave carried by the frame and over which the drill-rope passes, a drill secured to the drill-rope, means for raising and releasing the sheave, and means for imparting step-by-step rotative movement to the frame.

3. In a well-drilling machine, a frame having vertical pivots of which the lower is provided with an opening for the passage of the drill and drill-rope, a winding-drum supported by the frame, a drill and drill-rope of which the latter has one end connected to the winding-drum, a rope-guiding sheave supported by the frame and having vertical movement independent of said frame, and a vertically-movable rod for transmitting movement to the sheave, said rod forming the upper pivot of the frame.

4. In a well-drilling machine, a frame having vertical pivots of which the lower is provided with an opening for the passage of the drill-rope, a drill, a winding-drum carried by the frame, a drill-rope connected at one end to the drill and at the opposite end to the winding-drum, a pair of vertically-disposed guides arranged near the upper portion of the frame, a yoke adapted to the guides, a sheave carried by the yoke and supporting the drill-rope, and a vertically-movable bar connected to the yoke and serving also as the upper pivot of the frame.

5. In a well-drilling machine, a vertically-pivoted frame, of which the lower pivot is formed of a collar having a central opening for the passage of the drill and drill-rope, a winding-drum supported by the frame, a drill-rope connected at one end to the winding-drum and at the opposite end to the drill, a toothed annulus mounted on the collar and held in fixed engagement with the frame by

the weight of said frame, a second collar surrounding the first and provided with a radially-disposed arm, a pawl carried by the arm and engaging the ratchet-annulus, and a drill-rod-operating means having operative connection with said arm.

6. In a well-drilling machine, a vertically-pivoted frame, a winding-drum carried thereby, a drill-rope having one end secured to the winding-drum, a drill secured to the opposite end of the rope, a rope-guiding sheave adapted to vertical guideways on the frame and serving as a support for the drill-rope, a derrick, a lever pivoted to the derrick and having one end operatively connected to the sheave, a pivoted lever connected to the derrick-lever, a cam for actuating said pivoted lever, a ratchet-wheel carried by the revoluble frame, a pawl engaging said ratchet-wheel, and a link connecting the pawl to the pivoted lever.

7. In a well-drilling machine, the combination with a drill, a drill-rope, an actuating means connected to and adapted to raise the drill-rope, said actuating means including a cam-operated lever, an operating-rope, means for transmitting the movements of the operating-rope to the drill-rope, a revoluble winding-shaft for taking up the slack of the operating-rope and to which one end of the latter is connected, means for preventing unwinding movement of said operating-rope, and a rope-guide carried by the lever.

8. In a well-drilling machine, a drill, a drill-rope, a vertically-movable sheave over which the drill-rope passes, a rocking lever having one end connected to the sheave, a cam-operated lever, a winding-shaft, an operating-rope extending therefrom to the opposite end of the cam-operated lever, and a plurality of guiding-sheaves carried by the cam-actuated lever and serving as guiding devices for the operating-rope.

9. In a well-drilling machine, a drill, a drill-rope, and a feeding means controllable by the strain exerted on the drill-rope by the falling drill.

10. In a well-drilling machine, a drill, a drill-rope, a drill-rope feeding or releasing means, and mechanism controllable by the strain exerted on the drill-rope by the falling drill for governing said feeding means.

11. In a gravity drilling apparatus, a drill, and an automatic feeding means the speed of which is controlled by the cutting speed of the drill.

12. In a gravity drilling-machine, a feeding means, and means controllable by the degree of penetrability of the material being acted upon for governing the speed of the feeding means.

13. In a gravity drilling apparatus, a drill, a drill-rope, a drill-rope-feeding means, a movable derrick, and means for connecting the derrick to said feeding means, thereby to transmit movement of the derrick to said feeding means.

14. In a gravity drilling apparatus, a movable derrick, a drill, a drill-rope, a drill-rope-feeding means, an actuating means in part supported by the derrick, and means for connecting the derrick to the feeding means to thereby actuate the latter from movement of the derrick.

15. In a gravity drilling apparatus, a drill and drill-rope, a drill-rope-feeding means, and a vertically-movable derrick for actuating said feeding means.

16. In a gravity drilling apparatus, a drill and drill-rope, a drill-rope-feeding means, a yieldably-mounted derrick, and means for connecting the derrick to the feeding means.

