No. 622,459.

Patented Apr. 4, 1899.

P. B. FREEMAN.

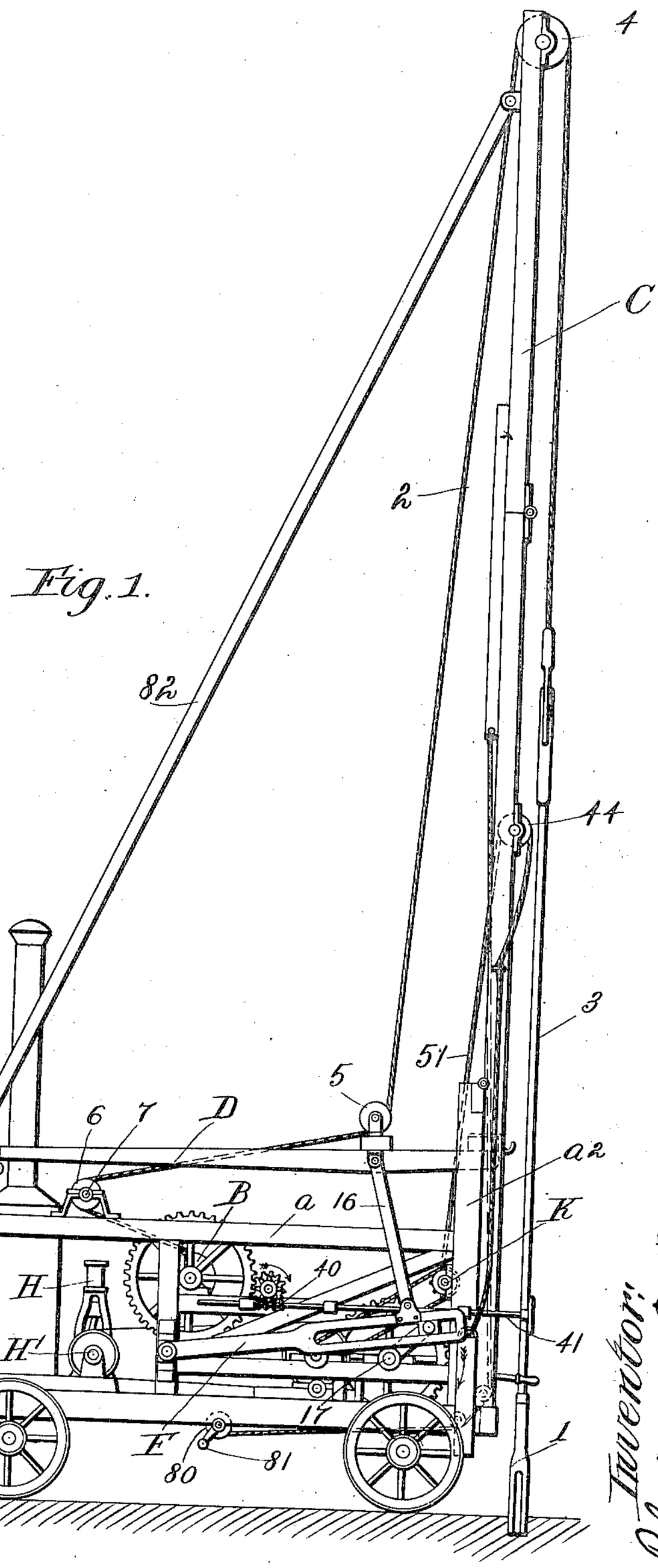
WELL DRILLING MACHINE.

(Application filed Sept. 24, 1897.)

(No Model.)

6 Sheets—Sheet 1.

Fig. 1.



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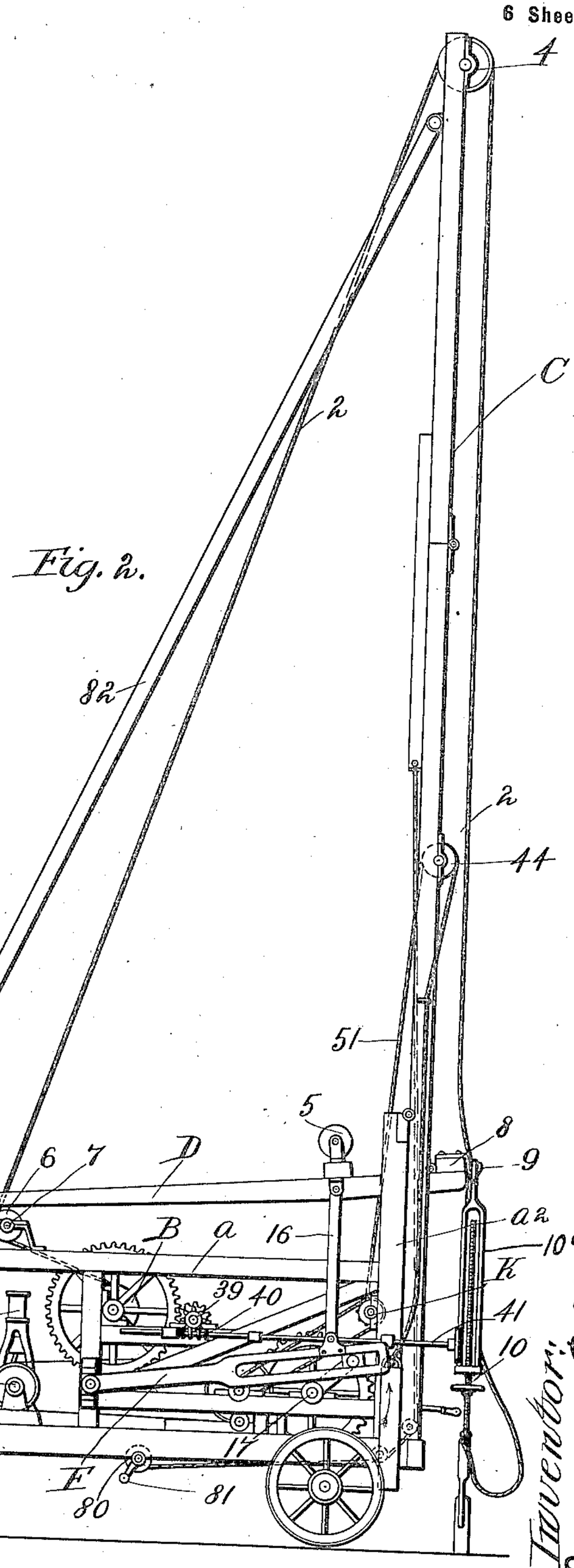
6 Sheets—Sheet 2.

Fig. 2.



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6 Sheets—Sheet 3.

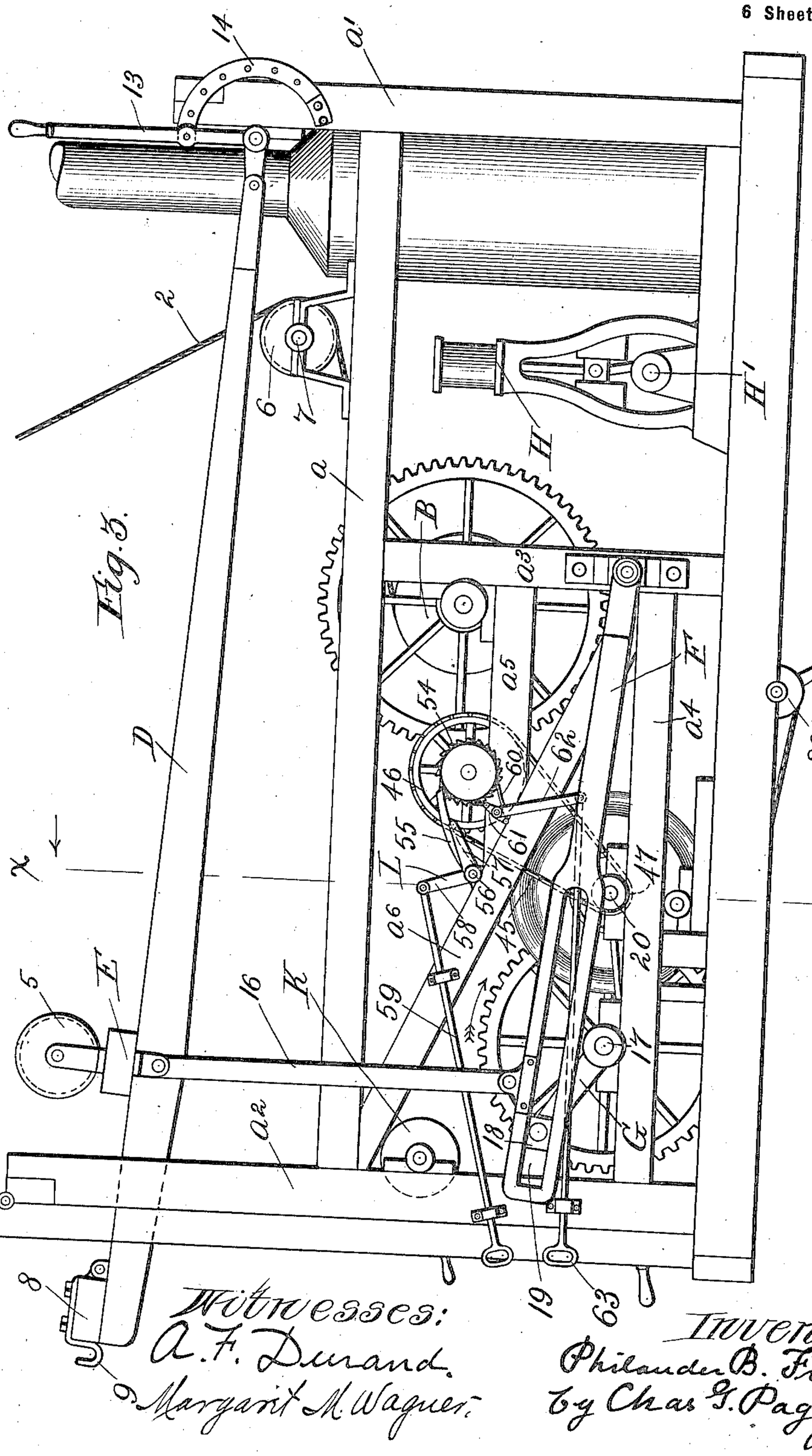

Fig. 3.

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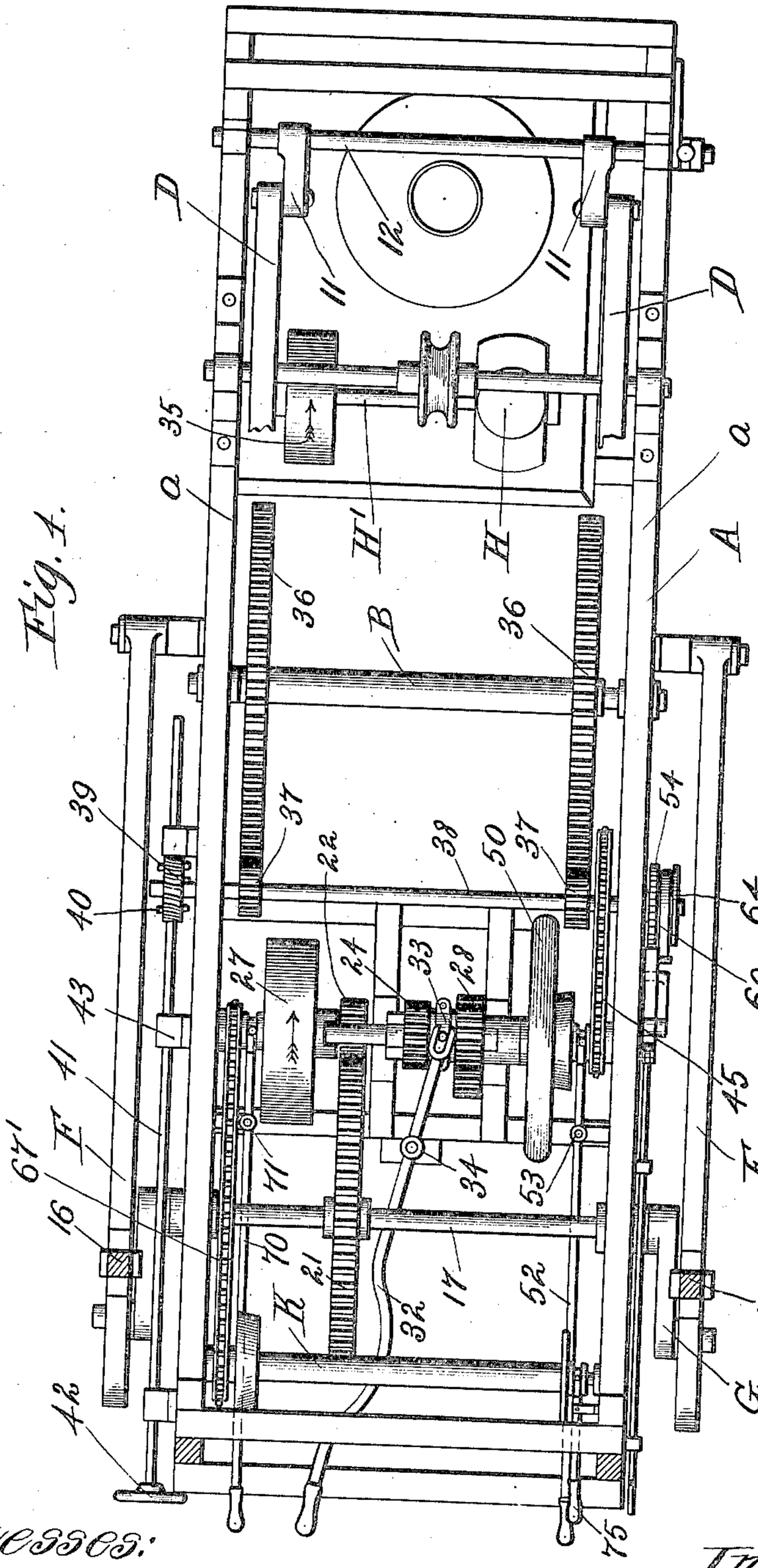
6 Sheets—Sheet 4.