17. In a gravity drilling apparatus, a drill and drill-rope, a drill-rope-feeding means, and a spring-supported derrick for actuating the feeding means.

18. In a gravity drilling-machine, a drill and drill-rope, a drill-rope-feeding means, a pair of pivoted levers on which the derrick rests, springs in part supporting said levers, and means for connecting the levers to the feeding means.

19. In a gravity drilling apparatus, a drill and drill-rope, a drill-rope-winding drum, an escapement mechanism for governing the unwinding movement of the winding-drum, and means controlled by the extent of falling movement of the drill for releasing the escapement.

20. In a gravity drilling-machine, a drill and drill-rope, a drill-rope-feeding means including an escapement mechanism, a vertically-movable derrick, and means for connecting the derrick to the escapement mechanism.

21. In a gravity drilling apparatus, a drill and drill-rope, a drill-rope-winding drum, an escapement mechanism for controlling the unwinding movement of the winding-drum, a vertically-movable derrick, a pair of yieldable levers on which the derrick rests, a cross-bar connecting said lever, and means for operatively connecting the cross-bars of the escapement mechanism.

22. In a gravity drilling apparatus, a drill and drill-rope, a drill-rope-winding drum, a toothed disk connected to the winding-drum, a pair of escapement anchors or pawls for alternately engaging said disk, and means for locking one of the pawls in inoperative position.

23. In a gravity drilling apparatus, a drill and drill-rope, a drill-rope-winding drum, a toothed disk geared to the winding-drum, and a pair of pivotally-mounted and independently-movable pawls for engaging said disk.

24. In a gravity drilling apparatus, a drill and drill-rope, a toothed disk, a drill-rope-winding drum to which the disk is geared, a pair of pivotally-mounted pawls for engaging the disk, and means connecting the pawls and

for permitting both neutral and independent movement thereof.

25. In a gravity drilling apparatus, a drill and drill-rope, a drill-rope-winding drum, a toothed disk and a friction-drum connected to the winding-drum, a locking-pawl engaging the disk, a band-brake encircling the friction-drum, and a single operating means connected to both the pawl and the brake.

26. In a gravity drilling apparatus, a drill and drill-rope, a drill-rope-feeding means, a pair of pivoted levers movable into operative engagement with the feeding means, a derrick resting on the levers and means for adjusting the foot of the derrick toward and from the fulcrum-point of said levers.

27. In a gravity drilling apparatus, a derrick comprising pivotally-connected upper and lower members, a pair of pivoted levers on which the lower members rest, means for adjusting the position of said lower members with respect to the fulcrum-points of the levers, a horizontally-revoluble drill-rope frame, a bracket extending from the upper member of the derrick and serving indirectly as a guide or support for the frame, a drill and drill-rope, a drill-rope windlass carried by the frame, means for controlling the unwinding movement of the drill-rope, and means for connecting the levers to said controlling means.

28. In a well-drilling machine, a main frame, a power-shaft having bearings thereon, a drill and drill-rope, a drill-rope-winding drum, a shaft carrying the same, a winding-shaft geared thereto, means for actuating the drill, a lever or bar fulcrumed adjacent to the power-shaft, an auxiliary winding-shaft carried by said lever or bar and adjustable into engagement with the winding-shaft, sprocket-wheels and a link belt serving as connections between the power and auxiliary shafts, and means for adjusting and for locking the bar in adjusted position.

29. In a well-drilling machine, a derrick, a movable frame having a linked connection with the derrick, a rock-shaft carried by the derrick, a rocker-arm connecting the shaft to the frame, a pair of rope-guides carried by the frame and disposed respectively at opposite ends thereof, a cleaning-bucket secured to one end of the rope, and a winding means for engaging the opposite end of the rope.

30. In a well-drilling machine, a derrick, a movable frame having a linked connection with the derrick, a rock-shaft carried by the derrick, a rocker-arm secured to the shaft and connected to the frame, a crank-arm secured to the rock-shaft and serving as a means for restoring the frame to inoperative position, sheaves disposed respectively at opposite ends of the frame, a bucket-hoisting rope passing over the sheave, a bucket secured to one end of the rope, and a hoisting means to which the opposite end of said rope is attached.

31. In a well-drilling machine, a main frame, a derrick formed of pivoted sections of which the upper may be lowered to rest on the main frame, and a drill-rope frame also formed of pivoted sections, the pivoting members of the latter being laterally extended in order to permit of the folding of the upper member thereof over the upper derrick member.