Fig. 4.



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6 Sheets—Sheet 5.

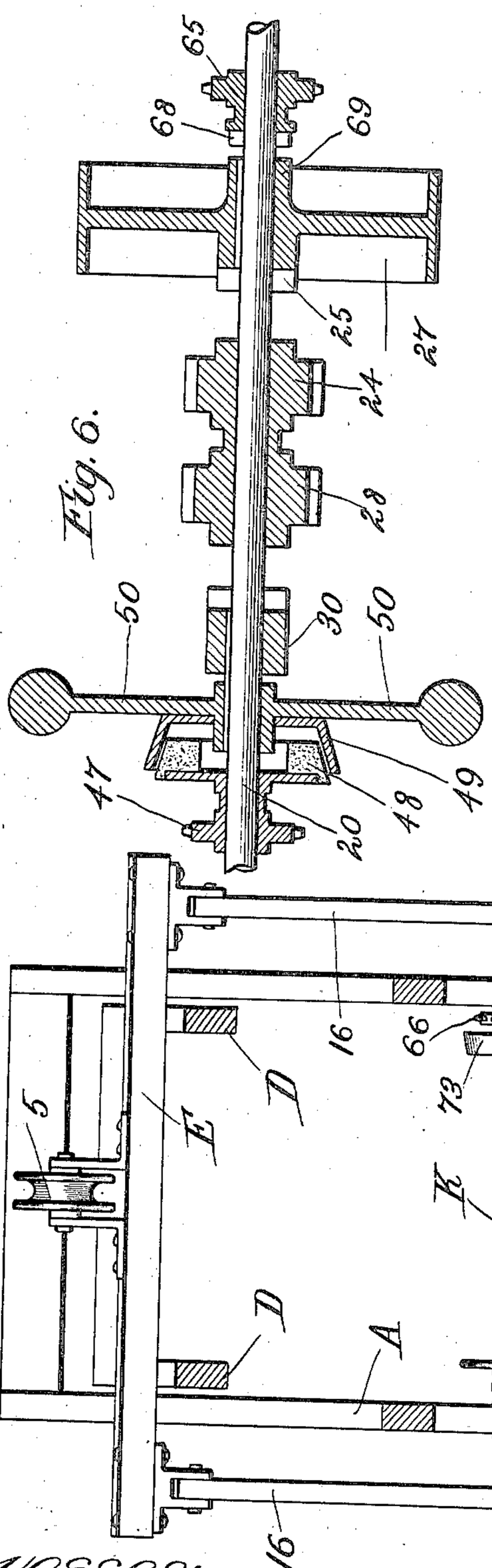

Fig. 6.

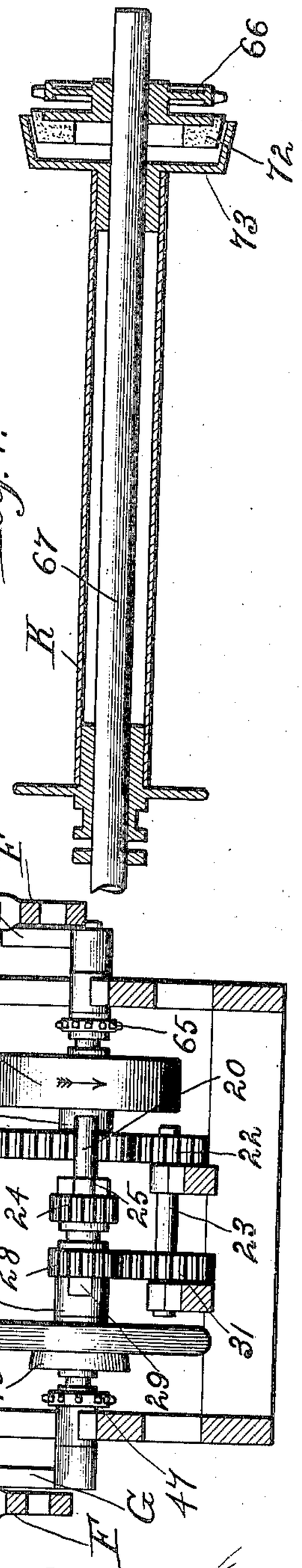

Fig. 7.

Fig. 5.

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6 Sheets—Sheet 6.

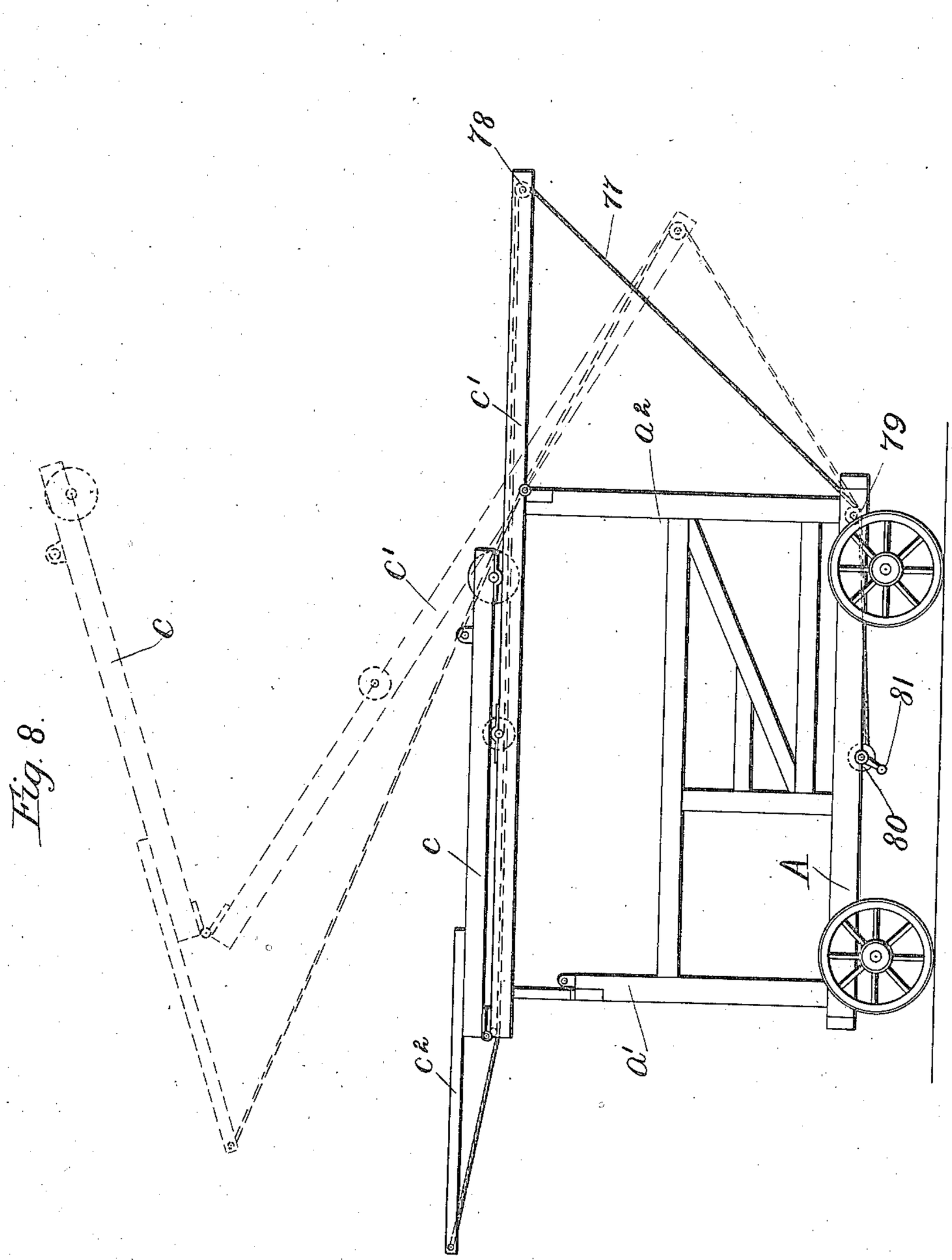

Fig. 8.

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UNITED STATES PATENT OFFICE.

PHILANDER B. FREEMAN, OF CHICAGO, ILLINOIS, ASSIGNOR TO FREDRICK C. AUSTIN, OF SAME PLACE.

WELL-DRILLING MACHINE.

SPECIFICATION forming part of Letters Patent No. 622,459, dated April 4, 1899.

Application filed September 24, 1897. Serial No. 652,939. (No model.)

To all whom it may concern:

Be it known that I, PHILANDER B. FREEMAN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Well-Drilling Machines, of which the following is a specification.

My invention relates, in general, to well-drilling machines adapted for drilling deep wells by means of a suspended drilling-tool which is alternately raised and allowed to fall so as to strike the soil, and thereby sink the well.

It also relates, in particular, to machines of the above class in which the drilling-tool can be suspended for "spudding" from the free end of a rope or cable which extends upwardly to an overhead or elevated support, usually a pulley, over which it is reeved, and thence to a spudding vibratory member which engages and operates it in a way to cause the portion thereof between such vibratory member and the overhead pulley to be alternately drawn in a direction away from the latter and allowed to return in a direction toward the same, so as to thereby raise and lower the drilling-tool, in which said machine the tool can also be alternately suspended for "drilling" proper from a substantially vertically reciprocating or vibratory drilling member arranged in position over or above the well and connected with the tool so as to impart thereto a reciprocal movement substantially identical with its own action.

Prominent objects of my invention are to arrange for the slow rise and quick drop of the drilling-tool both in spudding and in drilling proper; to provide simple, effective, and practical mechanism for such purpose; to arrange for the easy raising and lowering, each in a single operation and by a single operator standing upon the ground, of the mast or derrick upon which the overhead or elevated pulley is usually mounted, and to provide other novel and useful features tending to increase the efficiency of deep-drilling well-machines.

In a well-machine characterized by my invention the spudding vibratory member when the drilling-tool is suspended from the free end of the rope or cable and the latter is operated by such member—or, in other words, when the machine is in condition for spudding—can be given a differentially-reciprocating movement—that is to say, a movement involving alternately and relatively fast and slow reciprocatory strokes or impulses—in a way to cause the portion of the rope or cable between such spudding member and the overhead pulley to slowly recede from and rapidly approach the latter, and also the drilling vibratory member, alternately and when the drilling-tool is suspended therefrom—or, in other words, when the machine is in condition for drilling—can be given a differentially-reciprocating movement in a way to cause its slow elevation and quick descent. As a result, whether the machine be spudding or drilling proper the drilling-tool will be given a relatively slow rise and quick drop.

In the machine hereinafter described for carrying out my invention the rope or cable from whose free end the tool can be suspended is extended downwardly from the overhead pulley and has its other end portion coiled about and in effect held by a rotary reel or drum mounted upon the framework of the machine. In spudding this portion of the rope or cable between the reel or drum and the overhead pulley has a sliding connection with the vibratory spudding member in such way that it is alternately slowly flexed or drawn aside and quickly allowed to return to substantially its former position thereby. This alternate relatively slow flexure and rapid return to position of such actuated portion of the rope or cable causes the movement of the portion thereof between the spudding vibratory member and the overhead pulley alternately slowly away from and quickly toward the latter.

Both the differentially-reciprocating spudding and drilling vibratory members are carried by a single longitudinally-extending pivotally-connected vertically-swinging vibratory or swinging frame, which can be differentially vibrated or swung about its pivotally-connected end either with a relatively slow downstroke and quick upstroke or with a rela-

tively slow upstroke and quick downstroke. In this way when it is desired to spud the well and the machine is in spudding condition the swinging frame can be differentially swung with a relatively slow downstroke and quick upstroke, and when so operated it will cause the alternate relatively slow flexure and rapid return to position of the actuated portion of the rope or cable and the consequent relatively slow rise and rapid descent of the tool. Also when it is desired to drill and the machine is in spudding condition the swinging beam can be differentially swung with a relatively slow upstroke and quick downstroke, and when so operated it will cause the relatively slow rise and rapid descent of the drilling member and therefore of the drilling-tool.

The vertically-vibrating swinging frame is differentially vibrated alternately in one and the other of the two ways mentioned by a differentially-vibrating reversible actuating mechanism. This mechanism comprises a couple of vertically-swinging, longitudinally-arranged, and pivotally-connected swinging beams provided with longitudinal guideways and a couple of vertically-rotating rotary cranks rotating in unison and having their wrist-pins working in the guideways formed longitudinally in the swinging beams, and thereby elevating and lowering the latter either with a relatively quick rise and slow drop, or vice versa, according to their direction of rotation.

For other novel features and also for matters of detail in the particular form of machine illustrated reference is made to the accompanying drawings, in which—

Figures 1 and 2 are side elevations of a well-drilling machine embodying my invention and having its operating mechanism arranged for spudding and drilling, respectively. Fig. 3 is a side elevation of a portion of the same, particularly illustrating the vertically-swinging frame carrying both the spudding and drilling members and the differentially-reciprocating mechanism operating such frame. Fig. 4 is a plan of the portion of the machine illustrated in Fig. 3. Fig. 5 is a vertical section taken on line $x\,x$ in Fig. 3. Figs. 6 and 7 are vertical sectional views of details of construction.