32. In a well-drilling machine, a vertically-pivoted frame revoluble in a horizontal plane, a lower pivot member formed by a collar or sleeve having a central opening for the passage of the drill-rod and drill-rope, an upper pivot member formed by a vertically-movable bar, a drill-rope windlass carried by the frame, a sheave supported by the bar and forming a guide and support for the drill-rope, the center of rotation of the sheave being in a plane to one side of the vertical pivoting plane of the frame and one portion of the rim of said sheave being disposed in said pivoting plane.

33. In a well-drilling machine, a supporting-frame including a derrick, a sleeve or collar having a central opening and revolubly mounted at the lower portion of the frame, a drill-operating lever fulcrumed to the upper portion of the derrick, a vertically-guided rod connected to one end of said lever, a drill-rope frame secured at one end to the collar or sleeve and pivoted at its upper end upon the rod, a winding-drum carried by said frame, a pair of tubular guides also carried by the frame, a yoke connected to the vertically-movable bar and having arms adapted to said guides, and a drill-rope-guiding sheave carried by the yoke and having a portion of its periphery in the vertical plane of the frame-pivots.

34. In a well-drilling machine, a drill-rope-winding drum, a shaft carrying the drum, a gear secured to said shaft, a winding-shaft having a pinion intermeshing with the gear, an escapement-wheel on said winding-shaft, said escapement-wheel having alternate teeth and spaces, in which the spaces at the root-line are of a width equal to the width of the roots of the teeth, and a pair of pawls or escapement-anchors for engaging said teeth.

35. In mechanism of the class described, the combination with the winding-drum, a shaft carring the same, of a gear secured to the winding-shaft, a winding-shaft having a pinion intermeshing with the gear, an escapement-wheel secured to the winding-shaft, a pair of pivoted pawls adapted to alternately engage the escapement-wheel, means for connecting the pawls for mutual movement, and an operating-lever connected to said pawls.

36. In mechanism of the class described, a winding-drum, a shaft carrying the same, a winding-shaft, gearing connecting the two shafts, an escapement-wheel on the winding-shaft, a pair of pawls for engaging said escapement-wheel, a bar pivotally connected to one of said pawls and extending through an

opening in the other, said bar having a tooth or lug for engagement against one side of the pawl, and a compression-spring carried by the bar and engaging the opposite side of the pawl.

37. In mechanism of the class described, a winding-drum, a shaft carrying the same, a gear on said shaft, a winding-shaft having a pinion intermeshing with the gear, an escapement-wheel secured to the winding-shaft, a pair of pawls for engaging the escapement-wheel, a connecting-bar extending between the two pawls and arranged to permit both mutual and independent movement thereof, and a locking-catch for retaining one of the pawls in inoperative position.

38. In mechanism of the class described, a winding-drum, a gear connected thereto, a winding-shaft having a pinion intermeshing with the gear, a ratchet-wheel carried by the winding-shaft, a pivoted pawl engaging said ratchet-wheel, a friction-drum carried by the winding-shaft, a band-brake embracing the friction-drum, a two-armed lever having one of its arms connected to one end of the brake-band, an operating-lever fulcrumed to the other arm of the lever and connected to the opposite end of the brake-band, and a connecting-rod extending between the lever and the pawl.

39. The combination with a supporting-frame, of a pair of pivotally-mounted levers, springs serving as supports for the rear ends of the levers, a derrick resting on the levers, a revolubly-mounted drill-rope frame, a drill and drill-rope supported thereby, a drill-rope-winding drum, an escapement mechanism for controlling the unwinding movement of the winding-drum, a stirrup or cross-bar connecting the two levers and having an annulus encircling the lower pivotal member of the drill-rope frame, and a vertically-guided escapement-operating bar carried by the lower portion of the drill-rope frame and arranged at all times above the annulus.

40. In mechanism of the class described, a derrick, a bucket-rope frame adjustably mounted thereon, a bucket and bucket-rope, and a bucket-rope-hoisting mechanism serving by the exertion of stress on the rope to adjust the position of the frame.

41. In mechanism of the class described, a derrick, an adjustably-mounted bucket-rope frame carried by the derrick, and means for moving said frame from inoperative to operative position, substantially as specified.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

DELBERT W. SAUNDERS.

Witnesses:
J. H. JOCHUM, Jr.,
W. E. SAUNDERS.