In spudding, Fig. 1, the drill 1 is suspended, usually through the medium of a drill-rod 3, from the free end of a rope or cable 2, which latter is extended upwardly to and is reeved about an elevated or overhead pulley 4 at the top of a mast C, which rises from the rear end of the body-frame A of the machine. From the overhead pulley 4 the rope or cable 2 is extended downwardly and has its other end held or tied—as, for example, by being coiled upon a rotary drum or reel B. Intermediate of the overhead pulley 4 and the reel or drum B the rope or cable is looped forwardly and reeved about a sheave or pulley 6 on a transverse rotary shaft 7, mounted near the forward end of the machine in bearings supported by horizontal side bars $a\,a$ of the machine-frame A.

The portion of the cable 2 between the overhead pulley 4 and the forward pulley 6 is engaged and alternately slowly flexed or drawn aside downwardly and allowed to rapidly return to its original position, so as to alternately slowly elevate and rapidly lower the drilling-tool 1, by a vibratory spudding member, such as the sheave or pulley 5, which has a differentially-reciprocating movement involving alternately and relatively slow down and quick up strokes or impulses.

In drilling proper, Fig. 2, the rope or cable a is desirably disengaged from the differentially-reciprocating spudding-pulley 5 and the drilling-tool 1 is detached from the free end of such rope or cable and is suspended from a substantially vertically-reciprocating drilling member, such as a hook, which also reciprocates differentially, but with relatively slow up and quick down strokes, and so alternately slowly elevates and quickly lowers the drilling-tool 1. The drilling-tool 1 is usually thus suspended from the drilling member through the medium of a temper-screw 10, held in a fork-shaped holder 10^a.

The spudding vibratory member, such as the pulley 5, and the substantially vertically-reciprocating drilling member, such as the hook 9, could be mounted in any suitable manner, and they could be operated in any desired way, so as to cause alternately and relatively slow down and quick up strokes or impulses on the part of the former and relatively slow up and quick down strokes on the part of the latter. However, as a preferred arrangement and matter of further improvement both are mounted upon or carried by a vertically-vibratory frame which can be differentially reciprocated either with a relatively slow descent and quick rise, so as to properly actuate the spudding vibratory member when the machine is in spudding condition, or with a relatively slow rise and quick drop, so as to properly actuate the drilling member when the machine is in drilling condition.

The vibratory frame shown comprises a couple of connected swinging beams D D, extending longitudinally and substantially the length of the machine-frame A and having their forward ends pivotally connected to the forward end of the machine-frame and their rear ends projecting to the rear of the rear end of the same, so as to allow freedom of suspension of the drilling-tool when in drilling position, a forward cross-beam E, which extends between and is secured to the swinging beams D D forward of the rear ends and has the spudding-pulley 5 secured to it at its longitudinal middle, and a rear cross-beam 8, attached to the rear ends of the beams D D and carrying the hook 9 at its longitudinal middle.

In spudding the hook 9 can be retracted from position immediately above the well, so as to prevent its interference with the portion

of the rope or cable 2 depending from the overhead pulley 4, by longitudinally and forwardly adjusting the vibratory frame carrying such hook, as best shown in Fig. 1. This can be done by turning a transverse rock-shaft 12, Fig. 4, mounted in bearings attached to uprights a' a' at the forward end of the frame A, so as to draw upwardly and rearwardly a couple of cranks 11 11, mounted thereon and having their wrist-pins pivotally connected to the forward ends of the swinging beams D D, and thereby draw the latter rearwardly. The rock-shaft 12 can be thus turned by swinging down a hand-lever 13, Fig. 3, mounted at the end thereof, and after being turned it can be locked in adjustment by locking the lever 13 upon a segment 14, secured to one of the uprights a' a' of the frame A. When it is desired to drill with the drilling-tool suspended from the hook 9, the lever 13 can be swung upwardly to its uppermost position, as shown in Fig. 3, so as to project such hook 9 forwardly into position over the well and can be locked in such position upon the segment 14. In spudding, also, if desired, the hook 9 can be further retracted by turning the rearmost cross-beam 8, carrying the drilling-hook 9, about its lower forward edge as an axis by means of a hinge connection which it has with the beams D D, so as to in effect place it forward of its normal position on the latter, or the hook 9 can be suitably retracted by simply turning the beam 8 about its hinge or pivotal connection with the beams D D without longitudinally and forwardly adjusting the latter.

The vibratory frame carrying the spudding-pulley 5 and the drilling-hook 9 is desirably immediately actuated by a couple of substantially vertically-disposed and vertically-reciprocating links 16 16, having their upper ends pivotally connected with the beams D D, forming a part of such frame, in which way a substantially vertical reciprocating movement can be transmitted to the free end of the frame, while at the same time the frame can be longitudinally adjusted for the adjustment in position of the drilling-hook 9 without either interfering with or substantially changing such movement.

The vertically-arranged links 16 16 can be differentially reciprocated either with a relatively slow descent and quick rise for spudding or with a relatively slow rise and quick descent for drilling by any suitable reversible power-driven actuating mechanism. However, as a preferred arrangement and matter of further improvement they are so operated by the rotation in either one direction or the other of a transversely-disposed reversible crank-shaft 17, carrying a couple of cranks G G and supported by the frame-bars a^4 a^4. The rotation of the cranks G G causes the reciprocation of a couple of guide-blocks 18 18, holding their wrist-pins of a couple of rotary cranks G G in longitudinal guideways 19 19, formed in a couple of vertically-swinging vibratory or swinging beams F F. The swinging beams are disposed longitudinally of the machine in position below the swinging beams D D of the carrying-frame and have their forward ends pivotally connected to uprights a^3 a^3 of the machine-frame and are pivotally connected near their rear ends to the lower ends of the vertically-disposed links 16 16.

The swinging beams F F are desirably considerably shorter in length than the swinging beams D D of the carrying-frame, in which way a maximum difference in the relatively slow and rapid strokes of the carrying-frame can be obtained, while at the same time the drilling-hook 9 will deviate but slightly from the vertical in its reciprocation.

The rotary crank-shaft 17 is driven from a rotary driving-shaft 20, situated forward thereof and journaled in suitable bearings supported by the bars a^4 a^4, through the medium of suitable power-transmitting connection between such shafts, and it can have its direction of rotation reversed or be stopped at will by means of suitable reversing and stopping mechanism in such power-transmitting connection. The reversing and stopping mechanism shown comprises a large gear 21 on the crank-shaft 17, a lower idle-shaft 23, mounted in suitable bearings supported by the frame A and provided with a couple of rigidly-attached gears 31 and 22, whereof the latter meshes with the gear 21 on the crank-shaft 17, and a couple of rigidly-connected gears 24 and 28, loose on the driving-shaft 20 and respectively provided with clutch-jaws 25 and 29, adapted, respectively, to engage coöperating clutch-jaws 26 and 30, respectively, keyed to the shaft 20 and formed in the hub of a belt-pulley 27 on such shaft. These rigidly-connected gears 24 and 28 can be slid along the shaft 20—as, for example, by a longitudinally-arranged hand-lever 32 engaging their intermediate hub portion and pivotally connected to the machine-frame at 34—so as to cause either the gear 24 to mesh with the gear 21 on the crank-shaft and the clutch-jaws 25 thereof to engage with the coöperating jaws 26 or the gear 28 to mesh with the lower gear 31, and the clutch-jaws 29 thereof to engage with the coöperating jaws 30, Figs. 4 and 5, or both gears 24 and 28 to lie in position between and be disengaged from the gears 21 and 31 and the clutch-jaws 25 and 29 thereof to likewise lie between and be disengaged from the coöperating jaws 26 and 30. Assuming that the driving-shaft 20 is rotated in the direction indicated by the arrow in Figs. 4 and 5, in the first case the crank-shaft 17 will be rotated in the clockwise direction mentioned as being necessary for spudding, Fig. 1. In the second case it will be rotated in the opposite direction for drilling, Fig. 2, and in the third it will be entirely disconnected from the driving-shaft 20, and so will not be rotated at all. It is obvious that in place of the two gears 24 and 28 I could employ a sin-

gle gear with like result; but I prefer to use two, chiefly on account of the considerable distance between the gears 22 and 31 on the idle-shaft 23. The driving-shaft 20 is in turn driven from the shaft H′ of an engine H, receiving steam from a boiler, which, together with the engine H, is mounted upon the forward end of the machine-frame A, Figs. 3 and 4, and it is to such end belted to the engine-shaft H′ by a belt. (Not shown in the drawings, but understood to be arranged over and between the belt-pulley 27 on the driving-shaft 20 and a similar pulley 35 on the engine-shaft H′.)

The reel B, upon which the rope or cable 2 is wound, is carried by a rotary shaft, which is journaled in bearings supported by a couple of horizontal side bars a^5 a^5. It is controlled by a transversely-arranged rotary shaft 38, supported by the bars a^5 a^5 through the medium of a couple of pairs of intermeshing gears 36 36 and 37 37, respectively, on the reel-carrying shaft and the controlling-shaft 38.

The reel-controlling shaft 38 can be rapidly rotated by power in a way to coil the rope or cable 2 upon the reel B, and thereby rapidly elevate the drilling-tool 1, by swinging a longitudinally-extending hand-lever 52, which is pivotally connected to the frame A at 53, in a way to cause a friction-cone 48, engaged by its forward end and slidable upon the driving-shaft 20, to engage and rotate a coöperating friction-cup 49, secured to a fly-wheel 50 on said shaft 20. This rotates a sprocket-wheel 46 on the other end of the shaft 38 in a direction opposite to that indicated by the arrow in Fig. 1 through the medium of a sprocket-chain 45, which travels upon the sprocket 46 and also upon a sprocket 47, Fig. 6, rigidly attached to the slidable cone 48. The reel-controlling shaft 38 can also be alternately slowly rotated by hand in a way to unwind or pay out the rope or cable 2 from the reel B, and thereby slowly lower the drilling-tool, by turning in the proper direction a longitudinally-extending rotary hand-wheel shaft 41, Figs. 1, 2, and 4, supported in bearings 43 on the frame A and carrying near its forward end a worm 40, which meshes with a worm-wheel 39 on one end of the reel-controlling shaft 38.

The hand-wheel shaft 41 is mounted in its bearings 43 for longitudinal or endwise movement in a rearward direction, in which way it will be automatically moved or projected rearwardly, so as to disengage its worm 40 from the worm-wheel 39 by such worm-wheel 39 when the same is rotated in a direction to wind the rope or cable upon the reel or drum B. It is held against a stop provided by the foremost bearing 43 in position to maintain its worm 40 in engagement with the wheel 39 by the tendency on the part of the latter to rotate in the direction indicated by the arrow in Fig. 1, which tendency is caused by the tension of the weight of the drilling-tool 1 upon the rope or cable 2.

When the reel-controlling shaft 38 is engaged by the hand-operated paying-out mechanism, the reel is locked against rotation by the engagement of the worm 40 on the hand-wheel shaft 41 and the worm-wheel 39 on the reel-controlling shaft 38; but when the reel is disengaged both from the hand-operated paying-out mechanism and the power-driven drill-elevating mechanism it can at will either be locked against such rotation as will allow the descent of the drill by allowing the forward end of a pawl 55, having its rear end pivotally connected at the angle 56 of a bell-crank L, which latter is pivotally connected to a beam a^6 of the frame A, to engage the teeth of a ratchet-wheel 54 on the reel-controlling shaft 38 or be unlocked, so as to permit of its free rotation by rearwardly drawing a longitudinally-extending and longitudinally-adjustable hand-lever 59, which slides in cleats attached to the frame-bars a^2 and a^6 and has its forward end pivotally connected to the upper end of the upwardly-extending arm 58 of the bell-crank L, so as to swing such arm 58 thereof rearwardly and downwardly, and thereby cause a stud or bolt at the end of the forwardly-extending bell-crank arm 57 to elevate the pawl 55, so as to disengage the same from the teeth of the ratchet-wheel 54. It will be observed that the operation of the tooth-engaging pawl 55 by a bell-crank in this manner is exceedingly simple and effective and dispenses with the heretofore-employed complicated mechanism for such purpose.

When the reel B is disconnected from both the hand-operated paying-out mechanism and the power-driven winding or coiling mechanism and is not locked by the pawl-and-ratchet locking mechanism, it can be checked, so as to check the descent of the tool in the well, by drawing rearwardly a longitudinally-disposed hand brake-lever 63, having its rear end supported by a cleat attached to the frame-upright a^2 and its forward end pivotally connected to the lower end of a vertically-disposed link 62, so as to swing the latter rearwardly about its pivotal connection with the side bar a^5, and thereby cause a cross-head 61 on the upper end of such link 62 to tighten a strap or band 60, attached to the ends of the cross-head 61, about a brake-wheel 64 on the reel-controlling shaft 38.

If a sand-pump is employed in the operation of sinking the well, it can be lowered into and withdrawn from the latter by means of a sand-pump rope 51, Figs. 1 and 2, which depends from and is reeved about a sheave 44 on the mast C. From the sheave 44 the sand-pump rope 51 extends downwardly to and is coiled upon a rotary sand-pump reel L, which is carried by a rotary shaft 67, journaled in bearings supported at the rear of the machine by the rear frame-uprights a^2 a^2, but which is rotatable independently of its carrying-shaft 67 and is slidable along the same.

The sand-pump can be lowered into the well

by allowing the reel K to be independently turned by the weight of the pump. The reel can be rotated, so as to wind the sand-rope thereon, and thereby elevate the pump, by first operating a longitudinally-extending lever 70, pivotally connected to the machine-frame at 71 and having its forward end in engagement with a clutch member 68, Fig. 6, slidable upon the driving-shaft 20, so as to throw such clutch 68 into engagement with a coöperating clutch member formed on the hub of the belt-pulley 27 on said shaft 20, and thereby cause the latter to rotate the reel-carrying shaft 67 alone through the medium of a sprocket-chain 67', traveling upon sprocket-wheels 66 and 65, rigidly secured, respectively, upon shaft 67 and to the loose driving-shaft clutch member 68, and by thus operating a short longitudinally-disposed hand-lever 75, pivotally connected to the machine-frame and having its forward end in engagement with one end of the reel K, so as to slide the latter along its carrying-shaft 67 to an extent to cause the engagement of a friction-cup 73, formed at its opposite end, with a coöperating friction-cone 72, secured to or formed integral with the fixed sprocket 66, and thereby cause its rotation by its carrying-shaft 67.

With further reference to the framework of the machine it will be understood that the body-frame A is of suitable construction for supporting the operating mechanism and is supported on front and rear sets of wheels.

The mast or derrick C is desirably so constructed as to permit of its being raised and lowered at will, and it can of course be constructed and operated in any desired manner. However, as a preferred arrangement and matter of further improvement it can be raised by turning a handle 81 on one end of rotary reel 80, Fig. 8, supported below the machine-frame A, so as to wind thereon a rope 77, which extends rearwardly therefrom to and about a sheave 79 at the rear of the frame A, thence upwardly and rearwardly to and about a pulley 78 at the end of a lower swinging mast-section c', which is the rear end thereof when such section is in a lowered or horizontal position, and finally forwardly to the outer end of an extension a^2, attached to the end of an upper swinging mast-section c, which is the forward end of such section c when the same is in a lowered or horizontal position, in a way to draw downwardly and forwardly upon the sheave 78 at the end of the lower mast-section c' and also downwardly and rearwardly upon the end of the extension c^2 of the upper mast-section c. This causes the lower section c' to swing about its hinge or pivotal connection with the upper end of the frame-upright a^2 and assume a vertical position, with its lower portion alongside of the upright a^2, and also causes the upper mast-section c to swing about the hinge or pivotal connection which its lower end has with the upper end of the lower section c' and assume a vertical position about the latter, with its extension c^2 in position alongside the same.

Of course the mast can be lowered by turning the handle 81 of the reel 80 so as to unwind or pay out the rope 77 from the reel, and thereby gradually release the lower ends of the lower section c' and of the extension c^2 on the upper section c and allow such sections to assume a substantially horizontal position, with their connected ends resting upon the upper end of the forward frame-upright a'. It will be seen that in this way the mast can be easily raised and lowered by a single operator in a single simple operation requiring but little expenditure of power. Of course a mast having more than two swinging sections can be raised and lowered in the same way, the essential feature being to apply the operating-rope to each section at a point which will come into position below the point of pivotal or hinge connection of such section when the same is in elevated or vertical position. When in an elevated position, the mast can be there held and braced by a brace 82, which can have its ends connected, respectively, to the upper end of the upper mast-section c and to the upper end of the forward upright a' of the frame A.

What I claim as my invention is—

1. A well-drilling machine comprising an upwardly and downwardly movable member having a relatively slow down and quick up movement, for spudding, and having in alternation therewith a relatively quick down and slow up movement for drilling; a rope or cable held at one end and passing over an overhead pulley and having depending therefrom a free end portion; means for connecting the upwardly and downwardly movable member with a portion of the cord or cable between its held end and the overhead pulley, to permit the upwardly and downwardly movable member to operate the cord or cable; and power-actuated mechanism adapted and operative to impart to the upwardly and downwardly movable member a relatively slow down and quick up movement, and in alternation therewith a relatively quick down and slow up movement; a tool for spudding being suspended from the free end of the cord or cable, and a tool for drilling being suspended from the upwardly and downwardly movable member.

2. A well-drilling machine comprising a rope or cable held at one end; an overhead pulley over which the rope or cable is carried whereby its free end may drop therefrom and connect with the drilling-tool employed; a vibratory frame having an up-and-down movement and carrying a spudding member adapted for operating the rope or cable so as to cause the rise and fall of the drilling-tool when the latter is suspended from the cable, and also carrying a drilling member adapted for operating the drilling-tool so as to cause the rise and fall of the latter when it is suspended from the drilling member; a drilling-

tool which can be alternately suspended from the free end of the rope or cable, or suspended from the drilling member; according to requirements; a reversible power-driven actuating mechanism applied for operating the vibratory frame and imparting thereto a differential movement involving alternately fast and slow strokes or impulses, the down strokes or impulses of the vibratory member being relatively slow when the drilling-tool is suspended and operated by the rope or cable passing over the overhead pulley and in turn operated by the spudding member, and the downstrokes of the vibratory frame being relatively fast when the drilling-tool is suspended from and operated by the drilling member and the actuating mechanism for the vibratory frame is reversed; and means for reversing such power-driven actuating mechanism at will; substantially as described.

3. A well-drilling machine comprising a rope or cable having one of its ends held and the other free and adapted for the suspension of the drilling-tool; an elevated pulley over which the rope or cable is reeved and from which its free end depends; a vibratory frame having an up-and-down movement and carrying a spudding member adapted for operating the rope or cable so as to cause the rise and fall of the drilling-tool when the latter is suspended from the cable, and also carrying a drilling member adapted for operating the drilling-tool so as to cause the rise and fall thereof when it is suspended from the drilling member; a drilling-tool which can be alternately suspended from the free end of the rope or cable, or from the drilling member; a pair of pivotally-supported swinging beams connected with the vibratory frame so as to impart an up-and-down movement thereto; a pair of reversible rotary cranks having their wrist-pins working in guideways formed longitudinally in the swinging beams; and means for causing the rotation of the cranks in either direction at will; as set forth.

4. A well-drilling machine comprising a rope or caple having one of its ends held and the other free and adapted for the suspension of the tool; an elevated pulley over which the rope or cable is reeved and from which its free end depends; a drilling-tool which can be alternately suspended from the free end of the rope or cable, or from the drilling member; a vibratory frame comprising a pair of connected pivotally-supported swinging beams and carrying a drilling member at its free end and a spudding member at a point intermediate of its ends; a pair of reciprocating links by which the vibratory frame is operated; a pair of pivotally-supported swinging beams connected with said reciprocating links for operating the same; a pair of reversible rotary cranks having their wrist-pins working in longitudinal slots formed in the swinging beams; and means for rotating the cranks and for reversing their direction of rotation at will; substantially as described.

5. In a well-drilling machine, the combination of a vibratory frame carrying the drilling member and having an up-and-down movement which causes the substantially vertical reciprocation of the drilling member; a pair of pivotally-supported swinging beams connected with the vibratory frame so as to impart thereto an up-and-down movement, but not the circular movement of the beams about their pivotal connections; and a pair of cranks having their wrist-pins working in longitudinal slots formed in the swinging beams, as set forth.

6. In a well-drilling machine, the combination of a vibratory frame comprising a pair of connected pivotally-supported swinging beams; a pair of actuating swinging beams link-connected with the swinging beams comprising the vibratory frame, and relatively shorter than the same; and a pair of rotary cranks having their wrist-pins working in longitudinal guideways formed in the actuating swinging beams, as set forth.

7. In a well-drilling machine, the combination of a substantially horizontally-disposed vibratory frame comprising pivotally-supported connected swinging beams, and carrying a drilling member at its free end; laterally-adjustable means for pivotally supporting the swinging beams of such frame, whereby the latter can be longitudinally adjusted so as to project the drilling member thereon into and out of drilling position; a pair of pivotally-supported swinging actuating-beams link-connected with the vibratory frame; and a pair of rotary cranks having their wrist-pins working in guideways formed longitudinally in the actuating swinging beams; substantially as described.

8. In a well-drilling machine, the combination with the driving-shaft and with a pair of pivotally-supported swinging beams and a rotary crank-shaft carrying a pair of cranks having their wrist-pins working in longitudinal guideways in said swinging beams; and also with a vibratory frame connected with the swinging beams, of mechanism for transmitting the motion of the driving-shaft to the crank-shaft, so as to rotate the latter in either direction comprising an idle-shaft provided with a couple of gear-wheels, one of which is normally in mesh with a gear carried by the crank-shaft; and gearing and clutch mechanism loosely mounted on the driving-shaft, the gearing being adapted to engage either with the crank-shaft gear, or with the other gear of the idle-shaft, and the clutch mechanism being adapted to engage coöperating clutch mechanism on the driving-shaft so as to cause the rotation of the gearing when the same is in engagement with either one or the other of said gears; substantially as described.

9. In a well-drilling machine, the combination with a reel or drum upon which the rope or cable can be coiled; of power-driven mechanism for winding the rope or cable upon the reel or drum so as to rapidly elevate the drill

from the well; and hand-operated mechanism for turning the reel or drum in the opposite direction so as to slowly unwind or pay out the cable therefrom; said hand-operated mechanism being automatically thrown into inoperative relationship with the reel or drum upon the operation of the power-driven rope or cable coiling mechanism.

10. In a well-drilling machine, the combination with the drilling-tool, a rope or cable having a free end from which the tool can be suspended, and with a reel or drum upon which the rope or cable can be coiled, of power-transmitting connection by means of which the reel or drum can be rotated in a way to cause the rope or cable to be coiled or wound thereon and thereby elevate the tool; a rotary worm-wheel which can be rotated so as to unwind the rope or cable from the reel or drum; a rotary worm which meshes with the worm-wheel, and is held against a stop so as to be held in engagement therewith by the tendency on the part of the tool to turn the reel or drum, and which is longitudinally adjustable in the opposite direction, whereby it will be automatically projected longitudinally by and disengaged from the worm-wheel upon the rotation of the latter, as set forth.

11. In a well-drilling machine, the combination with the drilling-tool, a rope or cable having a free end from which the tool can be suspended, a reel or drum upon which the rope or cable can be coiled, and with the driving-shaft; of a rotary reel-controlling shaft geared connected with the reel or drum; a clutch upon the driving-shaft, and power-transmitting connection arranged between the same and the reel-controlling shaft, and adapted to operate the latter in a way to cause the rope or cable to be wound upon the reel or drum, whereby the tool can be elevated by operating the driving-shaft clutch; a worm-wheel upon the reel-controlling shaft; a rotary hand-wheel shaft which carries a worm adapted to mesh with the worm-wheel on the reel-controlling shaft; said hand-wheel shaft being adapted and arranged for longitudinal shift in the direction in which the worm-wheel teeth engaging it turn, when the reel-controlling shaft is rotated by the driving-shaft, and to an extent to allow it to become disengaged from such worm-wheel when so shifted thereby; and a stop by means of which the worm is held in engagement with the worm-wheel by the tendency on the part of the drill to rotate the reel or drum; substantially as described.

12. In a well-drilling machine, the combination of a mast comprising a plurality of swinging and pivotally-connected mast-sections which can be swung about their pivotal connections alternately into substantially horizontal or lowered and vertical or elevated positions, and which have their points of pivotal connection situated above their lower ends when they are in vertical or elevated positions; and a rope or the like applied to said mast-sections at points below their points of pivotal support; and having sliding connections with all the mast-sections except the uppermost one, so as to permit it to act upon the latter as well as upon the former; whereby the entire mast can be elevated at once by drawing on the rope; as set forth.

13. In a well-drilling machine, the combination of a mast comprising upper and lower swinging mast-sections, which can be swung alternately into substantially horizontal or lowered, and vertical or elevated positions, and which are pivotally connected, the lower one to the machine-frame, and the upper one to the upper end of the lower one, at points situated above their lower ends when they are in vertical or elevated positions; a rope applied to the mast-sections below their points of pivotal connection; and having a sliding connection with the lower section, so as to permit it to act upon the upper section as well as upon the lower one, and a reel or the like upon which the rope can be coiled or uncoiled; substantially as described.

14. A well-drilling machine comprising a vibratory frame comprising the connected swinging beams D, D, and carrying a spudding-pulley 5 and a drilling-hook 9; a rock-shaft 12 having cranks 11 to whose wrist-pins the forward ends of the swinging beams D, D, are pivotally connected; a pair of actuating swinging beams F, F, arranged below the beams D, D, of the swinging frame, and having their forward ends pivotally connected to the machine-frame; a pair of links 16, 16 connecting the beams D, D, and F, F; a rotary shaft 17 provided with a couple of cranks G, G, having wrist-pins which work in longitudinal slots formed in the beams F, F; and means for reversing the direction of rotation of the crank-shaft 17; substantially as described.

15. In a well-drilling machine, the combination with the rotary reel or drum B, and with the driving-shaft 20 of a reel-controlling shaft 38 having gears 37 which mesh with gears 36 on the reel; a sprocket 46 on one end of the reel-controlling shaft 38; a sprocket 47 loose upon the driving-shaft 20 and provided with a friction-cone 48 adapted to engage a cup 49, rigid on said shaft; a lever for throwing the cone 48 into engagement with the cup 49; a sprocket-chain 45 traveling upon said sprockets 46 and 47; a worm-wheel 39 on the other end of the reel-controlling shaft 38; a longitudinally-adjustable hand-wheel shaft 41 provided with a worm 40 which meshes with the worm-wheel 39 on the shaft 38, but which can be thrown out of mesh with the wheel 39 by the rotation of the same; and a stop by which the hand-wheel shaft 41 can be held against longitudinal movement in the opposite direction; substantially as described.

16. In a well-drilling machine the combination with the frame thereof, of a mast C having a pulley 4 at its upper end, and comprising a lower section c' pivoted above its lower

end to the frame, an upper section *c* having its lower end pivotally connected to the upper end of the lower section *c'*, and an extension c^2 of the upper section *c* extending below the lower end of such section *c;* a rope 77 reeved about a pulley 78 at the lower end of the lower mast-section *c'*, and attached to the lower end of the extension c^2 of the upper mast-section *c;* and a reel 80 upon which the rope 77 can be coiled; substantially as described.

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